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Airman Group C

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SECTION-A : Reasoning Ability

Chapter 1 Analogy

The meaning of analogy is 'similar properties' or similarity. If an object or word or digit or activity shows any similarity with another object or word or digit or activity in terms of properties, type, shape, size, trait etc., then the particular similarity will be called analogy. For example, cricket : ground and chess: table are the analogous pairs (why?). In fact, both pairs of words have similar relationship in terms of place of playing as cricket is played in the ground and similarly chess is played on the table. In this chapter, we will discuss different types of analogy because problems based on analogy are an important category of questions to be asked in almost all examinations of competitive level.

TYPES OF ANALOGY

There are three types of analogy

(1) Based on Words
(2) Based on Numbers
(3) Based on Letters

1. Based on Words

I. Tool & Object Based Analogy

This establishes a relationship between a tool and the object in which it works.

Examples:

Scissors : Cloth
Saw : Wood

II. Synonym Based Analogy

In such type of analogy two words have similar meaning.

Examples:

Huge : Gigantic
Benevolent : Kind

III. Worker & Tool Based Analogy

This establishes a relationship between a particular tool and the person of that particular profession who uses that tool.

Examples:

Writer : Pen
Barber : Scissors

IV. Worker & Product Based Analogy

This type of analogy gives a relationship between a person of particular profession and his/her creations.

Examples:

Writer : Book
Singer : Song

V. Causes & Effect Based Analogy

In such type of analogy 1st word acts and the 2nd word is the effect of that action.

Examples:

Work : Tiredness
Race : Fatigue

VI. Opposite Relationship (Antonym) Based Analogy

In such type of analogy the two words of the question pair are opposite in meaning.

Examples:

Poor : Rich
Tall : Short

VII. Gender Based Analogy

In such type of analogy, one word is masculine and another word is feminine of it. In fact, it is a 'male and female' or 'gender' relationship.

Examples:

Man : Woman
Bull : Cow

VIII. Classification Based Analogy

This type of analogy is based on biological, physical, chemical or any other classification. In such problems the 1st word may be classified by the 2nd word and vice-versa.

Examples:

Oxygen : Gas
Water : Liquid
Snake : Reptile
Parrot : Bird

IX. Function Based Analogy

In such type of analogy, 2nd word describes the function of the 1st word.

Examples:

Singer : Sings
Player : Plays

X. Quantity and Unit Based Analogy

In such type of analogy 2nd word is the unit of the first word and vice-versa.

Examples:

Distance : Mile
Mass : Kilogram

Type II: Double Analogy

In the following example, there is some relationship between the two words to the left of the sign (::) and the same relationship obtains between the two words to the right of the sign (::). The correct combination is given as one of the four alternatives (a), (b), (c) and (d). Find the correct combination.

Example **1.** Owl : Screech :: ? : ?

(a) Donkey : Neigh (b) Hoof : Pony
(c) Ride : Wagon (d) Saddle : Relay

Sol. (a) Clearly, Owl's sound is called Screech. Similarly, Donkey's sound is called Neigh.

Type III: Triple Analogy

In the following example, there is some relationship between the three words to the left of the sign (::) and the same relationship obtains between the three words to the right of the sign (::). The correct combination is given as one of the four alternatives (a), (b), (c) and (d). Find the correct combination.

Example **2.** Cat : Dog : Tail :: ? : ? : ?

(a) Home : Hut : Palace (b) Lion : Tiger : Fish
(c) Car : Bike : Gear (d) Horse : Cow : Horn

Sol. (c) Both 'Cat' and 'Dog' have 'tail' and following the similar relationship, option (c) is correct as 'Car' and 'Bike' both have 'Gear'.

2. Based on Number

Number Analogy is a crucial step in solving questions on reasoning ability. The reasoning ability is checked mainly by the questions related to Number Analogy. The candidates are asked to identify and point out relationships, similarities or differences, and dissimilarities in a series or between groups of numbers.

Example **3. 1: 226 : 15 :: 325 : ?**

(a) 19 (b) 18 (c) 17 (d) 16

Sol. (b) $(15)^2 + 1 : 15 :: (18)^2 + 1 : 18$

Example **4. 2: 11 : 1210 :: ? : ?**

(a) 6:216 (b) 7:1029 (c) 8:448 (d) 9:729

Sol. (c) Clearly, the relationship is (Cube of x -Square of x).
$(8)^3 - (8)^2 = 512 - 64 = 448$

Example **5. Given set: (181, 177, 169) :: ?**

(a) (156, 152, 144) (b) (164, 161, 153)
(c) (175, 171, 160) (d) (192, 188, 179)

Sol. (a) Here 1st number – 4 = 2nd Number
2nd Number – 8 = 3rd Number.
156 – 4 =152 – 8 = 144

3. Based on Letter

In this type of analogy, two groups of letters related to each other in same way, are given. The candidate is required to identify the relationship & choose a group of letters which is related in the same way to a 3rd group given in the question. These questions become easier to solve if you memorize the alphabetic positions of the letters in the alphabet. (eg: A=1, M=13, etc.)

Example **6. BCDE: PQRS :: WXYZ : ?**

(a) EFGH (b) KLMN (c) QJSP (d) TSUV

Sol. (b) Each letter of the 1st group is moved 14 steps forward to obtain the corresponding letter of the 2nd group. A similar relationship will exist between the 3rd and 4th groups.

Mixed Analogy:

In these types of analogy alphabet and number are mixed in the question as shown below:

Example **7. 1: K × P : 256 :: H × S : ?**

(a) 361 (b) 372 (c) 428 (d) 244

Sol. (a) As, K's place value from end side in alphabet is 16
P's place value from starting is 16
By multiplying both its 256
Similarly,
H's place value from end side is 19
S's place value from starting is 19
By multiplying both its 361

Example **8. ACT : 60 : : PAI : ?**

(a) 90 (b) 144 (c) 100 (d) 75

Sol. (b) 60 is the product of place values of A, C and T. Similarly, the product of the place values of P, A and I is 144.

EXERCISE

DIRECTIONS (Qs. 1-60) : *In each of the following questions, select the related letter/word/number from the given alternative.*

1. Train : Passenger :: Aeroplane : ?
(a) Aeronaut (b) Astronaut
(c) Pilot (d) Air hostess

2. India : New Delhi :: Pakistan : ?
(a) Rawalpindi (b) Peshawar
(c) Lahore (d) Islamabad

3. Election : Manifesto :: Meeting : ?
(a) Circular (b) Agenda
(c) Preface (d) Report

4. Muslims : Mosque :: Sikhs : ?
(a) Golden Temple (b) Madina
(c) Fire Temple (d) Gurudwara

5. Traveller : Journey :: Sailor : ?
(a) Water (b) Ship
(c) Voyage (d) Crew

6. Perch : Fresh water :: Salt water : ?
(a) Crocodile (b) Frog
(c) Cod (d) Snake

7. Ornithologist : Birds :: Anthropologist : ?
(a) Plants (b) Animals
(c) Mankind (d) Environment

8. Venerate : Worship :: Extol : ?
(a) Glorify (b) Homage
(c) Compliment (d) Recommend

9. Teheran : Iran :: Beijing : ?
(a) China (b) Japan
(c) Turkey (d) Malaysia

10. Dark : Fear :: Honesty : ?
(a) Personality (b) Money
(c) Treachery (d) Trust

11. Tanning : Leather :: Pyrotechnics : ?
(a) Wool (b) Fireworks
(c) Bombs (d) Machinery

12. Butter : Milk :: Book : ?
(a) Author (b) Printing
(c) Chapter (d) Paper

13. Mattock : Dig :: Shovel : ?
(a) Break (b) Push
(c) Scoop (d) Squese

14. Foresight : Anticipation :: Insomnia : ?
(a) Treatment (b) Disease
(c) Sleeplesness (d) Unrest

15. Cricket : Bat :: Hockey : ?
(a) Field (b) Stick
(c) Player (d) Ball

16. Energy : Joule :: Volume : ?
(a) Solid (b) Capacity
(c) Kilogram (d) Litre

17. Fire : Ashes :: Explosion : ?
(a) Flame (b) Death
(c) Sound (d) Debris

18. Man : Biography :: Nation : ?
(a) Leader (b) People
(c) Geography (d) History

19. 841 : 29 :: 289 : ?
(a) 23 (b) 21
(c) 17 (d) 13

20. 8 : 28 :: 27 : ?
(a) 85 (b) 28
(c) 8 (d) 64

21. 72 : 18 :: 56 : ?
(a) 63 (b) 66
(c) 22 (d) 124

22. 5.5 : 30.25 :: 11.0 : ?
(a) 22.0 (b) 30
(c) 55 (d) 121.00

23. 10 : 99 :: 09 : ?
(a) 49 (b) 80
(c) 69 (d) 79

24. 25 : 37 :: 49 : ?
(a) 41 (b) 56
(c) 60 (d) 65

25. 763 : 856 :: 637 : ?
(a) 866 (b) 730
(c) 737 (d) 637

26. 3 : 243 :: 5 : ?
(a) 425 (b) 465
(c) 546 (d) 3125

27. 6 : 222 :: 7 : ?
(a) 210 (b) 465
(c) 350 (d) 3125

28. 7584 : 5362 :: 4673 : ?
(a) 2451 (b) 3562
(c) 5487 (d) 5784

29. QDXM : SFYN :: UIOZ : ?
(a) WKPA (b) QNLA
(c) LPWA (d) PAQM

30. ASTN : ZTSO :: MSUB : ?
(a) LRRC (b) LTTA
(c) NTVC (d) LTTC

31. FILM : ADGH :: MILK : ?
(a) ADGF (b) HGDE
(c) HDGF (d) HEGF

32. MAD : JXA :: RUN : ?
(a) ORK (b) OSQ
(c) PRJ (d) UXQ

33. Dda : aDD : Rrb : ?
(a) BBr (b) bRR
(c) RRR (d) BrR

34. MUMBAI : LTLAZH :: DELHI : ?
(a) CDKGG (b) DNRWJ
(c) CDKGH (d) OPEN

35. CLOSE : DNRWJ :: OPEN : ?
(a) PRHR (b) PRJQ
(c) RPJB (d) RZWR

36. DOG : Z :: CAT : ?
(a) X (b) Y
(c) V (d) W

37. L × M : 12 × 13 :: U × W : ?
(a) 21 × 22 (b) 24 × 26
(c) 9 × 11 (d) 21 × 23

38. CFIL : ABCD :: ? : WXYZ
(a) YBEH (b) DCBA
(c) JHPS (d) XURO

39. CEDH : HDEC :: ? : PNRV
(a) VRNP (b) RNPV
(c) NRVP (d) VNRP

40. IJL : MNP :: ? : UVX
(a) RSU (b) QRT (c) KLN (d) GHI

41. MASTER : OCUVGT :: LABOUR : ?
(a) NCDQWT (b) HDERWT
(c) NBECRWT (d) NEDRWT

42. Salt : Hypertension :: Sugar : ?
(a) Cholesterol (b) Diabetes
(c) Sweet (d) Dehydration

43. Confirmed : Inveterate :: Financial : ?
(a) Callow (b) Incredible
(c) Bankrupt (d) Knot

44. FATIGUE : REST :: DEHYDRATE : ?
(a) WEIGHT (b) HEAT
(c) WATER (d) LIGHT

45. Mitochondria : Energy :: DNA : ?
(a) Inheritance (b) Reproduction
(c) Locomotion (d) Immunity

46. Chisel : Sculptor :: Harrow : ?
(a) Gardener (b) Mason
(c) Blacksmith (d) farmer

47. Soil : Erosion :: Forest : ?
(a) Pollution (b) Degradation
(c) Dense (d) Deforestation

48. Red Blood Cells : Erythrocytes :: White Blood Cells : ?
(a) Thrombocytes (b) Lymphocytes
(c) Monocytes (d) Leucocytes

49. Qualm : Nausea :: Burn : ?
(a) Fresh (b) Sear
(c) Sensible (d) Wet

50. International Literacy Day : September 8 :: International Women's Day : ?
(a) March 8 (b) June 26
(c) April 22 (d) November 4

51. Bihu : Assam :: Onam : ?
(a) Karnataka (b) Kerala
(c) Jammu & Kashmir (d) Rajasthan

52. Eye : Ophthalmologist :: Music : ?
(a) Player (b) Conductor
(c) Pianist (d) Composer

53. Pesticide : Crop :: Antiseptic : ?
(a) Wound (b) Clothing
(c) Bandage (d) Bleeding

54. Optimist : Cheerful :: Pessimist : ?
(a) Gloomy (b) Mean (c) Petty (d) Helpful

55. Vacant : Empty :: Dearth : ?
(a) Descend (b) Scarcity
(c) Squander (d) Abundant

56. Ammeter : Current :: ? : ?
(a) Scale : Speed (b) Seismograph : Density
(c) Barometer : Mass (d) Anemometer : Wind

57. Alive : Dead :: Question : ?
(a) Options (b) Answer (c) Right (d) Ask

58. Yellow : Lemon :: Purple : ?
(a) Apple (b) Brinjal (c) Mango (d) Onion

59. Goitre : Iodine :: Anaemia : ?
(a) Vitamin D (b) Iron
(c) Vitamin E (d) Calcium

60. Calendar : Date :: Index : ?
(a) Name of Author (b) Glossary
(c) Contents (d) Summary

Hints & Solutions

1. **(a)** One who travels in a train is called passenger.
One who travels in Aeroplane is called Aeronaut.

2. **(d)** New Delhi is the capital of India.
Islamabad is the capital of Pakistan

3. **(b)** A manifesto list all the jobs to be under taken by a party after Election.
An agenda list all the issues to be discussed at a meeting.

4. **(d)** Second is the place of worship for the first.

5. **(c)** Second is processed was done by first

6. **(c)** A perch is a fresh water fish, cod is salt water fish.

7. **(c)** Study of birds ornithologist. Study of mankind Anthropologist.

8. **(a)** Synonym of each other

9. **(a)** Country and capital based

10. **(d)** First lead to the second.

11. **(b)** Tanning is a process of manufacturing leather.
Pyrotechnics is a process of fireworks

12. **(d)** Second is used to prepare the first.

13. **(c)** Mattock is a tool to dig hard ground similarly, shovel is a tool to scoop

14. **(c)** Synonym of each other.

15. **(b)** Stick
In cricket ball is hit with bat same in hockey ball is hit with stick

16. **(d)** Joule is the unit of energy, Litre is the unit of volume.

17. **(d)** Debris
Remain of fire is called Ashes, Remain of explosion is called Debris.

18. **(d)** History
The story of man Biography, The story of Nation History

19. **(c)** $\sqrt{841} = 29$, $\sqrt{289} = 17$

20. **(a)** $8 \times 3 + 4 = 28$
$27 \times 3 + 4 = 85$

21. **(c)** $(7 + 2) \times 2 = 18$
$(5 + 6) \times 2 = 22$

22. **(d)** $(5.5)^2 = 30.25$
$(11.0)^2 = 121.00$

23. **(b)** $(10)^2 - 1 = 99$
$(09)^2 - 1 = 80$

24. **(d)** $5^2 = 25$
$7^2 = 49$
$6^2 + 1 = 37$
$8^2 + 1 = 65$

25. **(b)** $763 + 93 = 856$
$637 + 93 = 730$

26. (d) $3^5 = 243$
$(5)^5 = 3125$

27. (c) $6^3 + 6 = 222$, $7^3 + 7 = 350$

28. (a) 7584 – 2222 = 5362
4673 – 2222 = 2451

29. (a) Q D X M :: U I O Z
+2↓ +2↓ +1↓ +1↓   +2↓ +2↓ +1↓ +1↓
S F Y N   W K P A

30. (d) A S T N :: M S U B
–1↓ +1↓ –1↓ +1↓   –1↓ +1↓ –1↓ +1↓
Z T S O   L T T C

31. (c) F I L M :: M I L K
–5↓ –5↓ –5↓ –5↓   –5↓ –5↓ –5↓ –5↓
A D G H   H D G F

32. (a) M A D :: R U N
–3↓ –3↓ –3↓   –3↓ –3↓ –3↓
J X A   O R K

33. (b) Dda : aDD :: Rrb : bRR

34. (c) M U M B A I :: D E L H I
–1↓ –1↓ –1↓ –1↓ –1↓ –1↓   –1↓ –1↓ –1↓ –1↓ –1↓
L T L A Z H   C D K G H

35. (a) C L O S E :: O P E N
+1↓ +2↓ +3↓ +4↓ +5↓   +1↓ +2↓ +3↓ +4↓
D N R W J   P R H R

36. (a) D O G : Z :: C A T : ?Ⓧ
↓ ↓ ↓ ↓   ↓ ↓ ↓ ↓
4 + 15 + 7 = 26 = 26   3 + 1 + 20 = 24 = 24

37. (d) L × M :: U × W
↓ ↓   ↓ ↓
12 × 13 $\boxed{21 \times 23}$

38. (a)
C $\xrightarrow{-2}$ A   Y $\xleftarrow{+2}$ W
F $\xrightarrow{-4}$ B   B $\xleftarrow{+4}$ X
I $\xrightarrow{-6}$ C   E $\xleftarrow{+6}$ Y
L $\xrightarrow{-8}$ D   H $\xleftarrow{+8}$ Z

39. (a) C E D H :: V R N P
H D E C   P N R V

40. (b) IJL : MNP :: QRT : UVX
+1   +1   +1

41. (a) M A S T E R :: L A B O U R
+2↓ +2↓ +2↓ +2↓ +2↓ +2↓   +2↓ +2↓ +2↓ +2↓ +2↓ +2↓
O C U V G T   N C D Q W T

42. (b) The excess intake of salt causes hypertension. Similarly, high sugar in blood causes diabetes.

43. (c) Confirmed and inveterate are related terms. Similarly. Financial and Bankrupt are related terms.

44. (c) We take rest in the state of fatigue (the condition of being very tired).
Similarly, we drink water in the state of dehydration (the loss of water).

45. (a) Mitochondria is referred to as the powerhouse of the cell in which respiration of the cell in which respiration and energy production occur. DNA is the unit of inheritance.

46. (a) Here Tool-Worker relationship has been shown. Chisel is the tool of Sculptor. Similarly, Harrow is the tool of Gardener.

47. (d) Erosion destroys soil by means of rain, wind, streams etc. Similarly, deforestation refers to the loss of forest.

48. (d) Red Blood Cells are also called Erythrocytes. Similarly, White Blood Cells are called Leucocytes.

49. (b) Qualm cause nausea. Similarly, burn causes sear.

50. (a) International Literacy Day is celebrated on September 8 every year. Similarly, International Women's Day is celebrated on March 8.

51. (b) Bihu is celebrated in Assam. Similarly, Onam is celebrated in Kerala.

52. (d) Opthalmologist is a person who is specialised in eye and its diseases. Similarly, composer is a person who composes music.

53. (a) Pesticides protect crops from insects and antiseptics protect wound from germs.

54. (a) Optimist is a person who is always hopeful and expects the best in all things and hence remains cheerful.
Pessimist is a person who expects the worst to happen. Therefore such person remains gloomy.

55. (b) Synonym are used.

56. (d) Ammeter is an instrument which is used to measure the flow of current. Similarly, Anemometer is an instrument, used to measure the speed of wind.

57. (b) As alive is opposite to dead. Similarly, question is opposite to answer.

58. (b) As the colour of Lemon is Yellow, similarly, the colour of **Brinjal** is Purple.

59. (b) As, Lack of Iodine is a cause of Goitre, similarly, Lack of **Iron** is cause of Anaemia.

60. (c) As, Calendar is related to Date, similarly, Index is related to **Contents.**

Chapter 2

Classification

CLASSIFICATION

When we come to solve the reasoning part while preparing for any competitive examination of objective nature. We find that the problems based on classification are the very important segment. You can see such questions in every question paper and this is the reason why examinees are advised to be well aware of classification part of reasoning. In this chapter, efforts have been made to make, examinees of various objective competitive examinations, fully aware of reasoning based on classification.

WHAT IS CLASSIFICATION?

You must have in your mind that what does classification mean. In fact, in classification we take out an element out of some given elements and the element to be taken out is different from the rest of the elements in terms of common properties, shapes, sizes, types, nature, colours, traits etc. In this way the rest of the elements form a group and the element that has been taken out is not the member of that group as this single element does not possesses the common quality to be possessed by rest of the elements. For example, if we compare the elements like, lion, cow, tiger, panther, bear and wolf then we find that this is a group of animals. How do we classify them? To understand this let us see the presentation given below :-

Lion	Cow	Tiger	Panther	Bear	Wolf
↓	↓	↓	↓	↓	↓
Wild animal	Domestic animal	Wild animal	Wild animal	Wild animal	Wild animal

Here, if we want to separate out one animal then definitely that animal will be cow because cow is the only animal in the group which is a domestic animal. Rest of the animals (Lion, Tiger, Panther, Bear and Wolf) are wild animals. Hence rest of the animals (Lion, Tiger, Panther, Bear & Wolf) form a group of wild animals separating out the domestic animal (Cow).

Similarly, out of 6 letters A, M, N, F, P & Q, we will take out A and form a group of 5 letters M, N, F, P & Q because out of given six letters only A is a vowel while rest of the letters form a group of consonants.

Types of Classification

(1) Meaningful word based classification

(2) Digit based classification

(3) General knowledge based classification

Now we will discuss these four types of classifications one by one:-

1. Meaningful words based classification

In such type of classification we have to take odd word out of the given group of meaningful words.

Example **1. Out of the 4 words given below, three have certain thing common and so they form a group. Find out the word which one is not a part of that group.**

(a) Slim **(b) Trims**

(c) Greets **(d) Grid**

Sol. Option (c) is the correct option because this is the only option which has two vowels while the other options have only one vowel. Let us see the following presentation:-

(a) Sl(i)m → 1 vowel

(b) Tr(i)ms → 1 vowel

(c) Gr(ee)ts → 2 vowels

(d) Gr(i)d → 1 vowel

Example **2. Select the one which is different from the other three responses.**

(a) Mason : Wall **(b) Cobbler : Shoe**

(c) Farmer : Crop **(d) Chef : Cook**

Sol. (d) As it is clear that except option (d) all other pairs, second is prepared by the first.

Hence, option (d) is the correct option.

2. Digit based classification

In such type of classifications digits or numbers are given to find out one number that is not a part of the group of remaining numbers.

Example **3. Find the odd number out.**

(a) 122 **(b) 128** **(c) 199** **(d) 200**

Sol. Option (c) is the correct option because this is an odd number while all the other options are even numbers.

Example **4. Four of the following numbers have some similarity and hence they form a group. Find out the number which does not suit in the group.**

(a) 7842 **(b) 7562** **(c) 7122** **(d) 8952**

Sol. Option (d) is the correct answer, as except option (d) all other options start with 7 & end with 2.

Example **5. Select the one which is different from the other three responses.**

(a) 140 – 45 **(b) 110 – 35**

(c) 100 – 30 **(d) 80 – 25**

Sol. (c) The pattern seen here is (first number – 5) ÷ 3 = Second number.

Like (140 – 45) ⇒ (140 – 5) ÷ 3 = 45 But (100 – 30)
⇒ (100 – 5) ÷ 3 = ≠ 30

3. General knowledge based classification

Such classification is done on the basis of our general knowledge. No doubts that this is a word based classification but without having general knowledge this type of questions can not be solved.

Example **6. Find the odd man out.**

(a) Patna **(b) Mumbai**
(c) Kolkata **(d) Madhya Pradesh**

Sol. Option (d) is the correct answer because Madhya Pradesh is an Indian state while all other options are capitals of Indian states. Patna is the capital of Bihar; Mumbai is the capital of Maharashtra and Kolkata is the capital of West Bengal. In case of Madhya Pradesh (it is an Indian state), we can say that it has its capital in Bhopal.

Example **7. Which of the following animals does not fit into the group formed by remaining four animals?**

(a) Cat **(b) Dog**
(c) Tiger **(d) Octopus**

Sol. Option (d) is the correct option as this is the only animal out of given options which is a water animal. Rest of the options are land animals.

> Now, this chapter has come to an end. Readers are advised to move as per the following steps while solving the problems related to classification :-
>
> **Step I :** See all the given options with a serious eye.
>
> **Step II :** Try to make relation of similarity among the given options.
>
> **Step III :** Find out the one word not having the common similarity like other four options and that one word will be your answer.

EXERCISE

DIRECTIONS (Qs. 1-50): *Select the odd word/number from the given alternatives.*

1. (a) Medium (b) Average
(c) Mediocre (d) Terrible

2. (a) Mushroom (b) Yeast
(c) Mould (d) Smut

3. (a) Correction (b) Improvement
(c) Betterment (d) Elevation

4. (a) Crust (b) Mantle
(c) Core (d) Volcano

5. (a) Tempest (b) Hurricane
(c) Cyclone (d) Monsoon

6. (a) Microscope (b) Telescope
(c) Periscope (d) Stethoscope

7. (a) Beautician : Parlour (b) Chemist : Medicine
(c) Lawyer: Court (d) Engineer : Site

8. (a) Water : Thirst (b) Talent: Education
(c) Food : Hunger (d) Air : Suffocation

9. (a) Fish : Piciculture (b) Birds : Horticulture
(c) Bees : Apiculture (d) silkworm : Sericulture

10. (a) Twigs : Nest (b) Wood : Furniture
(c) Pitcher: Pottery (d) Gold: Ornaments

11. (a) Venus : Shukra (b) Uranus : Indra
(c) Mars : Mangal (d) Saturn : Budha

12. (a) Steel : Utensils (b) Bronze : Statue
(c) Duralumin : Aircraft (d) Iron : Rails

13. (a) scalpel : Surgeon (b) Chisel : Soldier
(c) Awl : Cobbler (d) Knife : Thief

14. (a) Cockroach : Antennae (b) Lizard : Flagella
(c) Hydra : Tentacles (d) Plasmodium : Cilia

15. (a) Pyrometer : Radiation (b) Calorimeter: Heat
(c) Parameter : Area (d) Barometer : Humidity

16. (a) Chandragupta : Mauryan
(b) Babar : Mughal
(c) Kanishka : Kushan
(d) Mahavira : Jainism

17. (a) Flurry : Blizzard (b) Moisten : Drench
(c) Prick : Stab (d) Scrub : Polish

18. (a) Mulder : Proteins
(b) Curie : Radium
(c) Becquerel : Radioactivity
(d) Einstein : Television

19. (a) Taiwan : Taipei (b) China: Mongolia
(c) Iran : Teheran (d) Japan : Tokyo

20. (a) Honest : Cheat (b) Good : Nice
(c) Extravagant : Thrifty (d) Seldom : Often

Choose the odd number pair group in each of the following questions :

21. (a) 1975 – 1579 (b) 3152 – 5321
(c) 4283 – 8432 (d) 7319 – 9731

22. (a) 73 – 61 (b) 57 – 69
(c) 42 – 29 (d) 35 – 47

23. (a) 8 – 27 (b) 125 – 216
(c) 343 – 512 (d) 1009 – 1331

24. (a) 15 : 46 (b) 12 : 37
(c) 9 : 28 (d) 8 : 33

25. (a) Sports – Ground (b) Cinema – Screen
(c) Drama – Stage (d) Rubber – Erase

26. (a) Perception (b) Discernment
(c) Penetration (d) Insinuation

27. (a) Gallon (b) Ton
(c) Quintal (d) Kilogram

28. (a) Short – Long (b) Man – Woman
(c) Light – Heavy (d) Crime – Blame

29. (a) Tomato (b) Potato
(c) Onion (d) Carrot

30. (a) Krishna (b) Cauvery
(c) Narmada (d) Mahanadi

31. (a) Lakshdeep (b) Tamil Nadu
(c) Andhra Pradesh (d) Kerala

32. (a) Nepal (b) Myanmar
(c) Bangladesh (d) Sri Lanka

33. (a) Silver (b) Platinum
(c) Zinc (d) Bronze

34. (a) Shimla (b) Darjeeling
(c) Ooty (d) Agra

35. (a) Influenza (b) Scurvy
(c) Rickets (d) Night – blindness

36. (a) Phycology : Algae (b) Ornithology : Birds
(c) Mycology : Fungi (d) Biology : Botany

37. (a) Anther (b) Retina
(c) Ovary (d) Petal

38. (a) January, May (b) April, June
(c) July, August (d) January, December

39. (a) Asia (b) Canada
(c) Europe (d) Africa

40. (a) Obstetrician (b) Podiatrist
(c) Pulmonologist (d) Prosthetist

41. (a) Liver (b) Pituitary
(c) Adrenal (d) Thyroid

42. (a) Violet (b) Pink
(c) Blue (d) Orange

43. (a) Tetanus (b) Pneumonia
(c) Tuberculosis (d) Hepatitis

44. (a) Tulip (b) Lotus
(c) Marigold (d) Rose

45. (a) Leglislator (b) Lawyer
(c) Mayor (d) Governor

46. (a) Rice : Cereals (b) Tea : Beverages
(c) Legumes : Nodules (d) Beans : Pulses

47. (a) Chlorophyll (b) Glucose
(c) Nitrogen (d) Photosynthesis

48. (a) Clouds : Rain (b) Injury : Pain
(c) Boiling : Evaporation (d) Freezing : Cold

49. (a) Time : Seconds
(b) Speed : km/hr
(c) Electric Current : Ampere
(d) Temperature : Kelvin

50. (a) Dog : Puppy (b) Horse : Mare
(c) Sheep : Lamb (d) Cow : Calf

51. (a) 0 – 3 – 8 (b) 9 – 12 – 16
(c) 17 – 20 – 24 (d) 51 – 54 – 58

52. (a) 515 – 103 (b) 635 – 127
(c) 745 – 149 (d) 856 – 214

53. (a) $\frac{9}{8}$ (b) $\frac{64}{16}$ (c) $\frac{25}{32}$ (d) $\frac{36}{64}$

54. (a) 6121 (b) 7364
(c) 1036 (d) 2710

55. (a) (96, 24) (b) (39, 18)
(c) (81, 54) (d) (82, 64)

56. (a) 543, 453 (b) 243, 432
(c) 234, 342 (d) 354, 543

57. (a) (17, 71) (b) (23, 32)
(c) (19, 90) (d) (46, 64)

58. (a) 97 – 16 (b) 78 – 15
(c) 58 – 13 (d) 69 – 14

59. (a) Year 2012 (b) Year 1998
(c) Year 2015 (d) Year 1997

60. (a) 1, 2, 4, 7 (b) 2, 3, 5, 8
(c) 3, 4, 6, 9 (d) 4, 2, 3, 9

Hints & Solutions

1. **(d)** All except Terrible are synonyms.
2. **(d)** All except Smut are forms of fungi
3. **(d)** All others are synonyms.
4. **(d)** All except Volcano are parts of the earth.
5. **(d)** All except Monsoon are violent winds.
6. **(d)** All except Stethoscope are optical instruments.
7. **(b)** In all other pairs, second is the place where first works.
8. **(b)** In all other pairs, lack of first causes the second.
9. **(b)** In all other pairs, second is the name given to artificial rearing of the first.
10. **(c)** In all other pairs, first is the material used to make the second.
11 **(d)** In all other pairs, second is the correct Indian name of the planet denoted by the first.
12. **(d)** In all other pairs, first is the alloy used to make the second. (Iron is not an alloy but a metal.)
13. **(b)** In all other pairs, first is a tool used by the second.
14. **(b)** In all other pairs, second is the organ for movement of the first.
15. **(d)** In all other pairs, first is an instrument used to measure the second.
16. **(d)** In all other pairs, second is the name of the dynasty founded by the first.
17. **(a)** In all other pairs, second is of higher intensity than the first.

18. **(d)** In all other pairs, first is the name of the scientist who discovered the second.

19. **(b)** In all other pairs, second is the capital of the first.

20. **(b)** In all other pairs, the given words are antonyms of each other.

21. **(a)** In all other pairs, second number is obtained by arranging the digits of the first number in a descending order.

22. **(c)** In all other pairs, the difference between the two numbers is 12.

23. **(d)** All other pairs contain cubes of two successive natural numbers e.g.
$8 = 2^3$ and $27 = 3^3$

24. **(d)** In all other pairs, 2^{nd} number = (1^{st} number × 3) + 1.

25. **(d)** Except Rubber-Erase, in all others Activity and Place relationship has been shown. In Rubber-Erase, the Article and Function relationship has been shown.

26. **(d)** Insinuation is different from the other words **Insinuate (Verb)** means "to suggest something bad about somebody/something is an unpleasant and indirect way." **Insinuation (Noun)** means "the action of insinuating something."

27. **(a)** Except Gallon, all others are units of mass. Gallon is the unit of volume.

28. **(d)** Except the pair Crime – Blame, in all other pairs of words one word is the antonym of the other.

29. **(a)** Except Tomato, all others are modified roots or stems.

30. **(c)** Narmada is a west flowing river and it flows into Arabian Sea. All other rivers are east flowing and fall into the Bay of Bengal.

31. **(a)** Lakshadweep is a Union Territory.

32. **(d)** Sri Lanka is an island nation. It is separated from India by Palk Strait. In the north, India is adjoined by China, Nepal and Bhutan. In the east lies Bangladesh and Myanmar.

33. **(d)** Except Bronze, all others are metals. Bronze is an alloy.

34. **(d)** Except Agra, all others are hillstations.

35. **(a)** Except Influenza, all others are diseases caused by deficiency of vitamins.

36. **(d)** The scientific study of the second is called the first in all the pairs except Biology : Botany.

37. **(b)** Except Retina, all others are parts of a flower.

38. **(b)** Except the months of April and June, all other months have 31 days each.

39. **(b)** Except Canada, all others are continents. Canada is northern half of North America.

40. **(d)** Except prosthetist, all others are related to real organs of mankind.

41. **(a)** Except liver, all other glands are smaller in size.

42. **(b)** Except Pink, all other colours are parts of a rainbow.

43. **(d)** Except hepatitis, all other diseases are caused by bacteria. Hepatitis is caused by virus.

44. **(b)** Lotus is different from all other flowers as it is grown in muddy water.

45. **(b)** Legislator and Mayor are elected representatives of people. Governor is appointed by the President. Lawyer is a person who pleads in the court.

46. **(c)** Except. Legumes – Nudules, in all other pairs, the second denotes the class to which the first belongs.

47. **(d)** Photosynthesis is chemical process by which plants make their food in the presence of sun – lights and certain constituents.

48. **(d)** In other pairs the first word is the cause to happen the event given in second word.

49. **(b)** In other options second word is then S.I. unit of first word.

50. **(b)** Except **Horse : Mare**, in all given options the second is the young one of first.

51. **(a)** $0 \xrightarrow{+3} 3 \xrightarrow{+5} 8$

$9 \xrightarrow{+3} 12 \xrightarrow{+4} 16$

$17 \xrightarrow{+3} 20 \xrightarrow{+4} 24$

$51 \xrightarrow{+3} 54 \xrightarrow{+4} 58$

52. **(d)** $\frac{515}{103} = 5; \frac{635}{127} = 5; \frac{745}{103} = 5; \frac{856}{214} = 4$

53. **(b)** In $\frac{64}{16}$, one number is completely divisible by the other number, Again, 16 is perfect square of 4 and 64 is perfect cube of 4.

$\frac{64}{16} = 4, 4 \times 4 = 16; 4 \times 4 \times 4 = 64$

54. **(a)** Except the number 6121, all other numbers are even numbers.

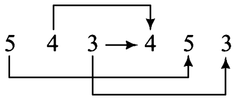
55. **(d)** Except the number pair (82, 64), in all other number pairs both the numbers are multiples of 3.

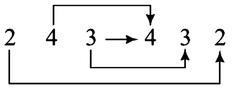
$96 = 32 \times 3; \quad 24 = 8 \times 3$

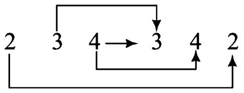
$39 = 13 \times 3; \quad 18 = 6 \times 3$

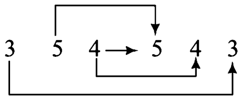
$81 = 27 \times 3; \quad 54 = 18 \times 3$

56. **(a)**









57. **(c)** Except in the number pair (19, 90) in each of the number pairs the digits have been interchanged.

58. **(d)** $97 \Rightarrow 9 + 7 = 16$

$78 \Rightarrow 7 + 8 = 15$

$58 \Rightarrow 5 + 8 = 13$

But, $69 \Rightarrow 6 + 9 = \boxed{15}$

59. **(a)** Year 2012 is a Leap Year.

60. **(d)** $1 \xrightarrow{+1} 2 \xrightarrow{+2} 4 \xrightarrow{+3} 7$

$2 \xrightarrow{+1} 3 \xrightarrow{+2} 5 \xrightarrow{+3} 8$

$3 \xrightarrow{+1} 4 \xrightarrow{+2} 6 \xrightarrow{+3} 9$

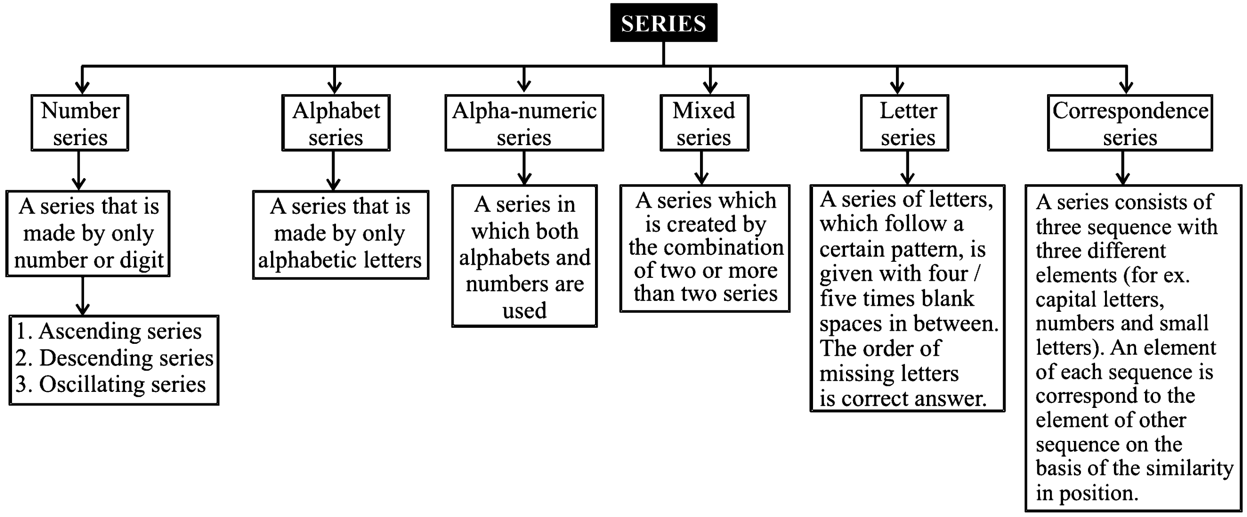
$4 \xrightarrow{+1} 2 \xrightarrow{+1} 3 \xrightarrow{+6} 9$

Chapter 3

Series

A series is a sequence of numbers/alphabetical letters or both which follow a particular rule. Each element of series is called ‘a term’. We have to analyse the pattern and find the missing term or next term to continue the pattern.

Types of Series are Explained in the following Chart :


SERIES
Number series
A series that is made by only number or digit
1. Ascending series
2. Descending series
3. Oscillating series
Alphabet series
A series that is made by only alphabetic letters
Alpha-numeric series
A series in which both alphabets and numbers are used
Mixed series
A series which is created by the combination of two or more than two series
Letter series
A series of letters, which follow a certain pattern, is given with four / five times blank spaces in between. The order of missing letters is correct answer.
Correspondence series
A series consists of three sequence with three different elements (for ex. capital letters, numbers and small letters). An element of each sequence is correspond to the element of other sequence on the basis of the similarity in position.

NUMBER SERIES

Number series is a form of numbers in a certain sequence, where some numbers are wrongly put into the series of numbers or some number is missing in that series, we need to observe first and then find the accurate number to that series of numbers.

Different types of Number Series

1. **Perfect Square Series**
   This type of series are based on square of a number which is in same order and one square number is missing in that given series.

Example **1. 841, ?, 2401, 3481, 4761**

Sol. $29^2, 39^2, 49^2, 59^2, 69^2$

2. **Perfect Cube Series**
   Perfect cube series is an arrangement of numbers is a certain order, where some number which is in same order and one cube is missing in that given series.

Example **2. 4096, 4913, 5832, ?, 8000**

Sol. $16^3, 17^3, 18^3, 19^3, 20^3$

3. **Mixed Number Series**
   Mixed number series is an arrangement of numbers in a certain order. This type of series has more than one different order which arranged alternatively in single series or created according to any non conventional rule.
   E.g 1, 111, 220, 438, ?, 1746.

Example **3. 6, ?, 33, 69, 141, 285**

Sol. × 2 + 3, × 2 + 3, × 2 + 3, × 2 + 3, × 2 + 3, × 2 + 3

Example **4. 4, 16, 64, 256, 1024, ?**

Sol. Multiply each number by 4 to get the next number.

$4 \times 4 = 16$
$16 \times 4 = 64$
$64 \times 4 = 256$
$256 \times 4 = 1024$
$1024 \times 4 = 4096$

Types of Questions

(I) Complete the series
(II) Find missing number of the series
(III) Find wrong number of the series

Examples on Number Series

(I) Complete the Series

Example **5. Which of the following is the next term of series given below ?**

4, 6, 9, 13, ...

(a) 17 **(b) 18** **(c) 19** **(d) 20**

Sol. (b) $4 \underset{+2}{\smile} 6 \underset{+3}{\smile} 9 \underset{+4}{\smile} 13 \underset{+5}{\smile} \boxed{18}$

So, 18 is correct answer.

(II) To Find the Missing Number of Series

Example **6. What will come in place of question mark in the following series?**

79, 87, ? , 89, 83

(a) 80, **(b) 81** **(c) 82** **(d) 88**

Sol. (b) 79 87 $\boxed{81}$ 89 83

+8 −6 +8 −6

So, 81 is correct answer.

(III) To Find the Wrong Number in the Series

Example 7. Find the wrong number in the series

3, 8, 15, 24, 34, 48, 63.

(a) 15 (b) 15 (c) 34 (d) 63

Sol. (c) $2^2 - 1, 3^2 - 1, 4^2 - 1, 5^2 - 1, 6^2 - 1$ ....

LETTER SERIES

What is letter series?

Letter series is a sequence of elements made of letters from English alphabet. Such series follow a certain pattern

Example 8. P, R, T, V, X

Series pattern: Every next letter in the series takes place two steps forward.

Types of the letter series:

(i) Forward order series:

Example 9. D, G, J, M, P, S, V

Series pattern: Every next letter takes place 3 steps forward.

(ii) Backward order series:

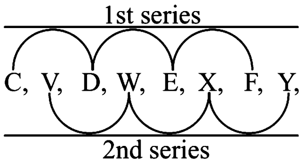
Example 10. U, R, O, L, I

Series pattern: Every next letter takes place 3 steps backward.

(iii) Multiple series:

Example 11. C, V, D, W, E, X, F, Y

Series pattern:



(iv) Opposite letter series:

Example 12. AZ, BY, CX, DW, EV

Series pattern: Each element of the series is made of two opposite letters.

(v) Series based on letter position:

Example 13. EF, CH, AJ, DG, BI

Series pattern: In each term, the sum of letter positions is equal to 11.

Let us see:

EF CH AJ DG BI

↓↓ ↓↓ ↓↓ ↓↓ ↓↓

5+6=11 3+8=11 1+10=11 4+7=11 2+9=11

(vi) Small letter based series:

Example 14. Complete the following series with one of the given options.

ab_d_aaba_na_badna_b

(a) andaa (b) babda (c) badna (d) dbanb

Series pattern: ab/adna/ab/adna/ab/adna/ab

Clearly, option (a) is the correct answer.

MIXED SERIES

Such series is a sequence of many elements made of numbers and letters arranged from left to right. In some cases some symbols may take place in such series. The symbols may be '+', '–', '×', '÷', ?. '>', '<', = etc. In other words we can say that a mixed series is sequence of diverse elements.

Types of the mixed series:

(i) Forward sequence pattern:

Example 15. E, -3, G, 1, I, 5, K, 9

Series pattern: Letters and numbers take place alternately. Every next letter is two letters ahead from the previous letter and every next number increases by 4.

(ii) Backward sequence pattern:

Example 16. T, 13, R, 12, P, 11, N, 10, L, 9, J, 8

Series pattern: Letters and numbers take place alternately. Every next letter is two letters backward from the previous letter and every next number decreases by 1.

(iii) Mixed Sequence (Forward & backward both) pattern:

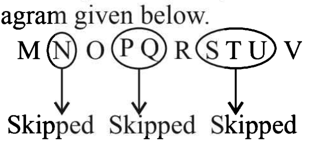
Example 17. E, 45, I, 40, M, 35, Q, 30

Series pattern: Letters and numbers take place alternately. Every next letter is four letters forward from the previous letter and every next number decreases by 5.

(iv) Miscellaneous pattern

Example 18. 25, M, 16, O, 25, R, 16, V

Series pattern: Letters and numbers take place alternately. Every next letter takes place by skipping 1, 2 and 3 letters respectively as diagram given below.



If we see the numbers, we find that they decreases by 9 and increase by 9 alternately.

Examples on Alphabetic Series

Example 19. What will come in place of question mark in the following series?

G, H, J, M, ?

(a) R (b) S (c) Q (d) P

Sol. (c) G H J M $\boxed{Q}$

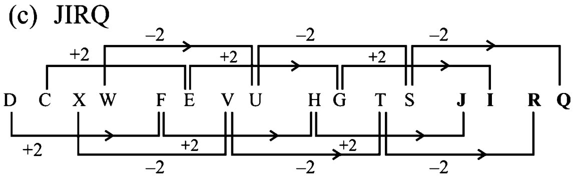
+1 +2 +3 +4

Example 20. What will come in place of question mark in the following series?

DCXW, FEVU, HGTS, ?

(a) LKPO (b) ABYZ (c) JIRQ (d) LMRS

Sol. (c) JIRQ



Examples on Alpha-Numeric Series

Example 21. What will come in place of question mark in the following series?

K 1, M 3, P 5, T 7, ?

(a) Y 9 (b) Y 11 (c) V 9 (d) V 11

Sol. (a) Alphabets follow the sequence

$$K \xrightarrow{+2} M \xrightarrow{+3} P \xrightarrow{+4} T \xrightarrow{+5} Y$$

And numbers are increasing by 2

Examples on Mixed Series

Example 22. Complete the series

Z, L, X, J, V, H, T, F, __, __

(a) D, R (b) R, D (c) D, D (d) R, R

Sol. (b) The given sequence consists of two series

(i) Z, X, V, T, __

(ii) L, J, H, F, __. Both consisting of alternate letters in the reverse order.

∴ Next term of (i) series = R, and

Next term of (ii) series = D

Examples on Letter Series

Example 23. Which sequence of letters when placed at the blanks one after another will complete the given letter series?

b a a b – a b a – b b a – –

(a) bbaa (b) aaaa (c) abab (d) baba

Sol. (d) b a a b $\underline{b}$ a / b a $\underline{a}$ b b a / $\underline{b}$ $\underline{a}$.

EXERCISE

DIRECTIONS (Qs.1 - 8): *Which one set of letters when sequentially placed at the gaps in the given letter series shall complete it ?*

1. _ a a _ b a _ b b _ a b _ a a b
(a) b a b a b (b) a a a b b (c) b b a a b (d) b b b a a

2. _ b b m _ a m b _ m _ a _ b b
(a) m b a b m (b) a b m a b (c) m a b a m (d) a m b b m

3. a b _ a a _ a a a _ a _ a b _ a
(a) a b b a b (b) a b a a a (c) a a b b a (d) a b b a a

4. LU _ TUPLUBTU _ LUBT _ P _ UBTUP
(a) PBUL (b) BPUL (c) LBPU (d) BUPL

5. B _ CCABB _ CABBC _ AB _ CCA
(a) BCCB (b) BCBC (c) BBCC (d) BBBC

6. _ _ aba _ _ ba _ ab
(a) bbaba (b) abbbb (c) baabb (d) abbab

7. SH _ ELAS _ EELA _ HEELA SHEE _ A
(a) ELHA (b) EHSL (c) EEHS (d) HHSS

8. BR _ _ NB _ O _ NB
(a) OWOW (b) OWRW (c) RORO (d) WNWN

DIRECTIONS (Qs. 9-32): *A series is given, with one term missing. Choose the correct alternative from the given ones that will complete the series.*

9. DIB, HMF, LQJ, ?
(a) OTM (b) QVO (c) PVO (d) PUN

10. NOA, PQB, RSC, ?
(a) TUD (b) DTU (c) ENO (d) FNQ

11. DFI, KMP, ?, YAD
(a) QSV (b) RTW (c) SUX (d) RTV

12. 313, 623, 933, 1243, ?
(a) 1863 (b) 2173 (c) 1553 (d) 2483

13. 975, 864, 753, 642, ?
(a) 431 (b) 314 (c) 531 (d) 532

14. 15, 31, 64, 131, ?
(a) 266 (b) 256 (c) 192 (d) 524

15. $\frac{2}{3}, \frac{4}{7}, ?, \frac{11}{21}, \frac{16}{31}$
(a) $\frac{6}{11}$ (b) $\frac{5}{9}$ (c) $\frac{9}{17}$ (d) $\frac{7}{13}$

16. 96 94 373 3353 ? 1341069
(a) 83819 (b) 53483 (c) 63813 (d) 53643

17. 45 43 83 245 975 ?
(a) 4869 (b) 4846 (c) 4896 (d) 4852

18. 16 16 40 140 ?
(a) 804 (b) 840 (c) 408 (d) 968

19. IKM, NPR, SUW, ?
(a) XZB (b) XAZ (c) AZX (d) ZAX

20. UXR, SVP, CFZ, ?
(a) ADX (b) YBW (c) VXT (d) QUN

21. Z, W, S, P, L, I, E, ?
(a) B (b) D (c) F (d) K

22. B I O ? X A
(a) T (b) R (c) V (d) P

23. $7\frac{1}{7}, 8\frac{2}{6}, 9\frac{5}{5}, 12\frac{2}{4}, 16\frac{2}{3}$, ____
(a) $\frac{50}{2}$ (b) $15\frac{2}{4}$ (c) 35 (d) $16\frac{4}{4}$

24. 24, 35, 20, 31, 16, 27, __, __
(a) 9, 9 (b) 8, 25 (c) 12, 23 (d) 5, 30

25. 4, 6, 10, 16, 24, ?
(a) 40 (b) 34 (c) 30 (d) 28

26. 3, 5, 9, 17, ?
(a) 65 (b) 33 (c) 42 (d) 26

27. 3, 5, 35, 10, 12, 35, ___, ___
(a) 19, 35, (b) 17, 19 (c) 19, 24 (d) 22, 35

28. 36, 34, 30, 28, 24, ?
(a) 26 (b) 23 (c) 22 (d) 20

29. AZBY, CXDW, EVFU, ?
(a) SHTG (b) GXHW (c) GTHS (d) STHO

30. 325, 259, 204, 160, 127, 105, ?
(a) 94 (b) 96 (c) 98 (d) 100

31. CGJ, KOR, TXA, ?
(a) ACE (b) JDP (c) DHK (d) UWY

32. B - 1, D - 2, F - 4, H - 8, J - 16, ?
(a) K - 64 (b) L - 32 (c) M - 32 (d) L - 64

DIRECTIONS (Qs. 33-35) : *Find the wrong number.*

33. 25, 27, 29, 31, 34, 35
(a) 27 (b) 29 (c) 34 (d) 35

34. 1236, 2346, 3456, 4566, 5686
(a) 1236 (b) 3456 (c) 4566 (d) 5686

35. 12439, 23549, 34659, 45769, 57689
(a) 34659 (b) 23549 (c) 57689 (d) 12439

DIRECTIONS (Qs. 36-50): *A series is given with one term missing. Choose the correct alternative from the given one that will complete the series.*

36. 2, 8, 40, ?, 1680, 13440
(a) 80 (b) 120 (c) 160 (d) 240

37. 15, 17, 20, 22, 27, 29, ?, ?
(a) 31, 38 (b) 36, 38 (c) 36, 43 (d) 38, 45

38. 1, 5, 25, 125, ?, ?, ?
(a) 245, 485, 965 (b) 225, 325, 425
(c) 625, 3225, 15605 (d) 625, 3125, 15625

39. $7\frac{1}{7}, 8\frac{2}{6}, 9\frac{5}{5}, 12\frac{2}{4}, 16\frac{2}{3}$, ___
(a) $35\frac{3}{4}$ (b) $16\frac{4}{4}$ (c) $\frac{50}{2}$ (d) $15\frac{2}{4}$

40. 0.15, 0.3, ?, 1.2, 2.4
(a) 0.6 (b) 0.9 (c) 0.06 (d) 4.8

41. 1.5, 9/4, 3, ?, 4.5, 21/4
(a) 15/4 (b) 7/2 (c) 8 (d) 9

42. 19, 38, ?, 228, 684, 1368
(a) 112 (b) 118 (c) 114 (d) 104

43. 3, 8, 5, 27, 8, 64, 12, 125, 17, ?
(a) 216 (b) 361 (c) 625 (d) 441

44. 19, 11, 13, 16, 15, 17, 13, 19, 21, ?
(a) 10 (b) 11 (c) 12 (d) 15

45. 100, –20, 4, ?, 0.6, –0.032
(a) 0.8 (b) 1 (c) –1 (d) –0.8

46. –7/4, –1, –0.25, ?, 5/4, 2
(a) 0.5 (b) 0.75 (c) 0.25 (d) 1

47. 3, 17, 73, 297, ?
(a) 1087 (b) 1193 (c) 2117 (d) 2197

48. 2, 6, 4, 9, 8, 13, 16, 18, 32, ?
(a) 24 (b) 26 (c) 22 (d) 28

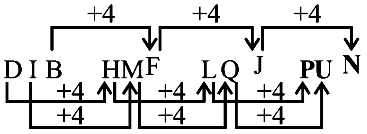
49. 534, 543, 559, 584, 620, ?
(a) 648 (b) 676 (c) 669 (d) 671

50. 2, 7, 11, 62, 28, 213, ?, ?
(a) 47, 518 (b) 45, 536
(c) 51, 476 (d) 53, 508

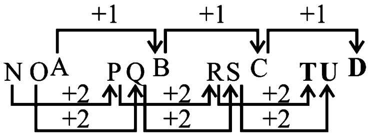
Hints & Solutions

1. **(c)** **b** a a **b**/b a **a** b/b **a** a b/**b** a a b
2. **(c)** **m** b b/m **a** a/m b **b**/m **a** a/**m** b b
3. **(d)** a b **a** a a **b** a a a **b** a **a** a b **a** a
4. **(b)** LU **B** TUP/LUBTU **P** / LUBT **U** P/**L** UBTUP]
5. **(a)** B **B** CCA/BB **C** CA/BBC **C** A/B **B** CCA
6. **(d)** **a b**/a b/ **a b**/**a** b/a **b**/a b
7. **(b)** S H **E** E L A / S **H** E E L A/**S** H E E L A /S H E E **L** A
8. **(b)** B R **O W** N /B **R** O **W** N /B

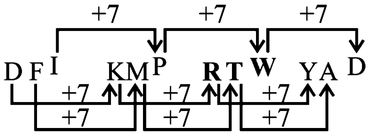
9. **(d)**



10. **(a)**



11. **(b)**

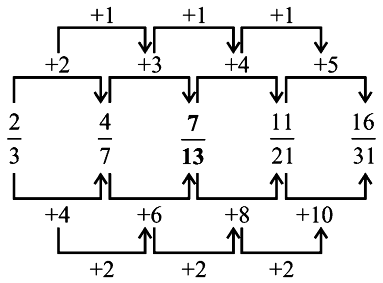


12. **(c)** 313 623 933 1243 **1553**
+310 +310 +310 +310

13. **(c)** 975 864 753 642 **531**
–111 –111 –111 –111

14. **(a)** 15 31 64 131 **266**
× 2 + 1 × 2 + 2 × 2 + 3 × 2 + 4

15. **(d)**

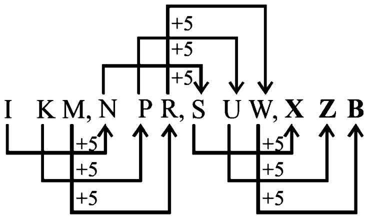


16. **(d)** 96 94 373 3353 **53643** 1341069
$\times(1)^2-2$ $\times(2)^2-3$ $\times(3)^2-4$ $\times(4)^2-5$ $\times(5)^2-6$

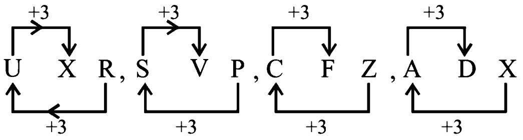
17. **(a)** 45 43 83 245 975 **4869**
×1–2 ×2–3 ×3–4 ×4–5 ×5–6

18. **(b)** 16 16 40 140 **840**
×1 ×2.5 ×3.5 ×6

19. **(a)**



20. **(a)**



21. (a)
−3 −3 −3 −3
Z W S P L I E $\boxed{B}$
−4 −4 −4

22. (a) B I O $\boxed{T}$ X A
+7 +6 +5 +4 +3

23. (a) $\frac{50}{7}$ $\frac{50}{6}$ $\frac{50}{5}$ $\frac{50}{4}$ $\frac{50}{3}$ $\boxed{\frac{50}{2}}$
−1 −1 −1 −1 −1

24. (c)
−4 −4 −4
24, 35,20,31,16,27,12,23
−4 −4

25. (b) 4 6 10 16 24 $\boxed{34}$
+2 +4 +6 +8 +10
+2 +2 +2 +2

26. (b) 3, 5, 9, 17, 33
$+2^1$ $+2^2$ $+2^3$ $+2^4$

27. (b) 3 5 35 10 12 35 **17** **19**
+7 +7 +7
+0 +7

28. (c) 36, 34, 30, 28, 24, 22,
−2 −4 −2 −4 −2

29. (c)
−2 −2 −2
−2 −2 −2
A Z B Y, C X D W, E V F U, G T H S
+2 +2 +2
+2 +2 +2

30. (a) 325 259 204 160 127 105 **94**
−66 −55 −44 −33 −22 −11
−11 −11 −11 −11 −11

31. (c)
+1 +2 +3
C G J, K O R, T X A, **D H K**
+4 +3 +4 +3 +4 +3 +4 +3

32. (b)
×2 ×2
+2 +2
B–1 D–2 F–4 H–8 J–16 **L–32**
+2 +2 +2
×2 ×2 ×2

33. (c)
33
25 27 29 31 $\boxed{34}$ 35
+2 +2 +2 +2 +2

34. (d)
5676
1236 2346 3456 4566 $\boxed{5686}$
+1110 +1110 +1110 +1110

35. (c)
1 2 4 3 9
+1 +1 +1 +1 +0
→ 2 3 5 4 9
+1 +1 +1 +1 +0
→ 3 4 6 5 9
+1 +1 +1 +1 +0
→ 4 5 7 6 9
+1 +1 1 +1 +0
→ 5 6 6 7 9

Hence, number 57689 is wrong.

36. (d) 2 8 40 240 1680 13440
×4 ×5 ×6 ×7 ×8

37. (b)
+5 +7 +9
15 19 20 22 27 29 36 38
+5 +7 +9

38. (d) 1 5 25 125 625 3125 15625
×5 ×5 ×5 ×5 ×5 ×5

39. (c) $7\frac{1}{7}=\frac{50}{7}$, $8\frac{2}{6}=\frac{50}{6}$,

$9\frac{5}{5}=\frac{50}{5}$, $12\frac{2}{4}=\frac{50}{4}$, $16\frac{2}{3}=\frac{50}{3}$

$$\left[\text{Series is} \Rightarrow \frac{50}{7},\frac{50}{6},\frac{50}{5},\frac{50}{4},\frac{50}{3},\mathbf{\frac{50}{2}}\right]$$

40. (a) 0.15 0.3 **0.6** 1.2 2.4
×2 ×2 ×2 ×2

41. (a) $\frac{3}{2}$ $\frac{9}{4}$ 3 $\mathbf{\frac{15}{4}}$ $\frac{9}{2}$ $\frac{21}{4}$
$\times\frac{3}{2}$ $\times\frac{4}{3}$ $\times\frac{5}{4}$ $\times\frac{6}{5}$ $\times\frac{7}{6}$

42. (c) 19, 38, $\boxed{114,}$ 228, 684, 1368
×2 ×3 ×2 ×3 ×2

43. (a)
+2 +3 +4 +5
3, 8, 5, 27, 8, 64, 12, 125, 17, 216
2^3 3^3 4^3 5^3 6^3

44. (a) 19, 11, 13, 16, 15, 17, 13, 19, 21, **10**
−3 −3 −3

45. (d) 100, −20, 4, **−0.8,** 0.16, −0.032
÷(−5) ÷(−5) ÷(−5) ÷(−5) ÷(−5)

46. (a) −7/4 −1 −0.25 **0.5** 5/4 2
+7.5 +7.5 +7.5 +7.5 +7.5

47. (b) 3 17 73 297 1193
×4 + 5 ×4 + 5 ×4 + 5 ×4 + 5

48. (a)
+3 +4 +5 +6
2 6 4 9 8 13 16 18 32 ? = 24
×2 ×2 ×2 ×2

49. (c) 534 543 559 584 620 ? = 669
9 16 25 36 49

50. (d) $1^2 + 1 = 2$, $2^3 - 1 = 7$
$3^2 + 2 = 11$, $4^3 - 2 = 62$
$5^2 + 3 = 28$, $6^3 - 3 = 213$
$7^2 + 4 = \mathbf{53}$, $8^3 - 4$
$= \mathbf{508}$

Chapter 4 Alphabet Test

INTRODUCTION

As we know that English alphabet is a group of English letters, hence the problems based on alphabet are the problems based on English letters. Problems under this segment are very important part of the questions asked in various competitive exams to be conducted for the purpose of requirement of officers and clerks. Particularly for getting job in SSC, Railway & banking exams, this type of questions cannot be ignored. This is the reason that we will discuss every aspect of such problems so that students do not face any kind of difficulty while solving the problems related to English alphabet.

Types of Problems

(1) General series of alphabet
(2) Random series of alphabet
(3) Words in alphabetical order
(4) Problems of word formation
(5) Problems of letter gap
(6) Formation of word from letters of another word.

Now we will discuss all the six types of problems one by one in detail.

(1) General Series of Alphabet

Example 1. Which of the following letter is seventh to the right of the 13th letter from the left in a forward alphabet series?

(a) R **(b) T** **(c) V** **(d) W**
(e) None of these

Sol. (b) 1st of all we will write the forward alphabet series as given below:

A B C D E F G H I J K L M
↑―――――――――――――――――――――↑
13th letter from left

| N | O | P | Q | R | S | T | U V W X Y Z
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

From above series it is clear that M is the 13th letter from left and to the right of M (13th letter from left), T is the 7th letter. Hence (b) is the correct option.

Here, we have solved this problem with a general method. But this type of problem can also be approached through quicker method that will help you save some extra consumed time.

Shortcut Approach-1

- If the directions are same then subtraction of numbers takes place.
- If the directions are opposite then addition of numbers takes place.

Shortcut Method for above example

Now, for solving the sample question we apply this rule. As we want to find out the 7th letter to the right of the 13th letter from the left, the directions are opposite and thus rule (b) will be applied here. Hence we add 7 + 13 = 20. Therefore, the answer will be 20th from left. Also, 20th from left less mean 26 – 20 + 1 = 7th from right. We can easily see.

∴ 20th letter from left = T

Also 7th letter from right = T

∴ This method also gives the answer choice (b).

After solving the sample question, you must have noticed that the above mentioned trick is to calculate the actual position of the required letter before going to search for it.

Other Variations of Such Type of Problems

Example 2. If alphabet series is given backward or in reverse order, then find out the eighth letter to the right of O?

(a) H **(b) G** **(c) U** **(d) X**
(e) None of these

Sol. (b) Z Y X W V U T S R Q P O

| N | M | L | K | J | I | H | G | F E D C B A
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

It's clear (b) is the correct answer.

Note

Even with the forward alphabet series we can solve this problem because the letter which is eight to the right of O in the reverse order alphabet series must be eight to the left of O in forward alphabet series.

Example 3. If the 1st half of the (Alphabetical Series) is written in reverse order, then find out the letter that would be 20th letter from the right end.

(a) G **(b) F** **(c) D** **(d) H**
(e) None of these

Sol. (a) As the 2nd half is not reversed, the 1st 13 letters would be same when we do counting from right. But not letters coming after 13th will be actually from the left.

Hence 14th letter from right would be A; 15th would be B; 16th would be C and we move further in the same manner. Hence from right 20th letter would be is G.

∴ Option (a) is the correct answer.

Remember...

I. While solving the problems based on alphabet, you must have in your mind the exact positions of every letters of alphabet in forward order as well as in backward or reverse order as given below:

Letters positions in forward alphabetical order:

A	B	C	D	E	F	G	H	I	J	K	L	M
1	2	3	4	5	6	7	8	9	10	11	12	13

N	O	P	Q	R	S	T	U	V	W	X	Y	Z
14	15	16	17	18	19	20	21	22	23	24	25	26

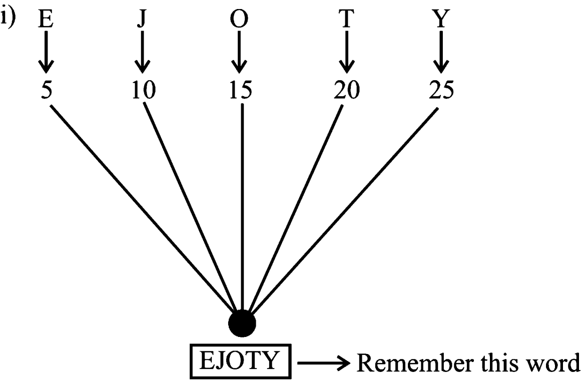
Letters positions in backward or reverse alphabetical order:

Z	Y	X	W	V	U	T	S	R	Q	P	O	N
1	2	3	4	5	6	7	8	9	10	11	12	13

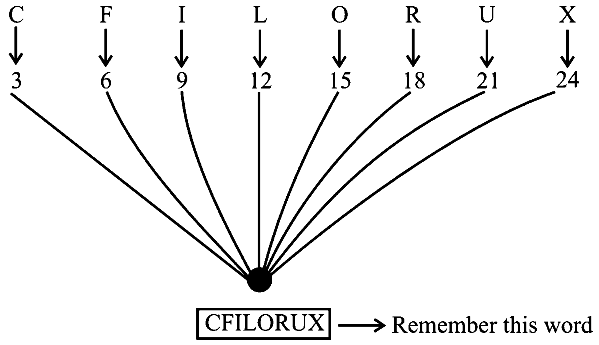
M	L	K	J	I	H	G	F	E	D	C	B	A
14	14	15	16	18	19	20	21	22	23	24	25	26

II. Just keep in mind, the following positions of the letters in the English alphabet (forward order).

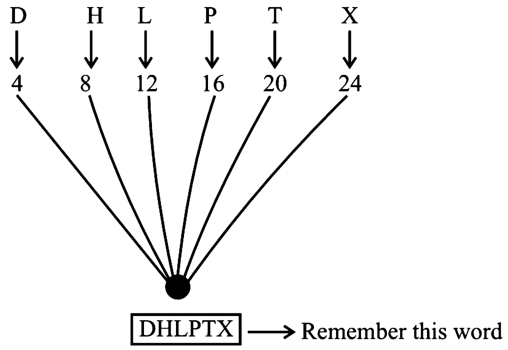
(i)



(ii)



(iii)



III. *m*th element to be counted from left to right of a series of *x* characters is equal to $(x + 1 - m)$th element to be counted from right to left of that series. This rule can be better illustrated by an example which is given below:

Let us take the forward order alphabet series,

A	B	C	D	E	F	G	H	I	J	K	L	M
1	2	3	4	5	6	7	8	9	10	11	12	13

N	O	P	Q	R	S	T	U	V	W	X	Y	Z
14	15	16	17	18	19	20	21	22	23	24	25	26

As we know that English alphabet has 26 characters, hence, we have $x = 26$.

Now suppose, we have to find out the position of K in the above given series counting from right to left.

Position of 'K' in the english alphabet from left to right is 11. Thus $m = 11$

∴ Position of K in the above given series from right to left would be $(26 + 1 - 11) = 16$

Note

I, II & III given under **"Remember"** tips are very important as they are very helpful in solving problems based on general series of alphabet. Readers are advised to take them as a rule.

How to Solve Problems When Letters are Dropped or Deleted at Regular Intervals?

Example 4. If every 3rd letter from left to right of english alphabetical series is deleted, then what would be the 6th letter from left in the new series obtained?

Sol. General method:

A B Ⓒ D E Ⓕ G H Ⓘ J K Ⓛ M N Ⓞ

P Q Ⓡ S T Ⓤ V W Ⓧ Y Z

Here, deleted letters have been encircled and we find the new series as given below:

A	B	D	E	G	H	J	K	M
1	2	3	4	5	6	7	8	9

N	P	Q	S	T	V	W	Y	Z
10	11	12	13	14	15	16	17	18

It is clear, that 6th letter from the left end in the new series is H.

Shortcut Approach - 2

No doubt, that general method gives the correct answer. But we need to save extra consumed time and this is the reason we go for a quicker approach.

As per the example, every third letter is deleted in the original series. It does mean that we are left of two letters after every deletion. Here, '2' is the key digit for us and we have to find out 6th letter from the left in the new obtained series. Therefore, we have to find a digit which is just less than 6 but divisible by 2. For this question the digit just less than 6 and divisible by 2 is 4. Now we follow the operation given below:

6th letter from the left in the new series = $6+\frac{4}{2}$

= 8th letter from the left in the original series, which is K.

In the same manners, we can find out any letter at a particular position in the new obtained series.

∴ 16th letter from the left in the new obtained series

$= 16+\frac{14}{2}$

= 23rd letter from the left in the original series which is W.

18th letter from the left in the new obtained series = $18+\frac{16}{2}$

= 26th letter from the left in the original series which is Z.

The sample example can be asked in following way also:

"If every third letter from left to right in English alphabet is dropped (or deleted), then find out the 13th letter from right in the new obtained series".

To solve this, we find first of all the number of letters in the new obtained series.

As every third letter is dropped, hence we have

$\left(26-\frac{26}{3}\right)=26-8=18$ letters in the new series.

Point to be noted here that we divide 26 by 3 as every 3rd letter is dropped and after division we take approximate value of $\frac{26}{3}$ in round figure (approximate value of $\frac{26}{3}$ will be 8).

As per the example we have to find out 13th letter from right in the newly obtained series. This mean (18 + 1 – 13) = 6th letter from left which is H.

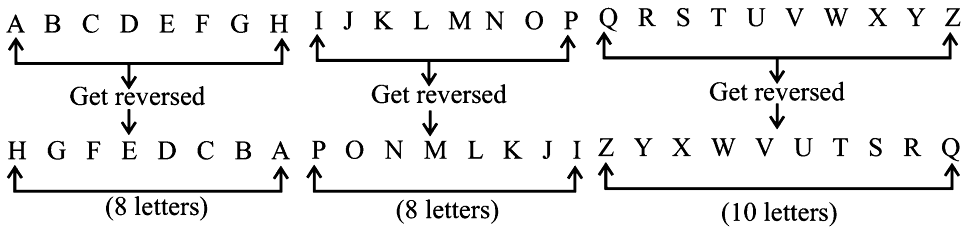
Note

This quicker approach can also be applied to the dropping of every 4th, 5th, 6th, 7th..... and so on letters from left to right at regular intervals.

How to Solve Problems Based on The Backward (Reversed) Alphabet Series?

While solving problems based on general series of alphabet, we come across the various cases. In some cases we see that whole alphabet series is reversed but in some other cases 1st half of the series is reversed, or second half of the series is reversed or many segments of the alphabet series are reversed.

Let us take a case when a forward order alphabet series get reversed in three segments. In 1st segment 8 letters get reversed; in 2nd segment the next 8 letters get reversed and in the 3rd segment the remaining 10 letters get reversed. Just see the presentation given below:


A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
Get reversed
Get reversed
Get reversed
H G F E D C B A P O N M L K J I Z Y X W V U T S R Q
(8 letters)
(8 letters)
(10 letters)

Now if you are asked to find out the 4th letter from left in the new obtained series, then through general method, we simply do counting from left in the new series and find out our required answer as 'E' because 'E' is at 4th position from left in the new obtained series. But while solving such type of problems, we have to do some time consuming formalities like (a) writing the original series (b) writing and reversing the letters of original series as per the question says and (c) counting them to get the required answer. Such time consuming processes can be avoided if we go through "**Remember point III**" and solve the question with shortcut approach.

Shortcut Approach - 3

It is clear that 4th letter from left in the new obtained series falls into first segment which has 8 letters. Hence 4th letter in the new obtained series = (8 + 1 – 4) = 5th letter from the left in the original series. As we know that exact position of 5th letter from left in the original alphabet series is the position of E. Hence E is our required answer.

If we have to find out 18th letter from left in the new obtained series, then that will be 16 + (10 + 1 – 2) = 25th letter from left in the original alphabet series, which is Y.

In fact, while finding out 18th letter, we can easily see that 18th letter is the 2nd letter of 3rd segment and hence it will be not affected by 1st two segments having 8 letters each. In other words to find out 18th letter in the new obtained series, we have to find out the 2nd letter in the 3rd segment. This is the reason we find out the 2nd letter in the 3rd segment and then add the 16 letters of 1st two segment to get the 18th letter in the new obtained series. From this, we find that 18th letter from left in the new obtained series is the 25th letter from left in the original series. As 25th letter from left in the original series is Y. So (Y) will be our required answer.

Readers are advised to practice such type of problems as much as possible and after a certain time will notice that you have got a skill to solve such problems in a few seconds and that too, without the use of pen and paper.

How to Solve if Positions of Letters are Interchanged?

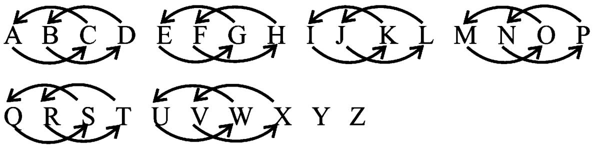
There is no any rule for such type of problems. Only the hard practice can give you a skill to solve such questions in a quick time.

Example 5. If A and C interchange their places, B and D interchange their places, E and G interchange their place, F and H interchange their places and so on, then which letter will be 5th to the left of Q?

(a) P (b) N (c) M (d) T

(e) None of these.

Sol. (a) As per the question the interchanges take place as follows:



Here we can see that Q interchanges with S. Then to left of Q, the 5th letter would be P because P interchanges with N.

How to Find the Middle Letter?

Case I : Remember that if m^{th} and n^{th} letter from the left in the English alphabet are given then

$$\text{Middle letter} = \left(\frac{m+n}{2}\right)^{th} \text{ letter from the left.}$$

Case II: Remember that if m^{th} and n^{th} letter from the right in the English alphabet are given then

$$\text{Middle letter} = \left(\frac{m+n}{2}\right)^{th} \text{ letter from right}$$

$$= \left[(26+1)-\left(\frac{m+n}{2}\right)\right] = \left[27-\left(\frac{m+n}{2}\right)\right]^{th}$$

letter from the left in the English alphabet.

Note

In case I and case II $(m + n)$ must be divisible by 2.

Case III : Remember that if the m^{th} letter from the left and the n^{th} letter from the right are given then middle letter

$$= \left[\frac{(m-n)+27}{2}\right] \text{th letter from the left in the alphabet.}$$

Note

In case III $(m - n) + 27$ must be divisible by 2.

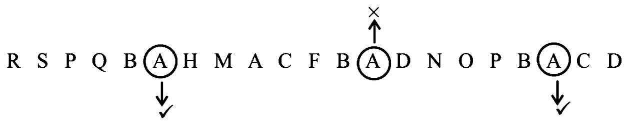
(2) Random Series of Alphabet

This series is not in the proper sequence and letters take their position in the series in jumbled manner. Further, there is also a possibility that all the 26 letters of English alphabet are not available in the series. Even same letters may be repeated in the series.

Example 6. How many letters in the following series are immediately preceded by B but not immediately followed by D?

R S P Q B A H M A C F B A D N O P B A C D.

Sol.



∴ Only the two times A fulfill the given condition and those A have been marked with the correct sign (✓). Those not fulfilling the condition have been marked with the cross sign (×). ∴ Required answer is 2.

(3) Words in Alphabetical Order

In such type of questions, words are given and you have to find out which word will appear in the dictionary. 1st or 2nd or 3rd or 4th etc.

Example 7. Which of the following words will come 2nd in the dictionary?

(a) Name (b) Shame (c) Fame

(d) Came (e) Wame

Sol. 'Came' comes 1st in the dictionary.

'Fame' comes 2nd in the dictionary.

'Name' comes 3rd in the dictionary.

'Shame' comes 4th in the dictionary.

'Wame' comes 5th in the dictionary.

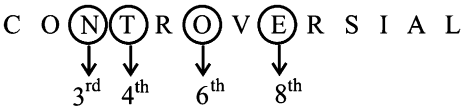
∴ (c) is the required answer.

(4) Problems of Word Formation

In such problems, a word is given and you have to find out the number of words to be formed out of some letters drawn from that particular word.

Example 8. How many meaningful words can be formed from the 3rd, 4th, 6th and 8th letter of the word 'CONTROVERSIAL'?

Sol.



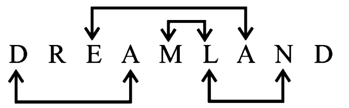
Now from letters N T O and E, two meaningful words 'NOTE' and 'TONE' can be formed.

(5) Problems of Letter Gap

Case I :

Example 9. How many pairs of letters are there in the word 'DREAMLAND' which have as many letters between them as in the English alphabet?

Sol. Here, we are asked to solve problem according to English (Alphabetical Series). In this case we have to count both ways. It does mean that we have to count from left to right and from right to left. Let us see the following presentation:



The above presentation makes it clear that the required pairs of letters are 4. (Pairs: DA, EA, ML and LN)

Case II :

Example 10. How many pairs of letters are there in the word 'DREAMLAND' which have the same number of letters between them as in the English alphabet in the same sequence.

Sol. Here we are asked to solve problems according to the alphabetical sequence. It does mean that we have to do counting only from left to right. Let us, see the following presentation:

D R E A M L A N D

The above presentation makes it clear that the required pair of letters is only 1 (Pair: LN)

(6) Formation of word from the letters of another word:

Example 11. From the given alternative words, select the word which can be formed using the letters of the given word. ENDEARMENT

(a) TEMPER (b) MEANS
(c) TENDER (d) TENT

Sol. (c) TENDER is the word which can be formed from the given word ENDEARMENT.

Example 12. From the give alternative select the word which cannot be formed using the letters of the given word. TEACHER

(a) REACH (b) EATER
(c) EARTH (d) TRACTOR

Sol. (d) TRACTOR is the word which cannot formed from the given word as T does not comes twice in the original word.

EXERCISE

1. If it is possible to make only one meaningful word from the second, fourth, fifth, seventh and eleventh letters of the word 'Distribution', third letter of that word is your answer. If more than one such word can be formed your answer is 'M'and if no such word can be formed your answer is 'X'.
(a) B (b) I (c) O (d) X
(e) M

2. How many such pairs of letters are there in the word 'IDEAL' each of which has as many letters between them in the word as in the English alphabet ?
(a) Nil (b) One (c) Two (d) Four
(e) None of these

3. If in the English Alphabet each consonant is substituted by the immediate preceding letter and each vowel is substituted by the immediate following letter, then the word CAPITALISE will be written as:
(a) BBOJSBMJRF (b) BBOJSBKJRD
(c) BBQJSBKJRF (d) BBOJSBKJRF
(e) None of these

4. If it is possible to make only one meaningful English word with the third, seventh, eighth and tenth letters of the word PREDICAMENT, which of the following will be the third letter of that word ? If no such word can be made, give 'X' as the answer and if more than one such word can be made, give 'Y' as the answer.
(a) M (b) N (c) E (d) X
(e) Y

5. The serial order of how many letters in the word CLIENT will not differ than their serial order in the arrangement when the letters of the word are arranged alphabetically?
(a) Four (b) One (c) Three (d) Two
(e) None of these

6. How many such pairs of letters are there in the word EXCURSION, each of which has as many letters between them in the word as they have in the English alphabet?
(a) None (b) One (c) Two (d) Three
(e) More than three

7. If it is possible to make only one meaningful word from the second, third, sixth and eighth letters of the word DEVIATION, the first letter of the meaningful word is your answer. If more than one such word can be formed your answer is 'A' and if no such word can be formed your answer is 'B'.
(a) V (b) T (c) E (d) A
(e) B

8. If each alternate letter beginning with the first in the word WORKING is replaced by the next letter in the English alphabet and each of the remaining letters is replaced by the previous letter in the English alphabet, which of the following will be the fourth from the right end after the replacement?
(a) N (b) Q (c) J (d) M
(e) None of these

9. How many three - letter meaningful words can be formed from the word TEAR beginning with 'A' without repeating any letter within that word?
(a) One (b) Three (c) Five (d) Two
(e) None of these

10. In the word FLOURISH, all the vowels are first arranged alphabetically and then all the consonants are arranged alphabetically and then all the vowels are replaced by the previous letter and all the consonants are replaced by the next letter from the English alphabet. Which letter will be third from the right end?
(a) I (b) S (c) M (d) V
(e) None of these

11. If it is possible to make a meaningful word from the second, third, tenth and eleventh letters of the word PASSIONATELY using each letter only once, second letter of that word is your answer. If no such word can be formed your answer is X and if more than one word can be formed your answer is Y.
(a) A (b) E (c) L (d) X
(e) Y

12. If in the word CERTIFICATE, the first and the seventh letters are interchanged, similarly the second and the eighth letters are interchanged and so on up to the fifth and eleventh letters are interchanged, then which letter will be third to the right of sixth from the right end?
(a) T (b) R (c) A (d) C
(e) None of these

13. How many such pairs of letters are there in the word ELEVATION, each of which have as many letters between them in the word as they have between them in the English alphabet?
(a) None (b) One (c) Two (d) Three
(e) More than three

14. If each vowel in the word HABITUAL is changed to the next letter in the English alphabet and each consonant is changed to the previous letter in the English alphabet, which of the following will be fourth from the left ?
(a) A (b) S (c) J (d) H
(e) None of these

15. In this question, a word has been given following by four other words, one of which cannot be formed by using the letters of the given word. Find this word.
'CHEMOTHERAPY'
(a) HECTARE (b) MOTHER
(c) THEATER (d) FATHER

16. From the given alternatives, select the word which can be formed using the letters of the given word.
REMEMBERING
(a) NEGRO (b) AGREE (c) RAIN (d) GREEN

17. In this question, a word has been given following by four other words, one of which can not be formed by using the letters of the given word. Find this word.
NOMENCLATURE
(a) CLEAN (b) MENTAL
(c) NATURE (d) RETIRE

18. How many pairs of letters are there in the word 'TABLE' each of which has as many letters between them in the word, as they have between them in the English alphabet?
(a) Three (b) Two (c) One (d) Four
(e) None of these

19. How many pairs of letter are there in the word COMMUNICATION which have as many letters between them as in the English alphabet ?
(a) Four (b) Five (c) Six (d) Seven

20. How many such pairs of letters are there in the word OVERSEE each of which has as many letters between them in the word (in both forward and backward directions) as they have between them in the English alphabetical series
(a) Three (b) One (c) Four (d) None
(e) None of these

Hints & Solutions

1. (a) Order of letters is as follows :
1 2 3 4 5 6 7 8 9 10 11 12
D I S T R I B U T I O N
↓ ↓ ↓ ↓ ↓
I T R B O
⇒ OR$\boxed{B}$IT

According to the question we obtain five letters I, T, R, B and 'O' which can form one meaningful word 'ORBIT'. The third letter of that world is 'B'.
Hence, required letter ⇒ B

2. (b) 9 4 5 1 12 ⇒ DE
I D E A L

Here, we observe that in the above word, only 'DE' is a letter pair each of which has as many letters between them in the word as in the English alphabet.
Hence, number of required letter pair ⇒ One

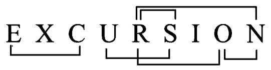
3. (d) C A P I T A L I S E
−1↓ +1 ↓−1↓ +1 ↓−1↓ +1 ↓−1↓ +1 ↓−1↓ +1↓
B B O J S B K J R F

4. (e) Third, the seventh, eighth and tenth letters of the word PREDICAMENT are E, A, M and N respectively. Meaningful words are: Mean, Name and Mane.

5. (a)

C	L	I	E	N	T
C	E	I	L	N	T

6. (e)



7. (d) 1 2 3 4 5 6 7 8 9
D E V I A T I O N
Second, Third, Sixth and Eighth letters are E, V, T and O.
Meaningful words are : VETO, VOTE

8. (c) W O R K I N G
+1 −1 +1 −1 +1 −1 +1
X N S J J M H
fourth from right

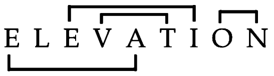
9. (b) Meaningful words are : ARE, ART, ATE

10. (c) According to the question
F L O U R I S H
↓
I O U F H L R S
↓
I O U F H L R S
−1↓ −1↓ −1↓ +1↓ +1↓ +1↓ +1↓ +1↓
H N T G I M S T
3rd from right

11. (e) Meaningful words are : SEAL and SALE.

12. (b) According to question,
third to the right of F
I C A T E $\boxed{F}$ C E $\boxed{R}$ T I
sixth from right

13. (e)



So, there are four pairs : EA, EI, VT, ON

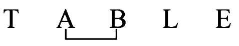
14. (c) Original word :
HABITUAL
Changed word :
GBAJSVBK
So, fourth from the left is J.

15. (d) FATHER

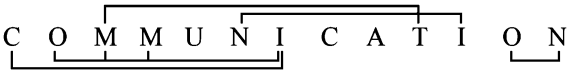
16. (d) GREEN

17. (d) RETIRE can't be formed using the above word.

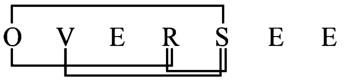
18. (c)



19. (c)



20. (c)



Chapter 5 Coding & Decoding

In this segment of commonsense reasoning, secret messages or words have to be decoded. They are coded as per a definite pattern/ rule which should be identified first. Then the same is applied to decode another coded word. Under this segment you come across two types of coding letter coding and number coding. Based on these two types of coding-decoding various types of problems comes your way. This chapter makes you familiar with every types of problems based on coding-decoding.

Type I : (Coding by Letter Shifting)

Pattern 1: Coding in Forward Sequence

Example **1. If 'GOOD' is coded as 'HPPE', then how will you code 'BOLD'?**

Sol. Here,every letter of the word 'GOOD' shifts one place in forward alphabetical sequence. Let us see:

$$\begin{array}{cccc} G & O & O & D \\ {\scriptstyle +1}\big\downarrow & {\scriptstyle +1}\big\downarrow & {\scriptstyle +1}\big\downarrow & {\scriptstyle +1}\big\downarrow \\ H & P & P & E \end{array}$$

Similarly, every letter in the word 'BOLD' will move one place in forward alphabetical sequence as given below:

$$\begin{array}{cccc} B & O & L & D \\ {\scriptstyle +1}\big\downarrow & {\scriptstyle +1}\big\downarrow & {\scriptstyle +1}\big\downarrow & {\scriptstyle +1}\big\downarrow \\ C & P & M & E \end{array}$$

∴ Code for 'BOLD' will be 'CPME'.

Pattern 2: Coding in Backward Sequence.

Example **2. If 'NAME' is coded as 'MZLD', then how will you code 'SAME'?**

Sol. Here, every letter of the word 'NAME' moves one place in backward alphabet sequence. Let us see:

$$\begin{array}{cccc} N & A & M & E \\ {\scriptstyle -1}\big\downarrow & {\scriptstyle -1}\big\downarrow & {\scriptstyle -1}\big\downarrow & {\scriptstyle -1}\big\downarrow \\ M & Z & L & D \end{array}$$

Similarly, every letter of the word 'SAME' will move one place in backward alphabet sequence. Let us see :

$$\begin{array}{cccc} S & A & M & E \\ {\scriptstyle -1}\big\downarrow & {\scriptstyle -1}\big\downarrow & {\scriptstyle -1}\big\downarrow & {\scriptstyle -1}\big\downarrow \\ R & Z & L & D \end{array}$$

∴ Code for 'SAME' will be 'RZLD'.

Pattern 3: Coding Based on Skipped Sequence.

Example **3. If the word 'FACT' is coded as 'IDFW'; then how will you code 'DEEP'?**

Sol. Here, you see that 2 letters are omitted in alphabetic sequence. The following diagram gives you the more clear picture :

$$\begin{array}{cccc} F & A & C & T \\ {\scriptstyle +3}\big\downarrow & {\scriptstyle +3}\big\downarrow & {\scriptstyle +3}\big\downarrow & {\scriptstyle +3}\big\downarrow \\ I & D & F & W \end{array}$$

Clearly, 'F' (skip 2 letters) 'I'
'A' (skip 2 letters) 'D'
'C' (skip 2 letters) 'F'
'T' (skip 2 letters) 'W'

Similarly, 'DEEP' can be coded. Let us see :

$$\begin{array}{cccc} D & E & E & P \\ {\scriptstyle +3}\big\downarrow & {\scriptstyle +3}\big\downarrow & {\scriptstyle +3}\big\downarrow & {\scriptstyle +3}\big\downarrow \\ G & H & H & S \end{array}$$

∴ Code for 'DEEP' will be 'GHHS'.

Type II : (Coding by Analogy)

Example **4. If 'RPTFA' stands for 'BLADE', how will you code 'BALE'.**

Sol. Here, 'BLADE' has been coded as 'RPTFA'. You will see that all the letters in the word 'BALE', which have to be coded, are also there in the word 'BLADE'. Hence, all that needs to be done is to choose the relevant code letters from the code word 'RPTFA'. Therefore, B becomes R, A becomes T, L becomes P, and E becomes A. Therefore, 'BALE' will be coded as 'RTPA'.

∴ Correct answer is 'RTPA'.

Type III : (Coding by Reversing Letters)

Example **5. If 'TEMPERATURE' is coded as 'ERUTAREPMET', then how will you code 'EDUCATION' following the same scheme.**

Sol. Here, the word 'TEMPERATURE' has been reversed. Hence, the code for 'EDUCATION' will be 'NOITACUDE'.

Type IV : (Coding in Fictitious Language)

In some cases of coding-decoding, fictitious language is used to code some words. In such questions, the codes for a group of words is given. In such types of problems, codes for each word can be found by eliminating the common words.

Example **6. In a certain code language 'over and above' is written as 'da pa ta' and 'old and beautiful' is written as 'sa na pa'. How is 'over' written in that code language?**

Sol. over and above = da pa ta
old and beautiful = sa na pa
clearly, 'and' is common in both and a common code is 'pa'.
∴ Code for 'and' must be 'pa'.
Code for 'over' = 'da' or 'ta'.
Code for above = 'da' or 'ta'.

Code for old = ‘sa’ or ‘na’
Code for beautiful = ‘sa’ or ‘na’
∴ We can’t certainly say what will be exact code for ‘over’. But it is sure that code for ‘over’ must be either ‘da’ or ‘ta’.

Type V : (Coding based on Numbers)

Pattern 1: When Numerical Values are Given to Words.

Example 7. If in a certain language A is coded as 1, B is coded as 2. C is coded as 3 and so on, then find the code for AEECD.

Sol. As given the letters are coded as below:

A	B	C	D	E	F	G	H	I
1	2	3	4	5	6	7	8	9

Now,

A	E	E	C	D
1	5	5	3	4

∴ Code for AEECD = 15534

Pattern 2: When alphabetical code value are given for numbers.

Example 8. In a certain code 3 is coded as ‘R’, 4 is coded as ‘D’, 5 is coded as ‘N’, 6 is coded as ‘P’, then find the code for ‘53446’.

Sol. As per the given condition

3	4	5	6
R	D	N	P

Now,

5	3	4	4	6
N	R	D	D	P

∴ Code for 53446 = NRDDP.

Type VI: (Mathematical Operations with the Position Numbers of Letters)

Example 9. In a certain code, if ‘TALE’ is written as 38, then how will you code ‘CAME’ using the same coding scheme?

Sol. Look at the numbered alphabet and write down the number corresponding to the letters of the word ‘TALE’.

T A L E
20 1 12 5

The fact that the code for ‘TALE’ is 38, gives you a clue that the code is probably obtained by performing an arithmatical operations of the numbers of each other. Let us see :

20 + 1 + 12 + 5 = 38

Thus, the code for ‘CAME’ is

C A M E
3 + 1 + 13 + 5 = 22

∴ Code for ‘CAME’ = 22

How to learn opposite letters:

A	B	C	D	E	F	G	H	I	J	K	L	M
Z	Y	X	W	V	U	T	S	R	Q	P	O	N

Trick to Remember

M N → Remember M N of **MAN**
L O → Remember L O of **LO**VE
K P → **K**evin **P**iterson (English cricketer)
J Q → **J**ack & **Q**ueen (in the game of cards)
I R → **I**ndian **R**ailway
H S → **H**igher **S**econdary
G T → **G T** Road (Built by Shershah)
F U → Remember F U of **FLU**
E V → Remember EV of **EV**M (Electronic Voting Machine)
D W → Remember D W of **DEW**
C X → Remember CX of **C**RU**X**
B Y → Remember the word **‘BY’**
A Z → Remember it as it is

EXERCISE

1. If EODGH is the code for BLADE, what is the code for CRICKET?
(a) WHNFLUF (b) FULFNHW
(c) DSJDLFU (d) ETKEMGV

2. If EARTH is coded as 41590 and PALE as 2134, what is the code for PEARL?
(a) 12345 (b) 54123 (c) 21534 (d) 24153

3. In a secret way of writing 'GANDHI WAS A GREAT LEADER OF INDIA' is written as 'RUFZOJ SUV U RDTUB QTUZTD EP JFZJU'. Keeping this in mind, pick the code for each word given below from the choices given:
(i) STRONG
(a) VBDERE (b) VBDEER
(c) VBEDFR (d) VBDEFR
(ii) ISLAND
(a) JVQUFZ (b) ZFUQVJ
(c) QUFZJV (d) FUZJVQ

4. In a given code SISTER is coded as 535301. UNCLE as 84670 and BOY as 129. How is RUSTIC written in that code?
(a) 633185 (b) 185336 (c) 363815 (d) 581363

5. If 'word' is coded as 2315184 then how will 'simple' be coded as?
(a) 199237612 (b) 1991316125
(c) 21237643 (d) 22145783

6. If wall is called window, window is called door, door is called floor, floor is called roof and roof is called ventilator, what will a person stand on?
(a) Door (b) Ventilator
(c) Roof (d) Floor

7. In a certain code language ‘La Ke Ta’ means ‘go and swim’, ‘Ne La Se’ means ‘you swim here’ and ‘Pe Ke Ne Ta’ means ‘he and you go’. Which of the following is the code for ‘here’ in that code language ?
(a) Cannot be determined (b) La
(c) Ne (d) La or Se
(e) None of these

8. If 'spoon' is called 'plate 'plate' is called 'knife', 'knife' is called 'jug', 'jug' is called 'glass', 'glass' is called 'saucer' and 'saucer' is called 'spoon', by what do we cut fruit?
(a) spoon (b) jug (c) glass (d) saucer
(e) None of these

9. If 'A' is substituted by 26, 'B' by 25 and so on upto 'Z' which is substituted by 1, what will be the sum of the numbers substituted for the word 'WAXY'?
(a) 33 (b) 35 (c) 37 (d) 73
(e) None of these

10. If E is coded as V, D is coded as Q, N is coded as Z, G is coded as T, R is coded as I and A is coded as M, which of the following will be the correct form of the word DANGER?
(a) QMZTIV (b) QMZTVI
(c) QMZITV (d) QZMTV I
(e) None of these

11. If 'A' is substituted by 1, 'B' by 2 and so on upto 'Z' which is substituted by 26, what will be, the sum of the numbers substituted for the word DECAY?
(a) 38 (b) 41 (c) 40 (d) 37
(e) None of these

12. If AMONG is written as NAOGM and SPINE is written as NSIEP, then LAMON will be written as
(a) OALNM (b) MLONA
(c) OLMNA (d) OLNMA
(e) None of these

13. In a certain code RETAIL is written as UFSBJM, how is EXPECT written in that code?
(a) FQYFDU (b) QYFIJOF
(c) FYQFDU (d) QYFFDU
(e) None of these

14. In a certain code NAMES is written as TFNBO.'How is CRANE written in that code ?
(a) FMBQD (b) DSBOF
(c) FOBSD (d) FBODS
(e) None of these

15. In a certain code DAYLONG is written as ZBEKHOP. How is CORDIAL written in that code?
(a) SPDCMBJ (b) SPDEMBJ
(c) DPSCMBJ (d) SPDCJBM
(e) None of these

16. In a certain code language 'do re me' means 'he is late', 'fa me la' means `she is early' and 'so ti do' means 'he leaves soon'. Which code in that language means 'late'?
(a) la (b) do
(c) me (d) Date inadequate
(e) None of these

17. In a certain code 'MOTHER' is written as OMHURF. How will 'ANSWER' be written in that code ?
(a) NBWRRF (b) MAVSPE
(c) NBWTRD (d) NBXSSE
(e) None of these

18. In a certain code DUPLICATE is written as MRV FJFVBE. How is CARTOUCHE written in that code?
(a) UTBEPWDJF (b) UTBFQFJDW
(c) UTBEQFJDW (d) UTBEPFJDW
(e) None of these

19. In a certain code CHITON is written as IHCNOT. How will DILATE be written in that code?
(a) ETALID (b) LIDATE
(c) LIDETA (d) ETADIL
(e) None of these

20. If 8 is written as B, 1 as R, 6 as K, 9 as O, 4 as M, 7 as W and 3 as T, then how, would WROMBT be Written in the numeric form?
(a) 714983 (b) 719483
(c) 769483 (d) 719486
(e) None of these

21. In a certain code HOUSE is written as FTVPI how is CHAIR written in that code?
(a) DIBJS (b) SBJID (c) SHBGD (d) SJBID
(e) None of these

22. In a certain code language 'in ba pe' means 'he has won', 'le ki ba' means 'she has lost' and 'in se pe' means 'he always won'. Which word in that language means 'he'?
(a) in (b) pe
(c) se (d) Data inadequate
(e) None of these

23. if 1 is coded as $, 5 is coded as %, 9 is coded as ★ , 3 is coded as +, 7 is coded as # and 4 is coded as?, what will be the correct code of the number 435971?
(a) ? + % ★ # $ (b) ? + % $ # ★
(c) ? + ★ % # $ (d) $ # ★ % + ?
(e) None of these

24. In a certain code SOLDIER is written as JFSCRNK. How is GENIOUS written in that code?
(a) PVTHHFO (b) PVTHFDM
(c) PVTHMDF (d) TVPHFDM
(e) None of these

25. In a certain code MEADOW is written as BFNVNC. How is CORNER written in that code?
(a) DPSQDM (b) SPDMDQ
(c) SPDQDM (d) DPSMDQ
(e) None of these

26. If in a certain code, **LUTE** is written as **MUTE** and **FATE** is written as **GATE**, then how will **BLUE** be written in that code?
(a) CLUE (b) GLUE (c) FLUE (d) SLUE

27. In a certain code, TWINKLE is written as SVHMJKD, then how would FILTERS be written in the same code?
(a) EHKSDQR (b) EHKUDQR
(c) EGKUDQR (d) GJMSFST

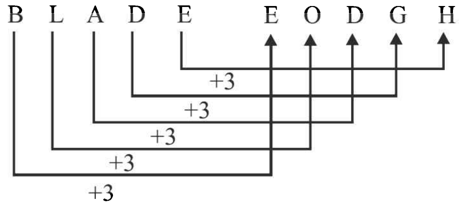
28. In a certain code, PRODUCTIONS is written as QQPCVEUHPMT. How is ORIENTATION written in that code?
(a) PQJDOVBSJNO (b) PQJDOUBUJPO
(c) PSJFOVBSJNO (d) NSHFMVBSJNO

29. If, in a code, MIND becomes KGLB and ARGUE becomes YPESC, then what will DIAGRAM be in that code?
(a) BGYEPYK (b) BGYPYEK
(c) GLPEYKGB (d) LKBGYPK

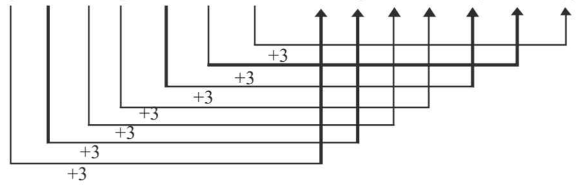
30. If in a certain code, GLAMOUR is written as IJCNMWP and MISRULE is written as OGUSSNC, then how will TOPICAL be written in that code?
(a) VMRJECN (b) VMRHACJ
(c) VMRJACJ (d) VNRJABJ

Hints & Solutions

1. (b) As,



Similarly,



2. (d) Codes for letters are: P=2, E=4, A=1, R=5 and L=3
Hence, code of PEARL is 24153

3. Here each letter of the original sentence is coded from different letter in a code as shown below:

Sentence	GANDHI	WAS	A	GREAT	LEADER	OF	INDIA
Code	RUFZOJ	SUV	U	RDTUB	QTUZTD	EP	JFZJU

(i) (d) Hence, code for STRONG is VBDEFR
(ii) (a) And code for ISLAND is JVQUFZ

4. (b) In this code the alphabets are coded as follows
SISTER UNCLE BOY
535301 84670 129
If we apply this method, the code comes out to be 185336

5. (b) Here we observe that 'W' has been replaced by its position code that is by 23. Similarly 'O' has been replaced by 15 therefore the word 'SIMPLE' will be coded as
S - 19, I - 9, M - 13, P - 16, L - 12, E - 5
Hence required will be code 1991316125

6. (c) A person stands on the floor and in the given code language, floor is called roof.
Hence, roof will be the correct answer.

7. (e) La Ke Ta → go and swim
Ne La Se → you swim here
Pe ke Ne Ta → he and you go
Hence, the code for 'here' is 'Se'

8. (b) We cut fruit with knife and knife is called jug, hence correct answer is jug.

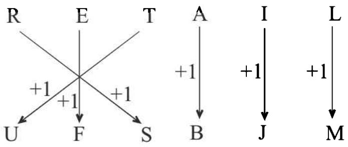
9. (b) W A X Y
↓ ↓ ↓ ↓
4 + 26 + 3 + 2 = 35

10. (b) D A N G E R
↓ ↓ ↓ ↓ ↓ ↓
Q M Z T V I

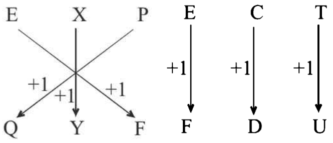
11. (a) D E C A Y
↓ ↓ ↓ ↓ ↓
4 + 5 + 3 + 1 + 25 = 38

12. (c) 1 2 3 4 5 4 1 3 5 2
A M O N G → N A O G M
1 2 3 4 5 4 1 3 5 2
S P I N E → N S I E P
Hence,
1 2 3 4 5 4 1 3 5 2
L A M O N → O L M N A

13. (d) As,

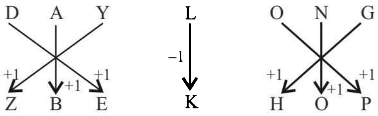


Similarly,

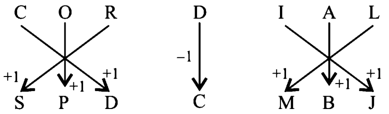


14. (c) N A M E S
↓+1 ↓+1 ↓+1 ↓+1 ↓+1
O B N F T
↓ reverse order
T F N B O
Similarly, C R A N E
↓+1 ↓+1 ↓+1 ↓+1 ↓+1
D S B O F
↓ reverse order
F O B S D

15. (a) As,

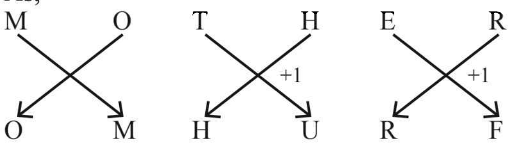


Similarly,

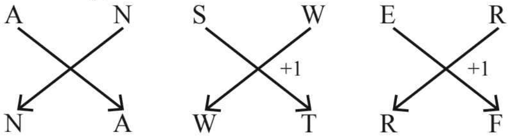


16. (e) do re me → he is late
fa me la → she is early
so ti do → he leaves soon
Hence re → Late

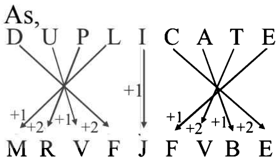
17. (e) As,



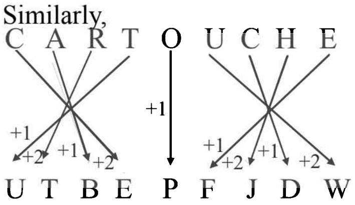
Similarly,



18. (d) As,



Similarly,



19. (c) As,
C H I T O N → I H C N O T
1 2 3 4 5 6 → 3 2 1 6 5 4
Similarly,
D I L A T E → L I D E T A
1 2 3 4 5 6 → 3 2 1 6 5 4.

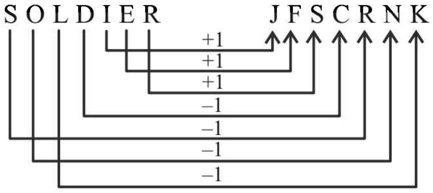
20. (b) W R O M B T → 7 1 9 4 8 3

21. (d) H O U S E
+1 +1 +1 +1 +1
I P V T F
Reverse order of code is FTVPI.
Similarly,
C H A I R
+1 +1 +1 +1 +1
D I B J S
Required code is SJBID.

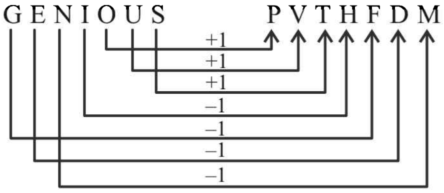
22. (d)
in (ba) pe → he (has) won
Ie ke (ba) → she (has) lost
in se pe → he always won
Code for word 'he' is 'in or 'pe'.

23. (a) 4 3 5 9 7 1
? + % ★ # $

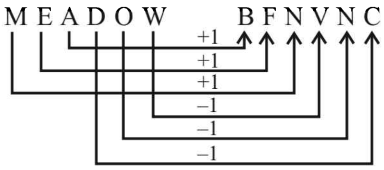
24. (b)



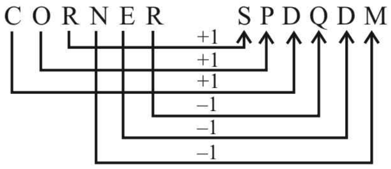
Similarly,



25. (c)



Similarly,



26 (a) LUTE, FATE, BLUE
+1 +1 +1
MUTE, GATE, **CLUE**

27. (a) T W I N K L E
–1 –1 –1 –1 –1 –1 –1
S V H M J K D

F I L T E R S
–1 –1 –1 –1 –1 –1 –1
E H K S D Q R

28. (a) P R O D U C T I O N S
+1 –1 +1 –1 +1 +2 +1 –1 +1 –1 +1
Q Q P C V E U H P M T

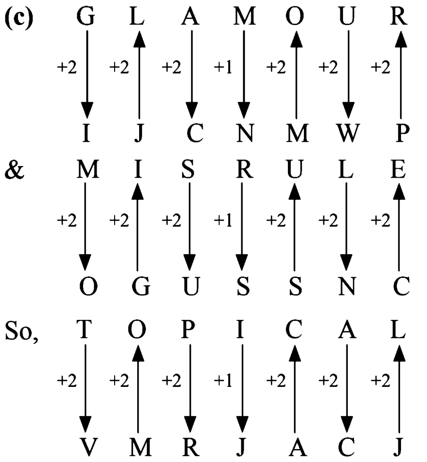
O R I E N T A T I O N
+1 –1 +1 –1 +1 +2 +1 –1 +1 –1 +1
P Q J D O V B S J N O

29. (a) M I N D
–2 –2 –2 –2
K G L B

A R G U E
–2 –2 –2 –2 –2
Y P E S C

D I A G R A M
–2 –2 –2 –2 –2 –2 –2
B G Y E P Y K

30. (c)



Chapter 6

Blood Relation

MEANING OF BLOOD RELATION

Blood relation does mean biological relation. Remember a wife and husband are met biologically related but they are biological parents of their own children. Similarly, brother, sister, paternal grandfather, paternal grandmother, maternal grandfather, maternal grandmother, grandson, granddaughter, niece, cousin etc. are our blood relatives.

Types of Blood Relations

There are mainly two types of blood relations

(i) **Blood relation from paternal side**

(ii) **Blood relation from maternal side**

Now, we will discuss both kind of relations one-by one.

(i) **Blood relation from paternal side :** This type of blood relation can be further subdivided into three types:

  (a) **Past generations of father :** Great grandfather, great grandmother, grandfather, grandmother etc.

  (b) **Parallel generations of father:** Uncles (Brothers of father). aunts (sisters of father) etc.

  (c) **Future generations of father:** Sons, daughters, grandsons, granddaughters etc.

(ii) **Blood relation from maternal side:** This type of blood relations can also be subdivided into three types:

  (a) **Past generations of mother:** Maternal great grandfather, maternal great grandmother, maternal grandfather, maternal grandmother etc.

  (b) **Parallel generations of mother:** Maternal uncles, maternal aunts etc.

  (c) **Future generations of mother:** Sons, daughters, grandsons, granddaughters etc.

In the examinations, the questions are given in complicated way. In other words, in the given questions, the easy relationship takes the complicated form and examinees are expected to solve this complication in order to find out the correct answer. How does an examinee get rid of this complication? For this, an examinee sees the given data in the question with a serious eye; then try to establish relation among elements of given data on the basis of certain logic and finally finds out the required answer. In fact complications in the asked question occur because of the given indirect relation. It is mean that the questions are in the form of indirect relation & one has to convert this indirect relation into direct relation. For example "only son of my father" does mean 'me' (myself). Here in place of 'me' indirect relation has been given in form of "only son of my father". Similarly, "the only daughter of the parents in laws of the husband of Vandana" does mean 'Vandana' herself. In this example also the sentence "the only daughter of the parents in laws of the husband of 'Vandana' has been given in the form of indirect relation. Below are given some indirect relation in the form of a list. Examinees are required to learn them with mind. If are keeps this list in one's mind, he/she will find it very easy to solve problems based on the blood relations.

1. Son of father or mother : Brother
2. Daughter of father or mother : Sister
3. Brother of father : Paternal uncle
4. Brother of mother : Maternal uncle
5. Sister of father : Aunt
6. Sister of mother : Maternal Aunt
7. Father of father : Grandfather
8. Father of father's father : Great grand father
9. Father of grandfather : Great grandfather
10. Mother of father : Grandmother
11. Mother of father's mother : Great grandmother
12. Mother of grandmother : Great grandmother
13. Father of mother : Maternal grandfather
14. Father of mother's father : Great maternal grand father
15. Father of maternal grandfather : Great maternal grandfather
16. Mother of mother : Maternal grandmother
17. Mother of Mother's, mother : Great maternal grandmother
18. Mother of maternal grandmother : Great maternal grandmother
19. Wife of father : Mother
20. Husband of mother : Father
21. Wife of Grandfather : Grandmother
22. Husband of Grandmother : Grandfather
23. Wife of son : Daughter-in-law
24. Husband of daughter : Son-in-law
25. Brother of Husband : Brother-in-law
26. Brother of wife : Brother-in-law
27. Sister of Husband : Sister-in-law
28. Sister of wife : Sister-in-law
29. Son of brother : Nephew
30. Daughter of brother : Niece
31. Wife of brother : Sister-in-law

32. Husband of sister : Brother-in-law
33. Son of sister : Nephew
34. Daughter of sister : Niece
35. Wife of uncle : Aunt
36. Wife of maternal uncle : Aunt
37. Son/daughter of uncle/ Aunt : Cousin
38. Son/daughter of maternal uncle/maternal aunt : Cousin
39. Son/daughter of sister of Father : Cousin
40. Son/daughter of sister of Mother : Cousin
41. Only son of grandfather : Father
42. Only daughter of maternal grandfather : Mother
43. Daughter of grandfather : Aunt
44. Sons of grandfather other than father : Uncle
45. Son of maternal grandfather/maternal grand mother : Maternal Uncle.
46. Only daughter in law of grandfather/grandmother : Mother
47. Daughters in law of grandfather/ grandmother : Aunt other than mother
48. Daughters-in-law of maternal grandfather/ : Aunt maternal grandmother
49. Neither brother nor sister : Self

Some Important Information About Blood Relation

A. Without the information of gender, no relationship can be established between two people. For example, If given that R is the child of P & Q, then we can only say that P & Q are the parents of R. But we can not find out:

(i) R is the son of P & Q or R is the daughter of P & Q.

(ii) Who is mother of R and who is father of R.

But if we have given that P is a male, Q is a female and R is male, then we can easily say that R is the son of P and Q. Further we can also say that P is father of R and Q is mother of R.

B. Gender can not be decided on the basis of name. For example in Sikh community the names like Manjit, Sukhvinder etc. are the names of both male and female. Similarly, in the Hindu Community ‘Suman’ is the name of both male and female.

Remember...

(a) While solving blood relation based question, first of all find out that two persons between whom a relationship has to be established.

(b) Next, try to find out middle relation

(c) Finally findout the relationship between two persons to be identified for this purpose.

Types of Problems

(1) **General problems of blood relation**

(2) **Blood relation based on family tree**

(3) **Blood relation based on symbols :**

Now, we will discuss all the three types of problems one by one

(1) General problem of blood relation

Example 1. Pointing towards a photograph, Mr. Sharma said, “She is the only daughter of mother of my brother’s sister.” How is Mr. Sharma related to the lady in the photograph?

(a) Cousin **(b) Sister**

(c) Aunt **(d) Daughter in law**

Sol. (b) Here we have to find relationship between Mr. Sharma & the lady in the photograph.

Mother of my brother’s sister does mean my (Mr. Sharma’s) mother. Only daughter of Mr. Sharma’s mother does mean “sister of Mr. Sharma”. Hence option (b) is the correct answer.

(2) Blood relation based on family tree

Example 2. Q is the brother of C and C is the sister of Q. R and D are brother and sister. R is the son of A while C & A are wife and husband. How is Q related with D.

Sol. For such type of question a family tree is made in which some symbols are used as below:

‘↔’ is used for husband & wife.

‘___’ is used for brother & sister

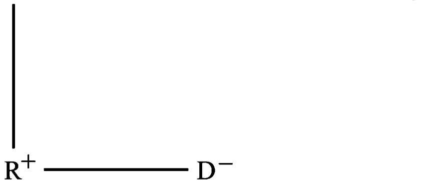
‘|’ is used for parents (father or mother). Parents are put on top while children are put at the bottom. (generation gap)

‘–’ or minus sign is used for female

‘+’ or plus sign is used for male.

Now adopting and using the above given symbols we can make a family tree and solve the given problem, let us see the family tree for sample question:

Family + tree :



As per the question Q is the brother of C and C is the sister of Q. Hence relation between C & Q has been presented as (C^{-} — Q^{+}) where ‘–’ sign above C makes it clear that C is a female and ‘+’ sign above ‘Q’ makes it clear that Q is a male. Similarly for R and D. The presentation $\left(\overset{+}{R} - D^{-}\right)$ has been made. Further **according to the question.**

A and C are having a husband and wife relationship and hence this has been presented as $\left(\overset{+}{A} \leftrightarrow C^{-}\right)$. As it is already given that C is the sister of Q and C and A are wife and husband, this becomes clear that A is the male member of the family and this is the reason A has '+' as its gender sign. Lastly, the vertical line gives father and son relationship and has been presented as $\left(\begin{array}{c} A^+ \\ | \\ R^+ \end{array}\right)$. Now from this family tree it becomes clear that C is the mother of R and D and as Q is the brother of C, then Q will definitely be the maternal uncle of R & D. Hence we can say that Q is the maternal uncle of D and this is the required answer for our sample question.

(3) Blood relation based on Symbols:

In this type of question, information are coded in the form of symbols like &, #, $, % .... etc.

Example **3. Read the following information carefully and then answer the question given below:**

A. A & B means A is mother of B.

B. A $ B means A is sister of B.

C. A * B means A is father of B.

D. A # B means A is brother of B.

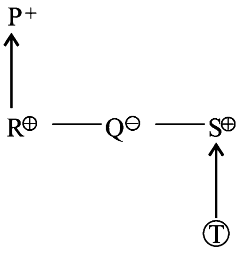
Which of the following means R is uncle of T?

(a) R*P #S & Q$T **(b) S * P # R * U # T**

(c) P*R#Q$S*T **(d) P * R $ Q $ S * T**

(e) None of these

Sol. From option (c) we will get R is uncle of T.



Hence, R is uncle of T.

EXERCISE

1. Pointing to a boy, Seema said "He is the son of my grandfather's only child". How is boy related to Seema?
(a) Brother (b) Cousin
(c) Sister (d) Data inadequate
(e) None of these

2. Deepika tells Shraddha "Your mother's father's son is the husband of my sister." How is Deepika related to Shraddha?
(a) Sister-in-law (b) Cousin.
(c) Aunt (d) Data inadequate
(e) None of these

3. Pointing to a photograph of Hari, Vijay said, "The father of his sister is the husband of my wife's mother'. How is Vijay related to Hari?
(a) Brother (b) Brother-in-law
(c) Uncle (d) Data inadequate
(e) None of these

4. Pointing to a photograph, Sachin said "She is the grandmother of my father's sister's son". How is the woman in the photograph related to Sachin ?
(a) Mother (b) Aunt
(c) Cousin (d) Cannot be determined
(e) None of these

5. Pointing to a woman, Nirmal said, "She is the daughter of my wife's grandfather's only child". How is the woman related to Nirmal ?
(a) Wife (b) Sister-in-law
(c) Sister (d) Data inadequate
(e) None of these

6. X told Y, "Though I am the son of your father, you are not my brother". How is X related to Y ?
(a) Sister (b) Son
(c) Daughter (d) Father
(e) None of these

7. Pointing to a photograph, Arun said, 'She is the mother of my brother's son's wife's daughter.' How is Arun related to the lady?
(a) Uncle (b) Daughter-in-law
(c) Cousin (d) Brother
(e) None of these

8. A boy goes to see a film and finds a man who is his relative. The man is the husband of the sister of his mother. How is the man related to the boy?
(a) Brother (b) Nephew
(c) Uncle (d) Father
(e) None of these

9. Lakshmi and Meera were Rohan's wives, Shalini is Meera's step-daughter. How was Lakshmi related to Shalini?
(a) Sister (b) Mother-in-Law
(c) Mother (d) Step-mother
(e) None of these

10. Daya has a brother, Anil. Daya is the son of Chandra. Bimal is Chandra's father. In terms of relationship, what is Anil of Bimal?
(a) Son (b) Grandson
(c) Brother (d) Grandfather
(e) None of these

11. E is A's son. C is the mother of A and wife of D. How is A related to E?
(a) Father (b) Uncle
(c) Father-in-law (d) Data inadequate
(e) None of these

12. A is brother of B. C is mother of B. M is sister of C. How is M related to B?
(a) Nephew (b) Niece
(c) Aunt (d) Cannot be determined
(e) None of these

13. R is the daughter of Q. M is the sister of B who is the son of Q. How M is related to R?
(a) Cousin (b) Niece (c) Sister (d) Aunt
(e) None of these

14. M is N's brother. S is D's mother and M's aunt. How is D related to M?
(a) Sister (b) Cousin
(c) Aunt (d) Cannot be determined
(e) None of these

15. P is father of J. S is mother of N who is brother of J. B is son of S. C is sister of B. How J is related to C?
(a) Data inadequate (b) Cousin
(c) Brother (d) Sister
(e) None of these

16. If 'A × B' means 'B is father of A', 'A+ B' means 'A is wife of B' and 'A ÷ B' means 'A is brother of B', then, what is the relation of J with L in 'J + H ÷ R × L'?
(a) Daughter (b) Daughter-in-law
(c) Sister-in-law (d) Cannot be determined
(e) None of these

DIRECTIONS (Qs. 17-21): *Following questions are based on the information provided below:*

'A × B' means`A is mother of B'.
'A – B' means `A is brother of B'.
'A + B' means `A is sister of B'.
'A ÷ B' means 'A is father of B'.

17. Which of the following means 'R' is maternal uncle of 'T'?
(a) R – M × T (b) R + M × T
(c) T × M – R (d) T + M ÷ R
(e) None of these

18. Which of the following means 'F' is paternal grandfather of 'H'?
(a) F – J ÷ H (b) F ÷J – H
(c) F ÷ J ÷ H (d) H ÷ J ÷ F
(e) None of these

19. How is K related to M in R ÷ M – K?
(a) Son (b) Daughter
(c) Nephew (d) Cannot be determined
(e) None of these

20. How will 'M is daughter of N' be written?
(a) M + D × N (b) N ÷ M + W
(c) N ÷ M (d) N × M
(e) None of these

21. How is 'H' related to D in 'D ÷ R – M × H'?
(a) Grandson
(b) Granddaugter
(c) Grandson or Granddaughter
(d) Data inadequate
(e) None of these

22. If 'A ★ B' means 'A is the father of B', 'A × B' means 'A is the mother of B' and 'A # B' means 'A is the husband of B', then which of following means P is the grandson of Q?
(a) Q # R × S ★ P (b) Q ★ N × P # R
(c) Q ★ L # N × P (d) P # N × M ★ Q
(e) None of these

23. If 'P × Q' means `P is wife of Q', 'P + Q' means 'P is father of Q' and 'P ÷ Q' means 'P is sister of Q' then in G × H + R ÷ D, how is G related to D?
(a) Cannot be determined (b) Mother
(c) Niece (d) Aunt
(e) None of these

24. Deepak is the brother of Naresh and Suresh is the father of Deepak. Ramesh is the brother of Anu and Anu is the daughter of Naresh. Who is the uncle of Ramesh?
(a) Deepak (b) Suresh
(b) Naresh (d) None of these

25. Pointing towards a person, a man said to a women, "His mother is the only daughter of your Father". How is the woman related to that person ?
(a) Daughter (b) Sister
(c) Mother (d) Wife

26. Looking at a woman sitting next to him, Roman said, "she is the sister of the husband of my wife". How is the woman related to Raman?
(a) Daughter (b) Sister
(b) Wife (d) Niece

DIRECTIONS (Qs. 27-28) : *Study the following information carefully and answer the given questions.*

R is married to U. U is mother of L. L is sister of D. U has only one daughter. D is married to J. K is son of J, F is mother of J.

27. How is D related to F?
(a) Cannot be determined (b) Daughter
(c) Daughter-in-law (d) Son-in-law
(e) Son

28. How is R related to K?
(a) Cannot be determined (b) Father-in-law
(c) Grandfather (d) Father
(e) Uncle

DIRECTIONS (Qs. 29-30) : *Study the following information carefully and answer the questions given below:*

P is granddaughter of A, who is married to W. M is brother-in-law of A, who has two daughters but no son. R is cousin of Q and brother of P. U and V are sons-in-law of W. V has two daughters and one son. U has one son and one daughter. T and S are the daughters of X. D is also the member of this family.

29. How is X related to R according to the given information?
(a) Mother (b) Aunt
(c) Daughter (d) Can't be determined
(e) None of these

30. How is T related to W according to the given information?
(a) Granddaughter (b) Daughter
(c) Son (d) Grandmother
(e) None of these

Hints & Solutions

1. **(a)** Only child of Seema's Grandfather means Seema's mother or Seema's father.
Hence, that boy is Seema's brother.

2. **(c)** Shraddha's mother's father's son ⇒ Shraddha's maternal uncle. Shraddha's maternal uncle is husband of Deepika's sister. Deepika is 'aunt' of Shraddha.

3. **(b)** The father of his sister is the husband of Vijay's wife's mother means Vijay's mother-in-law and mother-in-law's daughter's brother means Vijay's brother-in-law.

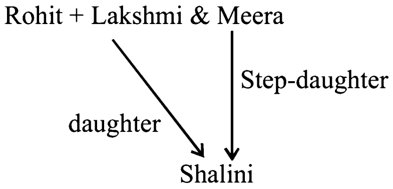
4. **(e)** The lady is the grandmother of Sachin's father's sister's son. Hence, she is Sachin's grandmother.

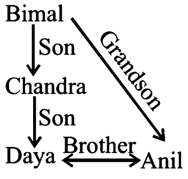
5. **(d)** Grandfather's only child means either father or mother.
So the woman is either Nirmal's wife or sister-in-law.

6. **(e)** As X is the son of Y's father and Y is the sister of X he has to be the brother of Y.

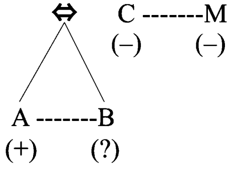
7. **(a)** One's brother's son's wife's daughter implies paternal grand-daughter of one's brother. Now, the mother of paternal grand-daughter of one's brother implies wife of one's nephew.
Thus, we can conclude that Arun is the paternal uncle of the female's husband.

8. **(c)** The sister of one's mother is one's maternal aunt. Hence the man is the husband of the boy's maternal aunt.

9. **(c)** 

10. **(b)** 

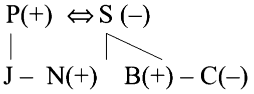
11. **(d)** C is the wife of D and E is the son of A. Hence, A is either father or mother of E.

12. **(c)** According to question,


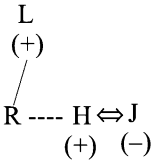
From above diagram it is clear that
M is the aunt of B.

13. **(c)** $R \xleftarrow{\text{daughter}} Q \xrightarrow{\text{son}} B \xrightarrow{\text{sister}} M$
∴ M, is R's sister.

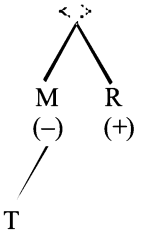
14. **(b)** S,isD'smotherandM'saunty.Therefore,DisM'scousin.

15. **(a)** 

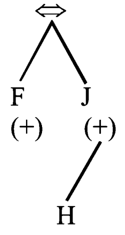
The gender of J is unknown, therefore J may be brother or sister of C.

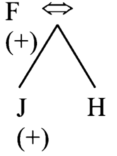
16. **(b)** 

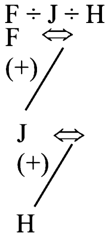
J is R's brother's wife. L is the father of H and R.
J is daughter-in-law of L.

17. **(a)** R – M × T :


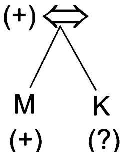
Hence, R is the maternal uncle of T.

18. **(c)** (a) F – J ÷ H :


(b) F ÷ J – H :


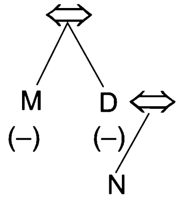
(c) F ÷ J ÷ H :


Hence, F is the paternal grandfather of H.

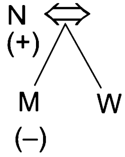
19. **(d)** R ÷ M – K :


gender of K is not clear

20. **(b)** a. M + D × N

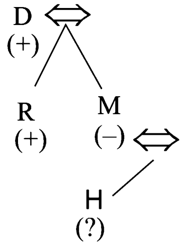


b. N ÷ M + W



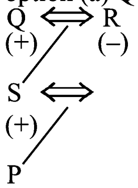
Hence, M is the daughter of N.

21. **(c)** D ÷ R – M × H:



The gender of H is unknown, H may be grand son or grand daughter.

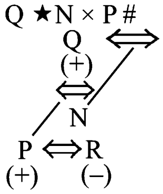
22. **(b)** option (a) Q # R × S★P



(Gender of P is not clear, So, we can't say that P is grandson of Q.)

Option (b)

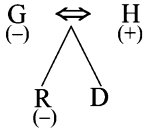
Q ★N × P # R



Here, gender of P is clear i.e., male

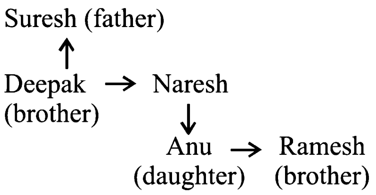
So, P is grandson of Q

23. **(b)** From given information,



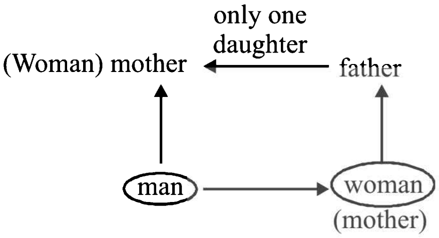
Hence, G is the mother of D.

24. **(a)**



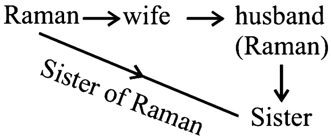
The uncle of Ramesh is Deepak.

25. **(c)**



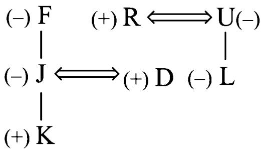
Woman is the mother of the man.

26. **(b)**



∴ The woman is the sister of Raman.

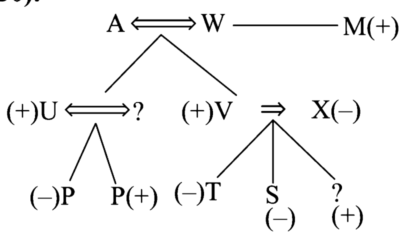
Sol. (27-28):



27. **(d)** D is son-in-law to F.

28. **(c)** R is grandfather to K.

Sol. (29-30):



29. **(b)** X is aunt R.

30. **(a)** T is granddaughter to W.

Chapter 7

Direction and Distance

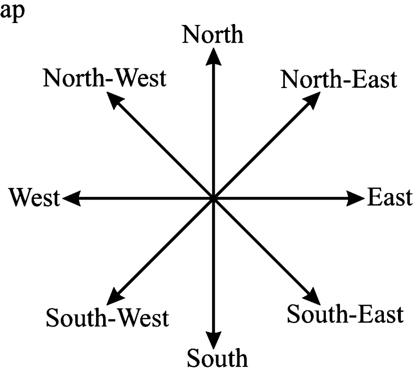
INTRODUCTION

This part of reasoning comes under the category of common sense reasoning. In fact, this segment gauges the sense of direction of a candidate. In every objective competitive examinations, these type of questions are asked. Particularly, in banking exams, these questions can be seen in every exam. This is the reason, examinees are required to pay special attention towards such questions.

Concept of Direction

In our day to day life, we make our concept of direction after seeing the position of sun. In fact, this is a truth that sun rises in the East and goes down in the west. Thus when we stand facing sunrise, then our front is called East while our back is called West. At this position our left hand is in the Northward and the right hand is in the Southward. Let us see the following direction map that will make your concept more clear:

Direction map

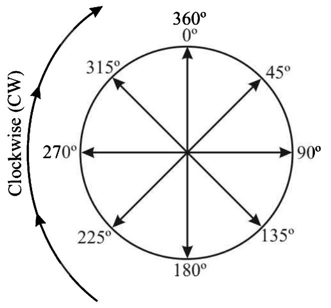


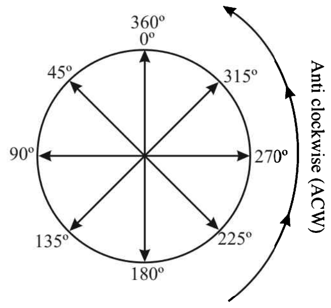
Note

On paper North is always on top be while South is always in bottom.

Concept of Degree

Let us see the following picture:



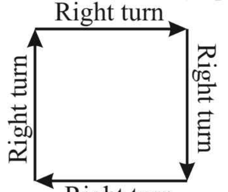


Concept of Turn

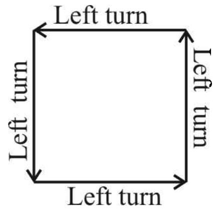
Right turn = Clockwise turn

Left turn = Anticlockwise turn

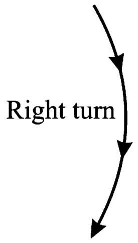
Let us understand it through pictorial representation:



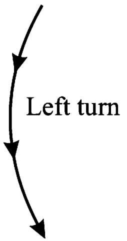
(i)



(ii)



(iii)



(iv)

Important Points Regarding Direction

- If our face is towards North, then after left turn our face will be towards West while after right turn, it will be towards East.
- If our face is towards South, then after left turn our face will be towards East and after right turn it will be towards West.
- If our face is towards East, then after left turn our face will be forwards North and after right turn it will be towards South.
- If our face is towards West, then after left turn our face will be towards South and after right turn it will be towards North.
- If our face is towards North-West, then after left turn our face will be towards South-West and after right turn it will be towards North-East.
- If our face is towards South-West, then after left turn our face will be towards South-East and after right turn it will be towards North-West.
- If our face is towards South-East, then after left turn our face will be towards North-East and after right turn it will be towards South-West.
- If our face is towards North-East, then after left turn our face will be towards North-West and after right-turn it will be towards South-East.

Shortcut Approach

Direction before taking the turn	Direction in which the person or vehicle will be moving after taking the turn	
	Right	Left
(i) North	East	West
(ii) South	West	East
(iii) East	South	North
(iv) West	North	South
(v) North-West	North-East	South-West
(vi) South-West	North-West	South-East
(vii) South-East	South-West	North-East
(viii) North-East	South-East	North-West

CONCEPT OF SHORTEST/MINIMUM DISTANCE :

The Shortest distance between two points may be different from the total distance covered going from initial position to final position.

CONCEPT OF MINIMUM DISTANCE

Minimum distance between initial and last point

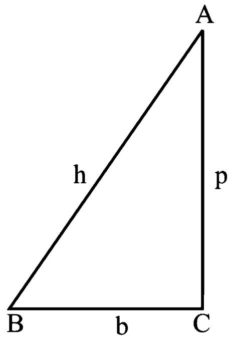
$h^2 = b^2 + p^2$, where

h = Hypotenuse

b = Base

p = Perpendicular

Remember this important rule is known as **'Pythogoras Theorem'**



SHADOW CASE

In Morning/Sunrise Time

(a) If a person facing towards Sun, the shadow will be towards his back or in West.

(b) If a person facing towards South, the shadow will be towards his right.

(c) If a person facing towards West, the shadow will be towards his front.

(d) If a person facing towards North, the shadow will be towards his left.

In Evening/Sunset Time

(a) If a person facing towards Sun, the shadow will be towards his back or in East.

(b) If a person facing towards North, the shadow will be towards his right.

(c) If a person facing towards East, the shadow will be towards his front.

(e) If a person facing towards South, the shadow will be towards his left.

Note

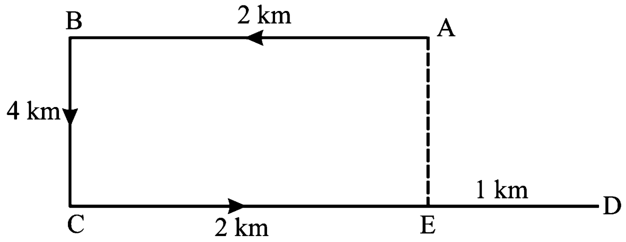
At 12:00 noon there is no shadow because the rays of the sun are vertically downward.

Example **1. Raman walked 2 km West from his office and then turned South covering 4 km. Finally, he waked 3 km towards East and again move 1 km West. How far is Raman from his initial position.**

(a) 4 km **(b) 8 km**
(c) 10 km **(d) 7 km**
(e) None of these

Sol. Raman starts from his office A, moves 2 km West upto B, then 4 km to the South upto C, 3 km East upto D and finally 1 km West upto E, Thus his distance from the initial position A = AE = BC = 4 km.

Hence option (a) is the correct answer.



EXERCISE

1. Ashok started walking towards South. After walking 50 metres he took a right turn and walked 30 metres. He then took a right turn and walked 100 metres. He again took a right turn and walked 30 metres and stopped. How far and in which direction was he from the starting point ?

(a) 50 metres South (b) 150 metres North
(c) 180 metres East (d) 50 metres North
(e) None of these

2. A school bus driver starts from the school, drives 2 km towards North, takes a left turn and drives for 5 km. He then takes a left turn and drives for 8 km before taking a left turn again and driving for 5 km. The driver finally takes a left turn and drives 1 km before stopping. How far and towards which direction should the driver drive to reach the school again?

(a) 3 km towards North (b) 7 km towards East
(c) 6 km towards South (d) 6 km towards West
(e) 5 km towards North

3. Veena walked 5m towards north, took a left turn and walked 7 m. She took a left turn again and walked 8m before taking a left turn and walking 7 m. She then took a final left turn and walked 1 m before stopping. How far is Veena from the starting point ?

(a) 3 m (b) 6 m (c) 4 m (d) 2 m
(e) 7 m

DIRECTIONS (Qs. 4-8) : *Study the given information and answer the given questions.*

Point A is 11 m North of point B.
Point C is 11 m East of point B.
Point D is 6 m North of point C.
Point E is 7 m West of point D.
Point F is 8 m North of point E.
Point G is 4 m West of point F.

4. How far is point F from point A?
(a) 43 m (b) 4 m (c) 3 m (d) 7 m
(e) 5 m

5. How far and in which direction is point G from point A?
(a) 3 m North (b) 5 m North
(c) 4 m North (d) 4 m South
(e) 3 m South

6. B is 7 metres away in the north of A. A moves 9 metres towards east from the starting point, takes a right turn and walks 2 metres, then takes a left turn and moves 1 metre and finally he takes a left turn and moves 9 metres. Now. how far and in which direction is A from the B?
(a) 5 metres East (b) 10 metres West
(c) 5 metres West (d) 10 metres East
(e) None of these

7. Ashok started walking towards South. After walking 50 metres he took a right turn and walked 30 metres. He then took a right turn and walked 100 metres. He again took a right turn and walked 30 metres and stopped. How far and in which direction was he from the starting point?
(a) 50 metres South (b) 150 metres North
(c) 180 metres East (d) 50 metres North
(e) None of these

8. Town D is 13 km towards the East of townA. A bus starts from town A, travels 8 km towards West and takes a right turn. After taking the right turn, it travels 5 km and reaches town B. From town B the bus takes a right turn again, travels 21 km and stops.
How far and towards which direction must the bus travel to reach town D?
(a) 13 km towards South (b) 5 km towards West
(c) 21 km towards South (d) 5 km towards South
(e) None of these

9. Two Person P and Q are separated by a distance of 20 meter in west-east direction respectively. Now P and Q start walking in north and south direction respectively and walked for 5 meter. Now P and Q took a right turn and walked 10m each. Now P and Q took left turn and after walking 5 meter both of them stopped. Find the distance between them
(a) 15 (b) 25 (c) 30 (d) 35
(e) None of these

10. A man walks 12m east from point A and reaches point B. From point B he takes left turn and walks 4m and then he takes right turn and walked 6m and again he takes right turn and walks 7m and again takes right turn and reaches point M. If it is given that point B is in north from point M, then what is the distance between B and M?
(a) 7m (b) 6m (c) 5m (d) 4m
(e) 3m

DIRECTIONS (Qs. 11-14): *Read the following information and answer the questions that follow:*

'A' walks 10 km north from point Q to reach point H. He takes a left turn and walks 9 km to reach point S. On the other side, 'B' walks 5 km north from point Y to reach point J. Point Y is 9 km either east or west from point Q. Next 'B' turns to his right and walks 4km to reach point D. Also 'A' turned left from point S and reached point M after walking 5 km. M is in west direction from J.

11. What is the shortest distance between points M and J?
(a) 10 km (b) 26 km (c) 18 km (d) 12 km
(e) Cannot be Determined

12. If 'B' walks 4 km east from point Y, then he is in which direction with respect to point D?
(a) South (b) North-west
(c) North-east (d) North
(e) South-west

13. What is the shortest distance between points Q and D?
(a) $\sqrt{194}$ km (b) $\sqrt{198}$ km
(c) $\sqrt{197}$ km (d) $\sqrt{196}$ km
(e) $\sqrt{195}$ km

14. What is the direction of J with respect to Q?
(a) South (b) North-west
(c) North-east (d) North
(e) South-west

15. Pole P is 13 km towards the East of Pole Q. Siddharth, starts from Pole Q, travels 8 km towards West and takes a right turn. After taking the right turn, he travels 5 km and reaches Pole B. From Pole B , Siddharth takes a right turn again, travels 21 km and reaches Pole C. How far and towards which direction must the Siddharth travel to reach Pole P?
(a) 5 km towards South (b) 5 km towards West
(c) 21 km towards South (d) 13 km towards South
(e) None of these

16. Shiva, starting from his house, goes 5 km in the East, then he turns to his left and goes 4 km. Finally he turns to his left and goes 5 km. Now how far is he from his house and in what direction?
(a) In East, at a distance of 5 km
(b) In East, at a distance of 4 km
(c) In West, at a distance of 4 km
(d) In North, at a distance of 4 km
(e) None of these

17. Suresh, starting from his house, goes 4 km in the East, then he turns to his right and goes 3 km. What minimum distance will be covered by him to come back to his house?
(a) 4 km (b) 5 km (c) 6 km (d) 7 km
(e) None of these

18. One morning just after sunrise Aarya, while going to school, met Mona at Boring Road crossing. Mona shadow was exactly to the right of Aarya. If they were face to face, which direction was Aarya facing?
(a) East (b) North-East
(c) West (d) South
(e) None of these

19. Hema, starting from her house, walked 5 km to reach the crossing of Palace. The direction in which she was going, a road opposite to that direction goes to Hospital. The road to the right goes to the station. If the road which goes to the station is just opposite to the road which goes to the IT-Park, then in which direction to Hema is the road which goes to the IT-Park?
(a) Right (b) Left (c) Opposite (d) Infront
(e) None of these

20. R is to the West of P. T is to the East of S. P is to the north of S. T is in which direction with reference to R?
(a) West (b) East (c) North (d) South
(e) None of these

21. Ram is facing South. Ramesh, walking towards him, stops, and turns to his right. He sees Umesh standing before him facing him. Which direction is Umesh facing?
(a) West (b) South
(c) East (d) Data inadequate
(e) None of these

22. Raman starts from point P and walks towards South and stops at point Q. He now takes a right turn followed by a left turn and stops at point R. He finally takes a left turn and stops at point S. If he walks 5 Kms before taking each turn, towards which direction will Raman have to walk from point S to reach point Q?
(a) North (b) South (c) West (d) East
(e) North-West

DIRECTIONS (Qs. 23-24) : *Study the following information to answer the given questions:*

Point B is 12 meters south of point A. Point C is 24 meters east of point B. Point D is 8 meters south of point C. Point D is 12 meters east of point E and point F is 8 meters north of point E.

23. If a man has to travel to point E from Point A (through these points by the shortest distance), which of the following points will he pass through first ?
(a) Point C (b) Point D
(c) Point F (d) Point B
(e) None

24. If a man is standing facing north at point C, how far and in which direction is point F ?
(a) 12 meters west (b) 24 meters east
(c) 12 meters east (d) 24 meters west
(e) None of these

DIRECTIONS (Qs. 25-27) : *Study the following information carefully and answer the given questions.*

Point D is 14 m towards the West of point A. Point B is 4 m towards the South of point D. Point F is 9 m towards the South of point D. Point E is 7 m towards the East of point B. Point C is 4 m towards the North of point E. Point G is 4 m towards the South of point A.

25. Which of the following points are in a straight line ?
(a) D, E, A (b) E, G, C
(c) D, B, G (d) E, G, B
(e) F, B, C

26. A is in which direction with respect to C ?
(a) East (b) West
(c) North (d) South
(e) Cannot be determined

27. If a person walks 5 m towards North from point F and then takes a right turn, which of the following points would he reach first ?
(a) G (b) D (c) E (d) A
(e) C

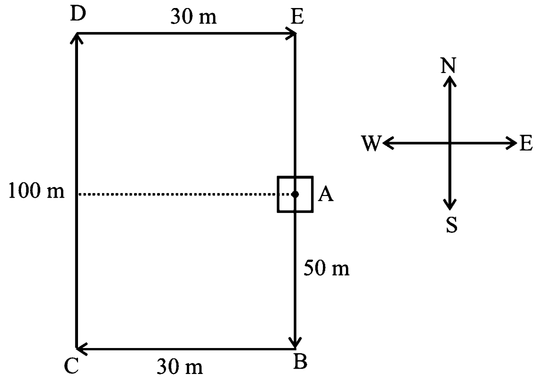
28. Pinky walks a distance of 600 metres towards east, turns left and moves 500 metres, then turns left and walks 600 metres and then turns left again and moves 500 metres and halts. At what distance in metres is she from the starting point?
(a) 0 (b) 2200 (c) 600 (d) 500
(e) None of these

29. Q walked 20 metres towards West, took a left turn and walked 20 metres. He then took a right turn and walked 20 metres and again took a right turn and walked 20 metres. How far is Q now from the starting point?
(a) 40 metres (b) 50 meters
(c) 80 metres (d) Data inadequate
(e) None of thsse

30. A postman was returning to the Post Office which was in front of him to the north. When the Post Office was 100 metres away from him, he turned to the left and moved 50 metres to deliver the last letter at Shanti Villa. He then moved in the same direction for 40 metres, turned to his right and moved 100 metres. How many metres away was he now from the Post Office?
(a) 0 metre (b) 150 metre
(c) 90 metre (d) 100 metre
(e) None of these

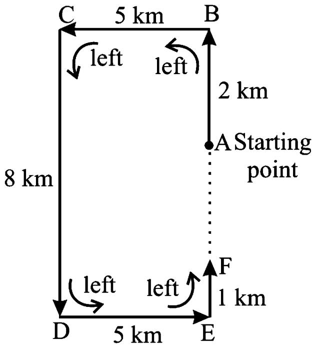
Hints & Solutions

1. **(d)**



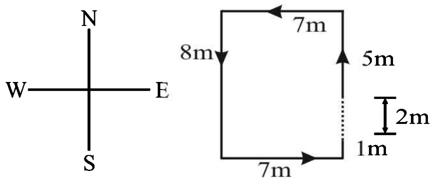
Required distance = (BE – AB) = (100 – 50) m = 50 m
Direction ⇒ North

2. **(e)**

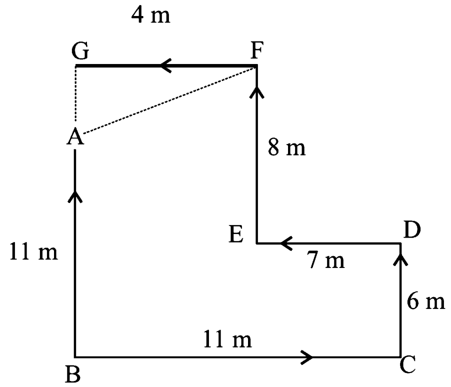


According to questions.
AB = 2 km, BC = 5 km, CD = 8 km, DE = 5 km
EF = 1 km, BC = DE = 5 km
CD = BE = 8 km
BE = EF + AF + AB
∴ AF = BE – (EF + AB)
= 8 – (1 + 2) = 8 – 3 = 5 km
∴ Required distance = AF = 5 km and required direction is North

3. (d)



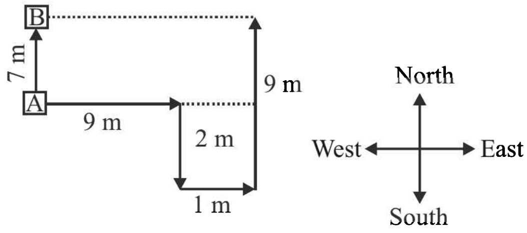
Sol. (4-5) :



4. (e) AG = BG – AB = (CD + EF) – (AB)
= (6 + 8) – 11 = 3 m and GF = 4 m
AF = $\sqrt{AG^2+GF^2}=\sqrt{9+16}=5$ m

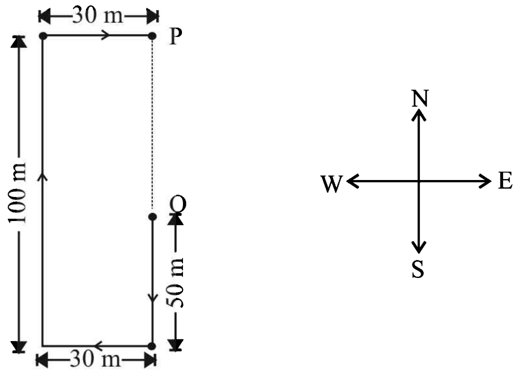
5. (a) 3 m- North from point A

6. (d)



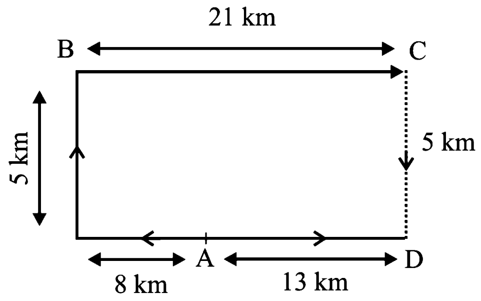
Required distance = (9 + 1) metres = 10 metres
Direction ⇒ East

7. (d)



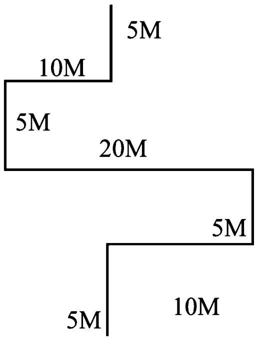
OP = 100 m – 50 m = 50 m
Besides, P is north of O.

8. (d)



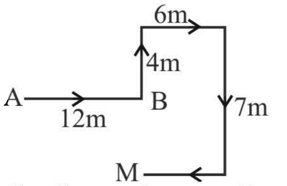
So, 5 km towards south

9. (e)



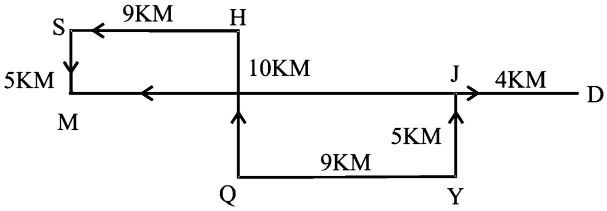
∴ Required distance = 20 meter.

10. (e)



The distance between B and M = 7– 4 = 3 m

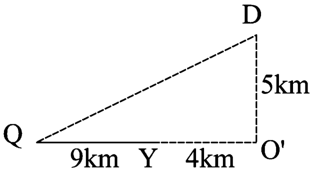
Sol. (11-13):



11. (c) Required distance = (9 + 9) = 18 km

12. (a) B is in south direction with respect to point D.

13. (a)

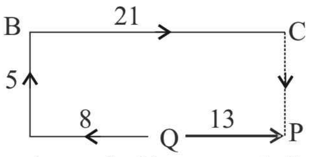


as QY + YO' = QO' = 13km

QD = $\sqrt{(QO')^2+(O'D)^2}=\sqrt{(13)^2+(5)^2}=\sqrt{194}$km

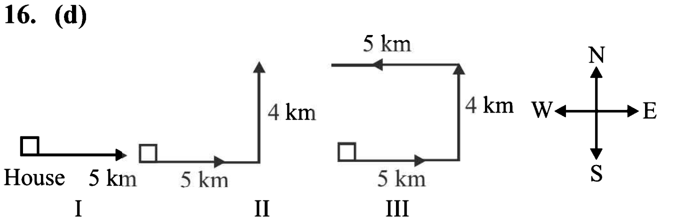
14. (c) J is in North-East direction with respect to Q.

15. (a)



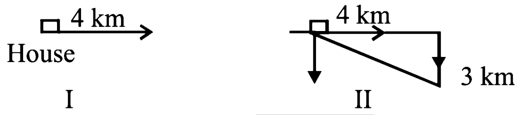
Sidharth travels 5 km towards South to reach Pole P.

16. (d)



From third position it is clear he is at 4 km from his house and is in North direction.

17. (b)

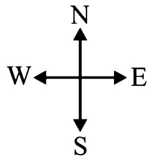


Minimum distance = $\sqrt{(4)^2+(3)^2}$

$= \sqrt{16+9} \quad = \sqrt{25}$

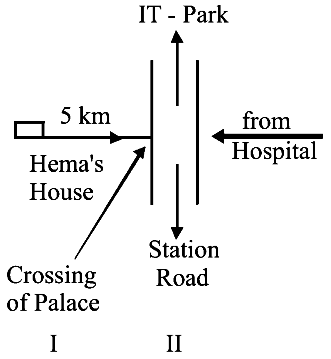
$= 5$ km

18. (d) In the morning the sun rises in the east.



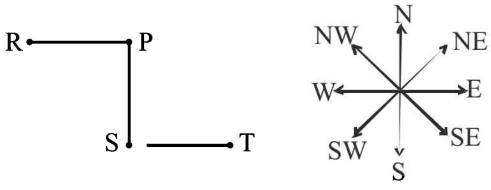
So in the morning the shadow falls towards the west. Now Mona's shadow falls to the right of the Aarya Hence Aarya is facing South.

19. (b)



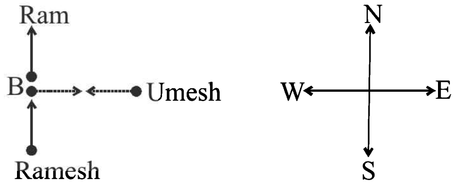
From II it is clear that the road which goes to IT-Park is to the left to Hema.

20. (e) According to question,



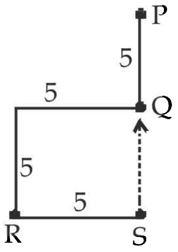
Hence, T is in south-east direction with respect to R

21. (a)



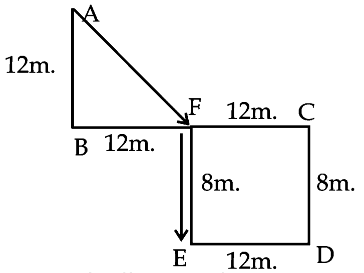
Hence, Umesh is facing West

22. (a)



So, Raman will have to walk in North direction to reach point Q from point S.

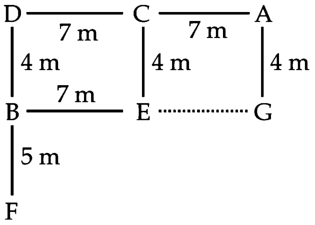
Sol. (23-24):



23. (c) See arrows in diagram above.

24. (a)

Sol. (25-27):

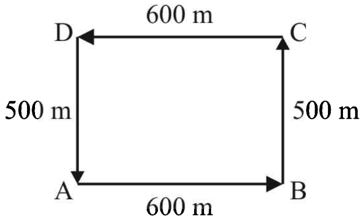


25. (d) Points B, E, G and A, C, D are in a straight line.

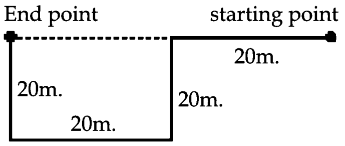
26. (a) A is towards East of C.

27. (c) He would reach first at point 'E'.

28. (a)

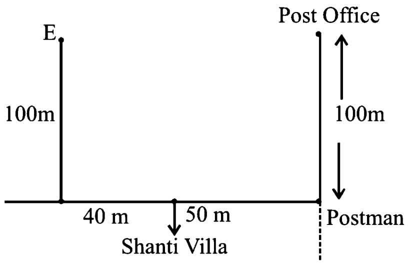


29. (a)



∴ Distance from starting point = 20 + 20 = 40 m

30. (c)



From the diagram, E is the final point where postman has reached. Hence his distance from the post office = 40 + 50 = 90m.

Chapter 8 Order and Ranking

WHAT IS ORDERING TEST?

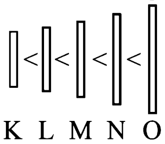
Under this segment, generally deals with the problems related to the arrangement of persons/objects is ascending/descending order (based on different parameters such as height, weight, ages, merit, marks, salary, length etc.).

Types of Order Sequence:

(A) **Ascending Order Sequence:** In the sequence, the persons or objects are arranged in increasing order of their heights, weight, ages etc.

Let us see

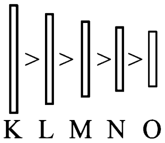
K<L<M<N<O



(B) **Descending Order Sequence:** In the sequence, the persons or objects are arranged in decreasing order of their heights, weight, ages etc.

Let us see

K>L>M>N>O



Example **1. Among M, T, R and P, M is older than only P. T is older than R. Who among them is the oldest?**

(a) T **(b) R**
(c) T or R **(d) Data inadequate**

Sol. (a) According to question,
M > P, T > R
T > R > M > P (∵ M is older than only P)
Hence, T is the oldest.

Example **2. Suman is heavier than Alok but not as heavier as Rakesh. Alok is heavier than Jayesh. Kapil is heavier than Suman but not as heavier as Rakesh. Who is the heaviest?**

(a) Suman **(b) Alok**
(c) Rakesh **(d) Kapil**

Sol. (c) According to the question,
Rakesh > Suman > Alok
Alok > Jayesh
Rakesh > Kapil > Suman
On arranging the above data, we get
Rakesh > Kapil > Suman > Alok > Jayesh
Hence, Rakesh is the heaviest.

Number Test

In such test, generally you are given a long series of numbers. The candidate is required to find out how many times a number satifying the conditions specified in the question occurs.

Example **3. How many 8s are there in the following number sequence which are immediately preceded by 5 but not immediately followed by 3?**

3 8 5 8 4 5 8 3 9 8 8 5 8 8 8 9 3

(a) 1 **(b) 4** **(c) 3** **(d) 2**
(e) None of these

Sol. (d) Let use see the following :
$3\ 8\ \boxed{5\ 8\ 4}\ 5\ 8\ 3\ 9\ 8\ 8\ \boxed{5\ 8\ 8}\ 8\ 9\ 3$
Clearly, two such 8s are there.
∴ Option (d) is correct.

Ranking Test

In such problems, the ranks of a person or object both from the top and from the bottom are given and on the basis of this the total number of persons or objects is asked. Sometimes question is twisted also and position of a particular person or object is asked.

EXERCISE

1. In a row of thirty five children, M is fifteenth from the right end and there are ten children between M and R. What is R's position from the left end of the row?
(a) 15th (b) 5th
(c) 30th (d) Data inadequate
(e) None of these

2. Among P, Q, T, A and B each having a different height, T is taller than P and B but shorter than A and Q. P is not the shortest. Who among them is the tallest?
(a) A (b) Q (c) P (d) P or B
(e) Data inadequate

3. In a queue of children, Kailash is fifth from the left and Mona is sixth from the right. When they interchange their places among themselves, Kailash becomes thirteenth from the left. Now what will be Mona's position from the right?
(a) 4th (b) 14th (c) 8th (d) 15th
(e) None of these

4. In a column of girls Kamal is 11th from the front. Leela is 3 places ahead of Sunita who is 22nd from the front.
How many girls are there between Kamal and Leela in the column?
(a) Six (b) Eight
(c) Seven (d) Cannot be determined
(e) None of these

5. Each odd digit in the number 5263187 is substituted by the next higher digit and each even digit is substituted by the previous lower digit and the digits so obtained are rearranged in ascending order, which of the following will be the third digit from the left end after the rearrangement?
(a) 2 (b) 4 (c) 5 (d) 6
(e) None of these

6. Among five friends, P, Q, R, S and T, each scored different marks in the examination. P scored more than Q but less than R. S scored more than' only T. Who amongst the following scored the second highest marks?
(a) P (b) Q (c) R (d) S
(e) T

7. The positions of the first and the fifth digits of the number 81943275 are interchanged. Similarly the positions of the second and the sixth digits are interchanged and so on till the fourth and the eighth digits. Which of the following will be the third digit from the right end after the rearrangement ?
(a) 1 (b) 9 (c) 2 (d) 4
(e) None of these

8. If all the alphabets of the series are written in reverse order, then which of the following will be 8th to the right of the 7th from the left end of the series?
(a) A (b) B (c) C (d) D
(e) None of these

9. In a vertical row 13 persons are sitting. A is seventh from the beginning and two persons sits between G and A. Persons between A and L is same as persons between G and Q. Then what is the position of Q from the beginning?
(a) Fourth (b) Eight (c) Sixth (d) Ninth
(e) Can't be determined

10. In a row of boys, Srinath is 7th from the left and Venkat is 12th from the right. If they interchange their positions, Srinath becomes 22nd from the left. How many boys are there in the row?
(a) 19 (b) 31 (c) 33 (d) 34

11. There are 45 trees in a row. The lemon tree is 20th from right end. What is the rank of lemon tree from left end?
(a) 26 (b) 24 (c) 25 (d) 27

12. In a row of 16 boys, when Prakash was shifted by two places towards the left, he became 7th from the left end. What was his earlier position from the right end of the row?
(a) 7th (b) 8th (c) 9th (d) 10th

13. In a class Rajan got the 11th rank and he was 31st from the bottom of the list of boys passed. Three boys did not take the examination and one failed. What is the total strength of the class?
(a) 32 (b) 42 (c) 45 (d) 46

14. In an examination, Rahul got the 11th rank and he was 47th from the bottom among those who passed. 3 students could not appear for the exam and 1 student failed. What is the total number of students?
(a) 60 (b) 62 (c) 59 (d) 61

15. In a row of books a book of English is 16th from left end of row. A book of Mathematics is 12th from the right end. If the Mathematics book is 6th to the right of the English book, then how many total books are in the row?
(a) 33 (b) 32 (c) 34 (d) 31

16. Among four books, Book 1 is twice as heavy as Book 2. Book 3's weight is half of Book 2's weight. Book 4 is 60 grams more heavy as compared to Book 2 but 60 grams less heavy as compared Book l. which book is heaviest?
(a) Book 1 (b) Book 2 (c) Book 3 (d) Book 4

17. In a row of girls, Kamla is 9th from the left and Veena is 16th from the right. If they interchange their positions, Kamla becomes 25th from the left. How many girls are there in the row?
(a) 34 (b) 36 (c) 40 (d) 41

18. In a row at a bus stop, 'A' is 7th from the left and 'B' is 9th from the right. They both interchange their positions. Now A becomes 11th from the left. How many people are there in the row?
(a) 10 (b) 20 (c) 19 (d) 18

19. Sita is elder than Swapna. Lavanya is elder than Swapna but younger than Sita. Suvarna is younger than both Hari and Swapna. Swapna is elder than Hari. Who is the youngest?
(a) Sita (b) Lavanya
(c) Suvarna (d) Hari

20. There are five friends - Satish, Kishore, Mohan, Anil and Rajesh. Mohan is tallest. Satish is shorter than Kishore but taller than Rajesh. Anil is little shorter than Kishore but Anil is little taller than Satish. Who is taller than Rajesh but shorter than Anil?
(a) Anil (b) Kishore (c) Rajesh (d) Satish

21. Age of Naren is equal to Naveen as they are twins. Nakul is younger than Naren. Priyanka is younger than Balaji but elder than Naveen. Who is the eldest of all?
(a) Naren (b) Balaji (c) Nakul (d) Naveen

22. Four kids P, Q, R and S are up on the ladder. P is further up the ladder than Q. Q is between P and R. If S is further up than P. Who is the third from the bottom?
(a) Q (b) R (c) P (d) S

23. N is more intelligent than M. M is not as intelligent as Y. X is more intelligent than V but not as good as N. Who is the most intelligent of all?
(a) M (b) Y (c) N (d) X

24. Vini is an year older than Smith. Smith is two years older than Salim. Raju is an year older than Salim. Who is the youngest of all?
(a) Raju (b) Salim (c) Vini (d) Smith

25. X is elder than Z, Y is younger than Z, Z is elder than W, W is younger than X, who is the eldest?
(a) X (b) Y (c) W (d) Z

26. In a class, P has more marks than Q and R does not have the least marks. S has more marks than T and T has more marks than P, who among them will have the least marks?
(a) P (b) Q (c) S (d) T

27. There are five houses A, B, C, D and O in a row. A is right side of B and left side of C. O is in the right side of A. B is right of D. Which house is in the middle?
(a) O (b) A (c) B (d) D

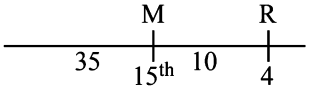
28. Four persons M, N, O and P are playing cards. M is one the right of N and P is one left of O. Then which of the following are partners?
(a) P and O (b) M and P
(c) M and N (d) N and P

29. Six friends A, B, C, D, E and F are sitting in a row facing East. 'C' is between 'A' and 'E'. 'B' is just to the right of 'E' but left of 'D'. 'F' is not at the right end. Which pair is sitting by the side of, 'D'?
(a) CE (b) FA (c) EB (d) FD

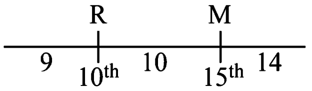
30. Four students ABCD are sitting one each at the four corners of a square all facing the centre of the square. The students E sitting at the centre is facing only C and the student A is sitting the back of E. If D is sitting on the right of E, where B will be sitting to E?
(a) B is sitting on the left of E
(b) B is to back of E
(c) A is facing B and E
(d) B is on the right of E

Hints & Solutions

1. **(d)** Since R can be to the right of M



or to the left of M

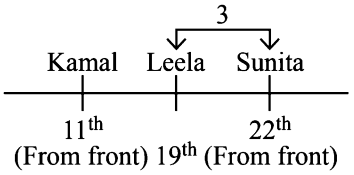


R's position can't be determined.

2. **(e)** T > P, B
T < A, Q
P > B
A, Q > T > P > B
So, either A or Q is the tallest.

3. **(b)** Clearly 6th position from right (Mona) is 13th position from left. That means there are 13 + 5 = 18 children in the row. Hence 5th position from left will be 18 – 5 + 1 = 14th from right (Mona's new position).
Previous by Kailash Mona
1 2 3 4 ⑤ 6 7 8 9 10 11 12 ⑬ 14 15 16 17 18
Present Mona Kailash

4. **(b)**



So there are eight girls between Kamal and Leela.

5. **(b)** 5 2 6 3 1 8 7
↓ ↓ ↓ ↓ ↓ ↓ ↓
6 1 5 4 2 7 8
1 < 2 < 4 < 5 < 6 < 7 < 8

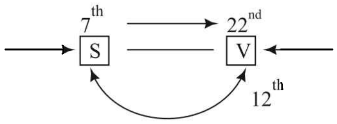
6. **(a)** R > P > Q > S > T
P scored the second highest marks.

7. **(a)** 8 1 9 4 3 2 7 5
3 2 7 5 8 $\boxed{1}$ 9 4

8. **(b)** 7th from the left
Reverse order ↓ ⟶
U B D B U A Ⓑ U D E C A D A Ⓑ
A C D E B E C A D C B D C A B
E C
So, 8th to right of the 7th from the left end = (8 + 7) = 15th from the left end = B

9. **(e)** Can't be determined.

10. **(c)**



Total number of boys in the row = 22 + 12 – 1 = 33

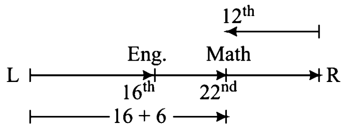
11. **(a)** Total No. of trees = 45
Position of lemon tree from the right end = 20
Rank of lemon tree from left end = (45 – 20) + 1 = 26

12. **(b)** Original position of Prakash from the left = 9th
Position from the right end = 16 – 9 + 1 = 8th

13. **(c)** Total number of boys passed
= 11 + 31 – 1 = 41
Now, total number of boys
= 41 + 3 + 1 = 45

14. **(d)** Number of successful candidates
= 11 + 47 – 1 = 57
Total number of students
= 57 + 3 + 1 = 61

15. **(a)**



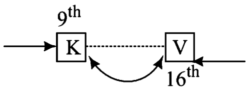
Position of book of mathematics from left end = 22
Position of book of mathematics from Right end = 12
Total no. of books in the row = (22 + 12) – 1 = 33

16. **(a)** Book 1 = 2(Book 2)

$$\text{Book } 3 = \frac{2 \text{ Book } 2}{2} = \text{Book } 2$$

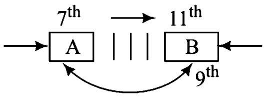
Book 4 = Book 2 + 60 (i)
Book 4 = Book 1 – 60 (ii)
on solving eqn (i) and (ii)
Book 2 = 120
Book 1 = 2 × 120 = 240
Book 4 = 240 – 60 = 180
Book 3 = 120
Book 1 >Book 4 >Book 2 = Book 3

17. (c)



Total number of girls = 25+16 – 1 = 40

18. (c)



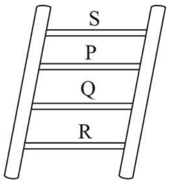
Total number of people in the row
= 11 + 9 –1 = 19

19. (c) Sita > Swapna ......(i)
S Sw
S > Lavanya > Sw ......(ii)
L
Hari < Sw > Suvarna ......(iii)
H Su Sw > H
From all the statements
S > L > Sw > H > Su

20. (d) Kishore > Satish > Rajesh
Kishore > Anil > Satish
Now,
Mohan > Kishore >Anil > Satish > Rajesh

21. (b) Naren = Naveen > Nakul
Balaji > Priyanka > Naveen
Clearly, Balaji is the eldest.

22. (c)



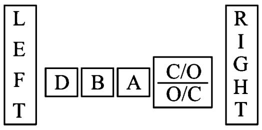
23. (c) N > M
X > Y > M
N > X
Now, N > X >Y > M
N is the most intelligent.

24. (b) Suppose the age of Salim is x years
Age of Raju = $x + 1$ year
Age of Smith = $x + 2$ years
Age of Vini = $x + 3$ years
Therefore, Salim is the youngest of all.

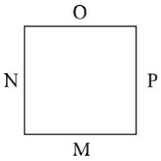
25. (a) X > Z > Y
X > Z > W
Clearly, X is the eldest.

26. (b) R > S > T > P > Q

27. (b)

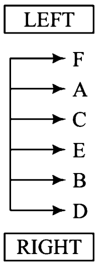


28. (d)



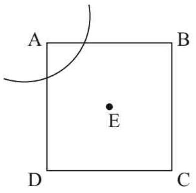
N and P are partners.

29. (c)



B and E are sitting by the side of D.

30. (a)



B is sitting on the left of E.

Chapter 9

Arithmetical Reasoning

Arithmetical Reasoning tests the ability to solve basic arithmetic problems encountered in everyday life. These problems require basic mathematical skills like addition, subtraction, multiplication, division etc. The tests include operations with whole numbers, rational numbers, ratio and proportion, interest and percentage, and measurement. Arithmetical reasoning is one factor that helps characterize mathematics comprehension, and it also assesses logical thinking.

Example 1. The total ages of Amar, Akbar and Anthony is 80 years. What was the total of their ages three years ago ?

(a) 71 years (b) 72 years
(c) 74 years (d) 77 years

Sol. (a) Required sum = (80 – 3 × 3) years = (80 – 9) years = 71 years.

Example 2. Two bus tickets from city A to B and three tickets from city A to C cost ₹ 77 but three tickets from city A to B and two tickets from city A to C cost ₹ 73. What are the fares for cities B and C from A ?

(a) ₹ 4, ₹ 23 (b) ₹ 13, ₹1 7
(c) ₹ 15, ₹ 14 (d) ₹ 17, ₹ 13

Sol. (b) Let ₹ x be the fare of city B from city A and ₹ y be the fare of city C from city A.

Then, $2x + 3y = 77$ ...(i)

and $3x + 2y = 73$ ...(ii)

Multiplying (i) by 3 and (ii) by 2 and subtracting, we get : $5y = 85$ or $y = 17$.

Putting $y = 17$ in (i), we get: $x = 13$.

Example 3. Rani, Reeta , Sukhada, Jane and Radhika are friends. Reeta is 18 years of her age, Radhika is younger to Reeta, Rani is in between Radhika and Sukhada while Reeta is in Between Jane and Radhika. If there be a difference of two years between the ages of girls from eldest to the youngest, how old is Sukhada?

(a) 10 years (b) 12 years
(c) 14 years (d) 16 years

Sol. (b) Arranging them on the basis of their ages,

Jane > Reeta > Radhika > Rani > Sukhada

If Reeta is 18 years old then Sukhada is 12 years

EXERCISE

1. Hari is twice as old as Johnny, who is three years older than Rahul. If Hari's age is five times Rahul's age, how old is Johnny?
(a) 2 years (b) 4 years (c) 5 years (d) 8 years
2. A bus leaves Delhi with half the number of women as men. At Meerut, ten men get down and five women get in. Now there are equal number of men andwomen. How many passengers boarded the bus initially at Delhi?
(a) 36 (b) 45 (c) 15 (d) 30
3. A bus left with some definite number of passengers. At the first stop, half of the passengers left the bus and 35 boarded the bus. At the second stop 1/5 of the passengers left and 40 boarded the bus. Then, the bus moved with 80 passengers towards its destination without stopping anywhere. How many passengers were there originally?
(a) 25 (b) 30 (c) 40 (d) 50
4. There are three baskets of fruits. First basket has twice the number of fruits in the 2nd basket. Third basket has 3/4th of the fruits in the first. The average of the fruits in all the baskets is 30. What is the number of the fruits in the first basket?
(a) 20 (b) 30 (c) 34 (d) 40
5. The average age of 19 boys in a class is 21 years. If the teacher's age is included, the average increases to 22 years. What is the teacher's age?
(a) 39 years (b) 41 years (c) 40 years (d) 44 years
6. A father tells his son, "I was three times of your present age when you were born." If the father's present age is 48 years, how old was the boy 4 years ago?
(a) 24 years (b) 8 years (c) 12 years (d) 16 years
7. In a family Mr. Prakash has his wife and his two married brothers of whom one has two children and another has no issue. How many members are there in the family?
(a) 12 members (b) 8 members
(c) 6 members (d) 10 members

8. A two member committee comprising one male and one female member is to be constituted out of five males and three females. Amongst the females, Mrs. A refuses to be a member of the committee in which Mr. B is taken as the member. In how many different ways can the committee be constituted?

(a) 11 (b) 12 (c) 13 (d) 14

9. Out of 100 families in the neighbourhood, 50 members have radios, 75 members have TVs and 25 members have VCRs. Only 10 families have all three and each VCR owner also has a TV. If some families have radio only, how many have only TV?

(a) 30 (b) 35 (c) 40 (d) 45

10. In a certain office, $\frac{1}{3}$ of the workers are women, $\frac{1}{2}$ of the someone married and $\frac{1}{3}$ of the married women have children. If $\frac{3}{4}$ of the men are married and $\frac{2}{3}$ of the married men have children, then what part of workers are without children?

(a) $\frac{5}{18}$ (b) $\frac{4}{9}$ (c) $\frac{11}{18}$ (d) $\frac{17}{36}$

11. A book has 300 pages and each page has 20 lines of 10 words each. How many words are there in the book altogether?

(a) 6000 (b) 60000

(c) 66000 (d) 600000

12. In a joint family, there are father, mother, four married sons and two unmarried daughters. Three sons have 2 daughters each and one has a son. How many female members are there in the family?

(a) 13 (b) 8 (c) 11 (d) 12

13. There are twelve dozens of apples in a basket. Two dozens are added late. Ten apples got spoilt and are removed. The remaining are transferred equally into two baskets. How many are there in each?

(a) 168 (b) 158 (c) 79 (d) 89

14. The average of 6 numbers is 40. If each of the first three numbers is increased by 4 and each of the remaining three numbers is decreased by 6, then the new average is

(a) 36 (b) 30 (c) 39 (d) 42

15. If 4 cats can kill 4 rats in 4 minutes, how many minutes will it take 8 cats to kill 8 rats?

(a) 8 (b) 4 (c) 2 (d) 16

16. An official meeting is attended by 130 department employees, of them, 66 drink tea, 56 drink coffee and 63 drink juice, 27 can drink either tea or coffee, 25 can drink coffee or juice and 23 can drink juice and tea. 5 employees can drink all of the three. How many drink only tea?

(a) 21 (b) 22 (c) 18 (d) 20

17. In a department, 24 employees know typing and 11 employees know stenography, 25 employees know to use a computer, 7 employees know both typing and stenography, 4 employees know stenography and computers and 3 employees know all the three. If there were 50 employees in the department, find how many employees don't know none of the three jobs.

(a) 40 (b) 10 (c) 47 (d) 33

18. In a class composed of x girls, y boys what part of the class is composed of girls?

(a) $y(x+y)$ (b) $\frac{x}{xy}$ (c) $\frac{}{(x \quad y)}$ (d) $\frac{y}{xy}$

19. In a row, 25 trees are planted at equal distance from each other. The distance from each other. The distance between 1st and 25th tree is 30 m. What is the distance between 3rd and 15th tree?

(a) 8m (b) 15m (c) 16m (d) 18m

20. In a zoo, there are Rabbits and Pigeons. If heads are counted, there are 200 and if legs are counted, there are 580. How many pigeons are there?

(a) 90 (b) 100 (c) 110 (d) 120

21. Ann, Bill and Ken shared some stamps in the ratio 2:3:4. After a game the ratio became 5 : 2 : 2. If Ann won 21 stamps how many did Ken lose?

(a) 28 (b) 21 (c) 7 (d) 14

22. A florist had 133 roses, she sold 5/7 of them. How many roses had she left?

(a) 58 (b) 38 (c) 57 (d) 19

23. A man climbing up a wall of 24 metres high. He climbs 16 m on one day but slipped back by 3m 40 cms in the evening. How far had the man reached on that day?

(a) 19 m, 40 cms (b) 12.6 m

(c) 11.4 m (d) 12 m 40 cms

24. The Weights of 4 boxes are 80, 60, 90 and 70 kilograms. Which of the following cannot be the total weight, in kilograms, of any combination of these boxes and in a combination a box can be used only once.

(a) 300 (b) 230 (c) 220 (d) 290

Hints & Solutions

1. **(c)** Suppose the age of Johnny is F years and that of Rahul is y years.
According to question
Age of Hari
$\Rightarrow$ 2F – 5y
or, 2F – 5y = 0 ...(i)
Again F = 3 + y
or, F – y = 3 ...(ii)
On solving equations (i) and (ii), we get
y = 2
$\therefore$ Age of Johny = 3 + y = 3 + 2 = 5 years

2. **(b)** Suppose the number of women boarded the bus at Delhi is F.
Therefore, the number of men= 2F
According to question,
2F – 10 = F + 5
$\Rightarrow$ 2 F – F = 10 + 5
$\because$ F = 15
Total number of passengers boarded the bus initially
= 3 F = 3 × 15 = 45

3. **(b)** Suppose there were F passengers initially
Number of passengers after first stop
Number of passengers after second stop

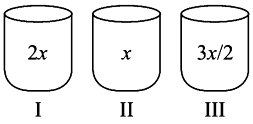
$$= \frac{4}{5}\left(\frac{F}{2}+35\right) + 40 = 80$$

$$\Rightarrow \quad \frac{F}{2}+35 = \frac{(80-40)}{4}\times 5$$

$$\Rightarrow \quad \frac{F}{2} = 50 - 35 = 15$$

F = 30

4. **(d)**



Suppose the number of fruits in the second basket = F
Number of fruits in the first basket

Number of fruits in the third basket = $2F \times \frac{3}{4} = \frac{3F}{2}$

Now, 2F + F + $\frac{3F}{2}$ = 30 × 3

$$\frac{4F+2F+3F}{2} = 30\times 3$$

9F = 30 × 3 × 2

$$\therefore \quad F = \frac{30\times 3\times 2}{9} = 20$$

Number of fruits in the first basket = 2F = 2 × 20 = 40

5. **(b)** Total age of 19 boys = 19 × 21 = 399 year
Total age including teacher's = 20 × 22 = 440
$\therefore$ Teacher's age = 440 – 399 = 41 years

6. **(b)** Present age of the son = 12 years The father was 36 years old when the boy was born.
= 12 × 3 = 36 years
0 + 12 = 12 years
and 36 + 12 = 48 years
Therefore, 4 years ago the boy was = 12 – 4 = 8 years

7. **(b)** Mr. Prakash and his wife = 2
Prakash's two married brothers = 4
Two children = 2
Total members = 2 + 4 + 2 = 8

8. **(d)** Total number of ways in which the committee can be formed = 5 × 3 = 15
But Ms. A refuses to be a member of the committee in which Mr. B is taken as a member.
Therefore, the required answer = 15 –1 = 14

9. **(c)** 25 have VCRs and each VCR owner also has a TV.
Therefore, the TV owners who have not VCRs
= 75 – 25 = 50 = 75 – 25 = 50
Now, 10 have all the three.
Therefore, 50 – 10 = 40 have only TV.

10. **(c)** Suppose total number of workers in the officer
Number of woman workers $\frac{F}{3}$
Number of man workers

$$\Rightarrow \quad x - \frac{x}{3} = \frac{3x-x}{3} = \frac{2x}{3}$$

Number of married woman workers = $\frac{F}{3}\times\frac{1}{2} = \frac{F}{6}$

Number of married woman workers that have children.= $\frac{F}{6}\times\frac{1}{3} = \frac{F}{18}$

Number of married man workers $\frac{2F}{3}\times\frac{3}{4} = \frac{F}{2}$

Number of married man workers who have children

$$\frac{F}{2}\times\frac{2}{3} = \frac{F}{3}$$

Number of workers who have children = $\frac{F}{3}+\frac{F}{18}$

$$= \frac{6F+F}{18} = \frac{7F}{18}$$

Number of workers without children

$$= F - \frac{7F}{8} = \frac{18F-7F}{18} = \frac{11}{18}F$$

11. **(b)** Total number of words = 300 × 20 × 10 = 60000

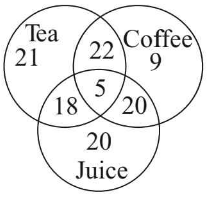
12. **(a)** Mother = 1
Wives = 4
Unmarried daughters = 2
Total number of female members
= 1 + 4 + 2 + 6 = 13

13. (c) Total number of apples = 14 × 12 = 168
Ten apple were removed, remaining apples 1 = 158
Now, Number of apples in each basket = $\frac{158}{2}=79$

14. (c) Sum of the six numbers = 6 × 40 = 240
Change in the sum of six numbers = (3 × 4) – (3 × 6) = 12 – 18 = – 6
∴ New average = $\frac{234}{6}=39$

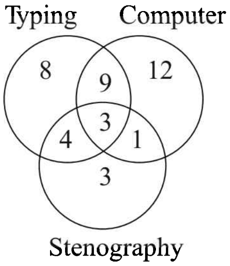
15. (b) 4 cats can kill 4 rats in 4 minutes. So, 8 cats can kill 8 rats in 4 minutes.

16. (a) There are 130 employees.



21 employees drink only tea.

17. (b)



Total number of employees who know either typing. Computer or stenography or two or three jobs.
= 8 + 9 + 12 + 4 + 3 + 1 + 3 = 40
Number employees who do not know any of three jobs.
= 50 – 40 = 10

18. (c) Total number of students in the class = (x + y).
∴ part of the class is composed of girls.
$= \frac{x}{x+y}$

19 (b) The distance between the two trees = $\frac{30}{24}=\frac{5}{4}$ metres
The distance between 3rd and 15th trees
$= \frac{5}{4}\times 12 = 15$ metres.

20. (c) Suppose the number of
Rabbits = F
Number of pigeons = y
According to question
F + y = 200 ....(i)
And, 4F + 2y = 580 .....(ii)
From equations (i) and (ii), F = 90
⇒ y = 200 – 90 = 110

21. (d) Difference between the ratios of Ann = 5 – 2 = 3 : 3 ⇒ 21
∴ $1 = \frac{21}{3} = 7$
Ken lost: 2 stamps : 2 = 2 × 7 = 14

22. (b) Florist sold = 133 × $\frac{5}{7}$ = 95 roses
Remaining roses = 133 – 95 = 38

23. (b) Then man climbed = (16.00 – 3.40) metres = 12.60 metres

24. (d) According to options, 1st option = 80 + 60 + 90 + 70 = 300
2nd option = 80 + 60 + 90 = 230
3rd option = 60 + 90 + 70 = 220
From given weight, we can not get total weight 290.
So, option (d) is different from other options.

Chapter 10

Seating Arrangement

Sitting arrangement questions are based on the sitting sequence pattern, direction, facing outside or inside, etc. You have to understand all the conditions given in the question as the given information may be in jumbled form. You have to segregate this information and make the arrangement as per the given conditions. After that you can easily give the answer of the questions based on it.

Sitting arrangement may be along a row, two rows or along a shape like circle, rectangle, square, triangle, etc.

LINEAR SITTING ARRANGEMENT

In sitting arrangement problems, the actual information can be classified into 2 categories:-

(a) Definite informations : A definite information is one when the place of person or object is definitely mentioned.

(b) Comparative informations : In such information the place of person or object is not mentioned definitely but only a comparative position is given.

To solve the problems based on linear sitting arrangement we have follow the following shortcut approach.

Shortcut Approach – 1

Step I. Sketch a diagram of empty places

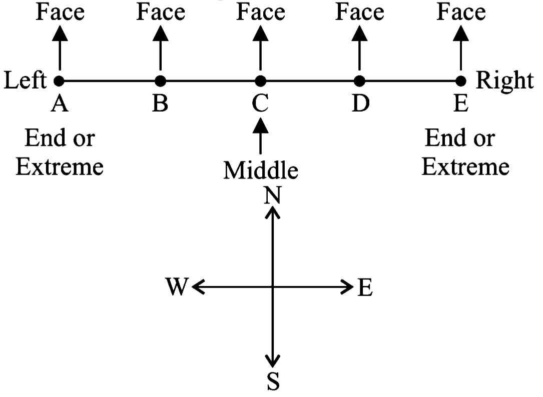
Step II. Fill up as many empty places as possible using all the definite informations.

Step III. With the help of comparative information consider all possibilities and select the possibilities which does not violate any condition.

In this way, we place the persons or objects in proper order in a single row or a straight line. After that, you can easily solve the problems based on linear sitting arrangement.

One Row Sequence

(A) When direction of face is not clear, then we take ourself as base and then the diagram will be as follows

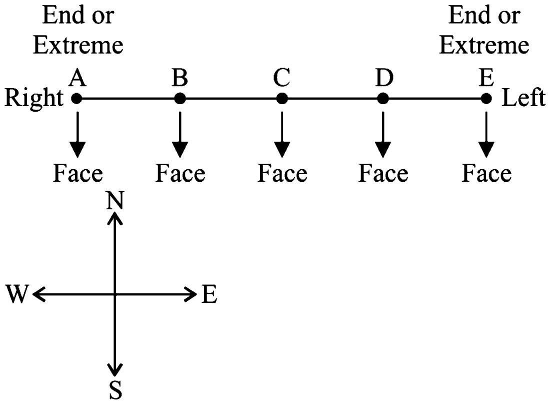


From the above diagram, it is clear that

(i) B, C, D, E are **right** of A but **only** B is the **immediate right** of A.

(ii) D, C, B, A are **left** of E but **only** D is the **immediate left** of E.

(B) When direction of face is towards you, then the diagram will be as follows



From the above diagram, it is clear that

(i) B is **immediate left** of A, C is **immediate left** of B; D is **immediate left** of C and E is **immediate left** of D.

(ii) D is **immediate right** of E; C is **immediate right** of D; B is **immediate right** of C; and A is **immediate right** of B.

Example **1. DIRECTIONS : Just read the following information carefully to answer the questions given below it:**

Five friends P, Q, R, S and T are sitting on a bench.

(1) P is sitting next to Q.
(2) R is sitting next to S.
(3) S is not sitting with T.
(4) T is on the last end of the bench.
(5) R is on the 2nd position from the right.
(6) P is on the right of Q and T.
(7) P and R are sitting together.
Q. At what position is P sitting?

Sol. Here, 4th and 5th sentences constitute definite information: Comparative informations are: 1st, 2nd, 6th and 7th sentences while 3rd is a negative information.

Now, start with definite information, sketch the following arrangement:

T __ __ R __

Now, this is the time to look for the comparative informations that tell about T and R. Such informations are 2nd, 6th and 7th sentences. Take the 7th and the 1st sentence. If P and R are together and also Q and P are together, then P must be between Q and R. Now the arrangement take the form as:-

T Q P R ____

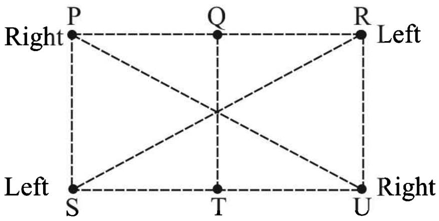
By the virtue of the 2nd sentence:

T Q P R S

So, P is sitting at the middle position.

Two Rows Sequence

Let us see 6 persons seating in two rows



From the above diagram, it is clear that

(i) P is sitting **opposite** S.
(ii) Q is sitting **opposite** T.
(iii) R is sitting **opposite** U.
(iv) P and U are sitting at **diagonally opposite** positions.
(v) S and R are sitting **diagonally opposite** positions.

DIRECTIONS (Qs. 2–7): *Study the following information to answer the given questions:*

Twelve people are sitting in two parallel rows containing six people each, in such a way that there is an equal distance between adjacent persons. In row 1, P, Q, R, S, T and V are seated and all of them are facing south. In row 2, A, B, C, D, E and F are seated and all of them are facing north. Therefore, in the given seating arrangement each member seated in a row faces another member of the other row. A sits third to right of D. Neither A nor D sits at extreme ends. T faces D. V does not face A and V does not sit at any of the extreme ends. V is not an immediate neighbour of T. B sits at one of the extreme ends. Only two people sit between B and E. E does not face V. Two persons sit between R and Q. R is not an immediate neighbour of T. C does not face V. P is not an imeediate neighbour of R.

2. Who amongst the following sit at extreme ends of the rows?
(a) B, E (b) S, T
(c) P, R (d) B, F
(e) None of these

3. Who amongst the following faces A?
(a) R (b) T
(c) P (d) Q
(e) S

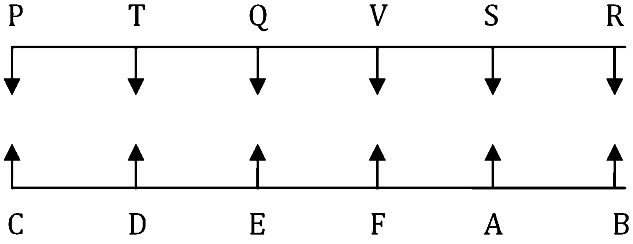
4. How many persons are seated between T and S?
(a) one (b) Two
(c) Three (d) Four
(e) None

5. P is related to V in the same way as C is related to F. Which of the following is E related to, following the same pattern?
(a) B (b) D
(c) C (d) A
(e) None of these

6. Which of the following is true regarding F?
(a) F sits second to right of C
(b) F is not an immediate neighbour of A.
(c) F sits third to left of D
(d) F sits at one of the extreme ends of the line
(e) F faces V.

7. Who amongst the following sits exactly between P and Q?
(a) R (b) V
(c) S (d) T
(e) Cannot be determined

Solutions for 2 – 7:

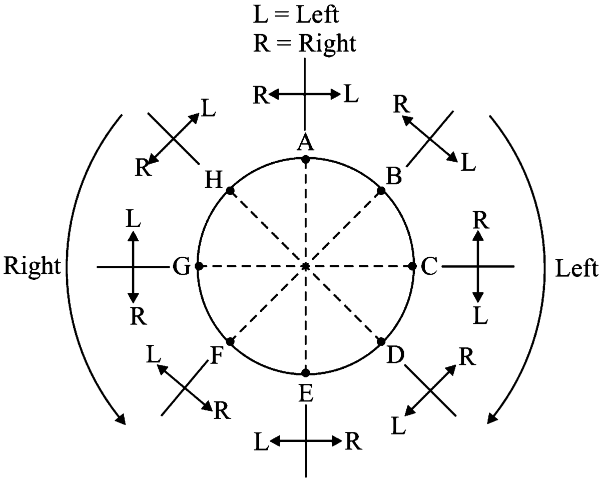


2. (c) is the correct answer
3. (e) is the correct answer
4. (b) is the correct answer
5. (a) is the correct answer
6. (e) is the correct answer
7. (d) is the correct answer

CIRCULAR SITTING ARRANGEMENT

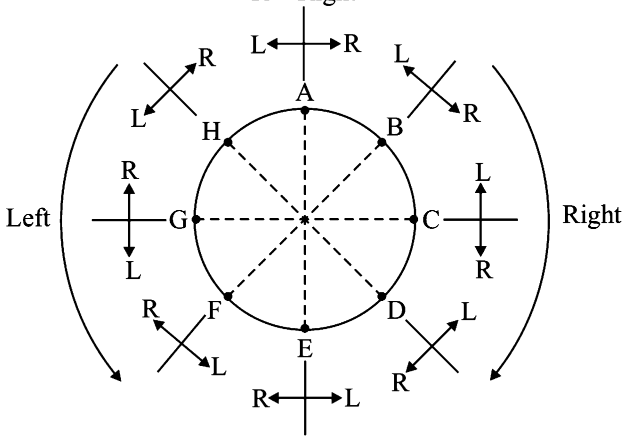
In this type of sitting arrangement, persons or objects are placed around a circle either facing the centre or facing the direction opposite to centre. The left and right of each person or object in both the cases can be understood with the help of following diagrams.

(1) (i)



Facing the centre

(ii) L = Left
R = Right

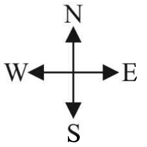


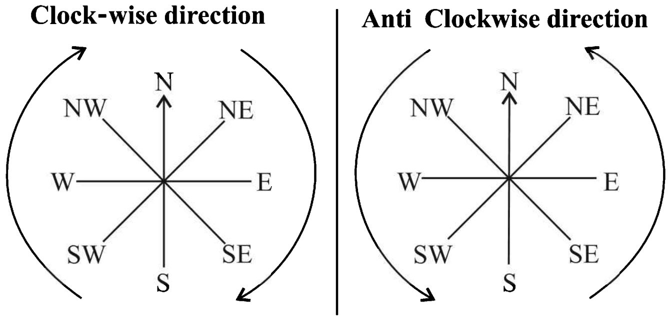
Facing the direction opposite to centre

Facing the centre

Here, A and E are in front of each other.
B and F are in front of each other.
C and G are in front of each other.
D and H are in front of each other.

(2) N= North , E= East , W=West , S= South

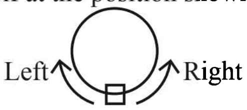




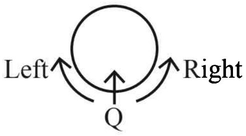
To solve the questions based on sitting arrangement follow the shortcut approach for the arrangement of people or objects in a circle:

Shortcut Approach – 2

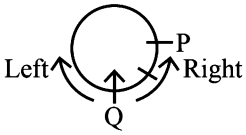
- Imagine yourself as one of the persons given in the question.
- Count how many people are mentioned in the question. Then draw a circle with those many people.
- Imagine yourself at the position shown by the box.



- Now your left hand is the left side and right hand is the right side.
- Now, if in question it is given, P is second to the right of Q, approach as follows.
  - Imagine yourself as Q.



  - Now, P is second to right of Q. The right of Q is your right side. So, place P at second place from Q towards its right.

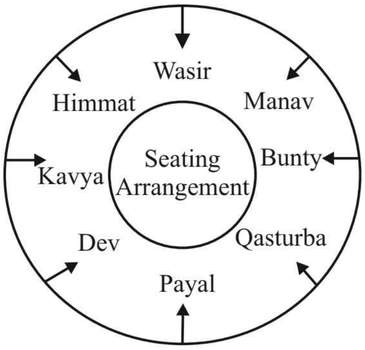


Example 8. Directions : Study the following information carefully and answer the question given below.

Bunty, Dev, Manav, Kavya, Payal, Qasturba, Wasir and Himmat are sitting around a circle facing at the centre. Manav is to the immediate right of Bunty who is 4th to the right of Kavya. Payal is 2nd to the left of Bunty and is 4th to the right of Wasir. Qasturba is 2nd to the right of Dev who is 2nd to the right of Himmat.

Q. Who is 3rd to the right of Bunty?

Sol.



To give the answer, see the setting position. You can easily found the Himmat is 3rd to the right of Bunty.

EXERCISE

DIRECTIONS (Qs. 1-7): *Study the following information carefully and answer the given questions :*

A, B, C, D, E, F, G and H are sitting around a circle facing the centre but not necessarily in the same order.

- B sits second to left of H's husband. No female is an immediate neighbour of B.
- D's daughter sits second to right of F. F is the sister of G. F is not an immediate neighbour of H's husband.
- Only one person sits between A and F. A is the father of G. H's brother D sits to the immediate right of H's mother. Only one person sits between H's mother and E.
- Only one person sits between H and G. G is the mother of C. G is not an immediate neighbour of E.

1. What is position of A with respect to his mother-in-law ?
(a) Immediate left (b) Third to the right
(c) Third to the left (d) Second to the right
(e) Fourth to the left

2. Who amongst the following is D's daughter ?
(a) B (b) C (c) E (d) G
(e) H

3. What is the position of A with respect to his grandchild ?
(a) Immediate right (b) Third to the right
(c) Third to the left (d) Second to the left
(e) Fourth to the left

4. How many people sit between G and her uncle in clockwise direction?
(a) One (b) Two (c) Three (d) Four
(e) More than four

5. Four of the following five are alike in a certain way based on the given information and so form a group. Which is the one that does not belong to that group ?
(a) F (b) C (c) E (d) H
(e) G

6. Which of the following is true with respect to the given seating arrangement ?
(a) C is the cousin of E
(b) H and H's husband are immediate neighbours of each other
(c) No female is an immediate neighbour of C
(d) H sits third to left of her daughter
(e) B is the mother of H

7. Who sits to the immediate right of C ?
(a) F's grandmother (b) G's son
(c) D's mother-in-law (d) A
(e) G

DIRECTIONS (Qs. 8-12): *Study the following information carefully and answer the given questions.*

Eight people - E, F, G, H, J, K, L and M are sitting around a circular table facing the centre. Each of them is of different profession-Chartered Accountant, Columnist, Doctor, Engineer, Financial Analyst, Lawyer, Professor and Scientist but not necessarily in the same order. F is sitting second to the left of K. The Scientist is an immediate neighbour of K. There are only three people between the Scientist and E. Only one person sits between the Engineer and E. The Columnist is to the immediate right of the Engineer. M is second to the right of K. H is the Scientist. G and J are immediate neighbours of each other. Neither G nor J is an Engineer. The Financial Analyst is to the immediate left of F. The Lawyer is second to the right of the Columnist. The Professor is an immediate neighbour of the Engineer. G is second to the right of the Chartered Accountant.

8. Who is sitting second to the right of E?
(a) The Lawyer (b) G
(c) The Engineer (d) F
(e) K

9. Who amongst the following is the Professor?
(a) F (b) L (c) M (d) K
(e) J

10. Four of the following five are alike in a certain way based on the given arrangement and hence form a group. Which of the following does not belong to that group?
(a) Chartered Accountant - H
(b) M - Doctor
(c) J - Engineer
(d) Financial Analyst - L
(e) Lawyer - K

11. What is the position of L with respect to the Scientist?
(a) Third to the left (b) Second to the right
(c) Second to the left (d) Third to the right
(e) Immediate right

12. Which of the following statements is true according to the given arrangement?
(a) The Lawyer is second to the left of the Doctor
(b) E is an immediate neighbour of the Financial Analyst
(c) H sits exactly between F and the Financial Analyst
(d) Only four people sit between the Columnist and F
(e) All of the given statements are true

DIRECTIONS (Qs. 13-15): *Study the following information and answer the questions that follow:-*

Twelve people Abhishek, Binit, Chand, Dhiraj, Eshita, Fatima, Garima, Hena, Ishan, Jatin, Kamal and Lalit are sitting around a rectangular table. The following information is known-

The table has 12 chairs numbered from 1 to 12. 6 seats on one side of the table and 6 on the opposite side. The chairs are arranged in such a way that chair number 1 is just opposite to 12, 6 is opposite to 7 and so on-

Abhishek is sitting opposite to Kamal who is the only person sitting between Chand and Jatin. Eshita is sitting opposite to Ishan who is the only person sitting between Binit and Lalit. Fatima, sitting at chair number 1, is diagonally opposite to Chand who is sitting opposite to Dhiraj.

13. If Garima is sitting opposite to Fatima then who is sitting opposite to Hena?
(a) Lalit (b) Binit
(c) Ishan (d) Can't be determined.
(e) None of these

14. If Lalit is sitting opposite to Hena, then who is sitting opposite to Garima?
(a) Eshita or Fatima (b) Jatin or Fatima
(c) Jatin or Eshita (d) None of these
(e) All of the above

15. How many persons are sitting between Binit and Dhiraj, if they are on the same side of the table?
(a) 2 or 3 (b) 1 or 2
(c) 1 or 3 (d) None of these
(e) All of the above

DIRECTION (Qs. 16-20): *Read the following information carefully and answer the questions given below it.*

Eight players P, Q, R, S, T, U, V,W of a cricket team are sitting on a circular table facing the centre. Three of them are batsman, three are bowlers and remaining are all rounders. All batsmans are sitting together but no two bowlers are sitting together. Only Q is sitting between the two all rounders. W is not an all rounder and is sitting second to the right of one of the all rounder. S is sitting opposite to a bowler and to the immediate left of P. V who is batsman is sitting adjacent to a bowler. R who is an all rounder is sitting adjacent to U.

16. Who is sitting to the opposite of T?
(a) R (b) Q (c) W (d) U
(e) Cannot be determined

17. Which of the following is a bowler?
(a) W (b) P (c) T (d) Q
(e) Cannot be determined

18. Who is sitting third to the right of S?
(a) a batsman (b) W
(c) an all rounder (d) T
(e) None of these

19. Which of the following is/are the only person sitting between two bowlers?
(a) P (b) T (c) V (d) R
(e) Both P and R

20. Four of the following five are alike in a certain way based on the given seating arrangement and thus form a group. Which is the one that does not belong to that group?
(a) VS (b) TV (c) UQ (d) RP
(e) WV

DIRECTIONS (Qs. 21-25): *On the basis of the information given below, select the correct alternative as answer for the questions which follow the information:*

(i) A, B, C, D, E, F and G are sitting on a wall facing east.
(ii) C is just right of D.
(iii) B is on end point and E is his neighbour.
(iv) G is sitting between E and F.
(v) D is third from south end.

21. Which of the following is a pair of persons who are on end points?
(a) AE (b) AB (c) FB (d) CB
(e) Cannot be determined

22. Which of the following information is not necessary to determine the position of A?
(a) i
(b) ii
(c) iii
(d) All information is necessary
(e) None of these

23. D is sitting between which of the following pairs?
(a) CE (b) AC (c) CF (d) AF
(e) None of these

24. C wants his seat as third from north. He will have to exchange his seat with which person?
(a) G (b) F (c) E
(d) Cannot be determined
(e) None of these

25. Who is seated to the right of E ?
(a) F (b) D (c) C (d) A
(e) None of these

DIRECTIONS (Qs. 26-30): *Study the following information carefully and answer the question given below:*

A, B, C, D, E, F, G and H are sitting around a circle facing to the centre. D is second to the left of F and third to the right of H. A is second to the right of F and the immediate neighbour of H. C is second to the right of B and F is third to the right of B. G is not an immediate neighbour of F.

26. How many of them are there between H and C?
(a) Two (b) Three
(c) Two or Three (d) Data inadequate
(e) None of these

27. Who is to the immediate left of A?
(a) H (b) E
(c) G (d) Data inadequate
(e) None of these

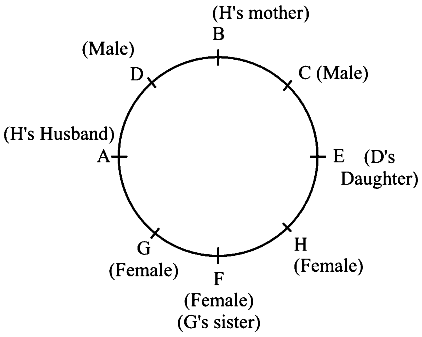
28. In which of the following pairs is the first person sitting to the immediate left of the second person ?
(a) CD (b) BG (c) HA (d) FC
(e) None of these

29. Who is fourth to the right of B ?
(a) E (b) C
(c) A (d) Data inadequate
(e) None of these

30. What is E's position with respect to G?
(a) Second to the right (b) Third to the left
(c) Third to the right (d) Second to the left
(e) None of these

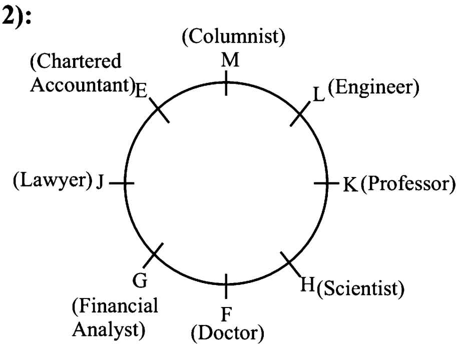
Hints & Solutions

Sol. (1-7):



1. **(d)** A's wife is H. H's mother is B. Therefore, B is the mother-in-law of A, A is second to the right of B.
2. **(c)** E is the daughter of D.
3. **(b)** A is the father of F and G. G is the mother of C. Therefore, C is the grandchild of A. A is third to the right of C.
4. **(a)** D is brother-in-law of A. A is father of F and G. Therefore, D is material uncle of G. There is only one person between G and D in clockwise direction.
5. **(b)** Except C, all others are females.
6. **(e)** B is the mother of H.
   C is the nephew of E,
   A is the husband of H, A is third to the left of H, Both the neighbours of C are females,
   F and G are daughters of H.
7. **(a)** B sits to the immediate right of C. B is grandmother of F.

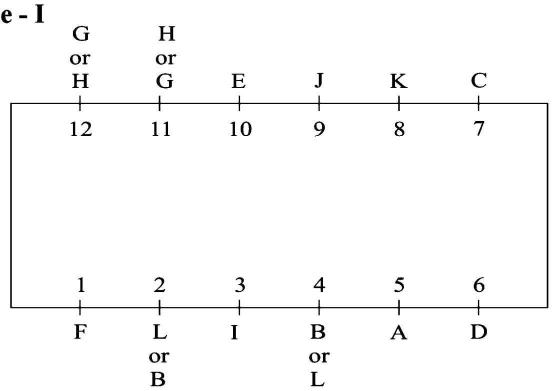
Sol. (8-12):



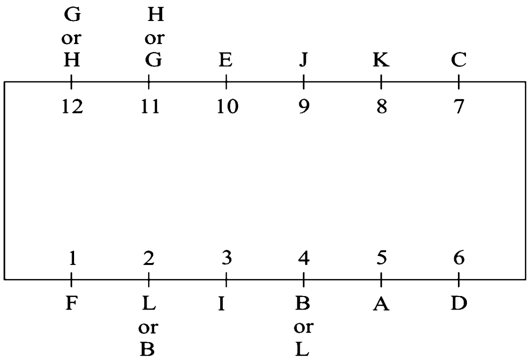
8. (b) 9. (d) 10. (c) 11. (b) 12. (a)

Sol. (13-15):

Case - I

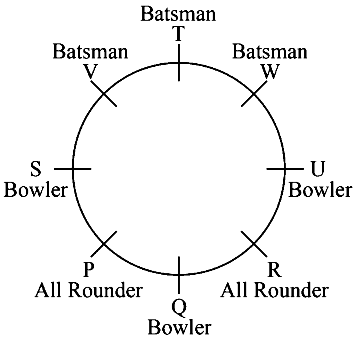


Case - II



13. **(d)** From the above 2 cases, it follows case (i) and opposite to Fatima is either Lalit or Binit.
14. **(b)** From the above 2 cases,
    In case (i) if Lalit is sitting opposite to Hena then Fatima is sitting opposite to Garima.
    In case (ii) if Lalit is sitting opposite to Hena then Jatin is sitting opposite to Garima.
15. **(c)** From the above 2 cases, it follows case (i) and number of persons sitting between Binit and Dhiraj is either 1 or 3.

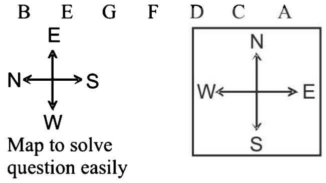
Sol. (16-20):



16. (b) 17. (d) 18. (c) 19. (e) 20. (a)

Sol. (21-25):

Given information can be digrammatically shown as follows

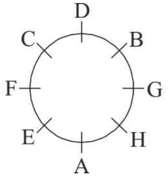


Map to solve question easily

21. (b) 22. (d) 23. (c) 24. (a) 25. (e)

Sol. (26-30):

Seating arrangement is as follows:



26. (b) 27. (b) 28. (e) 29. (a) 30. (b)

Chapter 11

Clock and Calendar

CLOCK

The concept of clock is the same as the concept of circular motion. Just like in circular motion, in case of clocks, the hour hand and the minute hand are continuously racing against each other around a circle.

The hour hand travels 5 minutes or 30° in 1 hour. Similarly, the minute hand travels 60 minutes or 360° in 1 hour. Therefore, in one hour, the minute hand moves 55 minutes or 330° more than the hour hand. This can also be called the relative speed of minute hand with respect to the hour hand.

Minute and Hour hand of a clock

Actual Time	Movement		Relative speed of minute hand with respect to hour hand
	Minute Hand	Hour Hand	
60 minutes	60 minutes or 360°	5 minutes or 30°	55 minutes or 330°

Other Important Concepts

(i) The two hands of a clock coincide once every hour, but in 12 hours they coincide only 11 times. This is because the coincide position at 12 is counted in both 11 to 12 and 12 to 1.

(ii) The hands are at right angles twice in every hour, but in 12 hours, they are at right angles only 22 times. This is because the right-angle position at 3 p.m. is common to both 2 p.m. to 3 p.m. and 3 p.m. to 4 p.m. Similarly, the right-angled position at 9 p.m. is common to both 8 p.m. to 9 p.m. and 9 p.m. to 10 p.m.

(iii) The hands point in the opposite direction once in every hour, but in 12 hours they are opposite only 11 times. This is because, the opposite position of at 6 p.m. is counted in both 5 p.m. to 6 p.m. and 6 p.m. to 7 p.m.

(iv) The hands are said to be in same straight line whenever they are coincident or opposite to each other.

(v) Two hands of a clock will coincide again when the minute hand takes a lead of 60 minutes from the hour hand. The minute hand takes a lead of 55 minutes from hour hand in 60 minutes.

Concept of Incorrect Clocks

Two hands of every correct clock coincide after every $\left(65+\frac{5}{11}\right)$ minutes.

An incorrect clock can either be a fast clock which gains time or a slow clock which loses time.

Fast clock : In fast clock, two hands of a clock coincide in every x minutes, where x is less than $\left(65+\frac{5}{11}\right)$.

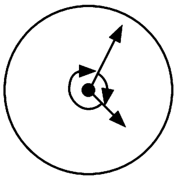
Time gained per minute $= \dfrac{65+\frac{5}{11}-x}{x}$ minute

Slow clock : In slow clock, two hands of a clock coincide in every x minutes, where x is greater than $\left(65+\frac{5}{11}\right)$ minutes.

Time loss per minute $= \dfrac{x-\left(65+\frac{5}{11}\right)}{x}$ minute

Example 1. Mrs. Veena Gupta goes for marketing between 5 P.M. and 6 P.M. When she comes back, she finds that the hour hand and the minute hand have interchanged their positions. For how much time was she out of her house ?

Sol.: Since two hands are interchange their positions, so sum of the angles subtended at the centre by hour hand and minute hand = 360°



Let us suppose that she was out of house for 't' minutes.

So, the sum of the angles subtended at the centre by the hour hand and minute hand $= (0.5 \times t)^\circ + (6t)^\circ$

$\because \quad 0.5t + 6t = 360$

$\Rightarrow \quad 6.5t = 360 \quad \Rightarrow \quad t = 55.4$ (app.)

Hence required time = 55.4 minutes.

CALENDAR

The topic of calendar includes concepts such as odd days, leap year and finding the day of the day week for a given date.

Leap Year

An end of the century year (the last year of the century, e.g. 1500, 1800, 2000 etc.) is a leap year only if divisible by 400. For all the other years, check the divisibility by 4, and if the year is divisible by 4 it is said to be a *leap year* and will have 366 days. This would mean that the year 1500 and 1800 inspite of being divisible by 4 not a leap year.

Concept of Odd Days : When a given number of days converted into week(s) by dividing 7, then the remaining days which are not covered in week(s) are called *odd days*.

(i) An ordinary year has 365 days, that is 52 weeks and one odd day. This means out of the 365 days in an ordinary year, 364 days will get converted into 52 weeks and one day will remain. This one day is referred to 1 odd day. This means that when we proceed from ordinary year to the next year, the name of the first day of the next year will be the name of the day which will come just after the first day of previous (ordinary) year.

For example, if 2 October 2015 is a Friday, then 2 October 2016 is a Sunday, that is a shift of two days because 2016 is a leap year.

(ii) A leap year has 366 days, that is 52 weeks and two odd days. This means that when we proceed from leap year to the next year, the name of the first day of the next year will be the name of the day which will come two days after the first day of previous (leap) year.

For example, if 26th January 2016 is a Saturday, then 26th January 2017 would be a Monday, that is a shift of two days because 2016 is a leap year.

(iii) If name of the day of a particular date is given and we have to find the name of the day of an other particular date, then we need to look at not only the years but also the date from which we are moving to the other given date. If the 29th of February falls between the two dates, there will be a shift of two days, otherwise there will be a shift of one day.

Counting Odd Days

1st January AD from where our calendar started was a Monday. That's why our week starting on a Monday. Saturday and Sunday are called **weekends.**

Therefore, if we are calculating from 1st January AD and after converting into weeks, whenever we have 1 odd day left, it would be a Monday. If there are 2 odd days left, then the first one would be a Monday, then second a Tuesday and so on.

First odd day = Monday
Second odd day = Tuesday
Third odd day = Wednesday
Fourth odd day = Thursday
Fifth odd day = Friday
Sixth odd day = Saturday
Seventh or Zeroth odd day = Sunday

In ordinary year,

1 year = 365 days = 52 weeks + 1 day (i.e. one odd day)

In leap year,

1 year = 366 days = 52 weeks + 2 days (i.e. two odd days)

Concept of Total Odd Days in 100, 200, 300 and 400 Years

If we take 100 consecutive years from 1st AD, there will be 24 leap years (remember the 100th year will not be a leap year) and 76 ordinary years.

24 leap years = 24 × 2 odd days = 48 odd days

Now 48 odd days = 6 weeks + 6 odd days

Hence 24 leap years have $\boxed{\text{6 ood days}}$

76 ordinary years = 76 × 1 odd days = 76 odd days

Now 76 odd days = 10 weeks and 6 odd days

Hence 76 ordinary years have $\boxed{\text{6 ood days}}$

Now 6 odd days + 6 odd days = 1 week + 5 odd days

Therefore, 100 consecutive years from 1st January AD have 5 odd days.

Similarly,

- 200 consecutive years contain 10 odd days i.e. 3 odd days.
- 300 consecutive years contain 15 odd days i.e. 1 odd day.
- But 400 consecutive years contain (20 + 1) odd days i.e. 0 odd day (this is because 400th year will be a leap year and contribute 1 extra day.)

Note that the last day of a century be one day out of Friday, Wednesday, Monday or Saturday. First day of a new century will be a Saturday, Thursday, Tuesday or Monday.

Example 2. What day of the week was 15th August 1949?

Sol.: 15th August 1949 means

1948 complete years + first 7 months of the year 1949 + 15 days of August.

1600 years give no odd days.

300 years give 1 odd day.

48 years give {48 + 12} = 60 = 4 odd days.

[∵ For ordinary years → 48 odd days and for leap year 1 more day; (48 ÷ 4) = 12 leap year; 60 = 7 × 8 + 4]

From 1st January to 15th August 1949, Odd days :

January → 3, February → 0, March → 3, April → 2, May → 3, June → 2, July → 3, August → 1.

17 ⇒ 3 odd days.

∴ 15th August 1949 → 1 + 4 + 3 = 8 = 1 odd day.

This means that 15th Aug. fell on 1st day of the week. Therefore, the required day was Monday.

Example 3. How many times does the 29th day of the month occur in 400 consecutive years?

Sol.: In 400 consecutive years, there are 97 leap years. Hence, in 400 consecutive years, February has the 29th day 97 times and the each remaining eleven months have the 29th day

400 × 11 = 4400 times

∴ The 29th day of the month occurs (4400 + 97) or 4497 times.

EXERCISE

1. Time appears in the mirror 11 : 09 Then what time will be appear in clock?
(a) 1 : 51 (b) 12 : 09 (c) 12 : 51 (d) 1 : 09

2. If reflecting time is 3 :43 then the real time of clock is?
(a) 3 : 17 (b) 7 : 17 (c) 8 : 17 (d) 8 : 43

3. What angle is made by minute and hour hand at 4 : 12?
(a) 66° (b) 44° (c) 54° (d) 60.5°

4. At what time between 6 to 7 O' clock minute and hour hand will coincide?
(a) $6:38\frac{2}{11}$ (b) $6:43\frac{7}{11}$
(c) $6:32\frac{8}{11}$ (d) $6:5\frac{5}{11}$

5. At what time between 3 to 4 O' clock minute and hour hand are opposite to each other?

(a) $3:43\frac{7}{11}$ (b) $3:38\frac{2}{11}$ (c) $3:49\frac{1}{11}$ (d) $3:54\frac{6}{11}$

6. When did the minute and hour hand makes 180° angle between 6 to 7 O' clock?

(a) $6:54\frac{6}{11}$ (b) 6 : 60 (c) 6 : 00 (d) $6:5\frac{5}{11}$

7. At what time between 8 to 9 O' clock the minute and hour will apart 7 minutes to each other?

(a) $8:42, 8:51\frac{3}{11}$ (b) $8:36, 8:51\frac{3}{11}$

(c) $8:09, 8:47\frac{4}{11}$ (d) $8:17, 8:28\frac{9}{11}$

8. The minute hand of a clock overtakes the hour hand at in tervals of 64 minutes of correct time. How much a day does the clock gain or lose?

(a) $43\frac{9}{11}$ minute loss (b) $32\frac{8}{11}$ minute gain

(c) $33\frac{9}{11}$ minute gain (d) $32\frac{8}{11}$ minute loss

9. The minute hand of a clock overtakes the hour hand at intervals of 66 minute of correct time. How much a day does the clock gain or lose?

(a) $11\frac{109}{121}$ minute gain (b) $11\frac{109}{121}$ minute loss

(c) $11\frac{117}{121}$ minute gain (d) $11\frac{117}{121}$ minute loss

10. A watch which gains uniformaly is 4 minute slow at 9 A.M on Sunday and is 4 minute 15 sec. fast at 9 P.M on upcoming Friday. When was it correct?

(a) 2 A.M Thursday (b) 6 P.M Wednesday

(c) 1 A.M Wednesday (d) 6 P.M Thursday

11. A watch which loses uniformaly is 3 minute fast at 6 A.M. on Thursday and is 3 minute 12 sec. slow at 5 P.M. on upcoming Wednesday. When was it correct?

(a) 9 P.M on Sunday (b) 9 A.M on Monday

(c) 9 A.M on Sunday (d) 8 A.M on Sunday

12. By looking in a mirror it ap-pears that it is 6 : 30 in the clock. What is the real time?

(a) 6 : 30 (b) 5 : 30 (c) 6 : 00 (d) 5 : 00

13. After 9'O clock at what time between 9 p.m. and 10 p.m will the hour and minute hands of a clock point in opposite direction?

(a) 15 minutes past 9 (b) 16 minutes past 9

(c) $16\frac{4}{11}$ minutes past 9 (d) $17\frac{1}{11}$ minutes past 9

14. At what time are the hand of clocks together between 6 and 7?

(a) $32\frac{8}{11}$ minutes past 6 (b) $34\frac{8}{11}$ minutes past 6

(c) $30\frac{8}{11}$ minutes past 6 (d) $32\frac{5}{7}$ minutes past 6

15. A clock only with dots marking 3, 6, 9, and 12 O' clock positions has been kept upside down in front of a mirror. A person reads the time in the reflection of the clock as 10:20. What is the actual time?

(a) 07: 10 (b) 02 : 40 (c) 04 : 50 (d) 10 : 20

16. A clock goes slow from midnight by 5 min. at the end of the first hour, by 10 min. at the end of the second hour, by 15 min. and the end of the 3rd hour and so on. What will be the time by this clock after 6 hours?

(a) 6 : 00 am (b) 5 : 30 am

(c) 6 : 30 am (d) 5 : 15 am

17. A clock goes fast by one minute during the first hour, by two minutes at the end of the second hour, by 4 minutes at the end of 3rd hour, by eight minutes by the end of 4th hour, and so on. At the end of which hour, will it be fast by just over sixty minutes?

(a) Fifth (b) Sixth (c) Seventh (d) Eighth

18. A clock with only dots marking 3,6,9 and 12 positions has been kept upside down in front of a mirror. A person reads the time in the reflection as 9.50. What is the actual time?

(a) 2: 15 (b) 8 : 40 (c) 8 : 50 (d) 4 : 15

19. A clock with only dots marking 3, 6, 9, and 12 positions has been upside down in front of a mirror. A person reads the time in the reflection as 6 : 10 The real time is:

(a) 06 : 50 (b) 12 : 40 (c) 11 : 20 (d) 6 : 10

20. A clock with only dot markings 3, 6, 9 and 12 positions has been kept upside down in front of a mirror. A person reads the time in the reflections of the clock as 12 : 30 the actual that will be

(a) 12 O'clock (b) 12 : 30

(c) 6 O' clock (d) 03 : 45

21. If 50 minutes ago, it was 45 minutes past four O' clock, how many minutes is it until six O' clock?

(a) 45 (b) 15 (c) 25 (d) 35

22. What was the day of week on 2nd October 1869?

(a) Friday (b) Saturday (c) Sunday (d) Monday

23. On what dates of May 1993 did Sunday fall?

(a) 1, 8, 15, 22, 29 (b) 2, 9, 16, 23, 30

(c) 3, 10, 17, 24, 31 (d) 4, 11, 18, 25

24. If the 3rd day of a month is Tuesday, which of the following will be the 6th day from 23rd of that month?

(a) Sunday (b) Saturday

(c) Thursday (d) Friday

25. If the 27th day of a month is Friday, which of the following will be the 4th day of that month?

(a) Sunday (b) Saturday

(c) Wednesday (d) Friday

Hints & Solutions

1. **(c)** Because the time 11:09 lies between 11:00 to 1:00, Hence we subtract that time from 23:60
23:60 –11:09 = 12:51

2 **(c)** Because the time 3:43 lies between 1:00 to 11:00. Hence, we subtract that time from 11:60
11:60 – 3:43 = 8:17

3. **(c)** Formula for Angle = H × 30 = F°

$$M\times\frac{11}{2}=\gamma°$$

(Subtract smaller from larger)

Hence H = 4, M = 12; $4 \times 30 = 120°$

$12 \times \frac{11}{2} = 66°$; $120° - 66° = 54°$

4. **(c)** Consider means O° Angle By unique Formula

$= H : \left(H \times 5 \pm \frac{\text{Angle}}{6}\right) \times \frac{12}{11}$

Angle = 0°, h = 6 then $= 6 : \left(6 \times 5 \pm \frac{0}{6}\right) \times \frac{12}{11}$

$= 6 : (30 \pm 0) \times \frac{12}{11} = 6 : \frac{360}{11} = 6 : 32\frac{8}{11}$

5. **(c)** By Unique Formula

H = 3, Angle = 180°

Note : Hands are opposite means 180°

$3 : \left(3 \times 5 \pm \frac{180}{6}\right) \times \frac{12}{11}$

$3 : (15 \pm 30) \times \frac{12}{11}$

$3 : (15 + 30) \times \frac{12}{11}, 3 : (15 - 30) \times \frac{12}{11}$

$3 : (45) \times \frac{12}{11}, 3 : (-15) \times \frac{12}{11}$

$3 : \frac{540}{11}, 3 : \left(\frac{-180°}{11}\right)$

Angle = 180° $= 3 : 49\frac{1}{11}$

6. **(c)** By unique formula

H = 6 Angle = 180°

$6 : \left(6 \times 5 \pm \frac{180}{6}\right) \times \frac{12}{11}$

$6 : (30 \pm 30) \times \frac{12}{11}$

$6 : (30 + 30) \times \frac{12}{11}, 6 : (30 - 30) \times \frac{12}{11}$

$6 : (60) \times \frac{12}{11}, 6 : (0) \times \frac{12}{11}$

$6 : \frac{720}{11}, 6 : 00$

Not possible

Note : Minute and hour hand does not makes 180°. Angle between 5 to 6 and 6 to 7 O' clock. It makes it correct at 6 O' clock.

7. **(b)** $\frac{\text{Angle}}{6} = \text{Minutes}$

By unique formula

$8 : (8 \times 5 \pm 7) \times \frac{12}{11}$

$8 : (40 \pm 7) \times \frac{12}{11}$

$8 : (40 + 7) \times \frac{12}{11}, 8(40 - 7) \times \frac{12}{11}$

$8 : 47 \times \frac{12}{11}, 8 : 33 \times \frac{12}{11}$

$8 : \frac{564}{11}, 8 : \frac{396}{11}$

$8 : 51\frac{3}{11}, 8 : 36$

8. **(b)** Normal watch overtakes in $= 65\frac{5}{11}$ Minute

This watch overtakes in = 64 minute

It means in 64 minutes the clock gains

$65\frac{5}{11} - 64 = \frac{16}{11}$ min.

"In one day = 24 × 60 minutes"

Then in 1 minute clock gains $= \frac{16}{11 \times 64}$

In 24 × 60 minute clock gains

$= \frac{16 \times 24 \times 60}{11 \times 64} = \frac{360}{11}$ Minutes $32\frac{8}{11}$ Minutes

9. **(b)** Total loses in 66 minutes is $= 66 - 65\frac{5}{11} = 66 - \frac{720}{11}$

$= \frac{726 - 720}{11} = \frac{6}{11}$

In 1 minutes $= \frac{6}{11 \times 66}$

In 24 × 60 Minute $= \frac{6 \times 24 \times 60}{11 \times 66} = \frac{1440}{121}$

$= 11\frac{109}{121}$ Minutes loss

10. **(c)** Sunday 9 A.M

Upcoming Friday 9 P.M

– 4 minute 4 Minute 15 sec.

Total gains = 8 min. 15 sec

$8 + \frac{15}{60} = 8 + \frac{1}{4} = \frac{33}{4}$ min.

Total hours = 5 days + 12 hr. = 120 + 12 = 132 hours

$\frac{33}{4}$ min. gains in = 132 hour

1 minute gains in $= \frac{132}{33} \times 4$

4 minute gains in $= \frac{132}{33} \times 4 \times 4 = 64$ hour

9 A.M Sunday + 64 hours

9 A.M Sunday + 2 days 16 hours = 1 A.M Wednesday

11. **(c)** 6 A.M Thursday 5 P.M upcoming Wednesday +3 minutes – (3 minutes + 12 sec.)

Total loses = 6 min. + 12 sec

$= 6 + \frac{12}{60} = 6 + \frac{1}{5} = \frac{31}{5}$ min.

Total hour = 6 days + 11

= 24 × 6 + 11 = 144 + 11 = 155 hour

$\frac{31}{5}$ minutes loss in = 155 hr.

1 minutes loss in = $\frac{155}{31} \times 5$

3 minutes loss in = $\frac{155}{31} \times 5 \times 3 = 75$ hour

75 hour = 3 day + 3 hour

Thursday 6 A.M + (3 day + 3 hour) = Sunday 9 A.M

12. (b) Because the time 6 : 30 lies between 1 : 00 to 11 : 00, hence we substruct that time from 11 : 60

13. (c) oppsite direction means in 180°. Angle by unique Formula H = 9, Angle = 180°

$$9 : \left(9\times5\pm\frac{180}{6}\right)\times\frac{12}{11}$$

$$9 : (45 \pm 30) \times \frac{12}{11}$$

$$9 : (45 + 30) \times \frac{12}{11}, 9 : (45 - 30) \times \frac{12}{11}$$

$$9 : (75) \times \frac{12}{11}, 9 : (15) \times \frac{12}{11}$$

Not possible $9 : \frac{180}{11}$; $9 : 16\frac{4}{11}$

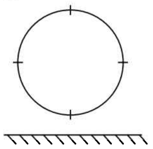
14. (a) Together = 0° Angle

By unique formula H = 6

$$6 : \left(6\times5\pm\frac{0}{6}\right) \times \frac{12}{11}$$

$$6 : (30 \pm 0) \times \frac{12}{11};\ 6 : \frac{360}{11} = 6 : 32\frac{8}{11}$$

15. (a) Here the reflection works as a water image



In this time 10 : 20, the hour hand is between 6 : 00 to 12 : 00 and the minute hand is between 12 : 00 to 6 : 00 clockwise. Hence we subtract that time from 17 : 30

17 : 30 − 10 : 20 = 7 : 10

16. (b) It goes a low In 1 hour = 5 mts

then in 6 hour = 5 × 6 = 30 minutes

Then after 6 hour the time will be = 5 : 30 a.m.

17. (c) Every hour it is double fast of given minutes

In 8 minute fast = In 4th hour

× 2

16 minute fast = In 5th hour

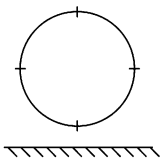
× 2

32 minute fast = In 6th hour

× 2

64 minute fast = In 7th hour

18. (b) In this question reflection works as water image



In this time 9 : 50 the both hand of clock are lies between 6 to 12 clockwise. Hence we subtract that time from 17 : 90

17 : 90 − 9 : 50 = 8 : 40

19. (c) In this time 6 : 10 the hour hand lies between 6 : 00 to 12 : 00 clockwise and hour hand lies between 12 : 00 to 600. Hence we subtract that time from 17 : 30

17 : 30 − 6 : 10 = 11 : 20

20. (c) In this time 12 : 30 we subtract that time from

17 : 90 – 12 : 30 = 5 : 60 = 6 : 00

21. (c) before 50 minutes its 4 : 45 means now times = 4:45 + 50 minutes = 5 : 35

22. (b) Total number of odd days till 20 Oct. 1869 ⇒

Year	Year	Year	Month	days
1600 +	200 +	68 +	Jan = 3 +	2
↓	↓	↓	Feb = 0	↓
0	3	1	March = 3	2
			April = 2	
			May = 3	
			June = 2	
			July = 3	
			August = 3	
			September = 2	

Total E.D. = 0 + 3 + 1 + 3 + 0 + 3 + 2 + 3 + 2 + 3 + 3 + 2 + 2 = 27

But = (27) can never be odd days

$\frac{27}{7} = 6$ (Remainder)

odd days 6 for ⇒ **Saturday**

23. (b) For Sunday in May, 1993 we should find the day on 1st May, 1993

Total add days till 1st May 1993

Year	Year	Year	Month	days
1600 +	30 +	92 +	Jan = 3	1
↓	↓	↓	Feb = 0	↓
0	1	3	March = 3	1
			April = 2	

Total odd days = 0 + 1 + 3 + 3 + 0 + 3 + 2 + 1 = 13

13 can never be odd days, Hence again divide by 7 and find remainder as odd days.

$\frac{13}{7} = 6$ (odd days)

Odd days on 1st May = 1993 = 6

6 for = Saturday

Then 1 May = Saturday

2 May = Sunday

3 May = Monday

First Sunday of this month is on 2nd day. Then on 2nd, 9th, 16th, 23th, 30th all are Sunday.

24. (b) 3rd day = Tuesday

When was start from 23rd, then the 6th day of the month will be 28th days of the same month

3rd day = Tuesday, Then on 10th, 17th, 24th = Tuesday

24th = Tuesday

25th = Wednesday

26th = Thursday

27th = Friday

28th = **Saturday**

25. (c) 27th day of Month = Friday Similarly 20th, 13th, 6th also are Friday

6th day = Friday

5th day = Thursday

4th day = **Wednesday**

Chapter 12

Syllogism

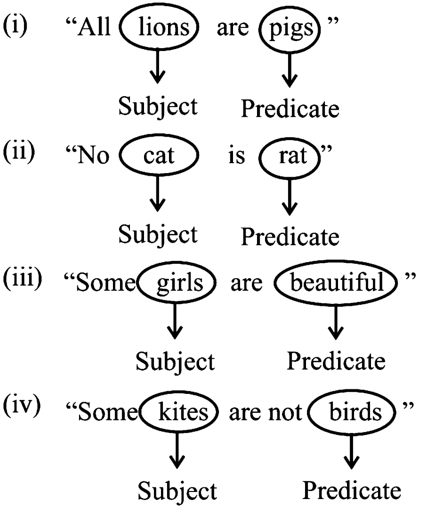
INTRODUCTION

Syllogism is a Greek word which means ‘inference’ or ‘deduction’. The problems of syllogism are based on two parts:

1. Proposition/Propositions
2. Conclusion/Conclusions drawn from given proposition/ propositions

PROPOSITION

Just consider the sentences given below:



All the sentences mentioned above are proposition which give a relation between subject and predicate. Here, it is clear from the sentences that a subject is the part of a sentence something is said about, while a predicate is the term in a sentence which is related to the subject.

Now, let us define the proposition :

A proposition is a sentence that makes a statement giving a relation between two terms. It has three parts :

(a) The subject
(b) The predicate
(c) The relation between subject and predicate

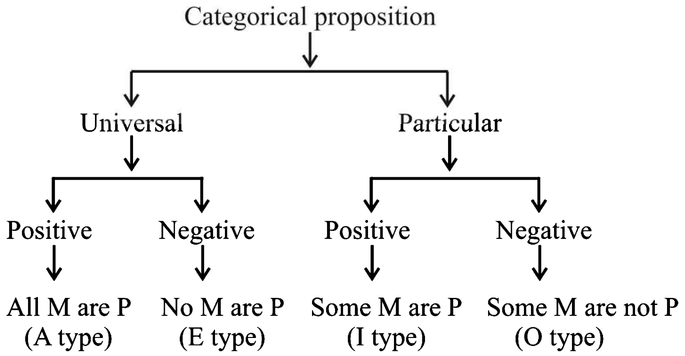
Categorical Proposition

Let us see the sentences given below:

“All M are P”
“No M are P”
“Some M are P”
“Some M are not P”

What we notice in all above-mentioned sentences that they are **condition free**. These type of sentences are called **Categorical Propositions**. In other words a categorical proposition has no condition attached with it and it makes direct assertion. It is different from non-categorical proposition, which is in the format “If M then P”

Types of categorical proposition



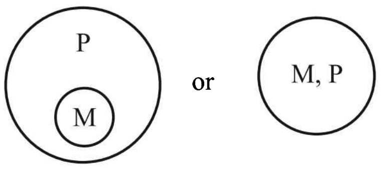
Therefore, it is clear, that universal propositions either completely include the subject (A type) or completely exclude it (E type). On the other hand, particular propositions either only partly include the subject (I type) or only partly exclude the subject (O type).

Now, we can summarise the four types of propositions to be used while solving the problems of syllogism:

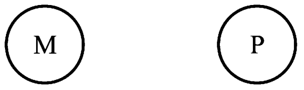
Format	Type
All M are P	A
No M are P	E
Some M are P	I
Some M are not P	O

Shortcut Approach – 1

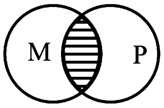
All M are P (A type):



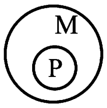
No M are P (E type):



Some M are P (I type):



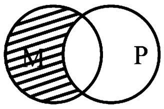
or



Some M are P

Some M are P
[All P are M]

Some M are not P (O type):



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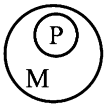


Some M are not P

Some M are not P
[All P are M]

Hidden Propositions

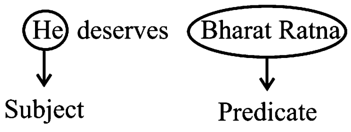
(A) A type:

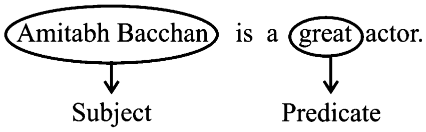
Apart from 'all' it starts with every, each and any.

Example 1.

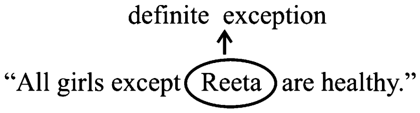
Every girl is beautiful.
[All girls are beautiful.]

(i) A positive sentence with a particular person as its subject is A type.





(ii) A sentence with a definite exception is A type :



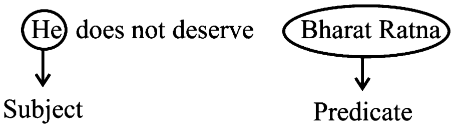
(B) E type:

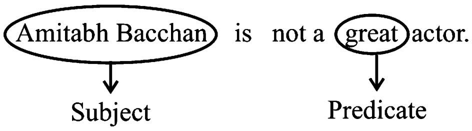
Apart from 'no' this type of propositions starts from 'no one', 'none', 'not a single' etc.

Example 2.

No one (student) is studious.
[No student is studious]

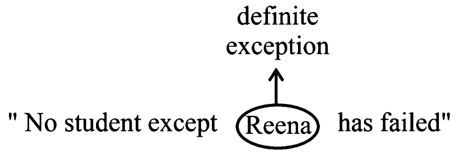
(i) A negative sentence with a particular person as its subject is E type propositions.





(ii) Sentences in following formats are E type :

(a)



(b) "Is there any truth left in the world ?"
[No truth is left in the world.]

(C) I type:

Apart from some, it also starts with words such as often, frequently, almost, generally, mostly, a few, most etc.

Example 3.

(i) Almost all the girls are beautiful.
[Some girls are beautiful].

(ii) Most of the garments are handmade.
[Some of the garments are handmade].

(iii) Usually girls are beautiful.
[Some girls are beautiful.]

(iv) A few money are left in my wallet.
[Some money are left in my wallet].

Further, let us see the sentences given below :

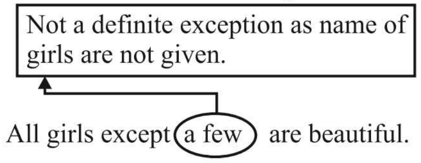
(i) Few girls are not studious.
[Some girls are studious.]

(ii) Rarely a girl is not beautiful.
[Some girls are beautiful].

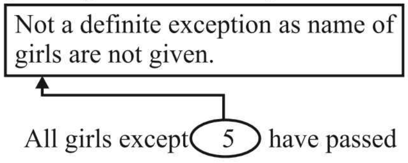
(iii) Seldom women are not housewife.
[Some women are housewife].

It is clear from the above examples that negative sentences begining with words like 'few', 'rarely', 'seldom', etc. (Also 'hardly', 'scarcely', 'little' etc.) are reduced to I type.

Just see the other formates given below


Not a definite exception as name of girls are not given.
All girls except a few are beautiful.

[Some girls are beautiful]


Not a definite exception as name of girls are not given.
All girls except 5 have passed

[Some girls have passed]

Therefore, a positive proposition with an indefinite exception is reduced to I type.

(D) O type :

Apart from "Some .... not', this type of statements start with words like 'all', 'every', 'any', 'each', etc.

Example 4.

(i) All girls are not beautiful.
[Some girls are not beautiful]

(ii) Poor are usually not healthy.
[Some poor are not healthy]
(iii) Every boy is not present.
[Some boys are not present.]
(iv) Almost all the girls are not beautiful.
[Some girls are not beautiful.]
(v) Most of the garments are not handmade.
[Some of the garments are not handmade.]
(vi) Girls are not frequently short tempered.
[Some girls are not short tempered].

It is clear from the above mentioned examples that negative propositions begining with the words like ‘almost’, ‘frequently’, ‘most’, ‘mostly’, ‘a few’, generally, etc. are reduced to O–type propositions.

Again, positive propositions starting with words like ‘few’, ‘scarcely’, ‘rarely’, ‘little’, ‘seldom’ etc. are said to be O–type.

Example 5.

Seldom women are jealous.
[Some women are not jealous]
Also, see the following formats :

No definite exception as name of girls are not given.

No girls except three are beautiful.

[Some girls are not beautiful.]

No definite exception as name of women are not given.

No women except a few are housewife.

[Some women are not housewife.]

Therefore, a negative proposition with an indefinite exception, is reduced to O type.

METHODS TO FIND THE CONCLUSION

(1) By Analytical Method
(2) By Venn Diagram

(1) Analytical method

This method has two main steps:
(a) Aligning the pair of sentences using IEA rule and table of conversion.
(b) Using conclusion table to draw conclusion.

Example 6. Statements:

I. All rats are cats.
II. All rats are men.

When aligned it takes the form as

I. Some cats are rats [I type]
II. All rats are men [A type]

Now we use the conclusion table given in this chapter that says
I + A = I type of conclusion.

Therefore, the drawn conclusion must be
“Some cats are men”

It is clear that the conclusion drawn “Some cats are men” is a mediate inference as it is the result of two propositions.

In actual problem, immediate inferences i.e., the conclusion drawn from a single statement are also given in conclusion part and that format is given below :

Example 7. Statements:

I. All rats are cats.
II. All rats are men.

Conclusion:

(i) Some cats are men.
(ii) Some men are cats.
(iii) Some rats are cats.
(iv) Some cats are rats.
(v) Some men are rats.
(vi) Some rats are men.

Answer options :

(a) only (iii) follows
(b) only (i), (ii) and (iii) follow
(c) only (iv) follows
(d) all follow
(e) none of these

Here, the correct option is (d).

(i) follows because it is the mediate inference of statements I & II.
Conclusion (ii) is the conversion of conclusion (i), conclusion (iii) is the immediate inference (conversion) of statement I while conclusion (iv) is the conversion of conclusion (iii).
Conclusion (v) is the immediate inference (conversion) of statement II while conclusion (vi) is the conversion of conclusion (v).
Further, in some problems, complementary pairs are also seen in the conclusion part in the forms of sentence :

(a) (i) Some cats are rats.
    (ii) Some cats are not rats
(b) (i) All cats are rats.
    (ii) Some cats are not rats.
(c) (i) Some cats are rats.
    (ii) No cats are rats.

Apart from I - O, A - O and I - E pair, the two sentences must have some subject and predicates as are in the above mentioned pairs. For these pairs we write the form 'Either (i) or (ii) follows.
For example, see the following format :

Venn diagram method for solving problems :

Students will have to adopt three steps to solve the syllogism problems through Venn diagram method :

(a) 1st step is sketching all possible pictorial representation for the statements separately.
(b) 2nd step is combining possible pairs of these representations of all the statements into one.
(c) 3rd and final step is doing interpretation of this combined figure. Conclusions are true if they are supported by all the combined figures in 2nd step.

If any pictorial representation contradicts the given conclusion, it will be put in the category of incorrect or wrong conclusion.

Example 8.

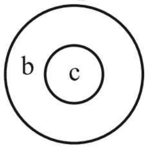
Statements :

A. All chairs are books.
B. All books are ties.

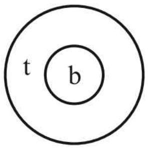
Conclusions :

I. Some ties are books.
II. Some ties are chairs.

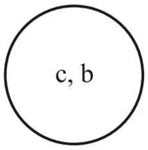
1st Step :



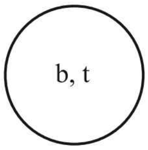
1A



1B



2A



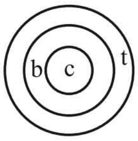
2B

Here, 1A and 2A are representations of statement A while 1B and 2B are representations of statement B. In these representations

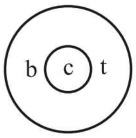
b = books
c = chairs
t = ties

2nd step :

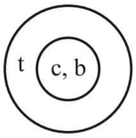
Let us combine all the possible pairs of this pictorial representations:



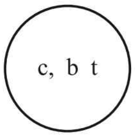
(1A + 1B)



(1A + 2B)



(2A + 1B)



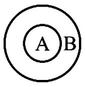
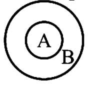
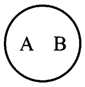
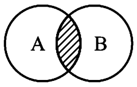
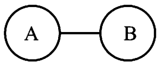
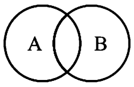
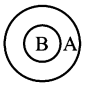
(2A + 2B)

3rd step :

When we interpret the pictures in step II, we find that all the pictures support both the conclusions. Therefore, conclusion I : "Some ties are books" and conclusion II.

"Some ties are chairs" both are true.

Venn Diagram :

Universal Affirmative	Particular Affirmative	Universal Negative	Particular Negative
Direct Statement: All A's are B's  **(1) Definite conclusion** (a) Some A's are B (b) Some B's are A's (i.e. These conclusions are sure conclusions without any doubt **(2) Possible conclusions** (a) Some B's are not A's is a possibility  (b) All B's are A, is a possibility. i.e. 	**Direct Statement:** Some A's are B's  **(1) Definite conclusions** (a) Some B's are A's **(2) Possible conclusions** (a) Some A's are not B is a possibility (b) Some B's are not A is a possibility (c) All A's are B's is a possibility (d) All B's is A is a possibility	**Direct Statement:** No A's are B  **(1) Definite conclusions** (a) All B's are not A (b) Some A's are not B (c) Some B's are not A **Note :** Since there is no relation between A&B ∴ No possibility are definite conclusions	**Direct Statement:** Some A's are not B's  **(1) Definite conclusion** Nothing definite can be said from the diagram. All are a possibility **(2) Possible conclusions** (a) Some A's are B's is a possibility (b) Some B is A is a possibility (c) Some B is not equal to A is a possibility (d) All A is not equal to B is a possibility (e) All B is not equal to A is a possibility (f) All B is equal to A is a possibility  **Note :** Vice-versa i.e. All A is equal to B is not a possibility as the direct statements itself states that some A is not equal to B".

ALL	SOME	ALL NOT	POSSIBILITIES
1. Each	1. Few	1. 0% (All A are not B)	1. Can
2. Every	2. Generally	2. None (none A is B)	2. Can be
3. Each and every	3. Frequently	3. Can never	3. May be
4. 100%	4. Most		4. Might be
5. Almost	5. 99% (any % between 0 and 100)		5. If
6. Always	6. At least		6. Can not
7. None but	7. Least		
8. Only			
9. Any*			

EXERCISE

DIRECTIONS (Qs. 1-4) : *In each of the questions below are given four statements followed by three conclusions numbered I, II & III. You have to take the given statements to be true even if they seem to be at variance from commonly known facts. Read all the conclusions and then decide which of the given conclusions logically follows from the given statements disregarding commonly known facts.*

1. **Statements:**
All chilies are garlics.
Some garlics are onions.
All onions are potatoes.
No potato is ginger.
Conclusions:
I. No onion is ginger.
II. Some garlics are potatoes.
III. Some chillies are potatoes.
(a) Only I follows (b) Only II follows
(c) Only I & II follow (d) Only I & III follow
(e) All follow

2. **Statements:**
Some windows are doors.
All doors are walls.
No wall is roof.
All roofs are shelters.
Conclusions:
I. Some windows are walls.
II. No wall is shelter.
III. No door is shelter.
(a) None follows (b) Only II and III follow
(c) Only I and III follow (d) Only I follows
(e) None of these

3. **Statements:**
All bottles are jars.
Some jars are pots.
All pots are taps.
No tap is tank.
Conclusions:
I. No pot is tank
II. Some jars are tanks
III. Some bottles are pots.
(a) Only I & III follow (b) Only I & II follow
(c) Only II & III follow (d) All follow
(e) None of these

4. **Statements:**
Some fish are crocodiles.
Some crocodiles are snakes.
No snake is tortoise.
All tortoises are frogs.
Conclusions:
I. No snake is frog.
II. Some snakes are fish.
III. Some fish are frogs.
(a) None follows (b) Only I & II follow
(c) Only II & III follow (d) Only I & III follow
(e) None of these

DIRECTIONS (Qs. 5-7) : *In each of the questions below are given two or three statements followed by the conclusions numbered I and II. You have to take the given statements to be true even if they seem to be at variance with commonly known facts and then decide which of the given conclusions logically follows from the given statements. Give answer*

(a) if only conclusion I follows.
(b) if only conclusion II follows.
(c) if either I or II follows.
(d) if neither I nor II follows.
(e) if both I and II follow.

5. **Statements :** All books are ledgers.
All pens are keys.
Some pens are books.
Conclusions : I. Some ledgers are keys.
II. Some keys are books.

6. **Statements :** Some roses are thorns.
All thorns are flowers.
No flower is a petal.
Conclusions : I. No petal is a rose.
II. Some flowers are roses.

7. **Statements:** All leaders are good team workers.
All good team workers are good orators.
Conclusions: I. Some good team workers are leaders.
II. All good orators are leaders.

DIRECTIONS (Qs. 8-12) : *In each of the questions below are given three statements followed by two conclusions numbered I and II. You have to take the given statements to be true even if they seem to be at variance with commonly known facts. Read all conclusions and then decide which of the given conclusions logically follows from the given statements, disregarding commonly known facts. Give answer*

(a) If only conclusion I follows
(b) If only conclusion II follows
(c) If either conclusion I or II follows
(d) If neither conclusion I nor II follows
(e) If both conclusions I and II follows

(8-10):
Statements:
Some poor are rich.
All rich are doctors.
Some intelligent are doctors.

8. Conclusions : I. At least some poor are intelligents.
II. All intelligents being rich is a possibility.

9. Conclusions : I. All intelligents being doctors is a possibility.
II. Some poor are doctors.

10. Statements : All fans are bulbs.
All wires are holders.
Some wires are bulbs.
Conclusions : I. At least some fans are wires.
II. All holders being fans is a possibility.

(11-12):
Statements:
No savings account is a current accounts.
Some fixed deposites are savings accounts.
Some current accounts are recurring deposits.

11. Conclusions:
I. All savings accounts being current accounts is a possibility.
II. All fixed deposits being current accounts is a possibility.

12. Conclusions:
I. All current accounts being fixed deposits is a possibility.
II. All savings accounts being recurring deposits is a possibility.

DIRECTIONS (Qs. 13-17) : *In each question below are given three statements followed by four conclusions numbered I, II, III and IV. You have to take the given statements to be true even if they seem to be at variance with commonly known facts. Read all the conclusions and then decide which of the given conclusions logically follows from the given statements, disregarding commonly known facts.*

13. Statements :
Some sheets are rods.
No sheet is a foil.
All rods are marbles.
Conclusions :
I. No foil is a marble.
II. Some sheets are marbles.
III. Some rods are foils.
IV. Some rods are not foils.
(a) Only I follows
(b) Only II follows
(c) Either III or IV follows
(d) Only I and either III or IV follow
(e) Only II and IV follow

14. Statements :
Some MLAs are not honest.
Some MLAs are dishonest.
No honest is a leader.
Conclusions :
I. Some MLAs are leader.
II. All dishonest are honest.
III. Some dishonest are MLAs.
IV. No leader is dishonest.
(a) Only IV follows (b) Only III and II follow
(c) Only I follows (d) Only I and IV follow
(e) None of these

15. Statements :
Some stones are not rods.
All rods are black.
No black is a crow.
Conclusions :
I. Some crows are rods.
II. Some blacks are stones.
III. Some crows are blacks.
IV. Some stones are rods.
(a) Only I follows (b) None follows
(c) Only I and IV follow (d) Only IV follows
(e) None of these

16. Statements :
Some garbages are money.
All papers are garbages.
All money are coins.
Conclusions :
I. Some papers are coins.
II Some garbages are coins.
III. No money is a paper.
IV. All coins are garbages.
(a) Only I follows (b) Only I and III follow
(c) Only II follows (d) Only II and III follow
(e) None of these

17. Statements :
Some pants are shirts.
No face is a pant.
No pant is a flower.
Conclusions :
I. No flower is a face.
II. No face is a flower.
III. Some shirts are not faces.
IV. Some shirts are pants.
(a) Only I and II follow (b) Only III and IV follow
(c) Either I or II follows (d) Only IV follows
(e) None of these

DIRECTIONS (Qs. 18-22) : *In each question below are given three statements followed by two conclusions numbered I and II. You have to take the given statements to be true even if they seem to be at variance with commonly known facts. Read all the conclusions and then decide which of the given conclusions logically follows from the given statements, disregarding commonly known facts. Give answer*

(a) if only conclusion I follows.
(b) if only conclusion II follows.
(c) if either conclusion I or II follows.
(d) if neither conclusion I nor II follows.
(e) if both conclusion I and II follow.

(18-19) :

Statements:
Some goals are ranks.
No goal is a game.
All games are players.

18. Conclusions :
I. Some ranks are definitely not games.
II. All ranks being goals is a possibility.

19. Conclusions :
I. All players are games.
II. At least some players are not goals.

(20-21) :

Statements :
All files are documents.
Some dictionary are documents.
No picture is a file.

20. Conclusions :
I. All documents being dictionary is a possibility.
II. Some documents are files.

21. Conclusions :
I. Some documents are pictures.
II. All files are definitely not picture.

22. Statements :
All books are pens.
No pen is a copy.
No paper is a book.
Conclusions :
I. No pen is a paper.
II. No copy is a book.

DIRECTIONS (Qs. 23-27): *In each questions bellow are given two statements followed by two conclusions numbered I and II. You have take the two given statements to be true even if they seem to be at variance with commonly known facts. Read the conclusions logically follows from the given statements disregarding commonly known facts. Give answer.*

(a) If only conclusion I follows.
(b) If only conclusion II follows.
(c) If either conclusion I or conclusion II follows.
(d) If neither conclusion I nor conclusion follows.
(e) If both conclusion I and Ii conclusion follow.

23. Statement:
All flowers are white
Some whites are beautiful
Conclusion:
(I) All flowers being beautiful is a possibility.
(II) Atleast some white may not be flowers.

24. Statement:
All mangoes are grapes.
Some grapes are black.
Conclusion
(I) Some mangoes being black is a possibility
(II) There is a possibility that some mangoes are not black

25. Statement:
Some dreams are nights
Some nights are days
Conclusion:
(I) All days are either nights or dreams
(II) Some days are nights

26. Statement:
All stars are moons.
All moons are planets.
All planets are round.
Conclusions:
(I) All moons being stars is a possibility.
(II) All stars are round

27. Statement:
Some cakes are pastries.
Some breads are pastries.
Conclusion:
(I) All pastries being cakes is a possibility.
(II) There is a possibility that some cakes are breads.

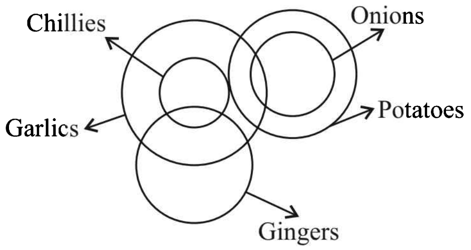
28. Statement:
All roads are bricks.
Some bricks are ropes.
All ropes are doors.
Conclusions:
(I) Some roads are doors.
(II) Some doors are bricks.
(III) Some roads are not doors.
(IV) All doors are ropes
(a) Only I and II follow.
(b) Only I, II and III follow.
(c) Either I or III and II follow.
(d) either I or III and IV follow
(e) None of these.

29. Statements:
Some pens are watches.
Some watch are tyre.
Some tyre are wheel.
Some wheels are buses.
Conclusion:
(I) Some buses are tyres.
(II) Some wheels are watches.
(III) Some wheels are Pens.
(IV) Some buses are watches.
(a) None follows
(b) Only I follows
(c) Only II follows
(d) Only III follows
(e) Only IV follows

30. Statement:
Some doctors are advocate
All teachers are advocate
Some engineers are advocate
All engineers are business- man
Conclusion :
(I) Some Teacher are Doctor.
(II) Some businessman are Advocate.
(III) Some businessman are Teacher.
(IV) Some Advocate are Teacher.
(a) Only I follows
(b) Only I and II follows
(c) Only I and either II or IV follows
(d) Only II and IV follows
(e) None of these

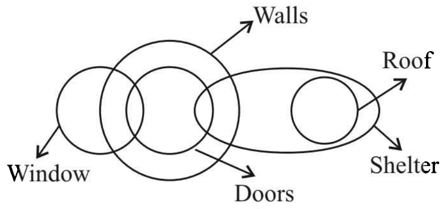
Hints & Solutions

1. (c)

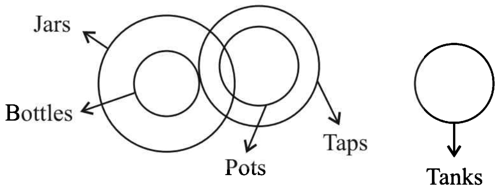


Only conclusions I and II follow.

2. (d)

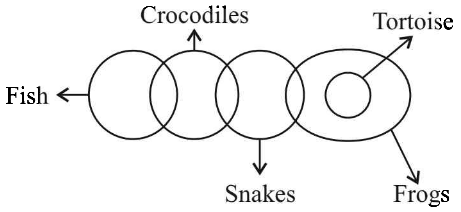


3. (e)

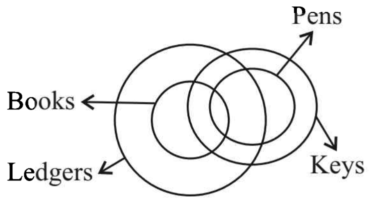


Hence, only conclusion I, no pot is tank follow.

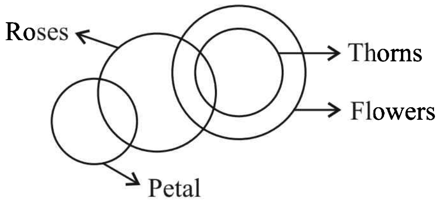
4. (a)



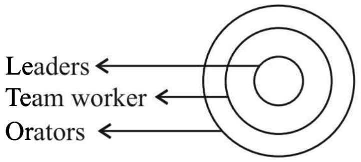
5. (e)



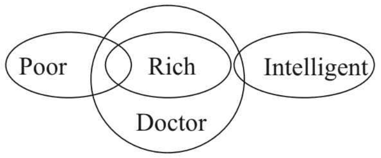
6. (b)



7. (a)

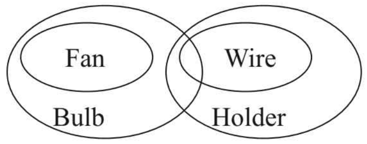


Sol. (8–9):

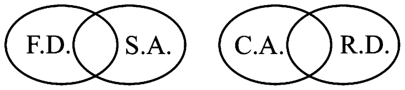


8. (b) 9. (e)

10. (b)



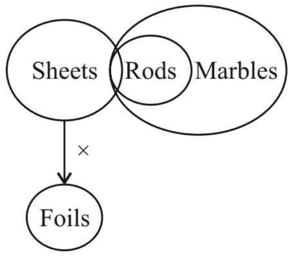
Sol. (11–12):



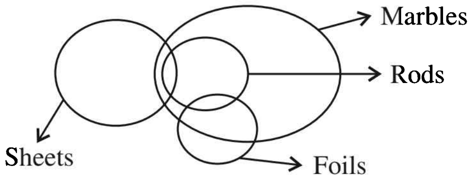
11. (d) 12. (e)

Sol. (13–14):

13. (e)

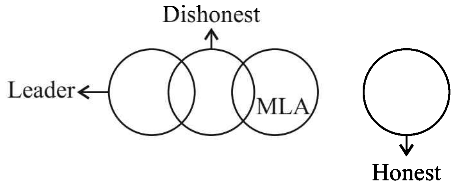


or



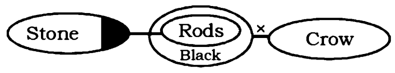
I. × II. ✓ III. × IV. ✓

14. (e)



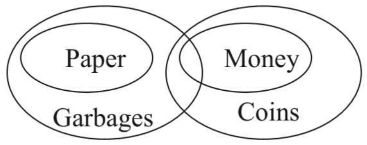
I. × II. × I II. ✓ IV. ×

15. (b)



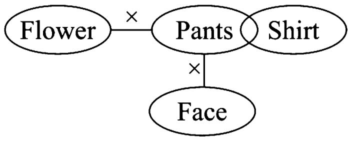
I. × II. × III. × IV. ×

16. (c)



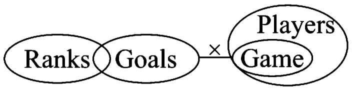
I. × II. ✓ III. × IV. ×

17. (b)



I. – II. – III. × IV. ✓

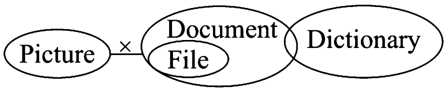
Sol. (18-19):



18. (e) Conclusion:
I. True II. True

19. (b) Conclusion:
I. Can't Say II. True

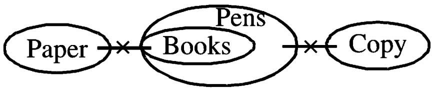
Sol. (20-21) :



20. (e) Conclusions:
I. True II. True

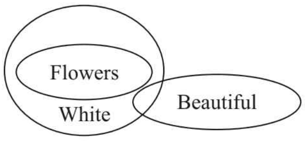
21. (b) Conclusions:
I. Can't say II. True

22. (b) Conclusions:



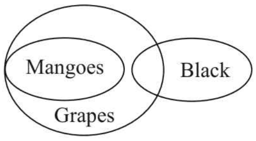
I. Can't say II. True

23. (e)



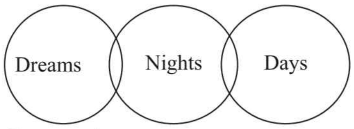
Conclusion:-
(I) All flowers being beautiful is a possibility. ✓
(II) Atleast some white may not be flowers. ✓

24. (e)



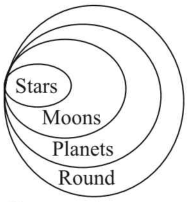
Conclusion:-
(I) Some mangoes being black is a possibility ✓
(II) There is a possibility that some mangoes are not black✓

25. (b)



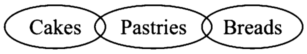
Conclusions:-
(I) All days are either nights or dreams ×
(II) Some days are nights ✓

26. (e)



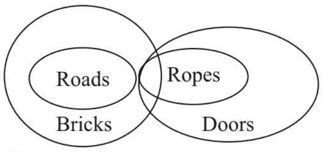
Conclusions:-
(I) All moons being stars is a possibility.✓
(II) All stars are round ✓

27. (e)



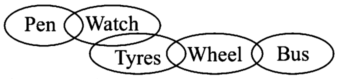
Conclusion:-
(I) all pastries being cakes is a possibility. ✓
(II) There is a possibility that some cakes are breads.✓

28. (c)



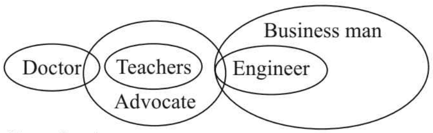
Conclusions:-
(i) Some roads are doors (×)
(ii) Some doors are bricks (✓)
(iii) Some roads are not doors (×)
(iv) All doors are ropes (×)
(i) Some roads are doors
either i or iii
(iii) Same roads are not doors

29. (a)



Conclusion:-
(I) Some buses are tyres.×
(II) Some wheels are watches.×
(III) Some wheels are Pens.×
(IV) Some buses are watches. ×

30. (d)



Conclusion:-
(I) Some Teacher are Doctor ×
(II) Some business man are advocate ✓
(III) Some business man are teacher ×
(IV) Some advocate are teacher ✓

Chapter 13

Statement & Conclusion

INTRODUCTION

In this type of questions, a statement is given followed by two or more conclusions. We have to find out which of these conclusions definitely follows from the given statement.

WHAT IS A 'CONCLUSION'?

'Conclusion' means a fact that can be truly inferred from the contents of a given sentence. Conclusion is the art of judging or deciding, based on reasoning.
It will be more clear from the following examples.

Directions (Qs. 1 to 3) : *In each of the following questions, a statement is given followed by two conclusions I and II. Give answer :*

(a) if only conclusion I follows;
(b) if only conclusion II follows;
(c) if either I or II follows;
(d) if neither I nor II follows;
(e) if both I and II follows;

Example 1.

Statement : The oceans are a store house of practically every mineral including uranium. But like most other minerals, it is found in extremely low concentration – about three gms per 1000 tonnes of water.

Conclusions :

I. The oceans are a cheap source of uranium.
II. The oceans harbour radiation hazards.

Sol. (d) I. Uranium is found in extremely low concentration in oceans. Hence oceans are not a cheap source of uranium.
II. It is out of context of the sentence.

Example 2.

Statement : Today, out of the world population of several thousand million, the majority of men have to live under government which refuses them personal liberty and the right to dissent.

Conclusions :

I. People are indifferent to personal liberty and the right to dissent.
II. People desire personal liberty and the right to dissent.

Sol. (b) It is mentioned in the statement that most people are forced to live under governments which refuse them personal liberty and right to dissent. This means that they are not indifferent to these rights but have a desire for them. So, only II follows.

Example 3.

Statement : It has been decided by the Government to withdraw 33% of the subsidy on cooking gas from the beginning of next month—a spokesman of the Government.

Conclusions :

I. People no more desire or need such subsidy from government as they can afford increased price of the cooking gas.
II. The price of the cooking gas will increase at least by 33% from the next month.

Sol. (d) I does not follow because a govt's policy is not determined merely by people's needs.
II does not follow. Let the present price be x

$\therefore$ Price if subsidy is removed = $\frac{x}{0.67} = 1.49x$

Hence increase in price will be around 49%

Directions (Qs. 4 to 5) : *In each of the following questions, a statement is given followed by two conclusions I and II. Give answer :*

(a) if only conclusion I follows;
(b) if only conclusion II follows;
(c) if either I or II follows;
(d) if neither I nor II follows;
(e) if both I and II follow.

Example 4.

Statement : Interest rate will be fixed on the basis of our bank's rate prevailing on the date of deposit and refixed every quarter thereafter.

Conclusions:

I. It is left to the depositors to guard their interest.
II. The bank's interest rates are subject to change on a day-to-day basis depending on market position.

Sol. (b) I does not follow because the statement is silent about the depositors. II follows from the phrase "bank's rate prevailing on the date of deposit" which means the rates are subject to day-to-day changes.

EXERCISE

DIRECTIONS (Qs. 1-10): *In each question below is given a statement followed by two conclusions numbered I and II. You have to assume everything in the statement to be true, then consider the two conclusions together and decide which of them logically follows beyond a reasonable doubt from the information given in the statement.*

1. **Statements:** In a one day cricket match, the total runs made by a team were 200. Out of these 160 runs were made by spinners.
Conclusions:
I. 80% of the team consists of spinners.
II. The opening batsmen were spinners.
(a) Only conclusion I follows
(b) Only conclusion II follows
(c) Either I or II follows
(d) Neither I nor II follows
(e) Both I and II follow

2. **Statements:** The old order changed yielding place to new.
Conclusions:
I. Change is the law of nature.
II. Discard old ideas because they are old.
(a) Only conclusion I follows
(b) Only conclusion II follows
(c) Either I or II follows
(d) Neither I nor II follows
(e) Both I and II follow

3. **Statements:** Government has spoiled many top ranking financial institutions by appointing bureaucrats as Directors of these institutions.
Conclusions:
I. Government should appoint Directors of the financial institutes taking into consideration the expertise of the person in the area of finance.
II. The Director of the financial institute should have expertise commensurate with the financial work carried out by the institute.
(a) Only conclusion I follows
(b) Only conclusion II follows
(c) Either I or II follows
(d) Neither I nor II follows
(e) Both I and II follow

4. **Statements:** Population increase coupled with depleting resources is going to be the scenario of many developing countries in days to come.
Conclusions:
I. The population of developing countries will not continue to increase in future.
II. It will be very difficult for the governments of developing countries to provide its people decent quality of life.
(a) Only conclusion I follows
(b) Only conclusion II follows
(c) Either I or II follows
(d) Neither I nor II follows
(e) Both I and II follow

5. **Statements:** Prime age school-going children in urban India have now become avid as well as more regular viewers of television, even in households without a TV. As a result there has been an alarming decline in the extent of readership of newspapers.
Conclusions:
I. Method of increasing the readership of newspapers should be devised.
II. A team of experts should be sent to other countries to study the impact of TV. on the readership of newspapers.
(a) Only conclusion I follows
(b) Only conclusion II follows
(c) Either I or II follows
(d) Neither I nor II follows
(e) Both I and II follow

6. **Statements:** A man must be wise to be a good wrangler. Good wranglers are talkative and boring.
Conclusions:
I. All the wise persons are boring.
II. All the wise persons are good wranglers.
(a) Only conclusion I follows
(b) Only conclusion II follows
(c) Either I or II follows
(d) Neither I nor II follows
(e) Both I and II follow

7. **Statements:** "The Government will review the present policy of the diesel price in view of further spurt in the international oil prices". – A spokesman of the Government.
Conclusions:
I. The Government will increase the price of the diesel after the imminent spurt in the international oil prices.
II. The Government will not increase the price of the diesel even after the imminent spurt in the international oil prices.
(a) Only conclusion I follows
(b) Only conclusion II follows
(c) Either I or II follows
(d) Neither I nor II follows
(e) Both I and II follow

8. **Statements:** The Government of country X has recently announced several concessions and offered attractive package tours for foreign visitors.
Conclusions:
I. Now, more number of foreign tourists will visit the country.
II. The Government of country X seems to be serious in attracting tourists.
(a) Only conclusion I follows
(b) Only conclusion II follows
(c) Either I or II follows
(d) Neither I nor II follows
(e) Both I and II follow

9. **Statements:** After this amendment to the Constitution, no child below the age of 14 years will be employed to work in any factory or mine or engaged in any other hazardous employment.
Conclusions:
I. Before this amendment, children below 14 years were employed to work in factory or mine.
II. The employers must now abide by this amendment to the Constitution.

(a) Only conclusion I follows
(b) Only conclusion II follows
(c) Either I or II follows
(d) Neither I nor II follows
(e) Both I and II follow

10. **Statements:** It has been decided by the Government to withdraw 33% of the subsidy on cooking gas from the beginning of next month. – A spokesman of the Government.

Conclusions:

I. People now no more desire or need such subsidy from Government as they can afford increased price of the cooking gas.
II. The price of the cooking gas will increase at least by 33% from the next month.

(a) Only conclusion I follows
(b) Only conclusion II follows
(c) Either I or II follows
(d) Neither I nor II follows
(e) Both I and II follow

DIRECTIONS (Qs. 11-20): *In each question below is given a statement followed by two conclusions numbered I and II. You have to assume everything in the statement to be true, then consider the two conclusions together and decide which of them logically follows beyond a reasonable doubt from the information given in the statement.*

Give answer:

(a) If only conclusion I follows
(b) If only conclusion II follows
(c) If either I or II follows
(d) If neither I nor II follows and
(e) If both I and II follow.

11. **Statements**: Government has spoiled many top ranking financial institutions by appointing bureaucrats as Directors of these institutions.

Conclusions:

I. Government should appoint Directors of the financial institutes taking into consideration the expertise of the person in the area of finance.
II. The Director of the financial institute should have expertise commensurate with the financial work carried out by the institute.

12. **Statements:** Population increase coupled with depleting resources is going to be the scenario of many developing countries in days to come.

Conclusions:

I. The population of developing countries will not continue to increase in future.
II. It will be very difficult for the governments of developing countries to provide its people decent quality of life.

13. **Statements:** Prime age school-going children in urban India have now become avid as well as more regular viewers of television, even in households without a TV. As a result there has been an alarming decline in the extent of readership of newspapers.

Conclusions:

I. Method of increasing the readership of newspapers should be devised.
II. A team of experts should be sent to other countries to study the impact of TV. on the readership of newspapers.

14. **Statements:** In Japan, the incidence of stomach cancer is very high, while that of bowel cancer is very low. But Japanese immigrate to Hawaii, this is reversed - the rate of bowel cancer increases but the rate of stomach cancer is reduced in the next generation. All this is related to nutrition - the diets of Japanese in Hawaii are different than those in Japan.

Conclusions:

I. The same diet as in Hawaii should be propagated in Japan also.
II. Bowel cancer is less severe than stomach cancer

15. **Statements:** Monitoring has become an integral part in the planning of social development programmes. It is recommended that Management Information System be developed for all programmes. This is likely to give a feedback on the performance of the functionaries and the efficacy with which services are being delivered.

Conclusions:

I. All the social development programmes should be evaluated.
II. There is a need to monitor the performance of workers.

16. **Statements:** In a highly centralised power structure, in which even senior cabinet ministers are prepared to reduce themselves to pathetic countries or yesmen airing views that are primarily intended to anticipate or reflect the Prime Minister's own performances, there can be no place for any consensus that is quite different from real or contrived unanimity of opinion, expressed through a well orchestrated endorsement of the leader's actions.

Conclusions:

I. The Ministers play safe by not giving anti-government views.
II. The Prime Minister does not encourage his colleagues to render their own views.

17. **Statements:** The eligibility for admission to the course is minimum second class Master's degree. However, the candidates who have appeared for the final year examination of Master's degree can also apply.

Conclusions:

I. All candidates who have yet to get their Master's degree will be there in the list of selected candidates.
II. All candidates having obtained second class Master's degree will be there in the list of selected candidates.

18. **Statements:** Applications of applicants who do not fulfill eligibility criteria and/or who do not submit applications before last date will be summarily rejected and will not be called for the written test.

Conclusions:

I. Those who are called for the written test are those who fulfill eligibility criteria and have submitted their applications before last date.
II. Written test will be held only after scrutiny of applications.

19. **Statements:** Although we have rating agencies like Crisil, ICRA, there is demand to have a separate rating agency for IT companies to protect investors.

Conclusions:

I. Assessment of financial worth of IT companies calls for separate set of skills, insight and competencies.

II. Now the investors investing in IT companies will get protection of their investment.

20. Statements: Wind is an inexhaustible source of energy and an aero-generator can convert it into electricity. Though not much has been done in this field, the survey shows that there is vast potential for developing wind as alternative source of energy.

Conclusions:

I. Energy by wind is comparatively newly emerging field.

II. The energy crisis can be dealt by exploring more in the field of aero-generation.

Hints & Solutions

1. (d) According to the statement, 80% of the total runs were made by spinners. So, I does not follow. Nothing about the opening batsmen is mentioned in the statement. So, II also does not follow.

2. (a) Clearly, I directly follows from the given statement. Also, it is mentioned that old ideas are replaced by new ones, as thinking changes with the progressing time. So, II does not follow.

3. (e) According to the statement, Government has spoiled financial institutions by appointing bureaucrats as Directors. This means that only those persons should be appointed as Directors who are experts in finance and are acquainted with the financial work of the institute. So, both I and II follow.

4. (b) The fact given in I is quite contrary to the given statement. So, I does not follow. II mentions the direct implications of the state discussed in the statement. Thus, II follows.

5. (d) The statement concentrates on the increasing viewership of TV and does not stress either on increasing the readership of newspapers or making studies regarding the same. So, neither I nor II follows.

6. (d) According to the statement, good wranglers are wise men. But it doesn't mean that all wise men are good wranglers. So, neither I nor II follows.

7. (c) The Government seeks to review the policy so as to determine whether the diesel price needs to be increased or it can be kept stable by adjusting certain other factors. So, either decision may be taken. Thus, either I or II follows.

8. (e) Clearly, the government has taken the step to attract more tourists. So, both I and II follow.

9. (e) The statement mentions that after the amendment, no child below 14 years will be engaged in hazardous employment. This means that before the amendment, the practice of employing children below 14 years was in vogue. This in turn means that employers will have to abide by the amendment. So, both I and II follow.

10. (d) The decision to withdraw subsidy has clearly been taken to compensate for the loss and not because people can now afford to pay more for cooking gas. So, I does not follow. Also, the statement talks of withdrawing 33% of the prevailing subsidy and not of reducing 33% of the actual price. So, II also does not follow.

11. (e) According to the statement, Government has spoiled financial institutions by appointing bureaucrats as Directors. This means that only those persons should be appointed as Directors who are experts in finance and are acquainted with the financial work of the institute. So, both I and II follow.

12. (b) The fact given in I is quite contrary to the given statement. So, I does not follow. II mentions the direct implications of the state discussed in the statement. **Thus, II** follows.

13. (d) The statement concentrates on the increasing viewership of TV. and does not stress either on increasing the readership of newspapers or making studies regarding the same. So, neither I nor II follows.

14. (d) The statement neither propagates the diet of any of the countries nor compares the two types of cancer. So, neither I nor II follows.

15. (e) According to the statement, monitoring and evaluation of social development programmes - their function, performance and efficiency - is absolutely essential. So, both I and II follow.

16. (a) According to the statement, even senior cabinet ministers are always ready to conform to the Prime Minister's views. So, I follows. However, II contradicts the given statement and so does not follow.

17. (d) The statement mentions that the candidates who have obtained second class Master's degree or have appeared for the final year examination of Master's degree, can apply for admission. This implies that both types of candidates may be selected on certain grounds. Thus, some candidates of each type and not all candidates of any one type, may be selected. So, neither I nor II follows.

18. (e) The statement clearly mentions that fulfilling the eligibility criteria and submitting the application before the stipulated date are both essential to avoid rejection. So, I follows. Also, since it is given that the candidates whose applications are rejected shall not be called for written test, so II also follows.

19. (a) The need for separate rating agency for IT companies clearly indicates that such assessment requires a separate set of skills. So, I follows. However, the statement indicates only the need or demand and neither the future course of action nor its after-effects can be judged. So, II does not follow.

20. (e) The phrase 'not much has been done in this field' indicates that wind energy is a comparatively newly emerging field. So, I follows. The expression 'there is vast potential for developing wind as alternative source of energy' proves II to be true.

Chapter 14 Logical Sequence of Word

WHAT IS 'LOGICAL SEQUENCE OF WORDS'?

As the name suggests, in this type of questions, a group of words are given and you are asked to arrange them in a meaningful and logical order. It may sound easy but sometimes the questions are tricky to answer. Let's discuss about various kinds of sequences and strategy to handle them well.

Tricks & Strategy for 'Logical Sequence of Words'

1. Sequence of stages of a process or series of events

In this type, the given group of words signifies the stages of development of a process or a series of events that led to a major happening. You are required to spot the order that goes from 'start to finish of the process'. E.g. the events that led to a war, the stages of manufacturing, etc.

Example **1. Arrange the words given below in a meaningful sequence.**

1. Presentation **2. Recommendation**
3. Arrival **4. Discussion**
5. Introduction
(a) 5, 3, 4, 1, 2 (b) 3, 5, 4, 2, 1
(c) 3, 5, 1, 4, 2 (d) 5, 3, 1, 2, 4

Sol. Option (c) is the correct answer because sequence of events happen in order is 3, 5, 1, 4, 2.

2. Sequence of increasing or decreasing value/ size/intensity

This type of sequences are easy to arrange in one go. You are asked to arrange the group of words in a decreasing or increasing order. The criteria may be: age, size, value, area, intensity, cost etc.

Example **2. Arrange the given words in the sequence and choose the correct sequence.**

A. Elephant **B. Cat**
C. Mosquito **D. Tiger**
E. Whale
(a) E, C , A, B, D **(b) A, C, E, D, B**
(c) C, B, D, A, E **(d) B, E, A, D, C**

Sol. Option (c) is the correct answer because these are arranged according to size.

3. According to dictionary

In this type of sequence, you need to arrange the words as per the order given in dictionary. In other words, you are required to arrange them alphabetically.

Example **3. Arrange the given words in the sequence in which they occur in the dictionary and choose the correct sequence.**

1 Repoint **2. Reptile**
3. Repent **4. Repute**
5. Report
(a) 3, 1, 5, 2, 4 **(b) 3, 5, 1, 2, 4**
(c) 5, 1, 4, 3, 2 **(d) 5, 4, 1, 3, 2**

Sol. Option (a) is the correct answer.

4. Sequence of objects/things from 'part' to 'whole'

In this type of sequence, the given words belong to a particular group or class of things. You need to arrange them in an order that shows the basic part of something to the whole. E.g. an arrangement may start with 'cell' being the basic unit and proceed to end with a 'living being'.

Example **4. Arrange the following in a meaningful sequence.**

1. Phrase **2. Letter**
3. Word **4. Sentence**
(a) 1, 2, 3, 4 **(b) 1, 3, 2, 4**
(c) 2, 3, 1, 4 **(d) 2, 3, 4, 1**

Sol. Option (c) is the correct because a group of letters makes a word. A group of words makes a phrase. A group of phrase makes a sentence. Thus, the correct order is 2, 3, 1, 4

EXERCISE

1. Arrange the following words as per order in the dictionary.
1. Pragmatic 2. Protect
3. Pastel 4. Postal
5. Pebble
(a) 4, 3, 5, 2, 1 (b) 3, 5, 4, 1, 2
(c) 3, 4, 5, 1, 2 (d) 4, 3, 5, 1, 2

2. Arrange the following words as per order in the dictionary.
1. Dillydallying 2. Dillydallied
3. Dillydally 4. Dilled
5. Dillydallies
(a) 4, 2, 3, 5, 1 (b) 4, 2, 5, 3, 1
(c) 4, 5, 3, 1, 2 (d) 4, 5, 3, 2, 1

3. Arrange the following words as per order in the dictionary.
1. Decollete 2. Desecrate
3. Decorous 4. Desipicable
5. Destitute
(a) 1, 3, 2, 4, 5 (b) 1, 5, 2, 4, 3
(c) 3, 2, 4, 5, 1 (d) 4, 5, 2, 3, 1

4. Arrange the following words as per order in the dictionary.
1. Flunching 2. Fluntlock
3. Flunpites 4. Fluntlocks
5. Flunchers
(a) 1, 5, 2, 4, 3 (b) 5, 1, 2, 4, 3
(c) 5, 1, 3, 2, 4 (d) 5, 1, 3, 4, 2

5. Arrange the following words as per order in the dictionary.
1. Brain 2. Brand 3. Beep 4. Boxer
5. Boxed
(a) 3, 5, 4, 1, 2 (b) 4, 5, 3, 1, 2
(c) 3, 4, 5, 1, 2 (d) 4, 3, 5, 1, 2

6. Arrange the following words as per order in the dictionary.
1. Temple 2. Trainef 3. Troup 4. Trainign
5. Tented
(a) 1, 5, 2, 3, 4 (b) 1, 5, 2, 4, 3
(c) 1, 5, 4, 3, 2 (d) 1, 4, 5, 3, 2

7. Arrange the following words as per order in the dictionary.
1. Prayer 2. Plane 3. Prey 4. Predate
5. Picture
(a) 5, 1, 2, 3, 4 (b) 5, 1, 2, 4, 3
(c) 5, 2, 1, 4, 3 (d) 5, 2, 1, 3, 4

8. Arrange the following words as per order in the dictionary.
1. Ambitions 2. Ambiguous
3. Ambiguity 4. Animation
5. Animal
(a) 3, 2, 4, 1, 5 (b) 3, 2, 5, 4, 1
(c) 3, 2, 1, 5, 4 (d) 3, 2, 4, 5, 1

DIRECTIONS (Qs. 9 - 11): *In the following questions, which one of the given responses would be a meaningful order of the following?*

---

9. 1. Crawling 2. Siting 3. Running
4. Standing 5. Walking
(a) 1 2 4 3 5 (b) 1 4 5 2 3
(c) 1 2 4 5 3 (d) 1 4 2 5 3

10. Diagnosis Post operational care, Operation, Discharge
(a) Discharge, Operation, Diagnosis, Post operational care
(b) Operation, Diagnosis, Discharge, Post Operational care
(c) Diagnosis, Operation, Post operational care, Discharge
(d) Post operational care, Discharge, Operation, Diagnosis

11. 1. Serve 2. Vegetable
3. Package 4. Prepare
5. Store 6. Cut
(a) 2 4 6 5 3 1 (b) 6 4 5 1 3 2
(c) 2 6 4 3 5 1 (d) 6 4 5 1 2 3

12. Arrange the following according to the stages in the life cycle of a butterfly:
A. Butterfly B. Caterpillar
C. Eggs D. Cocoon
(a) ABCD (b) CBDA
(c) CDBA (d) ADBC

13. Arrange the following in logical order :
1. Bihar 2. Universe
3. Patna 4. World
5. India
(a) 1, 5, 3, 2, 4 (b) 2, 1, 3, 5, 4
(c) 3, 1, 5, 4, 2 (d) 5, 4, 2, 1, 3

14. In the following questions, which one of the given responses would be a meaningful order of the following ?
(1) curd (2) grass (3) butter (4) milk
(5) cow
(a) 5, 2, 3, 4, 1 (b) 4, 2, 5, 3, 1
(c) 2, 5, 4, 3, 1 (d) 5, 2, 4, 1, 3

15. In the following questions, which one of the given responses would be a meaningful order of the following ?
1. Study 2. Job
3. Examination 4. Earn
5. Apply
(a) 1, 3, 2, 5, 4 (b) 1, 2, 3, 4, 5
(c) 1, 3, 5, 2, 4 (d) 1, 3, 5, 4, 2

DIRECTIONS (Qs. 16 - 25) : *In each of the following questions, arrange the given words in a meaningful sequence and then choose the most appropriate sequence from amongst the alternatives provided below each question :*

---

16. 1. Honey 2. Flower 3. Bee 4. Wax
(a) 1, 3, 4, 2 (b) 2, 1, 4, 3
(c) 2, 3, 1, 4 (d) 4, 3, 2, 1

17. 1. Police 2. Punishment
3. Crime 4. Justice
5. Judgement
(a) 1, 2, 3, 4, 5 (b) 3, 1, 2, 4, 5
(c) 3, 1, 4, 5, 2 (d) 5, 4, 3, 2, 1

18. 1. Book 2. Pulp 3. Timber 4. Jungle
5. Paper
(a) 2, 5, 1, 4, 3 (b) 3, 2, 5, 1, 4
(c) 4, 3, 2, 5, 1 (d) 5, 4, 3, 1, 2

19. 1. Leaf 2. Fruit 3. Stem 4. Root
5. Flower
(a) 3, 4, 5, 1, 2 (b) 4, 1, 3, 5, 2
(c) 4, 3, 1, 2, 5 (d) 4, 3, 1, 5, 2

20. 1. Travel 2. Destination
3. Payment 4. Berth/Seat number
5. Reservation
6. Availability of berth/seat for reservation
(a) 1, 2, 5, 4, 3, 6 (b) 2, 6, 3, 5, 4, 1
(c) 5, 3, 4, 1, 6, 2 (d) 6, 2, 5, 4, 3 ,1

21. 1. Heal 2. Shoulder 3. Skull 4. Neck
5. Knee 6. Chest 7. Thigh 8. Stomach
9. Face 10. Hand
(a) 2, 4, 7, 10,1, 5, 8, 9, 6, 3
(b) 3, 4, 7, 9, 2, 5, 8,10, 6, 1
(c) 4, 7, 10, 1, 9, 6, 3, 2, 5, 8
(d) 3, 9, 4, 2, 10, 6, 8, 7, 5, 1

22. 1. Rain 2. Monsoon
3. Rescue 4. Flood
5. Shelter 6. Relief
(a) 1, 2, 3, 4, 5, 6 (b) 1, 2, 4, 5, 3, 6
(c) 2, 1, 4, 3, 5, 6 (d) 4, 1, 2, 3, 5, 6

23. 1. Puberty 2. Adulthood
3. Childhood 4. Infancy
5. Adolescence
(a) 2, 4, 3, 1, 5 (b) 4, 3, 1, 2, 5
(c) 4, 3, 2, 1, 5 (d) 5, 2, 3, 4, 1

24. 1. District 2. Village
3. State 4. Town
5. City
(a) 2, 4, 1, 5, 3 (b) 2, 1, 4, 5, 3
(c) 5, 3, 2, 1, 4 (d) 2, 5, 3, 4, 1

25. 1. Never
2. Sometimes
3. Generally
4. Seldom
5. Always
(a) 5, 2, 1, 3, 4 (b) 5, 2, 4, 3, 1
(c) 5, 3, 2, 1, 4 (d) 5, 3, 2, 4, 1

Hints & Solutions

1. (b) Pastel → Pebble → Postal → Pragmatic → Protect.

2. (b) Dilled → Dillydallied → Dillydallies → Dillydally → Dillydallying.

3. (a) Decollete → Decorous → Desecrate → Desipicable → Destitute

4. (c) Flunchers → Flunching → Flunpites → Fluntlock → Fluntlocks

5. (a) Beep → Boxed → Boxer → Brain → Brand

6. (b) Temple → Trainef → Trainign → Troup → Tented

7. (c) Picture → Plane → Prayer → Predate → Prey

8. (c) Ambiguity → Ambiguous → Ambitions → Animal → Animation.

9. (c) Meaningful order of words:
1. Crawling
↓
2. Sitting
↓
4. Standing
↓
5. Walking
↓
3. Running

10. (c) Diagnosis
↓
Operation
↓
Post operational care
↓
Discharge

11. (c) Meaningful order of words:
2. Vegetable
↓
6. Cut
↓
4. Prepare
↓
3. Package
↓
5. Store
↓
1. Serve

12. (b) Arrangement according to the stages in the life cycle of a butterfly:
3. Eggs
↓
2. Caterpillar
↓
4. Cocon
↓
1. Butterfly

13. **(c)** **14.** **(d)** **15.** **(c)** **16.** **(c)** **17.** **(c)**
18. **(c)** **19.** **(d)** **20.** **(b)** **21.** **(d)** **22.** **(c)**
23. **(b)** **24.** **(a)** **25.** **(d)**

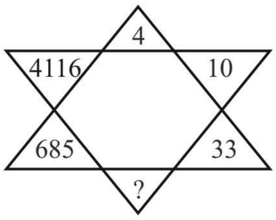
Chapter 15 Number Puzzle

INTRODUCTION

In this, the questions are based on different number. This type of problem having figure which follows a particular rule for its different number. We have then asked to find a missing number by using same rule.

TYPES OF NUMBER PUZZLE

PATTERN 1 : SINGLE FIGURE PATTERN

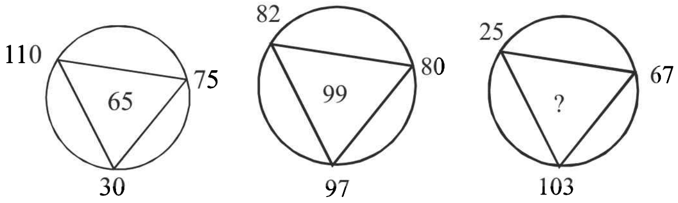


Here, a clockwise pattern is being followed. If we move clockwise we can see that numbers are increasing order. If we observe it more closely, we can crack the pattern which is

As, 4 × 2 + 2 = 10, 10 × 3 + 3 = 33

So, 33 × 4 + 4 = 136

PATTERN 2 : MULTIPLE FIGURE PATTERN



(i) (ii) (iii)

Here, a series of figure is given. Checking the pattern in the first two figures, we have to find missing number in the third. If we observe the first two figure properly, we get an idea of the pattern.

As, 110 + 30 – 75 = 65, 97 + 82 – 80 = 99

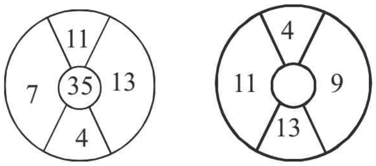
So, 103 + 25 – 67 = 61.

Shortcut Approach

- The first step is to observe the figure and check if there is any familiar pattern in the given question.
- The second step is finding out the pattern.
- There is no need to memorize any pattern.
- You need to understand the concept and decode the pattern.

DIRECTIONS : *(Sample problem)*

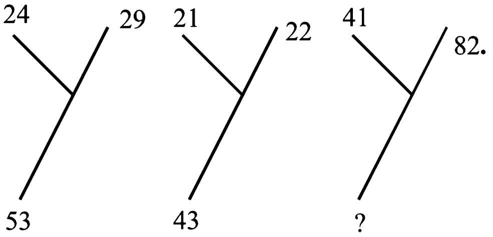
Example **1. Find the missing number in the following diagram:**



(a) 37 **(b) 39**
(c) 38 **(d) 33**

Sol. (a) 4 + 7 + 11 + 13 = 35
Similarly, 11 + 13 + 4 + 9 = 37.

Example **2.**



(a) 123 **(b) 121**
(c) 63 **(d) 33**

Sol. (a) 29 + 24 = 53
21 + 22 = 43
41 + 82 = 123

Example **3.**

2 5 7
6 15 21
10 19 ?

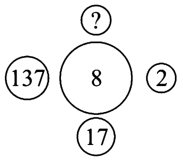
(a) 52 **(b) 48**
(c) 25 **(d) 28**

Sol. (c) 2 × 3 + 4 = 10
5 × 3 + 4 = 19
7 × 3 + 4 = 25

EXERCISE

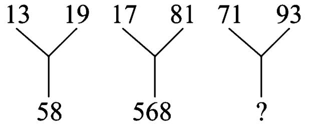
DIRECTIONS (Qs. 1-5): *Find the missing number from the given responses in each of the following questions.*

1.



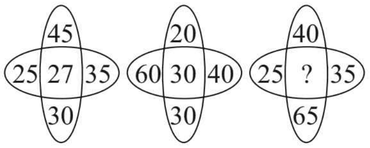
(a) 9107 (b) 97
(c) 907 (d) 1097

2.



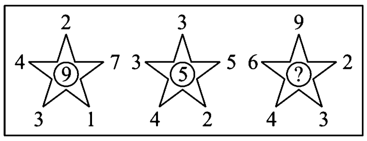
(a) 94 (b) 96
(c) 98 (d) 100

3.



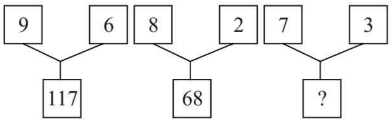
(a) 36 (b) 33 (c) 45 (d) 6

4.



(a) 4 (b) 7
(c) 10 (d) 11

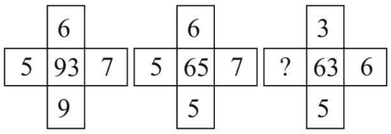
5.



(a) 48 (b) 52 (c) 55 (d) 58

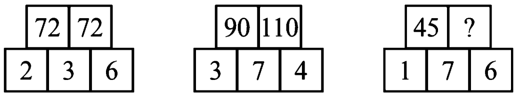
6. In the following question, select the number which can be placed at the sign of question mark (?) from the given alternatives.

Question figure:



(a) 11 (b) 6 (c) 8 (d) 16

7. In the following question, select the number which can be placed at the sign of question mark (?) from the given alternatives.



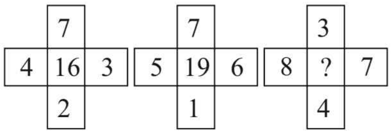
(a) 112 (b) 144 (c) 156 (d) 186

8. Select the missing number from the given responses

134	34	100
117	86	31
87	?	64

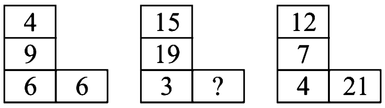
(a) 120 (b) 23 (c) 55 (d) 30

9. In the following question, select the number which can be placed at the sign of question mark (?) from the given alternatives.



(a) 20 (b) 21 (c) 22 (d) 24

10. In the following question, select the number which can be placed at the sign of question mark (?) from the given alternatives.



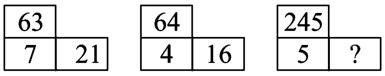
(a) 105 (b) 95 (c) 190 (d) 120

11. In the following question, select the number which can be placed at the sign of question mark (?) from the given alternatives.

1	$\frac{1}{2}$	$\frac{3}{2}$
2	$\frac{2}{3}$	$\frac{8}{3}$
3	?	$\frac{19}{5}$

(a) $\frac{1}{2}$ (b) – (c) $\frac{3}{4}$ (d) $\frac{4}{5}$

12. In the following question, select the number which can be placed at the sign of question mark (?) from the given alternatives.



(a) 45 (b) 30 (c) 40 (d) 35

DIRECTIONS (Qs. 13-25): *In each of the following question select the missing number from the given responses.*

13. Find the missing number from the given responses.

173	(24)	526
431	(18)	325
253	(?)	471

(a) 22 (b) 42 (c) 30 (d) 06

14. 2 7 9
7 3 4
9 8 ?
126 168 216
(a) 8 (b) 3 (c) 6 (d) 36

15.

2	3
4	5

= ?

(a) 14400 (b) 15600
(c) 23040 (d) 17400

16.

7	6	9
2	8	4
4	3	?
36	42	26

(a) 5 (b) 2 (c) 3 (d) 4

17.

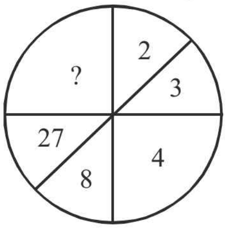
8	7	6
8	7	6
88	77	?
5632	3773	3132

(a) 66 (b) 87 (c) 78 (d) 76

18. 28 35 32
7 5 8
$\frac{4}{8}$ $\frac{3}{10}$ $\frac{?}{9}$
(a) 3 (b) 5 (c) 6 (d) 7

19. ? 27
9 5
(a) 14 (b) 15 (c) 12 (d) 13

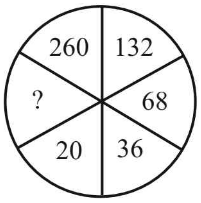
20. Select the missing number from the given responses.



(a) 56 (b) 49 (c) 45 (d) 64

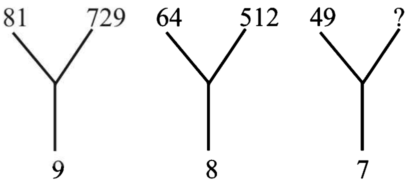
21. 22 46 24
27 58 31
32 68 ?
(a) 46 (b) 36 (c) 32 (d) 38

22. Find the missing number from the given responses.



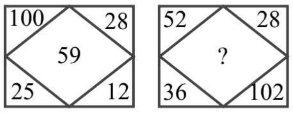
(a) 12 (b) 10 (c) 9 (d) 8

23.



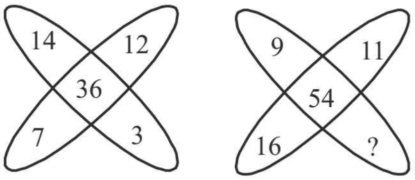
(a) 444 (b) 515 (c) 343 (d) 373

24.



(a) 50 (b) 90 (c) 218 (d) 64

25.

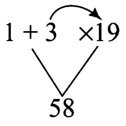


(a) 12 (b) 17 (c) 18 (d) 16

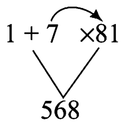
Hints & Solutions

1. **(d)** 2 × 8 + 1 = 17
17 × 8 + 1 = 137
137 × 8 + 1 = **1097**

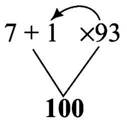
2. **(d)** In first figure



19 × 3 + 1 = 58
In 2nd figure



81 × 7 + 1 = 568
In 3rd figure



93 × 1 + 7 = **100**

3. **(b)** In first figure $= \dfrac{25+45+35+30}{5} = 27$

In 2nd figure $= \dfrac{20+40+30+60}{5} = 30$

In 3rd figure $= \dfrac{25+40+35+65}{5} = 33$

4. **(c)** In first figure
$\Rightarrow\ 4 + 2 + 7 - (3 + 1) = 9$
In 2nd figure
$\Rightarrow\ (3 + 3 + 5) - (4 + 2) = 5$
In 3rd figure
$\Rightarrow\ (6 + 9 + 2) - (4 + 3) = \mathbf{10}$

5. **(d)** $9^2 + 6^2 = 117$
$8^2 + 2^2 = 68$
Similarly,
$7^2 + 3^2 = \mathbf{58}$

6. **(a)** In first figure: $6 \times 5 + 7 \times 9 = 93$
In second figure: $6 \times 5 + 7 \times 5 = 65$
In third figure: $11 \times 3 + 6 \times 5 = 63$

7. **(c)** $(2 + 3) \times 4 = 20$
$(3 + 6) \times 8 = 72$
$(3 + 7) \times 9 = 90$
$(7 + 6) \times 12 = \mathbf{156}$

8. **(b)** In Ist row:
$134 - 100 = 34$
and in IInd row:
$117 - 31 = 86$
Similarly, in IIIrd row:
$87 - 64 = \mathbf{23}$

9. **(c)** In figure I:
$7 + 4 + 3 + 2 = 16$
In figure II:
$7 + 5 + 6 + 1 = 19$
In figure III:
$3 + 8 + 4 + 7 = 22$

10. **(b)** In figure Ist
$4 \times 9 = 36;\ 6 \times 6 = 36$
In figure IIIrd
$12 \times 7 = 84,\ 4 \times 21 = 84$
In figure IInd
$15 \times 19 = 285,\ 3 \times ? = 285$ **?**
$= \mathbf{95}$

11. **(d)** $\left(\dfrac{3}{2} - 1\right) = \dfrac{1}{2} \Rightarrow$ 1st row
$\left(\dfrac{8}{3} - 2\right) = \dfrac{2}{3} \Rightarrow$ 2nd row
$\left(\dfrac{19}{5} - 3\right) = \dfrac{\mathbf{4}}{\mathbf{5}} \Rightarrow$ 3rd row

12. **(d)** $7 \xrightarrow{\times 3} 21 \xrightarrow{\times 3} 63$
$\mathbf{4} \xrightarrow{\times 4} \mathbf{16} \xrightarrow{\times 3} \mathbf{64}$
$\mathbf{5} \xrightarrow{\times 7} \mathbf{35} \xrightarrow{\times 7} \mathbf{245}$

13. **(a)** $1 + 7 + 3 + 5 + 2 + 6 = 24$
$4 + 3 + 1 + 3 + 2 + 5 = 18$
Therefore,
$2 + 5 + 3 + 4 + 7 + 1 = \boxed{22}$

14. **(c)** Columnwise
I. $2 \times 7 \times 9 = 126$ II. $7 \times 3 \times 8 = 168$
III. $9 \times 4 \times ? = 216$
$\therefore\ \mathbf{?} = \dfrac{216}{9 \times 4} = \boxed{6}$

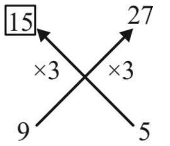
15. **(a)** $2 \times 3 \times 5 \times 4 = 120$
$120 \times 120 = 14400$

16. **(b)** First column $(7 + 2) \times 4 = 36$
Second Column $(6 + 8) \times 3 = 42$
Third Column $(9 + 4) \times ? = 26$
$\Rightarrow 13 \times ? = 26\ \therefore ? = \dfrac{26}{13} = 2$

17. **(b)** $8 \times 8 \times 88 = 5632$
$7 \times 7 \times 77 = 3773$
Similarly, $6 \times 6 \times ? = 3132$
$\therefore\ ? = \dfrac{3132}{6 \times 6} = \boxed{87}$

18. **(b)** $28 \div 7 + 4 = 4 + 4 = 8$
$35 \div 5 + 3 = 7 + 3 = 10$
Similarly, $32 \div 8 + ? = 9$
$\Rightarrow \mathbf{4} + ? = 9$
$\Rightarrow \mathbf{?} = 9 - 4 = \boxed{5}$

19. **(b)**



20. **(d)** 23 = 8; 33 = 27
$\therefore$ **43** = 64

21. **(b)** $46 - 22 = 24,\ 58 - 27 = 31$
$68 - 32 = \boxed{36}$

22. **(a)**

$$\boxed{12} \xrightarrow{+8} 20 \xrightarrow{+16} 36 \xrightarrow{+32} 68 \xrightarrow{+64} 132 \xrightarrow{128} 260$$

23. **(c)** $81 \times 9 = 729,\ 64 \times 8 = 512$
$49 \times 7 = \boxed{343}$

24. **(b)** $(100 + 12) - (28 + 25) = 59$
Similarly,
$(102 + 52) - (36 + 28) = 90$

25. **(c)** $(36) - (14 + 12 + 7) = 3$
$(54) - (9 + 11 + 16) = \boxed{18}$

Chapter 16 Venn Diagram

INTRODUCTION

Venn diagrams are pictorial way to represent the set of article. There are different regions which needs proper understanding for solving problems based on given Venn diagrams.

Types of Venn Diagram

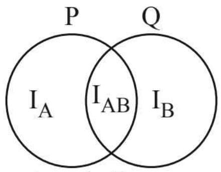
Analysis Based Venn Diagram
Identification of Relation Based Venn Diagram

(i) Analysis Based Venn Diagram-

In this type, generally a venn diagram comprising of different geometrical figures is given. Each geometrical figure in the diagram represents a certain class.

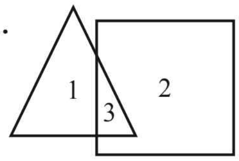
Case - I:

Two articles:



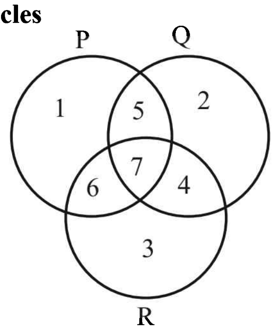
Here, I_A represents only P
I_B represents only Q
II_{AB} represents P and Q

Example **1.**



△– Represents student passed in English
□ – Represents student passed in Reasoning.
1 – Represents student passed in English only
2 – Represents student passed in Reasoning only
3 – Represents student passed in both English Reasoning both.

Case: - II Three articles

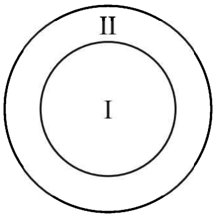


1 – Represents P only
2 – Represents Q only
3 – Represents R only
4 – Represents Q and R (not P)
5 – Represents P and Q (not R)
6 – Represents P and R (not Q)
7 – Represents P, Q and R

(ii) Identification of Relation Based Venn Diagram -

In this type, some standard representations for groups of three items with different cases of venn diagrams are given.

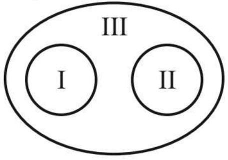
- When one class of items is completely included in the another class of item then it is represented by the given diagram



Example **2.**

I – Mango
II – Fruit
Here, all mango are fruit.

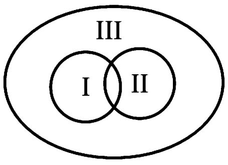
- If two classes of item are completely different from each other but they all are completely included in third class then the relationship is represent of the diagram.



Example **3.**

I – Represent potato
II – Represent onion
III – Represent vegetable

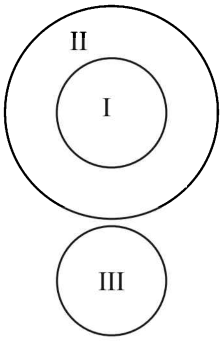
- If two group of items having some common relationship and both of them are all included in third class then the relationship is represented by the diagram.



Example **4. Brother, Father, Male.**

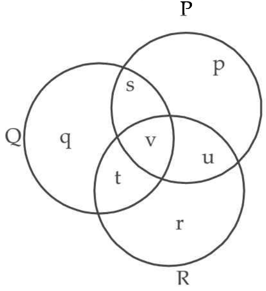
I → Brother
II → Father
III → Male
Some Brother may be Father and all are male.

- When one class of item is completely included in another group while third is not related to both of them then such condition are diagrammatically represented by



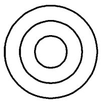
EXERCISE

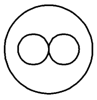
1. In the given diagram, circle P represents teachers who can teach Physics, circle Q represents teachers who can teach Chemistry and circle R represents those who can teach Mathematics. Among these, which represents teachers who can teach Physics and Mathematics but not Chemistry, is

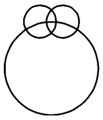


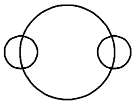
(a) v (b) u (c) s (d) t

2. Which one of the following Venn diagrams correctly illustrates the relationship among the classes: Carrot, Food, Vegetable?

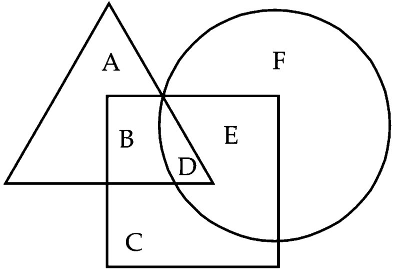
(a) 

(b) 

(c) 

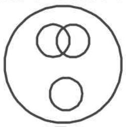
(d) 

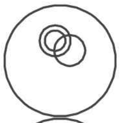
3. In the given figure, the triangle represents girls, the square represents sports persons and the circle represents coaches. The portion in the figure which represents girls who are sports persons but not coaches is the one labelled, as

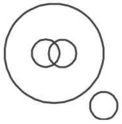


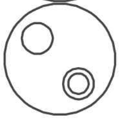
(a) A (b) B
(c) D (d) E

4. In a dinner party both fish and meat were served. Some took only fish and some only meat. There were some vegetarians who did not accept either. The rest accepted both fish and meat Which one of the following logic diagrams correctly reflects the above situation?

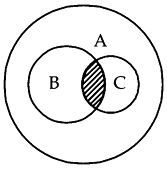
(a) 

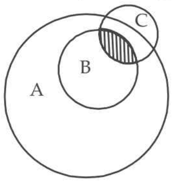
(b) 

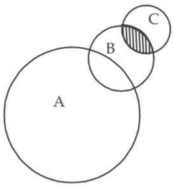
(c) 

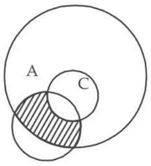
(d) 

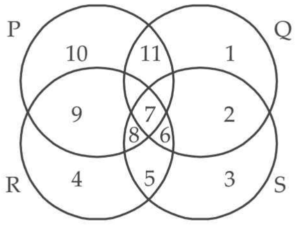
5. Most guitarists are beared males. If *A* represents all males, *B* represents beared males and *C* represents all male guitarists, then the correct diagram for their relations (shaded portion) is

(a) 

(b) 

(c) 

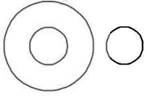
(d) 

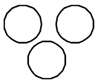
6. 

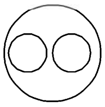
In the above figure, circle P represents hardworking people, circle Q represents intelligent people, circle R represents truthful people, and circle S represents honest people. Which region represents the people who are intelligent, honest and truthful but not hardworking?

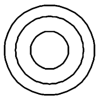
(a) 6 (b) 7 (c) 8 (d) 11

7. Which of the following diagrams indicates the best relationship between Page, Chapter and Book ?

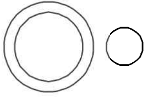
(a) 

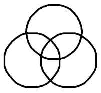
(b) 

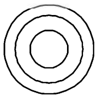
(c) 

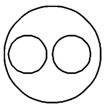
(d) 

8. Which of the following diagrams best indicates the relationship between Teacher, Writer and Musician ?

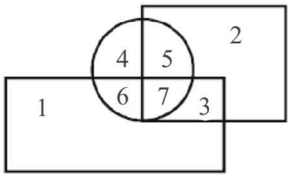
(a) 

(b) 

(c) 

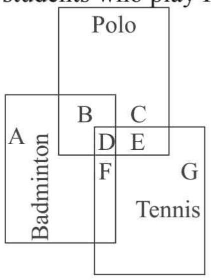
(d) 

9. In the following diagram, Square represents Doctors, Circle represents Players and Rectangle represents Artists. Which number represents Doors, Circle represents Players and Rectangle represents Artists. Which number represents those Doctors who are players as well as Artists ?



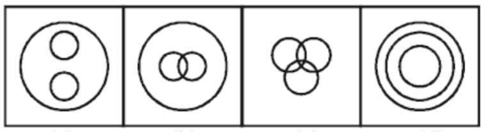
(a) 7
(b) 2
(c) 3
(d) 6

10. In the diagram given below which letter (s) represents the students who play Polo, as well as Badminton and Tennis.



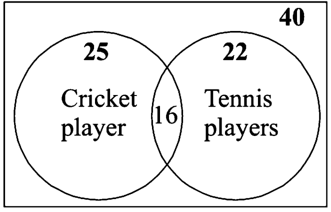
(a) D + E + F
(b) G
(c) D
(d) A + C + F

11. Which of the following diagram indicates the best relation between Collage Students, Singers and dancers ?



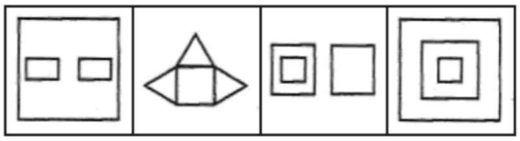
(a) (b) (c) (d)

12. Find out the number of people who do not play any game



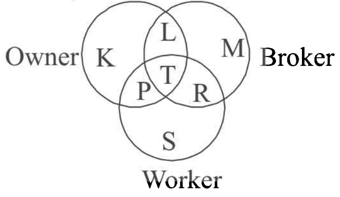
(a) 11 (b) 13 (c) 9 (d) 15

13. Which of the following diagrams indicate the best relation between North America, United States of America and New York ?



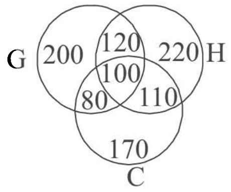
(a) (b) (c) (d)

14. The diagram given below represents owner, broker and worker. Identify the region which represents all the three i.e. owner, broker, worker:



(a) L
(b) T
(c) P
(d) R

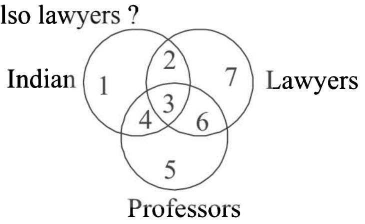
15. A result of a survey of 1000 students with respect to their knowledge of History (H), Geography (G) and Civics (C) is given below :



What is the ratio of those who know all the three subjects to those who know only Civics?

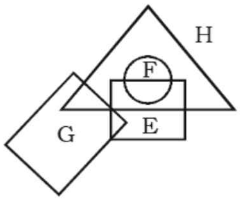
(a) 1/9
(b) 1/10
(c) 5/27
(d) 10/17

16. Find out the number that shows those Indian Professors who are also lawyers ?



(a) 2 (b) 3 (c) 4 (d) 6

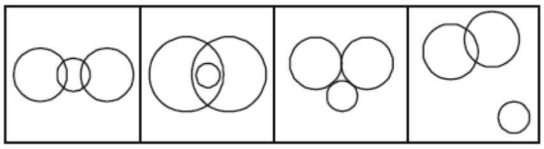
17. The triangle stands for Hindi-speaking people, circle for French-speaking, square for English-speaking and rectangle for German-speaking people.



In the above diagram, which one of the following statements is not true?

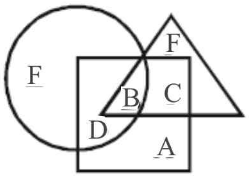
(a) German-speaking people cannot speak French.
(b) No French-speaking people can speak German.
(c) Some Hindi-speaking people can speak French, English and German as well.
(d) None of these

18. If animals that live on land and the animals that live in water are represented by two big circles and animals that live both in water and on land are represented by small circle. How the combination of these three can best be represented ?



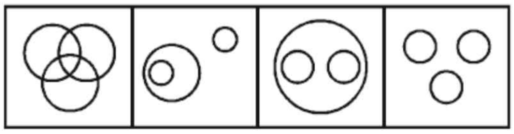
(a) (b) (c) (d)

19. Triangle represents school teachers, Square represents married persons. Circle represents persons living in joint families Married persons living in joint families but not working as school teachers are represented by



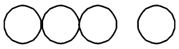
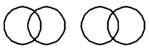
(a) F (b) A
(c) C (d) D

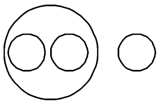
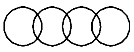
20. Find out the figure which best represents the relationship among Garden, Rose and Jasmine.



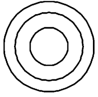
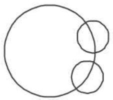
(a) (b) (c) (d)

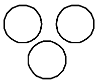
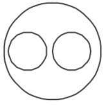
21. Which of the following diagrams indicates the best relation between INSAT, EDUSAT, ARYABHATTA and ISRO ?

(a)  (b) 

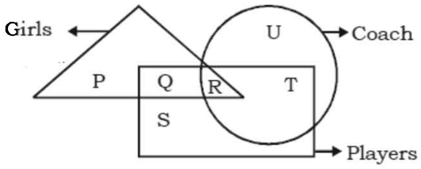
(c)  (d) 

22. Which of the following diagrams indicates the best relation among Gold, Metal and Zinc ?

(a)  (b) 

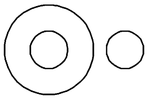
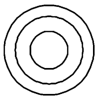
(c)  (d) 

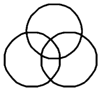
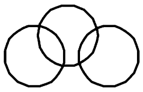
23. In the following figure triangle represents 'girls', square players and circle-coach. Which part of the diagram represents the girls who are players but not coach?



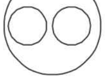
(a) P
(b) Q
(c) R
(d) S

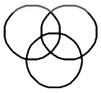
24. Which of the following diagrams indicates the best relation between Professors, Doctors and Men ?

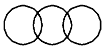
(a)  (b) 

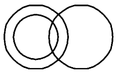
(c)  (d) 

25. Which of the following venn diagrams shows the relationship among women, widows and teachers?

(a) 

(b) 

(c) 

(d) 

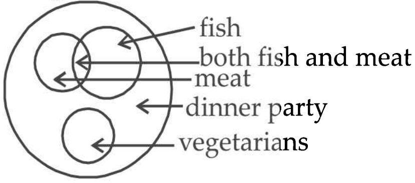
Hints & Solutions

1. **(b)** It is the common area between P and R but not including Q, i.e., u.

2. **(a)** Both carrot and vegetable come under the food category, while carrot comes under vegetable category.

3. **(b)** It is the common area between the triangle and the square, but excluding the circle, i.e., B.

4. **(a)** The given relation can be shown below :



5. **(a)** As all species comes under the male category, so *B* and *C* comes under *A*. Some guitarists are beared, so *B* and *C* have some common elements between them.

6. **(a)** The region (6) represents, the people who are intelligent, honest, truthful but not hardworking.

7. **(d)**

8. **(b)**

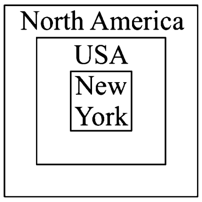
9. **(a)**

10. **(c)**

11. **(c)**

12. **(c)** People who don't play any game
= 40 – (25 + 22 – 16)
= 40 – 31 = 9

13. **(d)**



14. **(b)** The region which represents all three i.e., owner, broker and worker is 'T'.

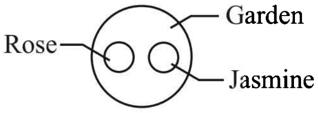
15. **(d)** Number of students who know all three subjects = 100
Number of students who know only civics = 170
$\therefore$ Required Ratio $= \frac{100}{170} = \frac{10}{17}$

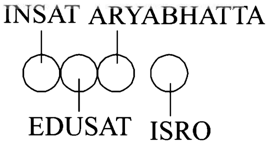
16. **(b)** We can observe from the given diagram that number 3 represents Indian professors who are also lawyers.

17. **(d)** 18. **(b)**

19. **(d)** D, represents, who are married and living in joint families but not teachers.

20. **(c)**





21. **(a)**

22. **(d)** Gold and Zinc are different from each other but both are metal.

23. **(b)** Q part of the figure represents those girls who are players but not coach.

24. **(c)** Some doctors may be professors and vice-versa.
Some professors may be men and vice-versa.
Some doctors may be men and vice-versa.
Some doctors may be men and professors as well.

25. **(d)**

Chapter 17

Mathematical Operation

Under this type of problem, usually mathematical symbol are converted into another form by either interchanging the symbol or using different symbol in place of usual symbol and then calculate the equation according to the given condition.

This topic deals with the questions on the basic fundamental operations – addition, subtraction, multiplication and division.

There are many types of questions covered in this chapter are as follows:

(1) Symbol Substitution
(2) Interchange of Sign and Numbers
(3) Balancing the Equation
(4) Trick Based Mathematical Operations

(1) Symbol Substitution:

Example 1. If '+' stands for division, '×' stands for addition, '–' stands for multiplication, and '÷' stands for subtraction, then which of the following equation is correct?

(a) 36 × 6 + 7 ÷ 2 – 6 = 20 **(b) 36 + 6 – 3 × 5 ÷ 3 = 24**
(c) 36 ÷ 6 + 3 × 5 – 3 = 45 **(d) 36 – 6 + 3 × 5 ÷ 3 = 74**

Sol. (d) 36 – 6 + 3 × 5 ÷ 3 ⇒ 36 × 6 ÷ 3 + 5 – 3
⇒ 36 × 2 + 5 – 3 = 74

Example 2. If P denotes '+', Q denotes '–', R denotes '×' and S denotes '÷' then, which of the following statement is correct?

(a) 16 R 12 P 49 S 7 Q 9 = 200
(b) 32 S 8 R 9 = 160 Q 12 R 12
(c) 8 R 8 P 8 S 8 Q 8 = 57
(d) 36 R 4 S 8 Q 7 P 4 = 10

Sol. (c) 8 R 8 P 8 S 8 Q 8

$= 8 \times 8 + 8 \div 8 - 8 = 8 \times 8 + \frac{8}{8} - 8$
$= 64 + 1 - 8 = 57$

(2) Interchange of Sign and Numbers :

Example 3. Given interchange : sign '+' and '–'and numbers 5 and 8. Which of the following is correct?

(a) 82 – 35 + 55 = 2 **(b) 82 – 35 + 55 = 102**
(c) 85 – 38 + 85 = 132 **(d) 52 – 35 + 55 = 72**

Sol. (a) 52 + 38 – 88 = 2

(3) Balancing the Equation:

In this type of questions, the signs in one of the alternatives are required to fill up the blank spaces in order to balance the given equation

Example 4. Choose the correct option in order to balance the following equation.

24 6 12 16 = 0

(a) –, + and + **(b) ÷, + and ÷**
(c) –, – and – **(d) ÷, + and –**

Sol. (d) From option (d):
24 ÷ 6 + 12 – 16 = 0
⇒ 4 + 12 – 16 = 0
16 – 16 = 0
LHS = RHS
Hence, option (d) is correct.

(4) Trick Based Mathematical Operations:

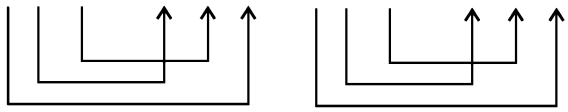
The questions are based on simple mathematical operations that do not follow a universal rule. These questions can be based on many types of patterns.

Example 5. If 9 × 5 × 2 = 5 2 9 and 4 × 7 × 2 = 724, then 3 × 9 × 8 = ?

(a) 983 **(b) 839** **(c) 938** **(d) 893**

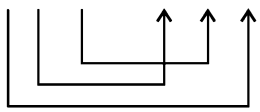
Sol. (a) According to question,

9 ×5 ×2 = 5 2 9 and 4 ×7 ×2 = 7 2 4



Similarly,

3 ×9 ×8 = 9 8 3



= 983

EXERCISE

1. If ÷ means +, – means ÷, × means – and + means ×, then

$$\frac{(36\times4)|8\times4}{4+8\times2+16\div1}=?$$

(a) 0 (b) 8 (c) 12 (d) 16

2. If *P* means 'division', *T* means 'addition', *M* means 'subtraction' and *D* means 'multiplication', then what will be the value of the expression

12*M* 12*S* 28*P* 7*T* 35 = ?

(a) –30 (b) –15 (c) 15 (d) 45
(e) None of these

3. If 'when' means '×', 'you' means '÷' 'come' means '–' and 'will' means '+', then what will be the value of

"8 when 12 will 16 you 2 come 10" = ?

(a) 45 (b) 94 (c) 96 (d) 112
(e) None of these

4. If '+' stands for 'division', '÷' stands for 'multiplication', '×' stands for 'subtraction' and '–' stands for 'addition', which one of the following is correct?

(a) 18 + 6 × 7 + 5 – 2 = 22 (b) 18 × 6 + 7 ÷ 5 – 2=16
(c) 18 + 6 – 7 + 5 × 2 = 20 (d) 18 + 6 ÷ 7 × 5 – 2 = 18

5. If *P* denotes +, *Q* denotes –, *R* denotes × and *S* denotes ÷, which of the following statement is correct?

(a) 36 *R* 4 *S* 8 *Q* 7 *P* 4 = 10
(b) 16 *R* 12 *P* 49 *S* 7 *Q* 9 = 200
(c) 32 *S* 8 *R* 9 = 160 *Q* 12 R 12
(d) 8 *R* 8 *P* 8 *S* 8 *Q* 8 = 57

6. If *L* denotes ÷, *M* denotes ×, *P* denotes + and *Q* denotes –, then which of the following statement is true?

(a) $32\ P\ 8\ L\ 16\ Q\ 4=\frac{3}{2}$

(b) $6\ M\ 18\ Q\ 26\ L\ 13\ P\ L=\frac{173}{13}$

(c) $11\ M\ 34\ L\ 17\ Q\ 8\ L\ 3=\frac{38}{3}$

(d) 9 *P* 9 *L* 9 *Q* 9 *M* 9 = –71

7. If '÷' stands for 'greater than', '×' stands for 'addition', '+' stands for 'division', '–' stands for 'equal to', '>' stands for 'multiplication', '=' stands for 'less than' and '<' stands for 'minus', then which of the following alternative is correct?

(a) 5 > 2 < 1 – 3 × 4 × 1 (b) 5 < 2 × 1 + 3 > 4 × 1
(c) 5 > 2 × 1 – 3 > 4 < 1 (d) 5 + 2 × 1 = 3 + 4 > 1

8. If ÷ implies =, × implies <, + implies >, – implies ×, > implies ÷, < implies +, = implies –, identify the correct expression.

(a) 1 – 3 > 2 + 1 – 5 = 3 – 1 < 2
(b) 1 – 3 > 2 + 1 × 5 = 3 × 1 > 2
(c) 1 × 3 > 2 + 1 × 5 × 3 – 1 > 2
(d) 1 – 3 > 2 + 1 × 5 + 3 – 1 > 2

9. If '–' stands for division '+' stands for subtraction, '÷' stands for multiplication, '×' stands for addition, then which one of the following equations is correct?

(a) 70 – 2 + 4 ÷ 5 × 6 = 44
(b) 70 – 2 + 4 ÷ 5 × 6 = 21
(c) 70 – 2 + 4 ÷ 5 × 6 = 341
(d) 70 – 2 + 4 ÷ 5 × 6 = 36

10. If *T* means '×', *U* means '–', *V* means '÷' and W means '+', then what will be the value of the following expression:

(50 *V* 2) *W* (28 *T* 4)

(a) 142 (b) 158 (c) 137 (d) 163

11. If – stands for addition, ÷ for multiplication, × for subtraction, and + for division, then which of the following is correct?

(a) 25 – 15 + 5 ÷ 4 × 16 = 21
(b) 25 + 11 – 4 ÷ 10 × 6 = 20
(c) 25 × 12 – 14 ÷ 4 + 6 = 16
(d) 25 – 12 + 14 ÷ 2 × 4 = 15

12. If + means ÷, – means ×, × means + and ÷ means –, then which of the alternatives is correct?

(a) 5 × 8 – 5 + 5 ÷ 1 = 12
(b) 55 – 2 + 10 ÷ 1 × 5 = 16
(c) 38 ÷ 10 – 5 + 7 × 8 = 25
(d) 10 – 12 + 2 ÷ 30 × 1 = 10

13. If * stands for +; # stands for –; @ stands for × and % stands for ÷, then which of the following statement is correct?

(a) 256% 16 @ 5 # 28 = 52
(b) 256 # 16% 5 # 28 = 120
(c) 256 @ 5 % 16 * 28 = 408
(d) 256 # 16 @ 5 % 28 = 80

14. If *P* denotes '÷', *Q* denotes '×', *R* denotes '+' and *S* denotes '–' then ?

16 *Q* 12 *P* 6 *R* 5 *S* 4 = ?

(a) 31 (b) 32 (c) 33 (d) 30

15. If × stands for ÷, ÷ stands for +, + stands for –, and – stands for ×, then what is the value of

(30 + 20) – 5(7 ÷ 3) × 25

(a) 100 (b) 10 (c) 20 (d) 25

16. In a certain code 0, 1, 2.......9 is coded as *a*, *b*, *c*......., *j*

baf* ÷ *bf* × *d

(a) *cb* (b) *d* (c) *df* (d) *be*

17. What will be the correct mathematical signs that can be inserted in the following?

4_6_2_4_8 = 16

(a) – × + ÷ (b) ÷ + × – (c) + ÷ – × (d) × ÷ – +

18. Correct the following equation by interchanging the two signs and two numbers.

7 × 6 + 5 – 4 = 33

(a) –, × and 4, 5 (b) ×, + and 4, 5
(c) +, – and 5, 6 (d) ×, – and 5, 6

19. If "–" means "added to", "+" means "divided by", "÷" means "multiplied by", "×" means "subtracted from", then

13 + 12 × 9 ÷ 3 – 6 = ?

(a) –117/11 (b) 117/11 (c) –237/12 (d) –239/12

20. In a certain coded language, '+' represents '×', '–' represents '+', '×' represent '÷' and '÷' represents '–'. What is the answer to the following question?

9 + 3 – 72 × 6 ÷ 3 = ?

(a) 46 (b) 21 (c) 9 (d) 36

Hints & Solutions

1. (a)

$\div \rightarrow +$	$- \rightarrow \div$
$\times \rightarrow -$	$+ \rightarrow \times$

$$\frac{(36\times4)-8\times4}{4+8\times2+16\div1}=?$$

Using the correct symbols,

$$\text{we have} = \frac{(36-4)\div8-4}{4\times8-2\times16+1} = \frac{32\div8-4}{32-32+1} = \frac{4-4}{0+1} = 0$$

2. (e)

$P \rightarrow \div$	$T \rightarrow +$
$M \rightarrow -$	$D \rightarrow \times$

$12\ M\ 12\ D\ 28\ P\ 7\ T\ 15 = ?$
Using the correct symbols, we have
$= 12 - 12 \times 28 \div 7 + 15 = 12 - 12 \times 4 + 15$
$= 12 - 48 + 15 = 27 - 48 = -21$

3. (b)
When → ×
You → ÷
Come → –
Will → +
8 When 12 Will 16 You 2 Come 10 = ?
Using the correct symbols, we have
$= 8 \times 12 + 16 \div 2 - 10$
$= 96 + 8 - 10$
$= 104 - 10 = 94$

4. (d)

$+ \rightarrow \div$	$\div \rightarrow \times$
$\times \rightarrow -$	$- \rightarrow +$

$18 + 6 \div 7 \times 5 - 2 = 18$
Using the proper notations in (d), we get the statement as:
$18 \div 6 \times 7 - 5 + 2 = 18$
$3 \times 7 - 5 + 2 = 18$
$21 - 5 + 2 = 18$
$22 - 5 = 18$
$18 = 18$

5. (d)

$P \rightarrow +$	$Q \rightarrow -$
$R \rightarrow \times$	$S \rightarrow \div$

$8\ R\ 8\ P\ 8\ S\ 8\ Q\ 8 = 57$
Using the proper notations in (d), we get the statement as:
$8 \times 8 + 8 \div 8 - 8 = 57$
$8 \times 8 + 1 - 8 = 57$
$64 + 1 - 8 = 57$
$65 - 8 = 57$
$57 = 57$

6. (d)

$L \rightarrow \div$	$M \rightarrow \times$
$P \rightarrow +$	$Q \rightarrow -$

$9\,P\,9\,L\,9\,Q\,9\,M\,9 = -71$
Using the proper nations in (d), we get the statement as:
$9 + 9 \div 9 - 9 \times 9 = -71$
$9 + 1 - 9 \times 9 = -71$
$9 + 1 - 81 = -71$
$10 - 81 = -71$
$-71 = -71$

7. (c)

$\div \rightarrow >$	$\times \rightarrow +$
$+ \rightarrow \div$	$- \rightarrow =$
$> \rightarrow \times$	$= \rightarrow <$
$< \rightarrow -$	

$5 > 2 \times 1 - 3 > 4 < 1$
Using the proper notations in (c), we get the statement as:
$5 \times 2 + 1 = 3 \times 4 - 1$
$10 + 1 = 12 - 1$
$11 = 11$

8. (d)

$\div \rightarrow =$	$\times \rightarrow <$
$+ \rightarrow >$	$- \rightarrow \times$
$> \rightarrow \div$	$< \rightarrow +$
$= \rightarrow -$	

$1 - 3 > 2 + 1 \times 5 + 3 - 1 > 2$
Using the proper notations in (d), we get the statement as:
$1 \times 3 \div 2 > 1 < 5 > 3 \times 1 \div 2$

$$\frac{3}{2} > 1 < 5 > \frac{3}{2}$$

9. (b)

$- \Rightarrow \div$	$+ \Rightarrow -$
$\div \Rightarrow \times$	$\times \Rightarrow +$

Option (a)
$70 - 2 + 4 \div 5 \times 6 = 44$
$\Rightarrow\quad 70 \div 2 - 4 \times 5 + 6 = 44$
$\Rightarrow\quad 35 - 20 + 6 \neq 44$
Option (b)
$70 - 2 + 4 \div 5 \times 6 = 21$
$70 \div 2 - 4 \times 5 + 6 = 21$
$\Rightarrow\quad 35 - 20 + 6 = 21$
$\Rightarrow\quad 41 - 20 = 21$

10. (c)

$T \Rightarrow \times$	$U \Rightarrow -$
$V \Rightarrow \div$	$W \Rightarrow +$

(50 V 2) W (28 T 4)
$\Rightarrow\quad (50 \div 2) + (28 \times 4)$
$\Rightarrow\quad 25 + 112 = 137$

11. (a)

$- \Rightarrow +$	$\div \Rightarrow \times$
$\times \Rightarrow -$	$+ \Rightarrow \div$

Option (a)
$25 - 15 + 5 \div 4 \times 16 = 21$
$\Rightarrow\quad 25 + 15 \div 5 \times 4 - 16 = 21$
$\Rightarrow\quad 25 + 3 \times 4 - 16 = 21$
$\Rightarrow\quad 25 + 12 - 16 = 21$
$\Rightarrow\quad 37 - 16 = 21$
Option (b)
$25 + 11 + 4 \div 10 \times 6 = 20$
$\Rightarrow\quad 25 \div 11 + 4 \times 10 - 6 = 20$

$$\Rightarrow\quad \frac{25}{11} + 40 - 6 \neq 20$$

Option (c)

$25 \times 12 - 14 \div 4 + 6 = 16$

$\Rightarrow\ 25 - 12 + 14 \times \frac{}{} = 16$

$\Rightarrow\ 25 - 12 + \frac{28}{3} \neq 16$

Option (d)

$25 - 12 + 14 \div 2 \times 4 = 15$

$\Rightarrow\ 25 + 12 \div 14 \times 2 - 4 = 15$

$\Rightarrow\ 25 + \frac{6}{7} \times 2 - 4 \neq 15$

12. (a)

$+ \Rightarrow \div$	$- \Rightarrow \times$
$\times \Rightarrow +$	$\div \Rightarrow -$

Option (a)

$5 \times 8 - 5 + 5 \div 1 = 12$

$\Rightarrow\ 5 + 8 \times 5 \div 5 - 1 = 12$

$\Rightarrow\ 5 + 8 \times 1 - 1 = 12$

$\Rightarrow\ 5 + 8 - 1 = 12$

Option (b)

$55 - 2 + 10 \div 1 \times 5 = 16$

$\Rightarrow\ 55 \times 2 \div 10 - 1 + 5 = 16$

$\Rightarrow\ \frac{55 \times 2}{10} - 1 + 5 = 16$

$\Rightarrow\ 11 - 1 + 5 \neq 16$

Option (c)

$38 \div 10 - 5 + 7 \times 8 = 25$

$\Rightarrow\ 38 - 10 \times 5 \div 7 + 8 = 25$

$\Rightarrow\ 38 - \frac{10 \times 5}{7} + 8 = 25$

$\Rightarrow\ 38 - \frac{50}{7} + 8 \neq 25$

Option (d)

$10 - 12 + 2 \div 30 \times 1 = 10$

$\Rightarrow\ 10 \times 12 \div 2 - 30 + 1 = 10$

$\Rightarrow\ 10 \times 6 - 3 + 1 = 10$

$\Rightarrow\ 60 - 30 + 1 \neq 10$

13. (a)

$* \Rightarrow +$	$\# \Rightarrow -$
$@ \Rightarrow \times$	$\% \Rightarrow \div$

Option (a)

$256\% \ 16 \ @ \ 5 \ \# \ 28 = 52$

$\Rightarrow\ 256 \div 16 \times 5 - 28 = 52$

$\Rightarrow\ 16 \times 5 - 28 = 52$

$\Rightarrow\ 80 - 28 = 52$

Option (b)

$256\# \ 16\% \ 5\# \ 28 = 120$

$\Rightarrow\ 256 - 16 \div 5 - 28 = 120$

$\Rightarrow\ 256 - \frac{16}{5} - 28 \neq 120$

Option (c)

$256 \ @ \ 5 \ \% \ 16 * 28 = 408$

$\Rightarrow\ 256 \times 5 \div 16 + 28 = 408$

$\Rightarrow\ \frac{256 \times 5}{16} + 28 \neq 408$

Option (d)

$256 \ \# \ 16 \ @ \ 5 \ \% \ 28 = 80$

$\Rightarrow\ 256 - 16 + 5 \div 28 = 80$

$\Rightarrow\ 256 - 16 + \frac{5}{28} \neq 80$

14. (c)

$P \Rightarrow \div$	$Q \Rightarrow \times$
$R \Rightarrow +$	$S \Rightarrow -$

$16 \ Q \ 12 \ P \ 6 \ R \ 5 \ S \ 4 = ?$

$= 16 \times 12 \div 6 + 5 - 4$

$= 16 \times 2 + 5 - 4 = 32 + 5 - 4$

$= 37 - 4 = 33$

15. (c)

$\times \Rightarrow \div$	$\div \Rightarrow +$
$+ \Rightarrow -$	$- \Rightarrow \times$

$(30 + 20) - 5\ (7 \times 3) \times 25 = ?$

$= (30 - 20) \times 5\ (7 + 3) \div 25$

$= 10 \times 5 \times 10 \div 25 = 20$

16. (a) $b\ af \div bf \times d$

$\Rightarrow\ 105 \div 15 \times 3$

$\Rightarrow\ 7 \times 3 = 21 \Rightarrow cb$

17. (d) $4 \times 6 \div 2 - 4 + 8 = 16$

$\Rightarrow\ 4 \times 3 - 4 + 8 = 16$

$\Rightarrow\ 12 - 4 + 8 = 16$

18. (c) **Option. (a)**

$7 \times 6 + 5 - 4 = 33$

$7 - 6 + 4 \times 5 = 33$

$7 - 6 + 20 = 33$

$21 \neq 33$ (wrong)

Option. (b)

$7 \times 6 + 5 - 4 = 33$

$7 + 6 \times 4 - 5 = 33$

$7 + 24 - 5 = 33$

$26 \neq 33$ (wrong)

Option, (c)

$7 \times 6 + 5 - 4 = 33$

$7 \times 5 - 6 + 4 = 33$

$35 - 6 + 4 = 33$

$33 = 33$ (right)

Option. (d)

$7 \times 6 + 5 - 4 = 33$

$7 - 5 + 6 \times 4 = 33$

$7 - 5 + 24 = 33$ $\quad 26 \neq 33$ (wrong)

19. (d)

$- \Rightarrow +$	$+ \Rightarrow \div$
$\div \Rightarrow \times$	$\times \Rightarrow -$

$13 + 12 \times 9 \div 3 - 6 = ?$

$= 13 \div 12 - 9 \times 3 + 6 = \frac{13}{12} - 27 + 6$

$= (13 - 234 + 72) \div 12 = \mathbf{-\ 239/12}$

20. (d)

$+ \Rightarrow \times$	$- \Rightarrow +$
$\times \Rightarrow \div$	$\div \Rightarrow -$

$9 + 3 - 72 \times 6 \div 3 = ?$

$9 \times 3 + 72 \div 6 - 3$

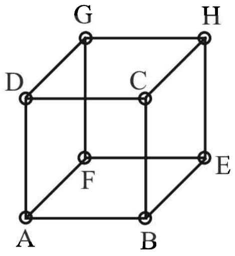
$27 + 12 - 3; \quad 27 + 9 = 36$

Chapter 18

Cube and Dice

CUBE

A cube is three dimensional object whose length, breadth and height are equal and any two adjacent faces are inclined to each other at 90°. It has 6 faces, 8 corners and 12 edges.



- Corners of the cube are A, B, C, D, E, F, G and H.
- Edges of the cube are AB, BE, EF, AF, AD, CD, BC, EH, CH, GH, DG and FG.

  Faces of the cube are ABCD, EFGH, CDGH, BCHE, ABEF and ADGF.

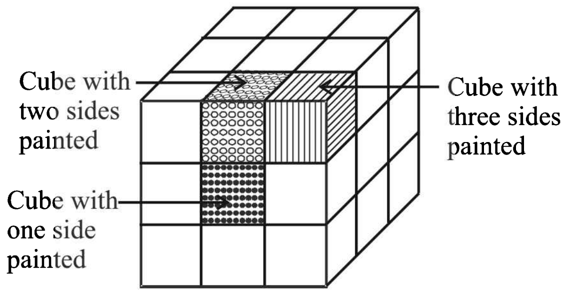
When a cube is painted on all of its faces with any colour and further divided into various smaller cubes of equal size, we get following results:

(i) Smaller cubes with no face painted will present inside faces of the undivided cube.

(ii) Smaller cubes with one face painted will present on the faces (except edges) of the undivided cube.

(iii) Smaller cubes with two faces painted will present on the edges (except corner) of undivided cube.

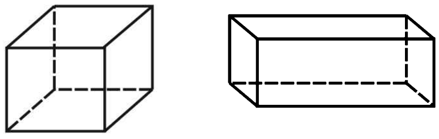
(iv) Smaller cubes with three faces painted will present on the corners of the undivided cube.

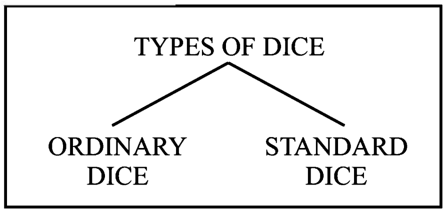

Cube with two sides painted
Cube with three sides painted
Cube with one side painted

The above figure may be analysed by dividing it into three horizontal layers :

CUBE

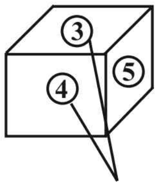
A dice is three-dimensional object with 6 surfaces. It may be in the form of a cube or a cuboid.





1. Ordinary Dice:

In this type of dice, the sum of numbers on opposite faces is not 7.



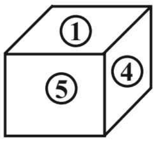
Ordinary Dice

$$4+3 = 7$$

But 3 and 4 are not on the opposite faces.

2. Standard Dice:

In such type of dice, the sum of numbers on opposite faces is 7 or sum of numbers on adjacent faces is not 7.



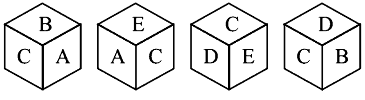
Here,
$1+4 =5$
$4+5=9$
$1+5=6$

Standard Dice

Opposite of 1 ....6 (since $1+6 =7$)
Opposite of 5 ....2 (since $5+2 =7$)
Opposite of 3 ....4 (since $3+4 =7$)

EXERCISE

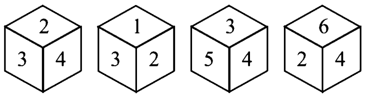
1. Four forms of a dice are shown below. In this dice which word will be on the surface opposite to the word *D*?



(i) (ii) (iii) (iv)

(a) *D* (b) *A* (c) *B* (d) *C*

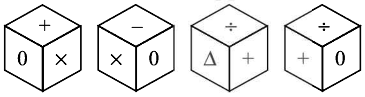
2. 1, 2, 3, 4, 5 and 6 have written on surface of dice. Four forms of dice shown below. In this dice which digit will be on the surface opposite to the digit 3?



(i) (ii) (iii) (iv)

(a) 4 (b) 5 (c) 6 (d) 1

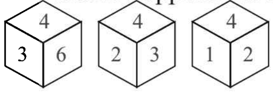
3. Four forms of a dice are shown below. In this dice which figure will be on the surface opposite to the figure Δ?



(i) (ii) (iii) (iv)

(a) × (b) + (c) 0 (d) ÷

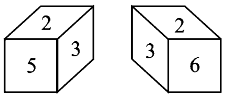
4. Three forms of a dice are shown below. In this dice which digit will be on the surface opposite to the digit 4 ?



(i) (ii) (iii)

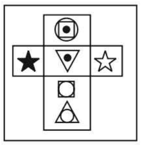
(a) 5 (b) 1 (c) 2 (d) 3

5. Form the following two different appearances of dice find out the number which is opposite to '5'

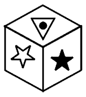
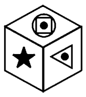
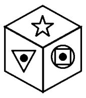
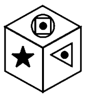


(a) 2 (b) 3 (c) 4 (d) 6

6. Choose from the four answer figures, the figure that will be formed when the question figure is folded into a box.

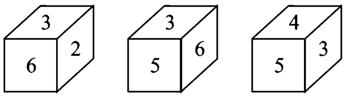


Answer Figures

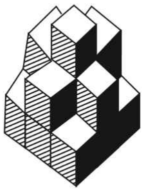
(a) (b) (c) (d)

7. Three positions of a dice are given below. Identify the number on the face opposite to 6.



(a) 1 (b) 4 (c) 5 (d) 6

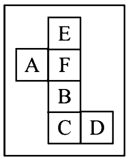
8. How many cubes are unseen in the figure?



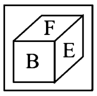
(a) 5 (b) 6 (c) 10 (d) 15

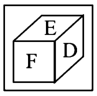
9. Which of the following cubes can be created by folding the given figure?

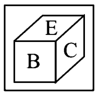
Questions Figure:

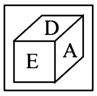


Answer Figures:



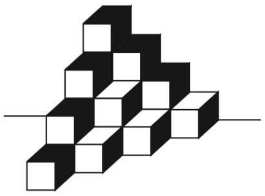






(a) (b) (c) (d)

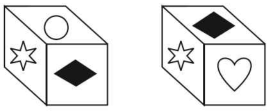
10. How many cubes are there in the group?



(a) 20 (b) 10 (c) 16 (d) 18

11. Two positions of a dice are shown below. When the heart shape is at the top what will be at the bottom?

Question Figures:

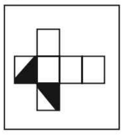


Answer Figures:

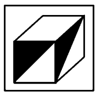
(a) ✡ (b) ◆ (c) ○ (d) ♡

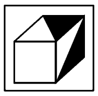
12. Choose the cube which will be formed on folding the given question figure.

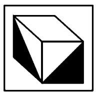
Question Figures:

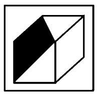


Answer Figures:


(a)

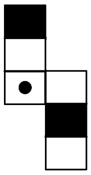

(b)

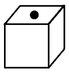

(c)

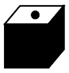

(d)

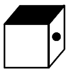
13. The figure given on the left hand side is folded to form a both choose from the alternatives (1), (2), (3) and (4) the boxes that similar to the box formed.

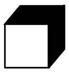
Question Figures:




(i)


(ii)

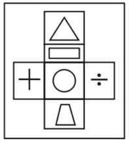

(iii)


(iv)

(a) (ii) and (iii) only
(b) (i), (iii) and (iv) only
(c) (ii) and (iv) only
(d) (i) and (iv) only

14. If a paper is folded as shown in figure to form a cube, then the pairs of opposite faces are:

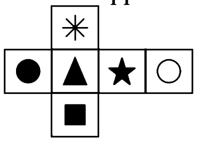
Question Figures:



Answer Figures:

(a)	(b)	(c)	(d)
+ AND △ ÷ AND ⏢ ○ AND ▭	+ AND ○ ÷ AND ▭ △ AND ⏢	△ AND ○ + AND ÷ ⏢ AND ▭	+ AND ÷ △ AND ⏢ ▭ AND ○

15. The following figure is folded to form a block. Which symbol will appear on the opposite of triangle



(a) ● (b) ★ (c) ○ (d) ■

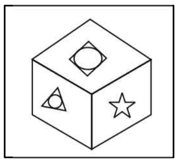
Hints & Solutions

1. (b) In figure (ii) and (iii) *C* and *E* are common. So *A* is opposite of *D*

2. (c) 3. (c) 4. (a)

5. (d) From the two different views of the dice it is clear that '6' lies opposite to '5'.

6. (b)



7. (b) The numbers 2, 4, 5 and 6 cannot be on the face opposite to 3.

The numbers 1, 3, 4 and 6 cannot be on the face opposite to 5.

Therefore, 2 lies opposite 5. Clearly, 4 lies opposite 6.

8. (a) Altogether there are 15 cubes. 10 cubes are seen in the figure. So, five cubes are unseen in the figure.

9. (b) From the two views of blocks it is clear that '*F*' is adjacent to '*B*', '*E*' appears opposite '*C*' and '*A*' appears opposite '*D*'.

In option (1) 'F' is adjacent to '*B*' In option (3) '*E*' is adjacent to '*C*' In option (4) '*D*' is adjacent to '*A*'

10. (a) 10 cubes are visible and 10 cubes are hidden. Clearly, there is one column having four cubes.

There are two columns each having three cubes.

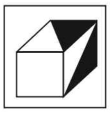
There are three columns, each having two cubes.

There are four columns, each having only one cube.

Thus, total number of cubes = 4 + 6 + 6 + 4 = 20 cubes.

11. (c) From the given positions of a dice, it is clear that circle would be at the bottom, when the heart shape is at the top.

12. (b)



13. (b) The dot will lie opposite one of the shaded surfaces. Therefore, option (2) cannot be formed.

14. (c) When paper is folded in the form of a cube, then

△ lies opposite ○
+ lies opposite ÷
▭ lies opposite ⏢

15. (c) When block is made

✳ lies opposite ■
● lies opposite ★
○ lies opposite ▲

Chapter 19 Completion of Figure

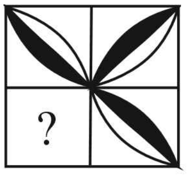
INTRODUCTION

In this chapter, an incomplete figure is given, in which some part is missing. We have to choose the segment, given in choices, that exactly fits into the blank portion of figure so that the main figure is completed.

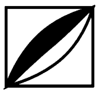
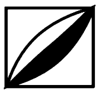
Note

If you observe carefully, you notice that the missing portion may be the mirror image of any one of the quarters.

Example **Select from alternatives the figure (X) that exactly fits in the main figure to complete its original pattern.**



(X)

(a)

(b)

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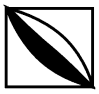
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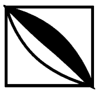
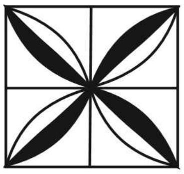


Sol. In this question, half shaded leaf is moved clockwise. So, option (b) is right one.



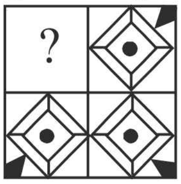
Shortcut Approach

- If answer figures contain similar figure but in rotated forms, then the correct answer figure is that figure which can be substituted at the missing part with least change in orientation.
- The correct option for the missing figure can be given in any rotated from, so student can rotate the figures to check the correctness of option.

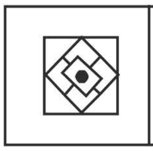
EXERCISE

DIRECTIONS (Qs. 1-25): *Which answer figure complete the form in question figure ?*

1. **Question Figure:**



Answer Figures :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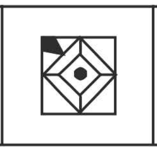
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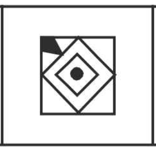
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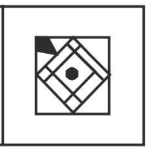
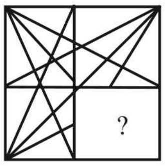
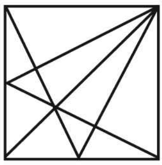

(d)

2. **Question Figure:**



Answer Figures: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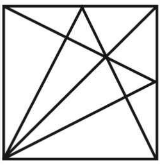
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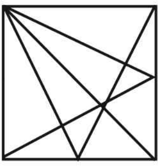
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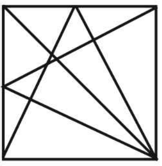
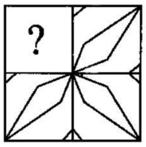
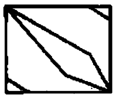
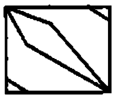
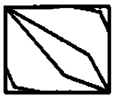
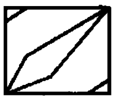

(d)

3. Question Figure:



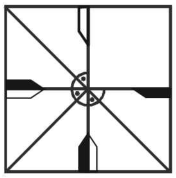
X

Answer Figures:

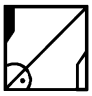
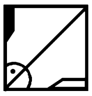
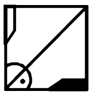
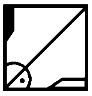
(a) (b) (c) (d)

4. Question Figure:



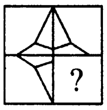
X

Answer Figures:

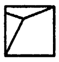
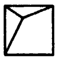
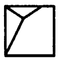
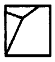
(a) (b) (c) (d)

5. Question Figure:



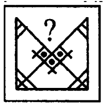
X

Answer Figures:

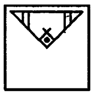
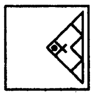
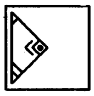
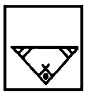
(a) (b) (c) (d)

6. Question Figure:



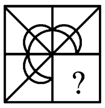
X

Answer Figures:

(a) (b) (c) (d)

7. Question Figure:



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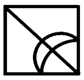
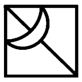
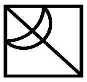
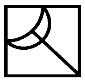
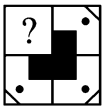
Answer Figures:

(a)  (b)  (c)  (d) 

8. Question Figure:



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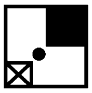
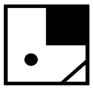
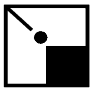
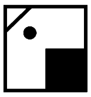
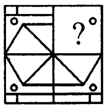
Answer Figures:

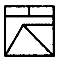
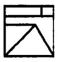
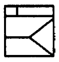
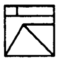
(a)  (b)  (c)  (d) 

9. Question Figure:

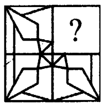


X

Answer Figures:

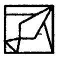
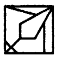
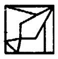
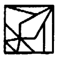
(a)  (b)  (c)  (d) 

10. Question Figure:

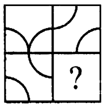


X

Answer Figures:

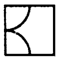
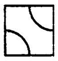
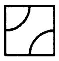
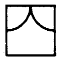
(a)  (b)  (c)  (d) 

11. Question Figure:



X

Answer Figures:

(a)  (b)  (c)  (d) 

Hints & Solutions

1. **(b)**

2. **(d)** Option (d) will complete the question figure.

3. **(a)** **4.** (d) **5.** (d) **6.** **(d)** **7.** (c) **8.** **(d)**

9. **(b)** **10.** **(c)** 11. (a)

Chapter

20

Figure Formation & Analysis

INTRODUCTION

In this chapter, a question is one of the following types :

I. Formation of triangles/square/rectangle etc. either by joining of three figures after choosing them from the given five figures or by joining any other pieces after selecting them from given alternatives.

II. Making up a figure from given components.

III. Making up a three dimensional figure by paper folding.

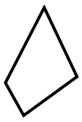
IV. Rearrangement of the parts of given figure.

V. Fragmentation of key figure into simple pieces.

Type-I : Formation of triangles/square/rectangle etc. either by joining of three figures after choosing them from the given five figures or by joining any other pieces after selecting them from given alternatives.

Example 1. A set of five figures (A), (B), (C), (D) and (E) are followed by four combinations as the alternatives. Select the combination of figures which if fitted together, will form a complete triangle.

(A)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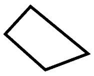
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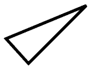
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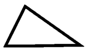
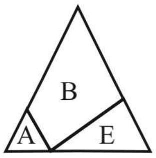
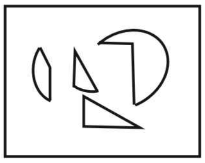

(E)

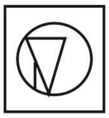
Sol. If figures A, B and E are fitted together, the resultant figure will be a triangle.

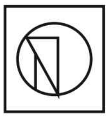


Type-II : Making up a figure from given components

Example 2. Find out which of the alternatives (a), (b), (c) and (d) can be formed from the pieces given in box 'X'.


(X)


(a)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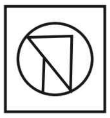
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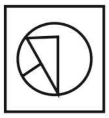

(d)

Sol.

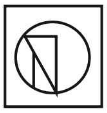
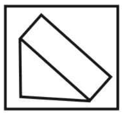
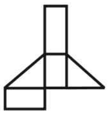


Figure (b) can be formed from the pieces the given in box 'X'.

Type-III : Making up a three dimensional figure by paper folding: In this type, we have to analyze when a paper folded along the lines, how a three dimensional figure look like. Sometimes, a key figure is given which is made by folding one of the four figures given in alternatives. We have to determine which figure can be used to create the key figure.

Example 3. A figure 'X' is given. You have to choose the correct figure, given in the alternatives, when folded along the lines, will produce the given figure 'X'.


(X)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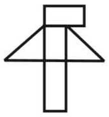
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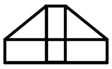
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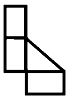
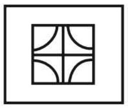

(d)

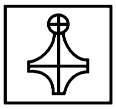
Sol. (a) Figure (a) will produce the given figure 'X'

Type-IV : Rearrangement of the parts of given figure.

In this type of questions, a key figure is given. We have to identify the figure from alternatives that is a rearrangement of parts of key figure.

Example 4. Which figure is the rearrangement of the parts of the given figure.


(X)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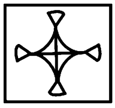
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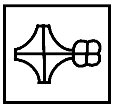
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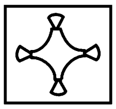
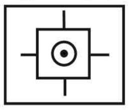

(d)

Sol. (a) Figure (a) is the rearrangement of the parts of the given figure 'X'.

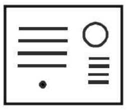
Type-V : Fragmentation of key figure into simple pieces.

This type is opposite to **Type-II.** In this type, a key figure is given and every alternatives has different pieces. We have to select the set of pieces that can make the given key figure.

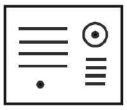
Example 5. **Find out which of the alternatives will exactly make up the key figure (X)**



(X)



(a)



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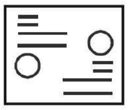

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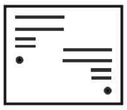


(d)

Sol. Figure (a) will exactly make up the key figure 'X'

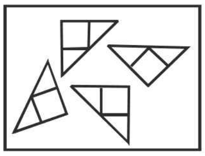
Shortcut Approach

- The number of elements given to form a figure must be equal to the elements present in the answer figure. This will help you to easily eliminate some of the option figures.
- The size of pieces of figures in the question figure and the size of pieces used to form a figure may vary but their shapes must have to be similar.

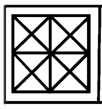
EXERCISE

DIRECTIONS (Qs. 1 - 12) : *In each of following questions find out which of the figures (a), (b), (c) and (d) can be formed from the pieces given in (X).*

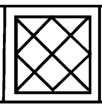
1. **Question Figure: Answer Figures:**



(X)



(a)



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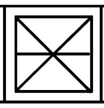

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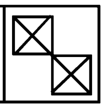
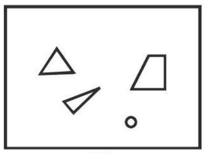
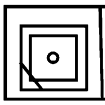


(d)

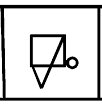
2. **Question Figure: Answer Figures:**



(X)



(a)



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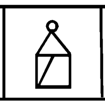

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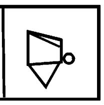
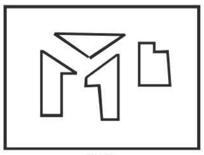
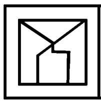


(d)

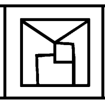
3. **Question Figure: Answer Figures:**



(X)



(a)



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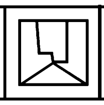

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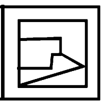
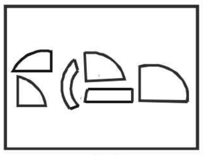
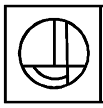


(d)

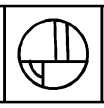
4. **Question Figure: Answer Figures:**



(X)



(a)



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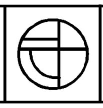

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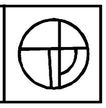

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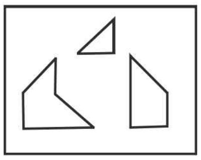
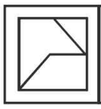
5. **Question Figure: Answer Figures:**



(X)



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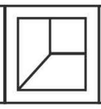

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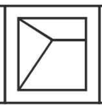

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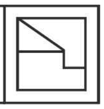

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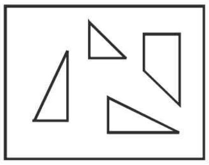

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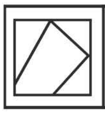

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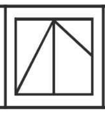

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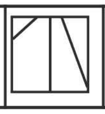

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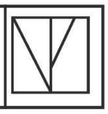

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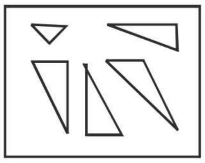
7. **Question Figure: Answer Figures:**



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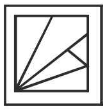
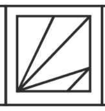


(a)



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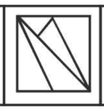

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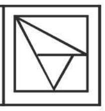
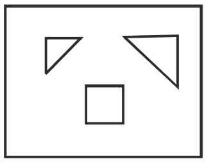
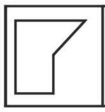


(d)

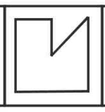
8. **Question Figure: Answer Figures:**



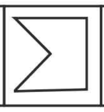
(X)



(a)



(b)



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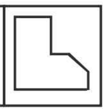
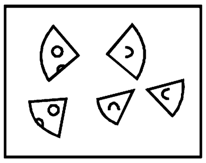


(d)

9. **Question Figure: Answer Figures:**



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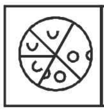
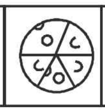


(a)



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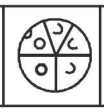

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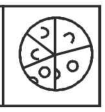
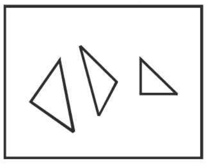
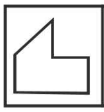


(d)

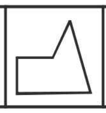
10. **Question Figure: Answer Figures:**



(X)



(a)



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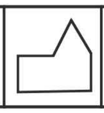

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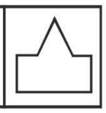
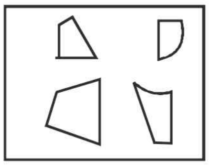


(d)

11. Question Figure: Answer Figures:



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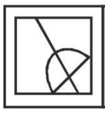
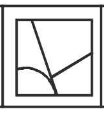


(a)



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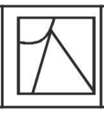

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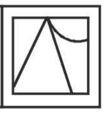
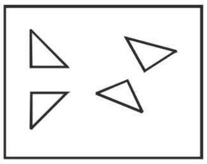


(d)

12. Question Figure: Answer Figures:



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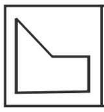
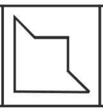


(a)



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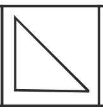

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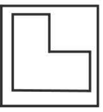
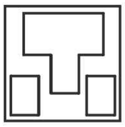


(d)

DIRECTIONS: (Qs. 13 - 22): *Problem figure is given and four answer figures, marked (a), (b), (c), (d) are given. Select the answer figure which can be formed from the cut-off pieces given in the Question figure.*

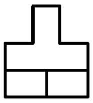
---

13. Question Figure:



Answer Figures:

(a)



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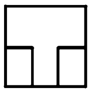

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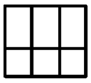
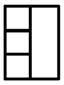
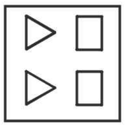


(d)

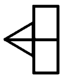


14. Question Figure:

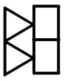


Answer Figures:

(a)



(b)



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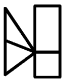

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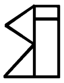
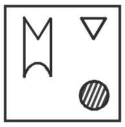
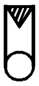


15. Question Figure:



Answer Figures:

(a)



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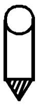

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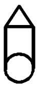
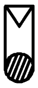
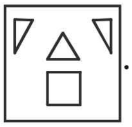


(d)

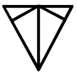


16. Question Figure:



Answer Figures:

(a)



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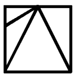

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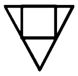

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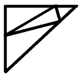
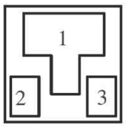
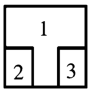


Hints & Solutions

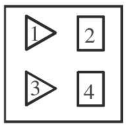
1. **(b)** **2.** **(c)** **3.** **(c)** **4.** **(a)** **5.** **(a)** **6.** **(b)**
7. **(c)** **8.** **(a)** **9.** **(c)** **10.** **(b)** **11.** **(b)** **12.** **(c)**

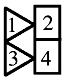
13. (b)



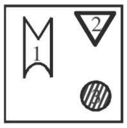


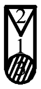
14. (b)



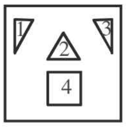


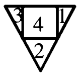
15. (d)





16. (c)





Chapter 21

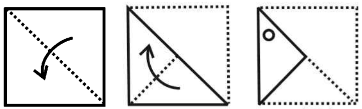
Paper Cutting & Folding

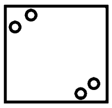
INTRODUCTION

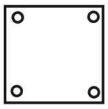
In this chapter, a sheet of paper is folded in given manner and cuts are made on it. A cut may be of varying designs. We have to analyze how this sheet of paper will look when paper is unfolded. Note that when a cut is made on folded paper, the designs of the cut will appear on each fold.

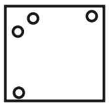
Directions: (Qs. 1-2) *In the following example, figures A and B show a sequence of folding a square sheet. Figure C shows the manner in which folded paper has been cut. You have to select the appropriate figure from alternatives which would appear when sheet is opened.*

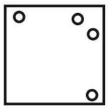
Example **1.**


(A) (B) (C)

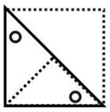

(a)


(b)

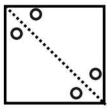

(c)


(d)

Sol. **(a)** Step I-When sheet C is unfolded once, it will appear as follows

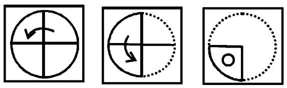


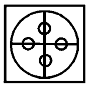
Step II -

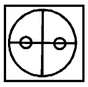


Clearly, the circle will appear in each of the triangular quarters of the paper. So, figure (a) would appear when sheet is opened.

Example **2.**


(A) (B) (C)


(a)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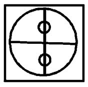
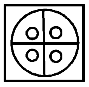

(c)

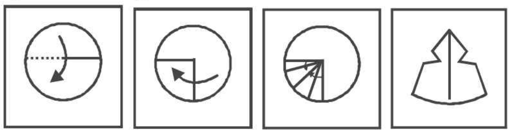

(d)

Sol. **(d)** Here, a circular cut is made on the quarter circle. Hence, this sheet, when completely unfolded, will contain small circle on each quarter and will appear as option (d).

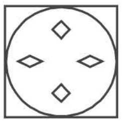
EXERCISE

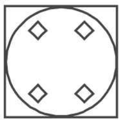
1. A piece of paper is folded and cut as shown below in the question figures. From the given answer figures, indicate how it will appear when opened.

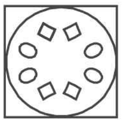
Question Figure:

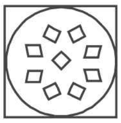


Answer Figures:


(a)

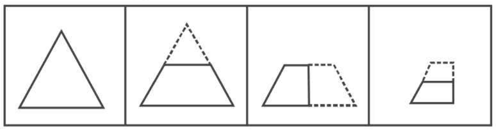

(b)


(c)

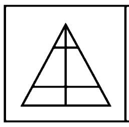

(d)

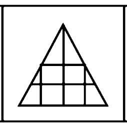
2. A sheet of paper has been folded as shown by the question figures. You have to figure out from amongst the four answer figures how it will appear when opened?

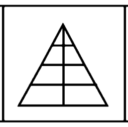
Question Figures :

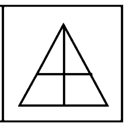


Answer Figures:


(a)

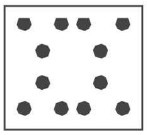

(b)


(c)

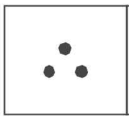
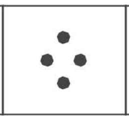
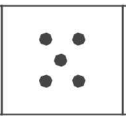
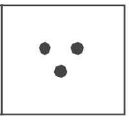

(d)

3. A sheet of paper when folded, punched and opened shows the question figure. Choose from the answer figures which punched hole pattern gives this figure.

Question Figure (Open pattern):

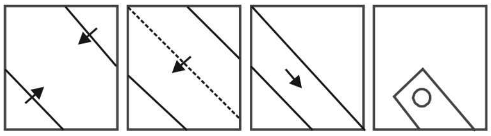


Answer Figures (Punched hole patterns) :

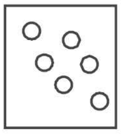
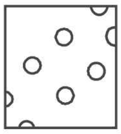
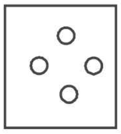
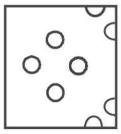

(a)

(b)

(c)

(d)

4. A piece of paper is folded and cut as shown below in the question figures. From the given answer figures, indicate how it will appear when opened.

Question Figures :

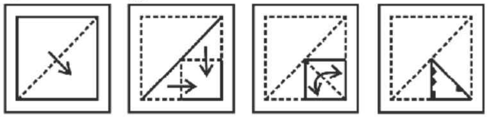


Answer Figures :

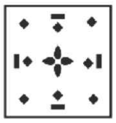
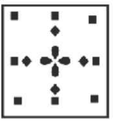
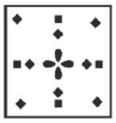
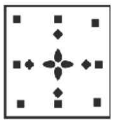

(a)

(b)

(c)

(d)

5. A piece of paper is folded and punched as shown below in the question figures. From the given answer figures, indicate how it will appear when opened.

Question Figure:

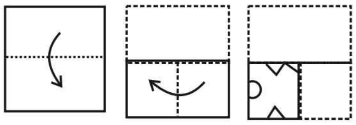


Answer Figures:

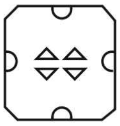
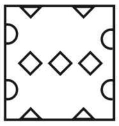
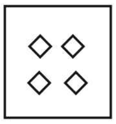
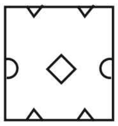

(a)

(b)

(c)

(d)

6. A piece of paper is folded and cut as shown below in the question figures. From the given answer figures, indicate how it will appear when opened.

Question Figure:

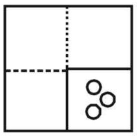


Answer Figures:

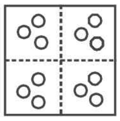
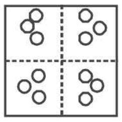
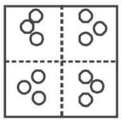
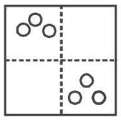

(a)

(b)

(c)

(d)

7. A piece of paper is folded and cut as shown below in the question figures. From the given answer figures indicate how it will appear when opened.

Question Figure:

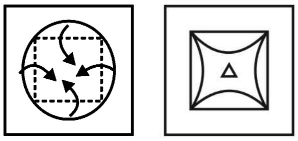


Answer Figures:

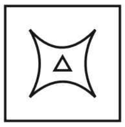
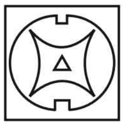
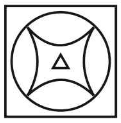
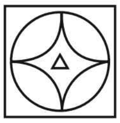

(a)

(b)

(c)

(d)

8. A piece of paper is folded and punched as shown below in the question figures. From the given answer figures, indicate how it will appear when opened?

Question Figure:



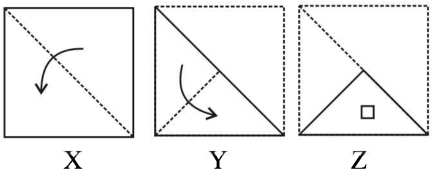
Answer Figures:


(a)

(b)

(c)

(d)

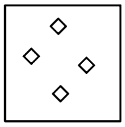
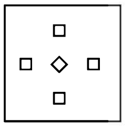
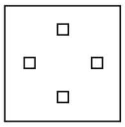
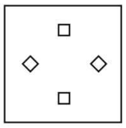
DIRECTIONS (Qs. 9-13) : *Consider the three figures, marked X, Y, and Z showing one fold in X, another in Y and the cut in Z. From amongst the four alternative figures (a), (b), (c) and (d), select the one showing the unfolded position of Z.*

---

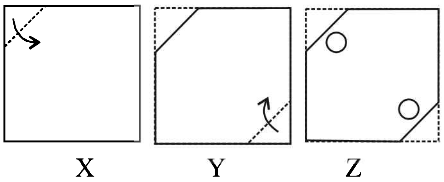
9. Question Figure:



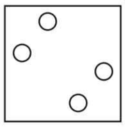
Answer Figures:

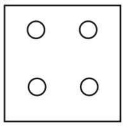

(a)

(b)

(c)

(d)

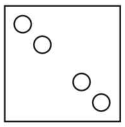
10. Question Figure:

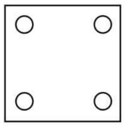


Answer Figures:

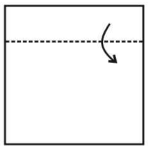

(a)

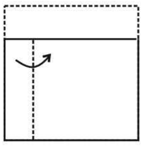

(b)

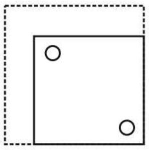

(c)


(d)

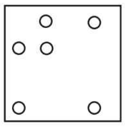
11. Question Figure:

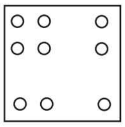

X

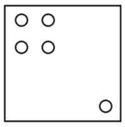

Y

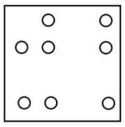

Z

Answer Figures:

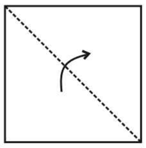

(a)

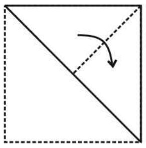

(b)

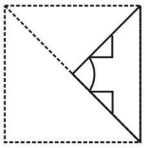

(c)


(d)

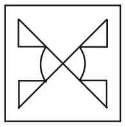
12. Question Figure:

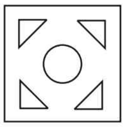

X

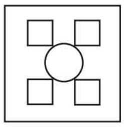

Y

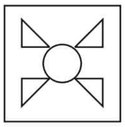

Z

Answer Figures:

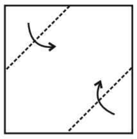

(a)

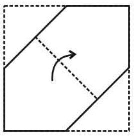

(b)

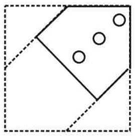

(c)


(d)

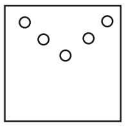
13. Question Figure:

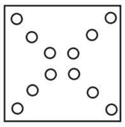

X

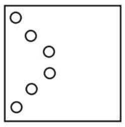

Y

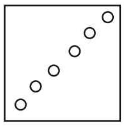

Z

Answer Figures:


(a)

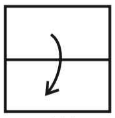

(b)

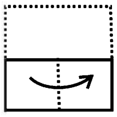

(c)

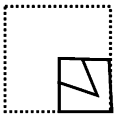

(d)

DIRECTIONS (Qs.14-16) : *In each of the following questions a set of three figures A, B and C showing a sequence of folding of a piece of paper. Fig. (C) shows the manner in which the folded paper has been cut. These three figures are followed by four answer figures from which you have to choose a figure which would most closely resemble the unfolded form of fig. (C).*

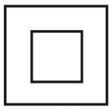
14. Question Figure:

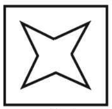

(A)

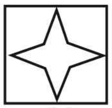

(B)

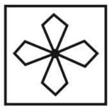

(C)

Answer Figures:

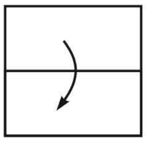

(a)


(b)


(c)


(d)

15. Question Figure: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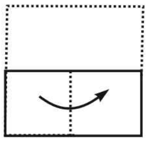
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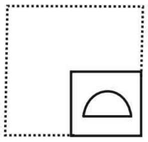
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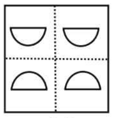
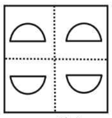
Answer Figures:


(a)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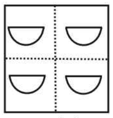
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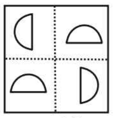
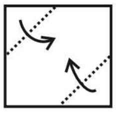

(d)

16. Question Figure: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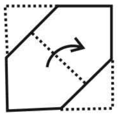
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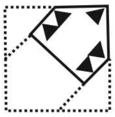
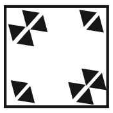
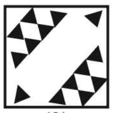

(C)

Answer Figures:


(a)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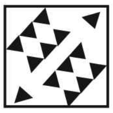
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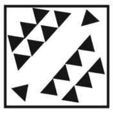
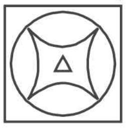

(d)

Hints & Solutions

1. **(c)** **2.** **(c)** **3.** **(a)** **4.** **(c)**
5. **(c)** **6.** **(b)** **7.** **(c)**
8. **(c)**



9. **(c)** **10.** **(c)** **11.** **(c)** **12.** **(c)**
13. **(d)** **14.** **(b)** **15.** **(a)** **16.** **(b)**

Chapter 22 Visual Reasoning

INTRODUCTION

Visual intelligence measures the ability to process visual material and to employ both physical and mental images in thinking. As a result people with a high visualization find it easier to comprehend information and communicate it to others. Your visualization skills determine how well you perceive visual patterns and extract information for further use. Visualization also facilitates the ability to form associations between pieces of information something which helps improve long term memory.

TYPES OF VISUAL REASONING

(A) Odd-Man Out Type
(B) Counting of Figures

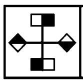
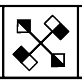
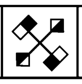
(A) Odd-man Out Type

1. Rotation of Same Figure

This is the most common type of classification. The similar figures are actually the rotated forms of the same figure in clockwise or anti-clockwise direction. The figure which comes out to be different from other is that figure which cannot be obtained by rotation of either of the other figures,

Example 1.

DIRECTIONS : *In the following question, a group of five figures is given. Out of which four figures are similar to each other in a certain way and one is different from other. Find the odd figure out.*


(a)

(b)

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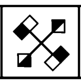
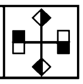

(d)

(e)

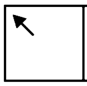
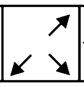
Sol. After examining the above figure, it is found that except (d) all figures can easily be obtained by clockwise and anti-clockwise movement or each other.

2. Number of Elements or Lines

A group of figure may be classified on the basis of number of elements or the number of lines present in figures. The figures can also be classified on even or odd number of lines or elements present in figures. Classification can also be done in the ratio of number of lines and elements.

Example 2.

DIRECTIONS : *In the following question, a group of five figures is given. Out of which four figures are similar to each other in a certain way and one is different from other. Find the odd figure out.*


(a)

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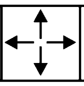
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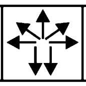
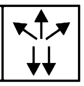

(d)

(e)

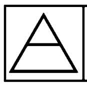
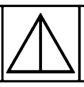
Sol. All except figure (c) contains odd number of arrows.

3. Division of Figures

This type of classification is done on the equal or unequal division of figures or divisioin of figure in some specified ratio or parts.

Example 3.

DIRECTIONS : *In the following question, a group of five figures is given. Out of which four figures are similar to each other in a certain way and one is different from other. Find the odd figure out.*


(a)

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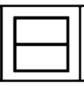
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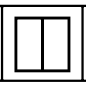
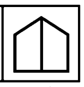

(d)

(e)

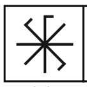
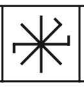
Sol. Except figure (a) all figures are divided into two equal parts.

4. Similarity of Figures

Classification on the basis of similarity of figure is done when orientation, shape, measure of angle or method of presentation of group is same except for the odd figure.

Example 4.

DIRECTIONS : *In the following question, a group of five figures is given. Out of which four figures are similar to each other in a certain way and one is different from other. Find the odd figure out.*


(a)

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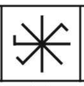
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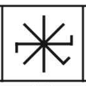
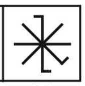

(d)

(e)

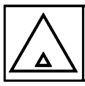
Sol. Let us consider the two adjacent bent lines as a pair. Then, in each figure except (d) there are two straight lines between the bent pair and the remaining bent line when the direction of bent is considered.

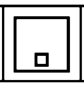
5. Relation between Elements of Figure

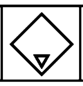
In this type of classification, the elements of the figure bears a certain relationship between them in which the odd figure does not posses. This relation can be based on shape of elements possesses, inversion of elements etc.

Example 5.

DIRECTIONS : *In the following question, a group of five figures is given. Out of which four figures are similar to each other in a certain way and one is different from other. Find the odd figure out.*


(a)


(b)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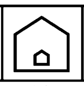
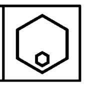

(d)


(e)

Sol. Except figure (c) in all the figures, both the inside and outside figures are similar but differ in size.

6. Interior-Exterior Consideration of Elements

A figure can be formed from two or more elements, it is likely that some elements may lie in interior of other elements while some may lie in the exterior of the other elements. This consideration can be used for classification of elements from a group.

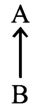
(B) Counting of Figures Type

Type-1: Counting of Straight Lines and Triangles

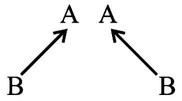
(a) Straight Lines

A. Horizontal line A ← B

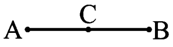
B. Vertical line



C. Slant line

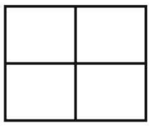


Shortcut Approach - 1

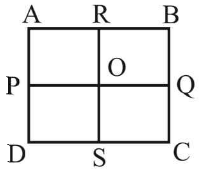
- Consider a line (AB) given 
- Then, on counting, it will be counted as one line, i.e., AB and not as a two straight lines AC and CB.

Example 6.

How many straight lines are there in the figure ?



Sol.



Horizontal lines = AB + PQ + DC = 3

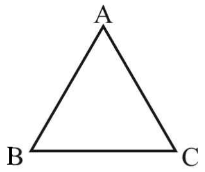
Vertical lines = AD + RS + BC = 3

Slant lines = 0

∴ Total lines = 3 + 3 + 0 = 6

(b) Triangle –

It is a closed figure bounded by three side.

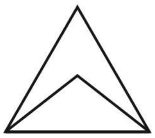


Shortcut Approach - 2

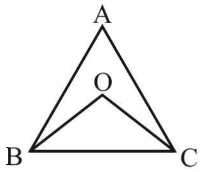
- Smallest triangles are counted first.
- Now, counted those triangles which are formed with the two triangles and further counting goes on in the same way.
- Largest triangle is counted in the last.

Example 7.

How many triangles are there in the figure ?



Sol.



Smallest triangle = BOC = 1

Largest triangle = ABC = 1

∴ Total triangle = 1 + 1 = 2

Type-2 : Counting of Quadrilaterals and Polygons

(a) Square

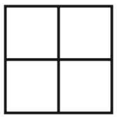
It has four equal sides, equal diagonals, and each of the four angles equal to 90°.

Shortcut Approach - 3

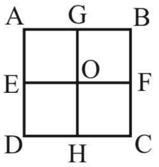
- Count smallest squares first.
- Now, count squares which are formed with two squares and further counting goes on in the same way.
- Largest square is counted in the last.

Example 8.

How many square are there in the figure ?



Sol.



Smallest squares

= AGOE + GBFO + EOHD + OFCH = 4

Square formed with four squares

= ABCD = 1

∴ Total squares = 4 + 1 = 5

EXERCISE

DIRECTIONS (Qs.1-20): *In each question, out of the four figures marked (a), (b), (c) and (d), three are similar in a certain manner. However one figure is not like the other three. Choose the figure which is different from the rest.*

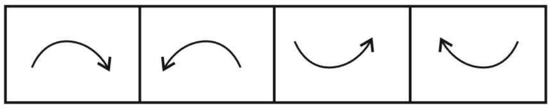
1.

M	U	O	A
(a)	(b)	(c)	(d)

2.

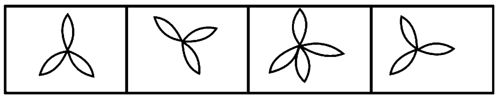
S	T	U	V
(a)	(b)	(c)	(d)

3.



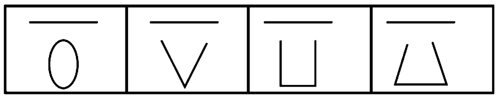
(a) (b) (c) (d)

4.



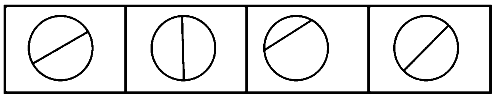
(a) (b) (c) (d)

5.



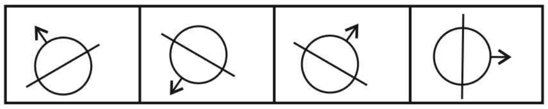
(a) (b) (c) (d)

6.



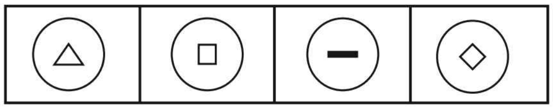
(a) (b) (c) (d)

7.



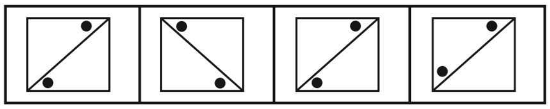
(a) (b) (c) (d)

8.



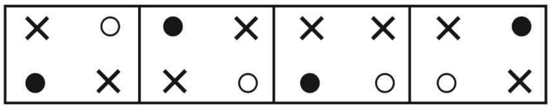
(a) (b) (c) (d)

9.



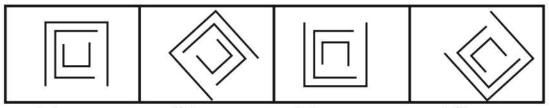
(a) (b) (c) (d)

10.



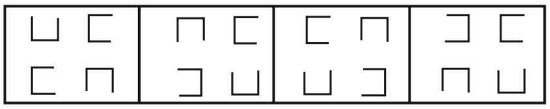
(a) (b) (c) (d)

11.



(a) (b) (c) (d)

12.

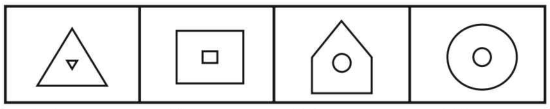


(a) (b) (c) (d)

13.

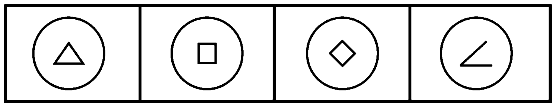
,	;	·	:
(a)	(b)	(c)	(d)

14.



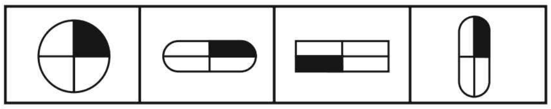
(a) (b) (c) (d)

15.



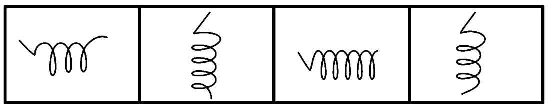
(a) (b) (c) (d)

16.



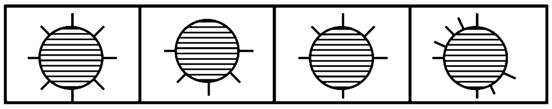
(a) (b) (c) (d)

17.



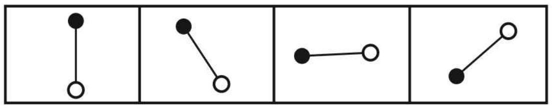
(a) (b) (c) (d)

18.



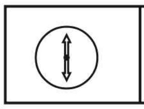
(a) (b) (c) (d)

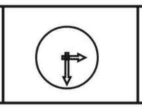
19.

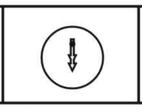


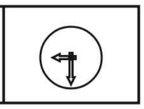
(a) (b) (c) (d)

20.


(a)

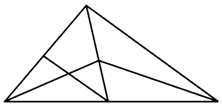

(b)


(c)


(d)

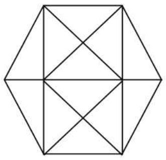
21. How many triangles are there in the following figure ?

(a) 11
(b) 13
(c) 9
(d) 15



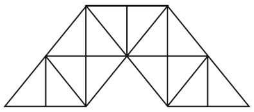
22. How many triangles are there in the following figure ?

(a) 20
(b) 24
(c) 28
(d) 32



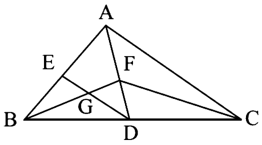
23. Count the number of triangles in the following figure.

(a) 27
(b) 23
(c) 31
(d) 29



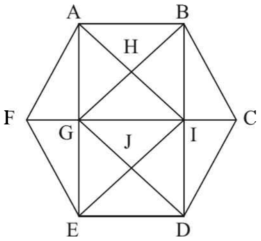
Hints & Solutions

1. **(a)** M is only consonant, rest are vowel.
2. **(c)** only U is vowel
3. **(d)** rest all are horizontal element except (d) which is vertical
4. **(c)** rest all has three petals.
5. **(a)** one element is enclosed figure, rest are one end open
6. **(c)** only c is not having diameter.
7. **(b)** arrows are moving anti clock wise direction 45 degree.
8. **(c)** all except (c) has enclosed figure.
9. **(d)** all except (d) dots are on either side of the line.
10. **(c)** Except (c) rest elements of figures are diagonally opposite direction.
11. **(a)** all other figure can be rotated into each other. The middle element is obtained by rotating the outer element through 90 degree clock wise and the inner element is obtained by rotating the middle element through 90 degree clock wise.
12. **(a)** only in figure (a) two of the four elements are oriented in the same direction.
13. **(d)** option (d) is mathematical symbol.
14. **(c)** all outer elements having the replica of its present inside of that, except option (c)
15. **(d)** all inner figures are enclosed one except (d)
16. **(c)** the shaded region is present on the left bottom region, where as rest all has on top right region.
17. **(d)** number of turning increases with a sequence.
18. **(b)** the line segment along with the circle are eight except option (b)
19. **(d)** all rotates in anti clock wise direction except option (d)
20. **(d)** one arrow is facing towards the centre.
21. **(b)**



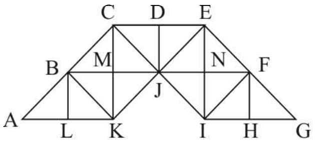
The triangles are:
ΔABC; ΔABD; ΔADC; ΔAFC
ΔFDC; ΔAFB; ΔFDB; ΔFBC
ΔGBD; ΔADE; ΔGBE; ΔFDG
ΔDBE;

22. **(c)**



The triangles are:
ΔFEB; ΔCBD; ΔFAG; ΔFEG
ΔBCI; ΔCDI; ΔAFI; ΔEFI
ΔBGC; ΔDCG; ΔAGI; ΔBIH
ΔAGB; ΔABI; ΔHAB; ΔHBI
ΔHGI; ΔHAG; ΔGEI; ΔGED
ΔIDE; ΔIDG; ΔJGI; ΔJDI
ΔJGE; ΔJDE; ΔAIE; ΔBGD

23. **(d)**



The briang les are:
ΔABL; ΔBLK; ΔBMK; ΔBMC;
ΔCMJ; ΔCDJ; ΔDEJ; ΔMKJ
ΔEJN; ΔJIN; ΔENF; ΔNFI;
ΔFIH; ΔFGH; ΔABK; ΔBCK;
ΔKAC; ΔBCJ; ΔKBJ; ΔJCE;
ΔEFJ; ΔIFJ; ΔFEI; ΔFGI;
ΔCKE; ΔCEI; ΔEGI; ΔCJK; ΔEJI

Chapter 23

Non-Verbal Series

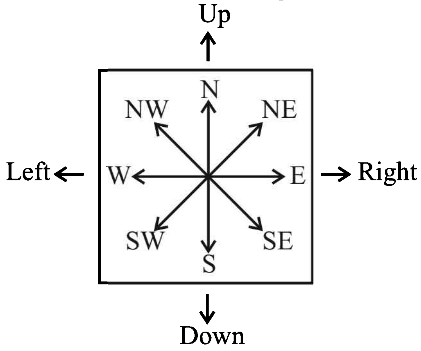
INTRODUCTION

The word **"series"** is defined as anything that follows or forms a specific pattern or is in continuation of a given pattern or sequence.

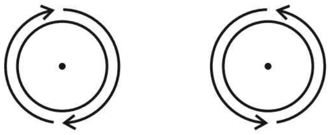
In this type of non-verbal test, two sets of figures pose the problem. The sets are called problem Figures and Answer Figures. Each problem figure changes in design from the preceding one.

Shortcut Approach

- **Directions –** There are eight directions as follows :

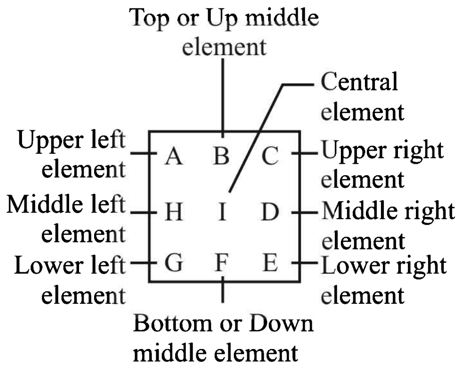


- **Rotational Directions –** There are two rotational directions as follows :

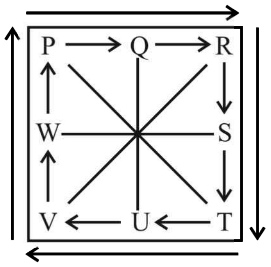


Clockwise direction (CW) Anticlockwise direction (ACW)

- **Positions of Elements –**



- **Movement of Elements through Distance –**



Clockwise Movement

$P \rightarrow Q = \frac{1}{2}$ arm/step

$P \rightarrow R = 1$ arm/step

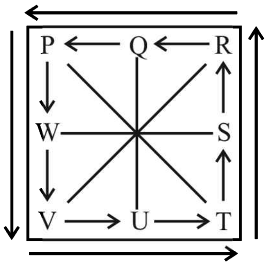
$P \rightarrow S = 1\frac{1}{2}$ arm/step

$P \rightarrow T = 2$ arm/step

$P \rightarrow U = 2\frac{1}{2}$ arm/step

$P \rightarrow V = 3$ arm/step

$P \rightarrow W = 3\frac{1}{2}$ arm/step



Anti Clockwise Movement

$P \rightarrow W = \frac{1}{2}$ arm/step

$P \rightarrow V = 1$ arm/step

$P \rightarrow U = 1\frac{1}{2}$ arm/step

$P \rightarrow T = 2$ arm/step

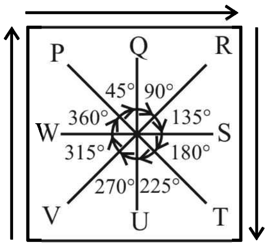
$P \rightarrow S = 2\frac{1}{2}$ arm/step

$P \rightarrow R = 3$ arm/step

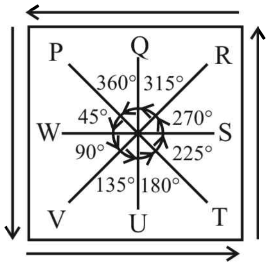
$$P \rightarrow Q = 3\frac{1}{2} \text{ arm/step}$$

$$P \rightarrow P = 4 \text{ arm/step}$$

- **Directional Movement of Elements –**



Clockwise Movement



Anticlockwise Movement

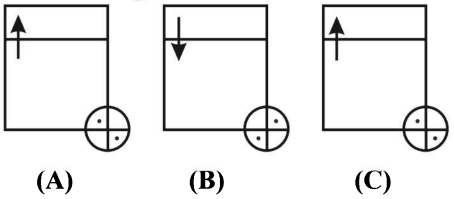
TYPES OF SERIES

Type-I.

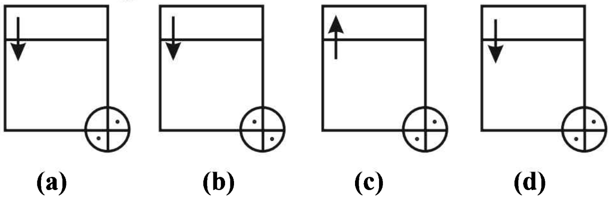
A definite relationship between elements in given figures.

Example **1. Study the problem figures marked (A), (B) and (C) carefully and try to establish the relationship between them. From the answer figures marked (a), (b), (c) and (d), pick out the figure which most appropriately completes the series.**

Problem Figures



Answer Figures

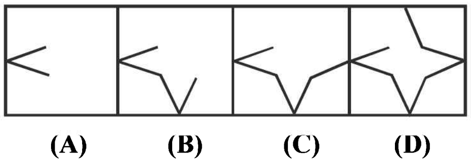


Sol. The direction of arrow which changes alternately. The dots are also changing alternately. Hence, we are looking for a figure in which the arrow points down and the dots and positioned as in figure (d).

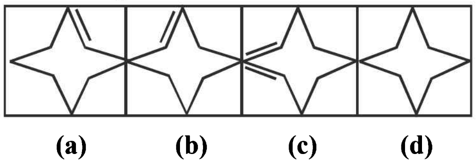
TYPE II.

Additions of Elements : In these type of questions, each figure is obtained by either sustaining the element of preceding figure as it is or adding a part of element or one element or more than one element of the preceding figure in a systematic way.

Example **2. Problem Figures**



Answer Figures

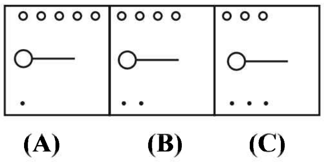


Sol. Two line segments are added in A to obtain B and one line segment is added in B to obtain C. This process is repeated again to obtain D. Hence, answer figure (d) continues the series.

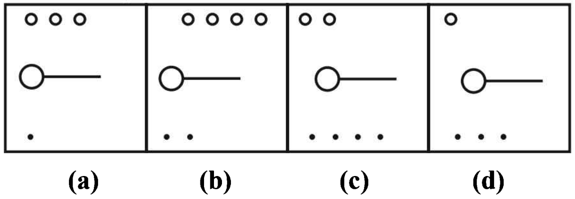
TYPE III.

Increasing/Decreasing of Elements : In these questions, the items in the diagrams either increase or decrease in number.

Example **3. Problem Figures**



Answer Figures

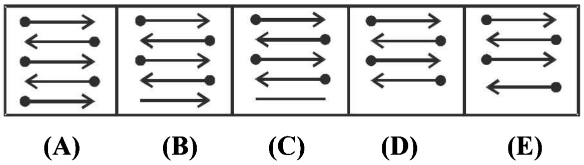


Sol. The small circles are decreasing consecutively and the black dots are increasing. So, figure (c) continues the series.

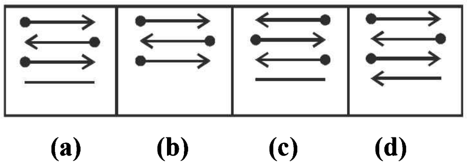
TYPE IV.

Deletion of Elements : In these type of questions, each figure is obtained by either sustaining the element of preceding figure as it is or deleting a part of an element or one element or more than one element of the preceding figure in a systematic way.

Example **4. Problem Figures**



Answer Figures

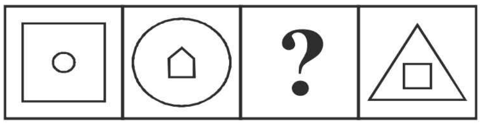


Sol. The qualitative characteristic of various elements in the diagrams change to complete the series. So, figure (a) continues the series.

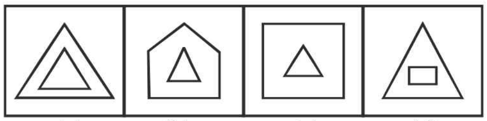
EXERCISE

DIRECTIONS (Qs. 1-15) : *In each of the questions, which one of the four figures (a, b, c, d) will continue the same series or replace the question mark so as to maintain the sequence.*

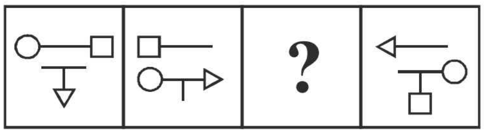
1. Problem Figures:


(A) (B) (C) (D)

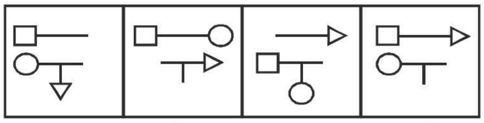
Answer Figures:


(a) (b) (c) (d)

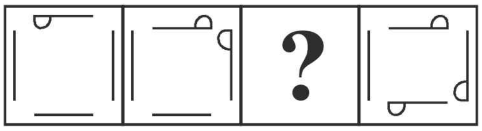
2. Problem Figures:


(A) (B) (C) (D)

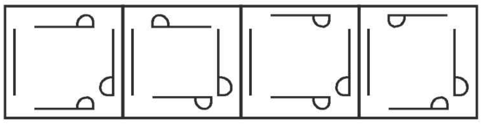
Answer Figures:


(a) (b) (c) (d)

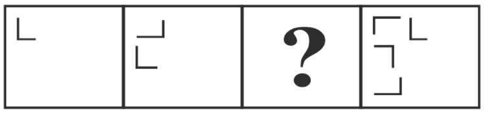
3. Problem Figures:


(A) (B) (C) (D)

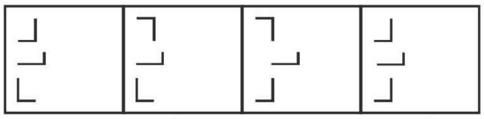
Answer Figures:


(a) (b) (c) (d)

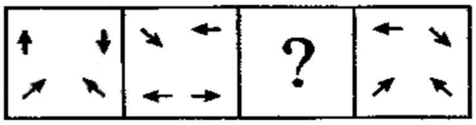
4. Problem Figures:


(A) (B) (C) (D)

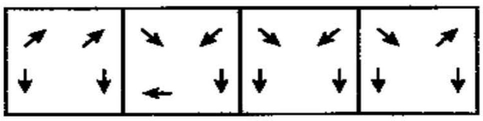
Answer Figures:


(a) (b) (c) (d)

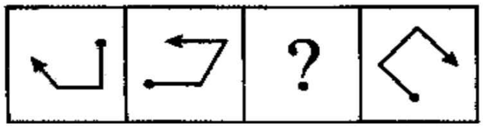
5. Problem Figures:


(A) (B) (C) (D)

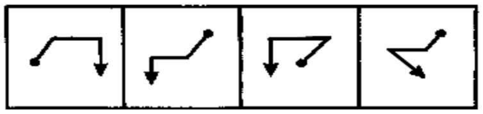
Answer Figures:


(a) (b) (c) (d)

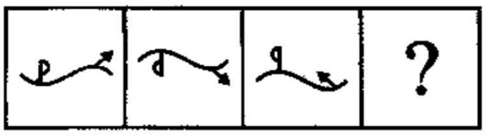
6. Problem Figures:


(A) (B) (C) (D)

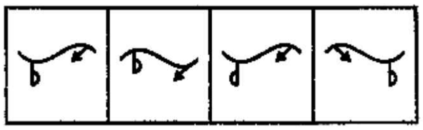
Answer Figures:


(a) (b) (c) (d)

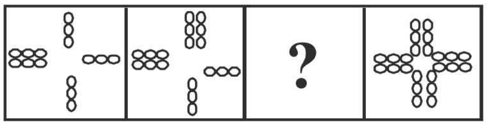
7. Problem Figures:


(A) (B) (C) (D)

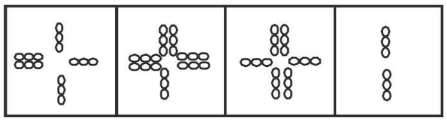
Answer Figures:


(a) (b) (c) (d)

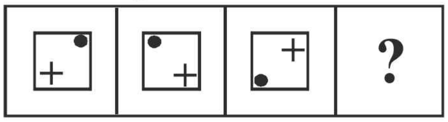
8. Problem Figures:


(A) (B) (C) (D)

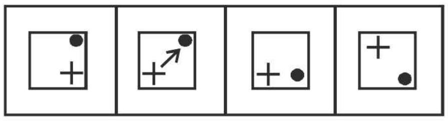
Answer Figures:


(a) (b) (c) (d)

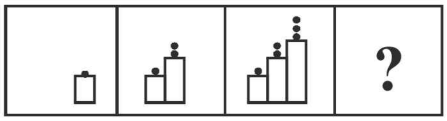
9. **Problem Figures:**


(A) (B) (C) (D)

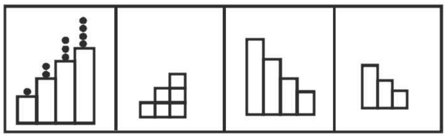
Answer Figures:


(a) (b) (c) (d)

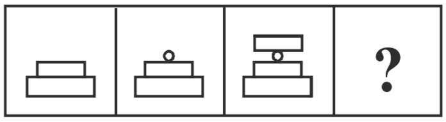
10. **Problem Figures:**


(A) (B) (C) (D)

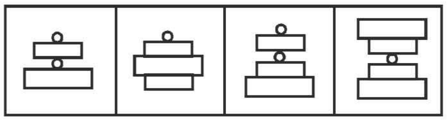
Answer Figures:


(a) (b) (c) (d)

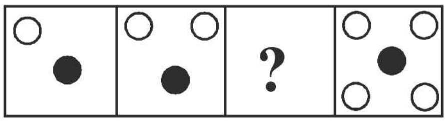
11. **Problem Figures:**


(A) (B) (C) (D)

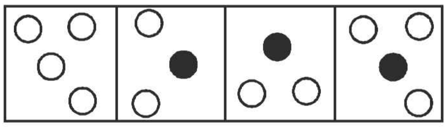
Answer Figures:


(a) (b) (c) (d)

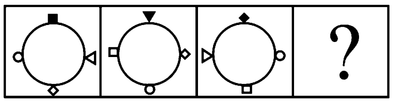
12. **Problem Figures:**


(A) (B) (C) (D)

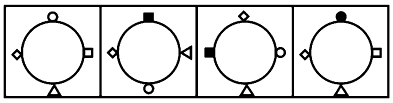
Answer Figures:


(a) (b) (c) (d)

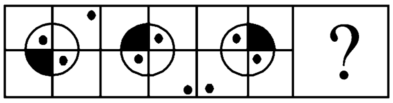
13.


(A) (B) (C) (D)

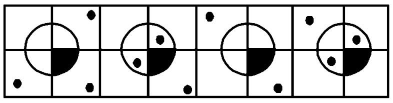
Answer Figures:


(a) (b) (c) (d)

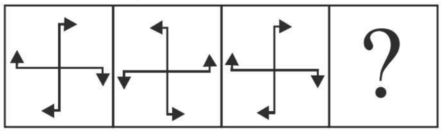
14.


(A) (B) (C) (D)

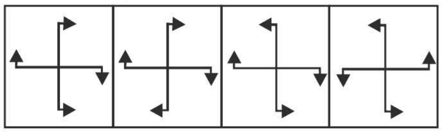
Answer Figures:


(a) (b) (c) (d)

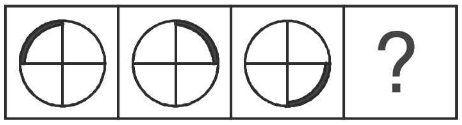
15. **Problem Figures:**


(A) (B) (C) (D)

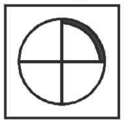
Answer Figures:


(a) (b) (c) (d)

16. **Problem Figures:**



Answer Figures:

(a)


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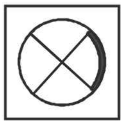

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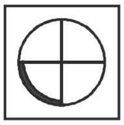
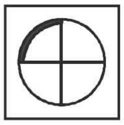


(d)


Hints & Solutions

1. **(b)** **2.** **(c)** **3.** **(d)** **4.** **(b)** **5.** **(c)** **6.** **(c)**
7. **(a)** **8.** **(b)** **9.** **(d)** **10.** **(a)** **11.** **(d)** **12.** **(d)**

13. **(d)** **14.** **(d)** **15.** **(d)**
16. **(c)** In every step, shaded region moves 90° clockwise.

SECTION-B : Quantitative Aptitude

Chapter 1 Number System

DIGITS

The ten symbols 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 are called *digits*, which can represent any number.

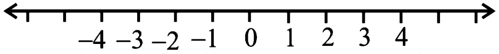
Face Value and Place Value

Face value is absolute value of a digit. Place value is value of a digit in relation to its position in the number. For example, face value and place value of 9 in 14921 are 9 and 900 respectively.

Note that to find the place value of a digit in a number, we put as many zero (0) after the digit as the number of digits after the digit whose place value is to be find in the given number.

THE NUMBER LINE

The number line is a straight line between negative infinity on the left to positive infinity on the right.



Each point on the number line represents a unique number on the number line.

NUMBERS

Natural Numbers

These are the numbers (1, 2, 3, etc.) that are used for counting. It is denoted by N.

There are infinite natural numbers and the smallest natural number is 1 (one).

Whole Numbers

The natural numbers along with zero (0), form the system of whole numbers.

It is denoted by W.

There is no largest whole number and
the smallest whole number is 0.

Integers

The number system consisting of natural numbers, their negative and zero is called integers.

It is denoted by Z or I.

The smallest and the largest integers cannot be determined.

Even Numbers

An integers which are divisible by 2 are even numbers. It is denoted by E.

$E = –24, – 4, –2, 2, 4, 6, 8, ...$

Smallest even natural number is 2. There is no largest even number.

Odd Numbers

Integers which are not divisible by 2 are odd numbers.

It is denoted by O.

$O = 1, 3, 5, 7, ...$

Smallest odd natural number is 1.

There is no largest odd number.

Prime Numbers

Natural numbers which have exactly two factors, 1 and the number itself are called prime numbers.

The lowest prime number is 2.

2 is also the only even prime number.

All prime number (Except 2 and 3) can be expressed in the form of $6N \pm 1$, where $N = 1, 2, 3, ...$

All prime numbers less than 100 are 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97.

Composite Numbers

It is a natural number that has atleast one divisor different from unity and itself.

Every composite number can be factorised into its prime factors.

For Example : $24 = 2 \times 2 \times 2 \times 3$. Here, 24 is a composite number and 2, 3 are prime numbers.

The smallest composite number is 4.

CO-prime Numbers

Those numbers are said to be co-prime if they do not have any common factors other than 1.

For Example : 14 and 15 are co-prime numbers. 14 and 15 have only common factor as 1.

Remember...

- 1 is neither prime nor composite.
- 1 is an odd integer.
- 0 is neither positive nor negative.
- 0 is an even integer.
- 2 is prime & even both.
- All prime numbers (except 2) are odd.

REAL NUMBERS

All numbers that can be represented on the number line by the points on it are called real numbers.

It is denoted by R.

R^+ : Positive real numbers and

R^- : Negative real numbers.

Real numbers = Rational numbers + Irrational numbers.

(i) Rational Numbers

Any number that can be put in the form of $\frac{p}{q}$, where p and q are integers and $q \neq 0$, is called a rational number.

It is denoted by Q.

Every integer is a rational number.

Zero (0) is also a rational number. The smallest and largest rational numbers cannot be determined.

Note that every integer is a rational number. Average of any two rational numbers is also a rational number. There are infinite number of rational number between any two rational numbers.

Decimal representation of any rational number is either terminating decimal number or non-terminating recurring (repeating) decimal number. So, all terminating decimal numbers (2.348, 0.07315, etc.) and all non-terminating repeating (recurring) decimal numbers ($54.3\overline{42}, 0.06\overline{3}, 5.\overline{2}$, etc.) are also rational numbers.

Remember...

- If x and y are two rational numbers, then $\frac{x+y}{2}$ is also a rational number and its value lies between the given two rational numbers x and y.
- An infinite number of rational numbers can be determined between any two rational numbers.

(ii) Irrational Numbers

The numbers which are not rational or which cannot be put in the form of $\frac{p}{q}$, where p and q are integers and $q \neq 0$, is called irrational number.

It is denoted by Q' or Q^c.

$\sqrt{2}, \sqrt{3}, \sqrt{5}, 2+\sqrt{3}, 3-\sqrt{5}, 3\sqrt{3}$ are irrational numbers.

Decimal representation of any irrational number is always non-terminating non-recurring (repeating) decimal number. So, all non-terminating and non-recurring (repeating) decimal numbers (68.3010010001......, 0.233223332223333...... etc.) are irrational numbers.

Note

- $\sqrt{2}+\sqrt{3} \neq \sqrt{5}$
- $\sqrt{5}-\sqrt{3} \neq \sqrt{2}$
- $\sqrt{3} \times \sqrt{2} = \sqrt{3 \times 2} = \sqrt{6}$
- $\sqrt{6} \div \sqrt{2} = \sqrt{\frac{6}{2}} = \sqrt{3}$
- Some times, product of two irrational numbers is a rational number.

  For example : $\sqrt{2} \times \sqrt{2} = \sqrt{2 \times 2} = 2$

  $(2+\sqrt{3}) \times (2-\sqrt{3}) = (2)^2 - (\sqrt{3})^2 = 4 - 3 = 1$

- Both rational and irrational numbers can be represented on number line. Thus real numbers is the set of the union of rational and irrational numbers.

  $R = Q \cup Q'$

- Every real number is either rational or irrational.

Example 1. Convert $2.\overline{46102}$ in the $\frac{p}{q}$ form of rational number.

Sol. Required $\frac{p}{q}$ form $= \frac{246102-2}{99999} = \frac{246100}{99999}$

Example 2. Convert $0.167\overline{3206}$ in the $\frac{p}{q}$ form of rational number.

Sol. Required $\frac{p}{q}$ form $= \frac{1673206-167}{9999000} = \frac{1673039}{9999000}$

TEST OF A PRIME NUMBER

A prime number is only divisible by 1 and by the number itself. The first prime number is 2. All other prime number are odd. To test whether any given number p is a prime number of not, following steps are to be considered :

Step 1 : If p is odd, then go to step 2. If even, then it is not a prime.

Step 2 : Find an integer $x > \sqrt{p}$.

Step 3 : Test the divisibility of the given number p by every prime number less than x.

Step 4 :

- If the given number is divisible by any of them in Step 3, then the given number is NOT a prime number.
- If the given number is not divisible by any of them in Step 3, then the given number is a **prime number**.

Example 3. Consider a number 437. Test if it is a prime number or not.

Step 1 : It is odd

Step 2 : The approximate square root 437 is 20 plus. Take $x = 21$.

Step 3 : Check the divisibility of 437 by the prime number less than 21 i.e., by 2, 3, 5, 7, 11, 13, 17, 19.

Step 4 : 437 is divisible by 19. Thus 437 is not a prime number.

Law of Indices

If a and b are any two real numbers and m and n are positive integers, then

(i) $a^m \times a^n = a^{m+n}$ (Example: $5^3 \times 5^4 = 5^{3+4} = 5^7$)

(ii) $\frac{a^m}{a^n} = a^{m-n}$, if $m > n$ $\left(\text{Example}: \frac{6^5}{6^2} = 6^{5-2} = 6^3\right)$

$\frac{a^m}{a^n} = \frac{1}{a^{n-m}}$, if $m < n$ $\left(\text{Example}: \frac{4^3}{4^8} = \frac{1}{4^{8-3}} = \frac{1}{4^5}\right)$

and $\frac{a^m}{a^n} = a^0 = 1$, if $m = n$ $\left(\text{Example}: \frac{3^4}{3^4} = 3^{4-4} = 3^0 = 1\right)$

(iii) $(a^m)^n = a^{mn} = (a^n)^m$ (Example: $(6^2)^4 = 6^{2 \times 4} = 6^8 = (6^4)^2$)

(iv) (a) $(ab)^n = a^n \cdot b^n$ (Example: $(6 \times 4)^3 = 6^3 \times 4^3$)

(b) $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}, b \neq 0$ $\left(\text{Example}: \left(\frac{5}{3}\right)^4 = \frac{5^4}{3^4}\right)$

(v) $a^{-n} = \frac{1}{a^n}$ $\left(\text{Example}: 5^{-3} = \frac{1}{5^3}\right)$

(vi) For any real number a, $a^0 = 1$ (Example : $8^0 = 1$)

Law of Surds

(i) $(a^{1/n})^n = a$ (Example: $(8^{1/3})^3 = 8$)

(ii) $a^{1/n} \cdot b^{1/n} = (ab)^{1/n}$ (Example: $5^{1/3} \cdot 8^{1/3} = (5 \times 8)^{1/3} = (40)^{1/3}$)

(iii) $(a^{1/n})^{1/m} = a^{\frac{1}{mn}}$ (Example : $(5^{1/3})^{1/5} = 5^{\frac{1}{3\times 5}} = 5^{1/15}$)

(iv) $a^{1/n} = \sqrt[n]{a}$ (Example : $5^{1/3} = \sqrt[3]{5}$)

(v) $a^{m/n} = \sqrt[n]{a^m}$ (Example : $5^{3/7} = \sqrt[7]{5^3}$)

ADDITION AND SUBTRACTION OF SURDS

Example:

$$5\sqrt{2} + 20\sqrt{2} - 3\sqrt{2} = (5 + 20 - 3)\sqrt{2} = 22\sqrt{2}$$

Example:

$$\sqrt{45} - 3\sqrt{20} + 4\sqrt{5} = 3\sqrt{5} - 6\sqrt{5} + 4\sqrt{5} = (3 - 6 + 4)\sqrt{5} = \sqrt{5}$$

GENERAL OR EXPANDED FORM OF 2 AND 3 DIGITS NUMBERS

(i) In a two digits number AB, A is the digit of tenth place and B is the digit of unit place, therefore AB is written using place value in expanded form as

$AB = 10A + B$

For example: $35 = 10 \times 3 + 5$

(ii) In a three digits number ABC, A is the digit of hundred place, B is the digit of tenth place and C is the digit of unit place, therefore ABC is written using place value in expanded form as

$ABC = 100A + 10B + C$

For example: $247 = 100 \times 2 + 10 \times 4 + 7$

These expanded forms are used in forming equations related to 2- and 3- digits numbers.

Example 4. In a two digit prime number, if 18 is added, we get another prime number with reversed digits. How many such numbers are possible ?

Sol. Let a two-digit number be $10p + q$.

$\therefore \quad 10p + q + 18 = 10q + p$

$\Rightarrow \quad -9p + 9q = 18 \Rightarrow q - p = 2$

Satisfying this condition and also the condition of being a prime number there are 2 numbers 13 and 79.

PRIME FACTORISATION

It is a process of representing a given number as a product of two or more prime numbers.

Each prime number which is present in the product is called a **prime factor** of the given number.

For example: 12 is expressed in the factorised form in terms of its prime factors as $12 = 2 \times 2 \times 3 = 2^2 \times 3$.

METHOD TO FIND THE NUMBER OF DIFFERENT DIVISORS OR FACTORS (INCLUDING 1 AND ITSELF) OF ANY COMPOSITE NUMBER *N* :

Step I : Express N as a product of prime numbers as

$N = x^a \times y^b \times z^c$ ....

Step II : Number of different divisors (including 1 and itself)

$= (a + 1)(b + 1)(c + 1)$ ....

NUMBER OF WAYS OF EXPRESSING A COMPOSITE NUMBER AS A PRODUCT OF TWO FACTORS

(i) Number of ways of expressing a composite number N which is not a perfect square as a product of two factors

$= \frac{1}{2} \times$ (Number of prime factors of the N)

(ii) Number of ways of expressing a perfect square number M as a product of two factors

$= \frac{1}{2}$ [(Number of prime factors of M) + 1]

Example 5. Find the number of ways of expressing 180 as a product of two factors.

Sol. $180 = 2^2 \times 3^2 \times 5^1$

Number of factors $= (2 + 1)(2 + 1)(1 + 1) = 18$

Since 180 is not a perfect square, hence there are total $\frac{18}{2} = 9$ ways in which 180 can be expressed as a product of two factors.

COUNTING NUMBER OF ZEROS

Sometimes we come across problems in which we have to count number of zeros at the end of factorial of any number. For example:

Number of zeros at the end of 10!

$10! = 10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$

Here basically we have to count number of fives, because multiplication of five by any even number will result in 0 at the end of final product. In 10! we have 2 fives (as $10 = 2 \times 5$). There are more than two even number also in 10! Thus total number of zeros are 2.

Note

'10!' is read as 'Ten factorial'.

Here '!' indicates 'factorial'.

We find the factorial of only natural numbers.

If 'n' is a natural number, then $n! = n(n-1)(n-2)\ .....\ 4.3.2.1$

Remember...

Number of zeros at the end of n! is the integral part of the value of

$$\frac{n}{5}+\frac{n}{5^2}+\frac{n}{5^3}+\frac{n}{5^4}+\cdots\cdots\cdots$$

Example 6. Number of zeros at the end of 100!

Sol. Number of zeros at the end of 100!

$$= \text{Integral part of } \frac{100}{5}+\frac{100}{5^2}+\frac{100}{5^3}+\cdots\cdots\cdots$$

$= 20 + 4 = 24$ zeros.

HIGHEST POWER OF A PRIME NUMBER CONTAINED IN A FACTORIAL

Highest power of a prime number P in $N!$

$$=\left[\frac{N}{P}\right]+\left[\frac{N}{P^2}\right]+\left[\frac{N}{P^3}\right]+---+\left[\frac{N}{P^r}\right],$$

where $[x]$ denotes the greatest integers less than or equal to x and is a natural number. Also $P^r < N$.

Example 7. Find highest power of 7 in 50!

Sol. The highest power 7 in 50!

$$=\left[\frac{50}{7}\right]+\left[\frac{50}{7^2}\right]=7+1=8$$

TO FIND THE LAST DIGIT OR DIGIT AT THE UNIT'S PLACE OF a^n.

(i) If the last digit or digit at the unit's place of a is 1, 5 or 6, then whatever be the value of n, it will have the same digit at unit's place, i.e.,

$(.....1)^n = (.....1)$

$(.....5)^n = (.....5)$

$(.....6)^n = (.....6)$

(ii) If the last digit or digit at the units place of a is 2, 3, 7 or 8, then the last digit of a^n depends upon the value of n and follows a repeating pattern in terms of 4 as given below :

n	last digit of $(...2)^n$	last digit of $(...3)^n$	last digit of $(...7)^n$	last digit of $(...8)^n$
1	2	3	7	8
2	4	9	9	4
3	8	7	3	2
4	6	1	1	6
5	2	3	7	8

(iii) If the last digit or digit at the unit's place of a is either 4 or 9, then the last digit of a^n depends upon the value of n and follows repeating pattern in terms of 2 as given below.

n	last digit of $(....4)^n$	last digit of $(....9)^n$
1	4	9
2	6	1
3	4	9

Example 8. Find unit digit of $963^{63} \times 73^{73}$.

Sol. $(963)^{63} = (963)^{4\times15} \times (963)^3$

$\therefore$ Unit digit of $963^{63} = 7$

$(73)^{73} = (73)^{4\times18} \times (73)^1$

Unit digit of $73^{73} = 3$

So unit digit of $963^{63} \times 73^{73} \Rightarrow 7 \times 3 \Rightarrow 21$. i.e., 1.

REMAINDER THEOREM

Remainder of expression $\frac{a\times b\times c}{n}$ [i.e. $a \times b \times c$ when divided by n] is equal to the remainder of expression $\frac{a_r\times b_r\times c_r}{n}$ [i.e. $a_r \times b_r \times c_r$ when divided by n] , where

a_r is remainder when a is divided by n.

b_r is remainder when b is divided by n. and

c_r is remainder when c is divided by n.

Example 9. Find the remainder of 15 × 17 × 19 when divided by 7.

Sol. On dividing 15 by 7, we get 1 as remainder.

On dividing 17 by 7, we get 3 as remainder.

On dividing 19 by 7, we get 5 as remainder.

$$\text{Remainder of } \frac{15\times17\times19}{7} = \text{Remainder of } \frac{1\times3\times5}{7}$$

$$= \text{Remainder of } \frac{15}{7} = \text{Remainder of } 2\frac{1}{7} \text{ i.e. } 1$$

POLYNOMIAL THEOREM

When $(x + a)^n$ is divided by x, then remainder is equal to the remainder of the expression $\frac{a^n}{x}$.

Example 10. Find the remainder of $\frac{9^{99}}{8}$.

Sol. $\frac{9^{99}}{8} = \frac{(8+1)^{99}}{8}$

According to polynomial theorem, remainder of $\frac{9^{99}}{8}$ will be equal to remainder of the expression $\frac{1^{99}}{8} \Rightarrow \frac{1}{8}$ i.e., Remainder $=1$

SHORTCUTS

Shortcut Approach – 1

When two numbers are divided by a third number, leave the same remainder, then the difference of these two numbers is always perfectly divisible by third number.

Example 11. 24345 and 33334 are divided by certain number of three digits and the remainder is the same in both the cases. Find the divisor and the remainder.

(a) 103, 6 (b) 809, 3 (c) 101, 4 (d) 109, 5

Sol. (c) Difference = 33334 – 24345 = 8989

Since, 8989 = 101 × 89

∴ 101 is the required 3 digit divisor
On dividing any of the given numbers by 101, we get 4 as remainder.

Shortcut Approach – 2

Sum of the digits of a given two digit number is S. When its digits are interchange their places, the number decreased by D. Then,

Given number $= 5\left(S+\frac{D}{9}\right)+\frac{1}{2}\left(S-\frac{D}{9}\right)$

Example 12. Sum of the digits of a given 2–digit number is 12. When its digits interchange their places, the number decreases by 54. Find the number.

(a) 93 **(b)** 84 **(c)** 75 **(d)** 66

Sol. (a) ∴ Given number $= 5\left[S+\frac{D}{9}\right]+\frac{1}{2}\left[S-\frac{D}{9}\right]$

$$= 5\left[12+\frac{54}{9}\right]+\frac{1}{2}\left[12-\frac{54}{9}\right] = 5\times18+\frac{1}{2}\times6=93$$

Shortcut Approach – 3

(i) $(a^n + b^n)$ is divisible by $(a + b)$ when n is odd

(ii) $(a^n - b^n)$ is divisible by both $(a + b)$ and $(a - b)$ when n is even

(iii) $(a^n - b^n)$ is divisible by only $(a - b)$ when n is odd

Example 13. If $(67^{67} + 67)$ is dividing by 68, the remainder is :

(a) 61 **(b)** 67 **(c)** 63 **(d)** 66

Sol. (d) ∵ $(x^n + y^n)$ is divisible by $(x + y)$ when n is odd
So, $((67^{67} + 1^{67}) + 66)$ $(67^{67} + 1^{67})$ is divisible by 68,
Hence remainder is 66.

Shortcut Approach – 4

When $(x^n + k)$ is divided by $(x - 1)$,

(a) Remainder $= 1 + k$; if $k < (x - 1)$

(b) Remainder $= 1 +$ (Remainder obtained when k is divided by $x - 1$); if $k > x - 1$

Example 14. Find the remainder on dividing $(9^{16} + 6)$ by 8.

(a) 5 **(b)** 7 **(c)** 2 **(d)** 3

Sol. (b) Here $k = 6$ and $x - 1 = 8$
∴ $k < (x - 1)$
So, Remainder $= 1 + k = 1 + 6 = 7$

Shortcut Approach – 5

To find the value of $\sqrt{x+\sqrt{x+\sqrt{x+\ldots\ldots}}}$, find the factors of x, such that the difference between the factors is 1, then the larger factor will be the result.

Example 15. $\sqrt{6+\sqrt{6+\sqrt{6+\ldots}}}$ is equal to

(a) 3 **(b)** 4 **(c)** 5 **(d)** 6

Sol. (a) $\sqrt{6+\sqrt{6+\sqrt{6+\ldots\ldots}}}$
The factors of 6 with difference one are 2 and 3
Here 3 is the larger factors.
Hence $\sqrt{6+\sqrt{6+\sqrt{6+\ldots\ldots}}} = 3$

Example 16. $\sqrt{12+\sqrt{12+\sqrt{12+\sqrt{12\ldots\ldots}}}} = ?$

(a) 3 **(b)** 4 **(c)** 6 **(d)** 12

Sol. (b) $\sqrt{12+\sqrt{12+\sqrt{12+\sqrt{12+\ldots}}}}$
The two factors of 12 with difference one are 4 and 3.
Here, 4 is the bigger factor.
Hence, $\sqrt{12+\sqrt{12+\sqrt{12+\sqrt{12+\ldots\ldots}}}} = 4$

Shortcut Approach – 6

To find the value of $\sqrt{x-\sqrt{x-\sqrt{x-\ldots\ldots}}}$ find the factors of x, such that the difference between the factors is 1, then the smaller factor will be the result.

Example 17. $\sqrt{2-\sqrt{2-\sqrt{2-\sqrt{2\ldots\ldots}}}} = ?$

(a) 0 **(b)** 1 **(c)** 2 **(d)** 3

Sol. (b) As given expression is
$\sqrt{2-\sqrt{2-\sqrt{2-\sqrt{2}}}}$
The factors of 2 with difference one are 1 and 2.
Here 1 is the smaller factor
Hence, $\sqrt{2-\sqrt{2-\sqrt{2-\sqrt{2}}}} = 1$

Shortcut Approach – 7

$$\sqrt{x\sqrt{x\sqrt{x\ldots\ldots\ldots\; n \text{ times}}}} = (x)^{\frac{2^n-1}{2^n}}$$

Example 18. The value of $\sqrt{2\sqrt{2\sqrt{2\sqrt{2\sqrt{2}}}}}$ will be

(a) 2 **(b)** $2^{15/32}$ **(c)** $2^{31/32}$ **(d)** 4

Sol. (c) $\sqrt{2\sqrt{2\sqrt{2\sqrt{2\sqrt{2}}}}} = (2)^{\left[\frac{2^5-1}{2^5}\right]} = 2^{(31/32)}$

Shortcut Approach – 8

$$\sqrt{x\sqrt{x\sqrt{x\sqrt{x\ldots\ldots\infty}}}} = x$$

Example 19. $\sqrt{3\sqrt{3\sqrt{3\ldots}}}$ is equal to

(a) $\sqrt{3}$ **(b)** 3 **(c)** $2\sqrt{3}$ **(d)** $3\sqrt{3}$

Sol. (b) $\sqrt{3\sqrt{3\sqrt{3\ldots\ldots}}} = 3$

Alternate Method :

Let $\sqrt{3\sqrt{3\sqrt{3\ldots\ldots}}} = x$
or, $\sqrt{3x} = x$
Squaring both side
$3x = x^2 \quad 0 = x^2 - 3x \quad 0 = x(x - 3)$
$x = 3$

EXERCISE

1. The difference between a two-digit number and the number obtained by interchanging the two digits of the number is 18. The sum of the two digits of the number is 12. What is the product of the two digits of the two digits number ?
(a) 35 (b) 27
(c) 32 (d) Cannot be determined
(e) None of these

2. The prime number 1999 can be written as $a^2 - b^2$, where a and b are natural numbers. Then the value of $a^2 + b^2$ is
(a) 1998000 (b) 1998001
(c) 1999000 (d) 1999001

3. If a two digits number is k times the sum of its digits, then the number formed by interchanging the digits is the sum of the digits multiplied by:
(a) $9 + k$ (b) $10 + k$ (c) $11 - k$ (d) $k - 1$

4. Which is the smallest number by which 4320 be divided to make it a perfect cube?
(a) 15 (b) 20 (c) 24 (d) 25

5. In every 30 minutes the time of a watch increases by 3 minutes. After setting the correct time at 5 am., what time will the watch show after 6 hours?
(a) 10 : 54 a.m. (b) 11 : 30 a.m.
(c) 11 : 36 a.m. (d) 11 : 42 a.m.
(e) 11 : 38 p.m.

6. If two numbers are each divided by the same divisor, the remainders are respectively 3 and 4. If the sum of the two numbers be divided by the same divisor, the remainder is 2. The divisor is :
(a) 9 (b) 7 (c) 5 (d) 3

7. If the digits in the unit and the ten's places of a Two digit number are interchanged, a new number is formed, which is greater than the original number by 63. Suppose the digit in the unit place of the original number the x. Then, all the possible values of x are
(a) 7, 8, 9 (b) 2, 7, 9 (c) 0, 1, 2 (d) 1, 2, 8

8. The numerator of a fraction is 4 less than its denominator. If the numerator is decreased by 2 and the denominator is increased by 1, the denominator becomes eight times the numerator. Find the fraction.
(a) $\frac{3}{8}$ (b) $\frac{3}{7}$ (c) $\frac{4}{8}$ (d) $\frac{2}{7}$

9. Given that, three numbers are such that the second number is twice the first and thrice the third. Also the average of the three numbers is 44. Then the difference of the first and the third is :
(a) 10 (b) 11 (c) 12 (d) 13

10. Let x be an odd natural number. If x is divided by 6, it leaves a remainder y. If y^2 is divided by 4, it leaves remainder of z. Which of the following must be true for z?
(a) $z = 3$ (b) $z = 5$
(c) $z = 1$ (d) z is even

11. When 9 is subtracted from a two digit number, the number so formed is reverse of the original number. Also, the average of the digits of the original number is 7.5. What is definitely the original number?
(a) 87 (b) 92 (c) 90 (d) 69
(e) 96

12. The sum of a series of 5 consecutive odd numbers is 195. The second lowest number of this series is 9 less than the second highest number of another series of 5 consecutive even numbers. What is 40% of the second lowest number of the series of consecutive even numbers?
(a) 16.8 (b) 18.8 (c) 19.4 (d) 17.6
(e) 16.4

13. The sum of a series of 5 consecutive odd numbers is 225. The second number of this series is 15 less than the second lowest number of another series of 5 consecutive even numbers. What is 60% of the highest number of this series of consecutive even numbers?
(a) 36.0 (b) 34.6 (c) 38.4 (d) 40.8
(e) 39.2

14. $(x^{2a})^b = \sqrt{x^{\frac{4b}{c}}}$ and $\frac{x^{4b}}{x^{3a}} = x^{3(a-b)}.x^b$. a, b and c being natural numbers.
(a) $a \neq b \neq c$ (b) $a = b < c$
(c) $a < b = c$ (d) $a = b = c$
(e) None of these

15. A classroom has equal number of boys and girls. Eight girls left to play Kho-Kho, leaving twice as many boys as girls in the classroom. What was the total number of girls and boys present initially?
(a) Cannot be determined (b) 16
(c) 24 (d) 32
(e) None of these

16. If in a three-digit number the last two digits places are interchanged, a new number is formed which is greater than the original number by 45. What is the difference between the last two digits of that number?
(a) 9 (b) 8 (c) 6 (d) 5

17. In a two digit number the digit in the unit's place is twice the digit in the ten's place and the number obtained by interchanging the digits is more than the original number by 27. What is 50% of the original number?
(a) 36 (b) 63
(c) 48 (d) 18
(e) None of these

18. What is the greater of two numbers whose product is 1092 and the sum of the two numbers exceeds their difference by 42?
(a) 48 (b) 44
(c) 52 (d) 54
(e) None of these

19. Two numbers are such that the sum of twice the first number and thrice the second number is 36 and the sum of thrice the first number and twice the second number is 39. Which is the smaller number?

(a) 9 (b) 5
(c) 7 (d) 3
(e) None of these

20. In a three digit number the digit in the unit's place is twice the digit in the ten's place and 1.5 times the digit in the hundred's place. If the sum of all the three digits of the number is 13, what is the number?

(a) 364 (b) 436
(c) 238 (d) 634
(e) None of these

21. The denominators of two fractions are 5 and 7 respectively. The sum of these fractions is $\frac{41}{35}$. On interchanging the numerators, their sum becomes $\frac{43}{35}$. The fractions are

(a) $\frac{2}{5}$ and $\frac{4}{7}$ (b) $\frac{3}{5}$ and $\frac{4}{7}$
(c) $\frac{4}{5}$ and $\frac{2}{7}$ (d) $\frac{3}{5}$ and $\frac{5}{7}$
(e) None of these

22. The number $25^{64} \times 64^{25}$ is the square of a natural number *n*. The sum of digits of *n* is

(a) 7 (b) 14
(c) 21 (d) 28

23. Let *x* be the product of two numbers 3, 659, 893, 456, 789, 325, 678 and 342, 973, 489, 379, 256. The number of digits in *x* is

(a) 32 (b) 34
(c) 35 (d) 36

24. The number $(2^{48} - 1)$ is exactly divisible by two numbers between 60 and 70. The numbers are:

(a) 63 and 65 (b) 63 and 67
(c) 61 and 65 (d) 65 and 67

25. If $(2^{36} - 1) = 68$ a 19476735, where a is any digit, then the value of a is

(a) 1 (b) 3 (c) 5 (d) 7

26. Given the numbers: 2^{5555}, 3^{3333}, 6^{2222}. These can be written in ascending order as

(a) $2^{5555}, 3^{3333}, 6^{2222}$ (b) $3^{3333}, 2^{5555}, 6^{2222}$
(c) $2^{5555}, 6^{2222}, 3^{3333}$ (d) $6^{2222}, 2^{5555}, 3^{3333}$
(e) None of these

27. Rachita enters a shop to buy ice-creams, cookies and pastries. She has to buy atleast 9 units of each. She buys more cookies than ice-creams and more pastries than cookies. She picks up a total of 32 items. How many cookies does she buy?

(a) Either 12 or 13 (b) Either 11 or 12
(c) Either 10 or 11 (d) Either 9 or 11
(e) Either 9 or 10

28. The fare of a bus is ₹ *x* for the first five kilometres and ₹13 per kilometres thereafter. If a passenger pays ₹ 2,402 for a journey of 187 kilometres, what is the value of *X*?

(a) ₹ 29 (b) ₹ 39
(c) ₹ 36 (d) ₹ 31
(e) None of these

29. In an examination, a student scores 4 marks for every correct answer and losses 1 mark for every wrong answer. A student attempted all the 200 questions and scored in all 200 marks. The number of questions, he answered correctly was :

(a) 82 (b) 80
(c) 68 (d) 60

Hints & Solutions

1. **(a)** Let the two-digit number be $= 10x + y$, where $x > y$

According to the question,

$10x + y - 10y - x = 18$ or, $9x - 9y = 18$

or, $x - y = \frac{18}{9} = 2$ ...(i)

and, $x + y = 12$ ...(ii)

From equations (i) and (ii)

$2x = 14 \Rightarrow x = 7$

From equation (i)

$y = 7 - 2 = 5$

$\therefore$ Required product $= xy = 7 \times 5 = 35$

2. **(b)** $a^2 - b^2 = 1999$

$\Rightarrow (a + b)(a - b) = 1999$

$\Rightarrow (1000 + 999)(1000 - 999) = 1999$

$\therefore a^2 + b^2 = (1000)^2 + (999)^2$

$= 1000000 + 998001 = 1998001$

3. **(c)** $10x + y = k(x + y)$

$\therefore 10y + x = 11y + 11x - 10x - y$

$= 11(x + y) - k(x + y) = (11 - k)(x + y)$

4. **(b)**

2	4320
2	2160
2	1080
2	540
2	270
5	135
3	27
3	9
3	3
	4

$\therefore 4320 = 2 \times 2 \times 2 \times 2 \times 2 \times 5 \times 3 \times 3 \times 3 = 2^5 \times 3^3 \times 5$

$\therefore$ Required number $= 2^2 \times 5 = 20$

5. **(c)** Time gained in 6 hours = 12 × 3 = 36 minutes

$\therefore$ Required time = 11 : 36 a.m.

6. **(c)** Divisor = Remainder 1 + Remainder 2 – Remainder 3

$= 3 + 4 - 2 = 7 - 2 = 5$

7. **(c)** Let the two digit no. be $10x + y$ where $y > x$

$10y + x - 10x - y = 63$

$9y - 9x = 63$

$y - x = 7$

$y = 7, 8, 9$ and $x = 0, 1, 2$

8. **(b)** Let 'd' be denominator so numerator be $(d - 4)$

According to question

$\Rightarrow \frac{(d-4)-2}{d+1} = \frac{1}{8} \quad \Rightarrow \frac{d-6}{d+1} = \frac{1}{8}$

$\Rightarrow 8d - 48 = d + 1$

$7d = 49$

$d = 7$

numerator $\Rightarrow d - 4 = 7 - 4 = 3$

denominator (d) $\Rightarrow 7$

$\therefore$ fraction $= \frac{3}{7}$

9. **(c)** Let three numbers are $3x, 6x, 2x$

Avg. $= \frac{11x}{3} = 44$

$x = 12$

Difference of first and third number

$= 3x - 2x = x = 12$.

10. **(c)** $x = 6Q + y$

$y^2 = 4Q^1 + z$

The value of z may be 1, 2 or 3.

The value of y may be 1, 3, or 5 as if 2 or 4 be the value, y^2 will be exactly divisible by 4.

$\therefore z = 1$

11. **(a)** Let the two-digit number be $10x + y$

According to the questions,

$10x + y - 9 = 10y + x$

$\Rightarrow 10x + y - 10y - x = 9$

$\Rightarrow 9x - 9y = 9$

$\Rightarrow x - y = 1$ ...(i)

and, $\frac{x+y}{2} = 7.5$

$\Rightarrow x + y = 15$ ...(ii)

On adding equations (i) and (ii),

$2x = 16$

$\Rightarrow x = 8$

from equation (i),

$8 - y = 1$

$\Rightarrow y = 8 - 7 = 7$

$\therefore$ Required number = 10 × 8 + 7 = 87

12. **(a)** Five consecutive odd numbers

$\Rightarrow x, x + 2, x + 4, x + 6$ and $x + 8$

$\therefore x + x + 2 + x + 4 + x + 6 + x + 8 = 195$

$\Rightarrow 5x + 20 = 195$

$\Rightarrow 5x = 195 - 20 = 175$

$\Rightarrow x = \frac{175}{5} = 35$

$\therefore$ Second lowest number = 35 + 2 = 47

$\therefore$ Second highest even number = 37 + 9 = 46

$\therefore$ Second lowest even number = 42

$\therefore$ 40% of 42 $= \frac{42 \times 40}{100} = 16.8$

13. **(c)** Let the odd number be: $x, x + 2, x + 4, x + 6$ and $x + 8$

$\therefore x + x + 2 + x + 4 + x + 6 + x + 8 = 225$

$\Rightarrow 5x + 20 = 225$

$\Rightarrow 5x = 225 - 20 = 205$

$\Rightarrow x = \frac{205}{5} = 41$

$\therefore$ Second number = 43

Second lowest even number = 43 + 15 = 58

$\therefore$ Largest even number = 58 + 6 = 64

$\therefore$ 60% of 64 $= \frac{64 \times 60}{100} = 38.4$

14. **(d)** $(x^{2a})^b = (x)^{\frac{4b}{2c}}$

$\Rightarrow 2\,ab = \frac{2b}{c} \quad \Rightarrow ac = 1$

$a = c = 1$ [$\because$ Both a and c are natural numbers] ...(i)

$\frac{x^{4b}}{x^{3a}} = x^{3(a-b)}.\,x^b \quad \Rightarrow x^{4b-3a} = x^{3a-2b}$

$\Rightarrow 4b - 3a = 3a - 2b \quad \Rightarrow 6b = 6a$

$\Rightarrow a = b$ ....(ii)

From (i) and (ii) we have,

$a = b = c$

15. **(d)** Let the no. of boys and girls each be x.

$2(x - 8) = x$

$2x - 16 = x$

$x = 16$

$\therefore$ Total no. of boys and girls present initially in the classroom = $2x$ = 32

16. **(b)** Three digit number = $100x + 10y + z$

To make number after changing last two digits

$= 100x + 10z + y$

Now, $100x + 10y + z = 100x + 10z + y - 45$

$9z - 9y = 45$

$z - y = 5$

17. **(d)** Let the ten's digit be x, then, unit's digit = $2x$

$\therefore$ Original number = $10x + 2x = 12x$

On interchanging the digits, the new number

$= 10 \times 2x + x = 21x$

According to question,

$21x - 12x = 27$

$\Rightarrow \quad 9x = 27 \quad \Rightarrow \quad x = \frac{27}{9} = 3$

$\therefore$ Original number = $12x = 12 \times 3 = 36$

Hence, 50% of original number = $36 \times \frac{50}{100} = 18$

18. (c) Let the numbers be x and y.
According to the question,
$x + y - (x - y) = 42 \quad \Rightarrow \quad 2y = 42$

$\Rightarrow \quad y = \frac{42}{2} = 21 \quad \therefore \quad x = \frac{1092}{21} = 52$

19. (e) Let the numbers be x and y.
According to the question,
$2x + 3y = 36$ ...(i)
$3x + 2y = 39$ ...(ii)
By equation (i) × 3 – (ii) × 2,
$6x + 9y - 6x - 4y = 108 - 78$

$\Rightarrow \quad 5y = 30 \quad \Rightarrow \quad y = \frac{30}{5} = 6$

From equation (i), we have,
$2x + 3 \times 6 = 36$
$\Rightarrow \quad 2x = 36 - 18 = 18$

$\Rightarrow \quad x = \frac{18}{2} = 9$ and, $y = 6$

$\therefore$ The smaller number = 6

20. (b) Let the ten's digit be x.
then, Unit's digit = $2x$

and hundred's digits = $\frac{2x}{1.5}$

According to the question,

$x + 2x + \frac{2x}{1.5} = 13 \quad \Rightarrow \quad \frac{1.5x + 3x + 2x}{1.5} = 13$

$\Rightarrow \quad 6.5x = 13 \times 1.5$

$\Rightarrow \quad x = \frac{13 \times 1.5}{6.5} = 3$

$\therefore$ Unit's digit = 6, ten's digit = 3 and hundred's digit $= \frac{6}{1.5} = 4$

$\therefore$ Number = 436

Note: This question can be solved by oral calculation, taking the alternatives into consideration.

21. (b) From given alternatives,

$\frac{3}{5} + \frac{4}{7} = \frac{21+20}{35} = \frac{41}{35}$ and

$\frac{4}{5} + \frac{3}{7} = \frac{28+15}{35} = \frac{43}{35}$

22. (b) $n^2 = 25^{64} \times 64^{25} = (5^2)^{64} \times (2^6)^{25}$
$= 5^{128} \times 2^{128} \times 2^{22}$
$\therefore \quad n = 5^{64} \times 2^{64} \times 2^{11}$
$= (5 \times 2)^{64} \times 2048 = 10^{64} \times 2048$
$\therefore$ Sum of digits = $2 + 0 + 4 + 8 = 14$

23. (b) $365989345689325678 = 37 \times 10^{17}$
and $342973489379256 = 3 \times 10^{14}$
$\therefore \quad 37 \times 10^{17} \times 3 \times 10^{14} = 111 \times 10^{31}$
$\therefore$ Number of digits = $31 + 3 = 34$

24. (a) $2^{48} - 1 = (2^{24} + 1)(2^{24} - 1)$
$= (2^{24} + 1)(2^{12} + 1)(2^6 + 1)(2^6 - 1)$
$\therefore$ Required numbers = $2^6 + 1$ and $2^6 - 1 = 65$ and 63.

25. (a) $2^2 - 1 = 4 - 1 = 3$
$2^4 - 1 = 16 - 1 = 15$
$2^6 - 1 = 64 - 1 = 63$
$2^8 - 1 = 256 - 1 = 255$
Hence, if n = even number, then $(2^n - 1)$, is divisible by 3.
We know a number is divisible by 3. If the sum of its digits is divisible by 3.
$\therefore \quad a = 1$

26. (b) $2^{5555} = (2^5)^{1111} = (32)^{1111}$
$3^{3333} = (3^3)^{1111} = (27)^{1111}$
$6^{2222} = (6^2)^{1111} = (36)^{1111}$
$3^{3333} < 2^{5555} < 6^{2222}$

27. (c) According to the question,
Ice-creams + Cookies + Pastries = 32
$\Rightarrow \quad 9 + 11 + 12 = 32$
or, $\quad 9 + 10 + 13 = 32$
$10 + 11 + 12 \neq 32$
Hence, either she but 10 or 11 Cookies.

28. (c) According to the question,
$x + 182 \times 13 = 2402$
$\Rightarrow \quad x + 2366 = 2402$
$\Rightarrow \quad x = 2402 - 2366 =$ ₹ 36

29. (b) Let the correct answer are 'n'
According to question

$$\overbrace{4n}^{\text{Correct marks}} - \overbrace{(200 - n) \times 1}^{\text{Incorrect marks}} \overbrace{= 200}^{\text{Total marks}}$$

$4n - 200 + n = 200$
$5n = 400$
$n = 80$

Chapter 2

HCF, LCM and Simplification

HCF AND LCM

HIGHEST COMMON FACTOR (HCF) OR GREATEST COMMON DIVISOR (GCD)

The highest (i.e. largest) number that divides two or more given numbers is called the highest common factor (HCF) of those numbers.

Methods to Find the HCF or GCD

There are two methods to find HCF of the given numbers.

(i) Prime Factorization Method

When a number is written as the product of prime numbers, then it is called the prime factorization of that number. For example, $72 = 2 \times 2 \times 2 \times 3 \times 3 = 2^3 \times 3^2$. Here, $2 \times 2 \times 2 \times 3 \times 3$ or $2^3 \times 3^2$ is called prime factorization of 72.

To find the HCF of given numbers by this methods, we perform the prime factorization of all the numbers and then check for the common prime factors in it. For every prime factor common to all the numbers, we choose the least index of that prime factor among the given numbers. The HCF is the product of all such prime factors with their respective least indices.

(ii) Division Method

To find the HCF of two numbers by division method, we divide the larger number by the smaller number. Then we divide the smaller number by the first remainder, then first remainder by the second remainder and so on, till the remainder becomes 0. The last divisor is the required HCF.

LEAST COMMON MULTIPLE (LCM)

The least common multiple (LCM) of two or more numbers is the lowest number which is divisible by all the given numbers.

Methods to Find the LCM

There are two methods to find the LCM.

(i) Prime Factorization Method

After performing the prime factorization of all the given numbers, we find the highest index of all the prime factors among the given numbers. The LCM is the product of all these prime factors with their respective highest indices because LCM must be divisible by all of the given numbers.

(ii) Division Method

Check whether any prime number that divides at least two of all the given numbers. If there is no such prime number, then the product of all these numbers is the required LCM, otherwise write all the given numbers in a row separating them by putting the comma ‘,’ in between the numbers and find the smallest prime number that divides at least two of the given numbers.

RULE FOR FINDING HCF AND LCM OF FRACTIONS

(I) HCF of two or more fractions

$$= \frac{\text{HCF of numerator of all fractions}}{\text{LCM of denominator of all fractions}}$$

(II) LCM of two or more fractions

$$= \frac{\text{LCM of numerator of all fractions}}{\text{HCF of denominator of all fractions}}$$

Example **1. Find the HCF and LCM of $\frac{4}{5}, \frac{6}{11}$ and $\frac{3}{5}$.**

Sol. $\text{HCF} = \frac{\text{HCF of } 4, 6, 3}{\text{LCM of } 5, 11, 5} = \frac{1}{55}$

$$\text{LCM} = \frac{\text{LCM of } 4, 6, 3}{\text{HCF of } 5, 11, 5} = \frac{12}{1} = 12$$

The product of the H.C.F and L.C.M of any two numbers is always equal to the product of these two numbers. However the same pattern is not applicable to three or more numbers.

Thus, for any two numbers a and b.

$$a \times b = \text{H.C.F.} \times \text{L.C.M.}$$

SIMPLIFICATION

FUNDAMENTAL OPERATIONS

1. Addition

(a) Sum of two positive numbers is a positive number.
For example : (+ 5) + (+ 2) = + 7

(b) Sum of two negative numbers is a negative number.
For example : (– 5) + (– 3) = – 8

(c) Sum of a positive and a negative number is the difference between their magnitudes with the sign of the number with greater magnitude.

For example : (– 3) + (+ 5) = 2 and (– 7) + (+ 2) = – 5

2. Subtractions

Subtraction of two numbers is same as the sum of a positive and a negative number.

For Example : $(+9) - (+2) = (+9) + (-2) = 7$

$(-3) - (-5) = (-3) + 5 = +2.$

3. Multiplication

(a) Product of two positive numbers is positive.

(b) Product of two negative numbers is positive.

(c) Product of a positive number and a negative number is negative.

(d) Product of more than two numbers is positive or negative depending upon the presence of negative quantities.

If the number of negative numbers is even then product is positive and if the number of negative numbers is odd then product is negative.

For Example : $(-3) \times (+2) = -6$

$(-5) \times (-7) = +35$

$(-2) \times (-3) \times (-5) = -30$

$(-2) \times (-3) \times (+5) = +30$

4. Division

(a) If both the dividend and the divisor are of same sign, then quotient is always positive.

(b) If the dividend and the divisor are of different sign, then quotient is negative,

For Example : $(-36) \div (+9) = -4$

$(-35) \div (-7) = +5$

5. Brackets

Types of brackets are :

(i) Vinculum or bar : '_'

(ii) Parenthesis or small or common brackets : ( )

(iii) Curly or middle brackets : { }

(iv) Rectangular or big brackets : [ ]

The order for removal of brackets is : ( ), { }, [ ]

Note

If there is a minus (–) sign before the bracket then while removing bracket, sign of each term will change + to – and – to +.

6. 'BODMAS' Rule

Now a days BODMAS becomes 'VBODMAS' where,

'V' stands for "Vinculum" or Bar

'B' stands for "Bracket" order of operation of bracket is ( ), { }, [ ].

'O' stands for "Of" (Calculation is done the same as multiplication)

'D' stands for "Division"

'M' stands for "Multiplication"

'A' stands for "Addition"

'S' stands for "Subtraction"

A given series of calculations or operations is done in a specific order as each letter of VBODMAS in order represent.

So, first of all we solve vinculum then the inner most brackets moving outwards. Then we perform 'of' which means multiplication, then division, addition and subtraction.

- Addition and subtraction can be done together or separately as required.
- Between any two brackets if there is not any sign of addition, subtraction and division it means we have to do multiplication

$(20 \div 5)(7 + 3 \times 2) + 8 = 4(7 + 6) + 8$

$= 4 \times 13 + 8 = 52 + 8 = 60$

Example 2. Simplify : 7 – 2 + 13 – 5 – 2 + 1

Sol. $7 - 2 + 13 - 5 - 2 + 1$

$= 7 + 13 + 1 - 2 - 5 - 2 = 21 - 9 = 12$

$[7 + 13 + 1 = 21 \text{ and } -2 - 5 - 2 = -9]$

Example 3. Find the approximate value of

$234 \div 17 + 15.3 \times 18 - 13 \times 3.7$

(a) 250 **(b) 220**

(c) 245 **(d) 235**

Sol. (d) $234 \div 17 + 15.3 \times 18 - 13 \times 3.7$

$= 225 \div 15 + 15 \times 18 - 13 \times 4$

$= 15 + 270 - 52 = 15 + 270 - 50 = 235.$

Example 4. What approximate value should come in place of the question mark?

$11^3 + 0.8^3 + 12^3 + 1.1^3 + 1.2^3 = ?$

(a) 3063 **(b) 3060**

(c) 3066 **(d) 3068**

Sol. (a) $11^3 + 0.8^3 + 12^3 + 1.1^3 + 1.2^3$

$= 1331 + 1 + 1728 + 1.331 + 1.728$

$= 1332 + 1728 + 1 + 2 = 3063.$

Example 5. What approximate value should come in place of the question mark (?) in the following question?

$$\frac{256}{\sqrt{17}} + \frac{190}{16} = ?$$

(a) 68 **(b) 76** **(c) 78** **(d) $\frac{446}{16}$**

Sol. (b) $\frac{256}{\sqrt{17}} + \frac{190}{16} = \frac{256}{4} + 12 = 64 + 12 = 76.$

ALGEBRAIC IDENTITIES

Standard Identities

(i) $(a + b)^2 = a^2 + 2ab + b^2$

(ii) $(a - b)^2 = a^2 - 2ab + b^2$

(iii) $a^2 - b^2 = (a + b)(a - b)$

(iv) $(x + a)(x + b) = x^2 + (a + b)x + ab$

(v) $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

Some More Identities

We have dealt with identities involving squares. Now we will see how to handle identities involving cubes.

(i) $(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$

$\Rightarrow (a + b)^3 = a^3 + 3ab(a + b) + b^3$

(ii) $(a - b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$

$\Rightarrow (a - b)^3 = a^3 - 3ab(a - b) - b^3$

(iii) $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$

(iv) $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$

(v) $a^3 + b^3 + c^3 - 3abc$

$= (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ca)$

If $a + b + c = 0$ then $a^3 + b^3 + c^3 = 3abc$

EXERCISE

1. The smallest five digit number which is divisible by 12, 18 and 21 is:
(a) 10080 (b) 30256 (c) 10224 (d) 50321

2. The H.C.F. and L.C.M. of two numbers are 8 and 48 respectively. If one of the numbers is 24, then the other number is
(a) 48 (b) 36 (c) 24 (d) 16

3. The greatest number, which when subtracted from 5834, gives a number exactly divisible by each of 20, 28, 32 and 35, is
(a) 1120 (b) 4714 (c) 5200 (d) 5600

4. The H.C.F. and L.C.M. of two numbers are 12 and 336 respectively. If one of the numbers is 84, the other is
(a) 36 (b) 48 (c) 72 (d) 96

5. The traffic lights at three different road crossings change after 24 seconds, 36 seconds and 54 seconds respectively. If they all change simultaneously at 10 : 15 :00 AM, then at what time will they again change simultaneously?
(a) 10 : 16 : 54 AM (b) 10 : 18 : 36 AM
(c) 10 : 17 : 02 AM (d) 10 : 22 : 12 AM

6. Four runners started running simultaneously from a point on a circular track. They took 200 seconds, 300 seconds, 360 seconds and 450 seconds to complete one round. After how much time they meet at the starting point for the first time?
(a) 1800 seconds (b) 3600 seconds
(c) 2400 seconds (d) 4800 seconds

7. L.C.M. of $\frac{2}{3}, \frac{4}{9}, \frac{5}{6}$ is
(a) $\frac{8}{27}$ (b) $\frac{20}{3}$ (c) $\frac{10}{3}$ (d) $\frac{20}{27}$

8. Amit, Sucheta and Neeti start running around a circular track and complete one round in 18, 24 and 32 seconds respectively. In how many seconds will the three meet again at the starting point if they all have started running at the same time?
(a) 196 sec. (b) 288 sec.
(c) 324 sec. (d) Cannot be determined
(e) None of these

9. The H.C.F. of $\frac{1}{3}, \frac{5}{6}, \frac{2}{9}, \frac{4}{27}$ is
(a) $\frac{1}{54}$ (b) $\frac{1}{27}$ (c) $\frac{20}{3}$ (d) $\frac{27}{3}$

10. HCF of two numbers each of 4 digits is 103 and their LCM is 19261. Sum of the numbers is
(a) 2884 (b) 2488 (c) 4288 (d) 4882

11. Let x be the least number, which when divided by 5, 6, 7 and 8 leaves a remainder 3 in each case but when divided by 9 leaves remainder 0. The sum of digits of x is
(a) 24 (b) 21 (c) 22 (d) 18

12. The LCM of four consecutive numbers is 60. The sum of the first two numbers is equal to the fourth number. What is the sum of four numbers?
(a) 17 (b) 14 (c) 21 (d) 24

13. The least number which when divided by 48, 64, 90, 120 will leave the remainders 38, 54, 80, 110 respectively, is
(a) 2870 (b) 2860
(c) 2890 (d) 2880

14. Three numbers which are co-prime to one another are such that the product of the first two is 551 and that of the last two is 1073. The sum of the three numbers is:
(a) 75 (b) 81
(c) 85 (d) 89

15. If A and B are the HCF and LCM respectively of two algebraic expressions x and y, and $A + B = x + y$, then the value of $A^3 + B^3$ is
(a) $x^3 - y^3$ (b) x^3
(c) y^3 (d) $x^3 + y^3$

16. A milk vendor has 21 litres of cow milk, 42 litres of toned milk and 63 litres of double toned milk. If he wants to pack them in cans so that each can contains same litres of milk and does not want to mix any two kinds of milk in a can, then the least number of cans required is:
(a) 3 (b) 6
(c) 9 (d) 12

17. The LCM of two positive integers is twice the larger number. The difference of the smaller number and the GCD of the two numbers is 4. The smaller number is:
(a) 12 (b) 6
(c) 8 (d) 10

18. The number of prime factors in $6^{333} \times 7^{222} \times 8^{111}$?
(a) 1221 (b) 1222
(c) 1111 (d) 1211

19. $\frac{\sqrt{10+\sqrt{25+\sqrt{108+\sqrt{154+\sqrt{225}}}}}}{\sqrt[3]{8}} = ?$
(a) 8 (b) 4
(c) 1/2 (d) 2

20. (3x – 2y) : (2x + 3y) = 5 : 6, then one of the value of $\left(\frac{\sqrt[3]{x}+\sqrt[3]{y}}{\sqrt[3]{x}-\sqrt[3]{y}}\right)^2$ is
(a) $\frac{1}{25}$ (b) 5
(c) $\frac{1}{5}$ (d) 25

Hints & Solutions

1. **(a)** Lowest 5 digit number = 10,000
The number which is divisible by 12, 18 and 21 is LCM of 12, 18, 21 which is 252.
$\frac{10000}{252}$ gives 172 as remainder
So, 252 – 172 = 80
10,000 + 80 = 10080
If 10080 when divided by 12, 18 and 21 gives 0 as remainder
So, 10080 is the least 5–digit number.

2. **(d)** $p \times q = \text{HCF} \times \text{LCM}$
$\therefore$ Second number $= \frac{8 \times 48}{24} = 16$

3. **(b)** LCM of 20, 28, 32, 35 is 1120
$\therefore$ Required number = 5834 – 1120 = 4714

4. **(b)** First number × second number = HCF × LCM
$q = \frac{12 \times 336}{84} = 48$

5. **(b)** LCM of 24, 36 and 54 seconds = 216 seconds
= 3 minutes 36 seconds
$\therefore$ Required time
= 10 : 15 : 00 + 3 minutes 36 seconds
= 10 : 18 : 36 A.M.

6. **(a)** Required time = LCM of 200, 300, 360 and 450 seconds = 1800 seconds.

7. **(b)** LCM of $\frac{2}{3}, \frac{4}{9}, \frac{5}{6}$
$\frac{\text{LCM of }(2,4,5)}{\text{HCF of }(3,9,6)} = \frac{20}{3}$

8. **(b)** Required time = LCM of 18, 24 and 32 seconds.
= 288 seconds

9. **(b)** $\text{HCF} = \frac{\text{HCF of } 1,\ 5,\ 2,\ 4}{\text{LCM of } 3,\ 6,\ 9,\ 27} = \frac{1}{27}$

10. **(a)** Let the numbers be $103x$ and $103y$ where x and y are prime to each other.
$\therefore$ LCM = $103xy$ $\Rightarrow$ $103xy = 19261$
$\Rightarrow xy = \frac{19261}{103} = 187 \Rightarrow x = 11$ or 17
$y = 17$ or 11
$\therefore$ Numbers = 103 × 11 = 1133
and 103 × 17 = 1751 and Sum = 1751 + 1133 = 2884

11. **(d)** LCM of 5, 6, 7 & 8 = 840
$\frac{840n+3}{9} \Rightarrow \frac{3n+3}{9}$
$\Rightarrow$ Take $n = 2$ $\Rightarrow$ 3(2) + 3
$\Rightarrow \frac{9}{9} =$ Remainder = 0
$\therefore$ Number is = $840n + 3$
$\Rightarrow$ 840(2) + 3 ($n = 2$) $\Rightarrow$ 1683
Sum of digits = 18

12. **(b)** Numbers = $x, x + 1, x + 2, x + 3$
$\text{I}^{\text{st}} + \text{II}^{\text{nd}} = \text{IV}^{\text{th}}$
$x + x + 1 = x + 3$
$\therefore$ $x = 2$
$\therefore$ Numbers are 2, 3, 4, 5
$\therefore$ Sum of four numbers = 2 + 3 + 4 + 5 = 14.

13. **(a)** Here, (48 – 38) = 10, (64 – 54) = 10, (90 – 80) = 10 and (120 – 110) = 10.
$\therefore$ Required number
= (L.C.M of 48, 64, 90 and 120) – 10 = 2870

14. **(c)** Let numbers are a, b and c.
= a, b, c are co-prime numbers
HCF of co-prime numbers = 1
$\therefore$ HCF $(a, b, c) = 1$
$\therefore$ $a \times b = 551,\ b \times c = 1073$
$\Rightarrow \frac{a \times b}{b \times c} = \frac{551}{1073} = \frac{19 \times 29}{37 \times 29} \Rightarrow \frac{a}{c} = \frac{19}{37}$
$\therefore$ $a = 19$, $b = 29$ $c = 37$
$\therefore$ Sum of numbers = $a + b + c$ = 19 + 29 + 37 = 85

15. **(d)** HCF = A (given)
LCM = B
Given numbers are x & y respectively.
$\Rightarrow$ (Product of numbers is = Product of LCM × HCF)
$\Rightarrow$ $xy = AB$
Now $\Rightarrow$ $A + B = x + y$ (given)
Take cube on both sides
$(A+B)^3 = (x+y)^3$
$\Rightarrow A^3 + B^3 + 3AB\,(A+B) = x^3 + y^3 + 3xy\,(x+y)$
$\Rightarrow A^3 + B^3 + 3xy\,(x+y) = x^3 + y^3 + 3xy\,(x+y)$
$\therefore A^3 + B^3 = x^3 + y^3$

16. **(b)** For least or minimum number of canes we should have maximum capacity canes for required quantity
$\Rightarrow$ For this we take HCF of given quantities.
HCF (21, 42, 63) = 21
$\therefore$ Maximum capacity of a cane = 21 litres
$\therefore$ Number of canes of cow milk $= \frac{21}{21} = 1$
$\therefore$ Number of canes of toned milk $= \frac{42}{21} = 2$
$\therefore$ Number of canes of double toned milk $= \frac{63}{21} = 3$
$\therefore$ Total number of canes = 1 + 2 + 3 = 6

17. (c) Let G.C.D. = a

$\therefore$ Let number are ax and ay $(ax > ay)$

LCM = axy

$\Rightarrow$ LCM = 2 × larger number

$\therefore$ $axy = 2 \times ax \quad \therefore \quad y = 2$

Also given that

$\Rightarrow$ Smaller number – G.C.D = 4 $\Rightarrow$ $ay - a = 4$

$2a - a = 4$

$a = 4$

G.C.D. = $a = 4$

$y = 2$

$\therefore$ Smaller number = $ay \Rightarrow 2 \times 4 = 8$

18. (a) $6^{333} \times 7^{222} \times 8^{111} \Rightarrow 2^{333} \times 3^{333} \times 7^{222} \times (2^3)^{111}$

$\Rightarrow 2^{666} \times 3^{333} \times 7^{222}$

$\Rightarrow$ Total factors = 666 + 333 + 222 = 1221

19. (d)
$$\frac{\sqrt{10+\sqrt{25+\sqrt{108+\sqrt{154+\sqrt{225}}}}}}{\sqrt[3]{8}}$$

$$\Rightarrow \frac{\sqrt{10+\sqrt{25+\sqrt{108+\sqrt{169}}}}}{2}$$

$$\Rightarrow \frac{\sqrt{10+\sqrt{25+\sqrt{121}}}}{2} \Rightarrow \frac{\sqrt{10+\sqrt{36}}}{2}$$

$$\Rightarrow \frac{\sqrt{16}}{2} = \frac{4}{2} = 2$$

20. (d)
$$\frac{3x-2y}{2x+3y} = \frac{5}{6}$$

$18x - 12y = 10x + 15y$

$8x = 27y$

$$\frac{x}{y} = \frac{27}{8}$$

$$\left[\frac{\sqrt[3]{x}+\sqrt[3]{y}}{\sqrt[3]{x}-\sqrt[3]{y}}\right]^2 = \left(\frac{\sqrt[3]{27}+\sqrt[3]{8}}{\sqrt[3]{27}-\sqrt[3]{8}}\right)^2$$

$$= \left(\frac{3+2}{3-2}\right)^2 = (5)^2 = 25$$

Chapter 3 Percentage

PERCENTAGE

The word "per cent" is derived from the latin words "per centum", which means "per hundred".

It is denoted by the symbol %.

Thus 25 per cent is written as 25% and it means 25 out of 100.

This is written in the ratio form as $\frac{25}{100}$.

Percentage Increase, Decrease or Error

- Increase % or percentage increase $= \dfrac{\text{Increase value}}{\text{Original value}} \times 100\%$
- Decrease % or percentage decrease $= \dfrac{\text{Decrease value}}{\text{Original value}} \times 100\%$
- Error percent $= \dfrac{\text{Error}}{\text{Correct value}} \times 100\%$

Note

If the value of any thing increases, then percentage change is the percentage increase and if the value of any thing decreases, then percentage change is the percentage decrease. Thus,

Percentage change = Percentage increase, if value of the thing increases

and Percentage change = Percentage decrease, if value of the thing decreases.

POPULATION FORMULA

- If the original population of a town is P, and the annual increase is r %, then the population after n years is $P\left(1+\dfrac{r}{100}\right)^n$ and population before n years $= \dfrac{P}{\left(1+\dfrac{r}{100}\right)^n}$.
- If the annual decrease be r%, then the population after n years is $P\left(1-\dfrac{r}{100}\right)^n$ and population before n years $= \dfrac{P}{\left(1-\dfrac{r}{100}\right)^n}$.

STUDENT AND MARKS

- The percentage of passing marks in an examination is x%. If a candidate who scores y marks fails by z marks, then the maximum marks, $M = \dfrac{100(y+z)}{x}$.
- A candidate scoring x% in an examination fails by 'a' marks, while another candidate who scores y% marks gets 'b' marks more than the minimum required passing marks.

  Then the maximum marks, $M = \dfrac{100(a+b)}{y-x}$.
- In an examination x% and y% students respectively fail in two different subjects while z% students fail in both subjects. Then the % of student who pass in both the subjects will be $\{100 - (x+y-z)\}$%.

EXERCISE

1. In a college election between two candidates, one candidate got 55% of the total valid votes. 15% of the votes were invalid. If the total votes were 15,200, what is the number of valid votes the other candidate got ?
   (a) 7106 (b) 6840 (c) 8360 (d) 5814
   (e) None of these
2. The red blood cells in a blood sample grows by 10% per hour in first two hours, decreases by 10% in next one hour, remains constant in next one hour and again increases by 5% per hour in next two hours. If the original count of the red blood cells in the sample is 40000, find the approximate red blood cell count at the end of 6 hours.
   (a) 40000 (b) 45025 (c) 48025 (d) 50025
3. Twenty five percent of Pranab's annual salary is equal to eighty percent of Surya's annual salary. Surya's monthly salary is forty percent of Dheeru's monthly salary. If Dheeru's annual salary is ₹ 6 lacs,what is Pranab's monthly salary ? (At some places annual income and in some place monthly income is given.)
   (a) ₹ 7.68 lacs (b) ₹ 56,000
   (c) ₹ 8.4 lacs (d) ₹ 64,000
   (e) None of these
4. In a big garden 60% of the trees are coconut trees, 25% of the number of coconut trees are mango trees and 20% of the number of mango trees are apple trees. If the number of apple trees in the garden is 1440. Then find the number of trees in the garden is:
   (a) 48000 (b) 50000
   (c) 51000 (d) 45000
5. Mr. *X* spends 20% of his monthly income on household expenditure. Out of the remaining 25% he spends on children's education, 15% on transport, 15% on medicine and 10% on entertainment. He is left with ₹ 9, 800 after incurring all these expenditures. What is his monthly income?
   (a) ₹ 35,000 (b) ₹ 28,000
   (c) ₹ 65, 333 (d) ₹ 48,400
   (e) None of these
6. Aman's expense is 30% more than Vimal's expense and Vimal's expense is 10% less than Raman's expense. If the sum of their expense is ₹ 6447, then what would be the Aman's expense?
   (a) ₹ 2, 200 (b) ₹ 2, 457
   (c) ₹ 1, 890 (d) ₹ 2, 100
   (e) None of these
7. Twenty percent of Anuj's annual salary is equal to seventy five percent of Raj's annual salary. Raj's monthly salary. Raj's monthly salary is 60% of Ravi's monthly salary. If Ravi's annual salary is ₹ 1.44 lac,s what is Anuj's monthly salary?
   (a) ₹ 2,70,000 (b) ₹ 27,000
   (c) ₹ 34,000 (d) ₹ 54,000
   (e) None of these
8. Twelve percent of Kaushal's monthly salary is equal to sixteen percent of Nandini's monthly salary. Suresh's monthly salary is half that of Nandini's monthly salary. If Suresh's annual salary is ₹ 1.08 lacs, what is Kaushal's monthly salary?
   (a) ₹ 20,000 (b) ₹ 18,000
   (c) ₹ 26,000 (d) ₹ 24,000
   (e) None of these
9. In a school there are 2000 students out of whom 36 percent are girls. Each boy's monthly fee is ₹ 480 and each girl's monthly fee is 25 percent less than a boy. What is the total of the monthly fees of girls and boys together?
   (a) ₹ 8,73,400 (b) ₹ 8,67,300
   (c) ₹ 8,76,300 (d) ₹ 8,73,600
   (e) None of these
10. A sum of ₹ 731 is divided among *A*, *B* and *C*, such that '*A*' receives 25% more than '*B*' and '*B*' receives 25% less than '*C*'. What is C's share in the amount?
    (a) ₹ 172 (b) ₹ 200 (c) ₹ 262 (d) ₹ 258
    (e) None of these
11. An HR Company employs 4800 people, out of which 45 percent are males and 60 percent of the males are either 25 years or older. How many males are employed in HR Company who are younger than 25 years?
    (a) 2480 (b) 2320 (c) 1278 (d) 864
    (e) None of these
12. Dinesh's monthly income is four times Suresh's monthly income Suresh's monthly income is twenty percent more than Jyoti's monthly income. Jyoti's monthly income is ₹ 22,000. What is Dinesh's monthly income?
    (a) ₹ 1,06,500 (b) ₹ 1,05,600
    (c) ₹ 1,04,500 (d) ₹ 1,05,400
    (e) None of these
13. Ruby's monthly income is three times Gayatri's monthly income. Gayatri's monthly income is fifteen percent more than Priya's monthly income, Priya's monthly income is ₹ 32,000. What is Ruby's Annual income?
    (a) ₹ 1,20,300 (b) ₹ 13,24,800
    (c) ₹ 38,800 (d) ₹ 54,600
    (e) None of these
14. Akash scored 73 marks in subject *A*. He scored 56% marks in subject *B* and *x* marks in subject *C*. Maximum marks in each subject were 150. The overall percentage marks obtained by Akash in all the three subjects together were 54%. How many marks did he score in subject *C*?
    (a) 84 (b) 86 (c) 79 (d) 73
    (e) None of these

15. In a company '*XYZ*', the respective ratio between the total number of under-graduate employees and the total number of graduate employees is 13 : 23. The Company has only two branches, one in Mumbai and other in Delhi. If the total number of under-graduate employees in Mumbai branch is 351, which is 30% of the total undergraduate employees in the company, what is the total number of graduate employees in the company?
(a) 2185 (b) 1955 (c) 2070 (d) 2691
(e) None of these

16. In a competitive examination in state '*A*', 6% candidates got selected from the total appeared candidates. State '*B*' had an equal number of candidates appeared and 7% candidates got selected with 80 more candidates got selected than state '*A*'. What was the number of candidates appeared from each state?
(a) 8000 (b) 8400
(c) 7600 (d) Data inadequate
(e) None of these

17. In a recent survey 40% houses contained two or more people. Of those houses containing only one person 25% were having only a male. What is the percentage of all houses, which contain exactly one female and no males?
(a) 75% (b) 40%
(c) 15% (d) Cannot be determined
(e) None of these

18. The strength of a school increases and decreases every alternate year. It startes with increase by 10% and thereafter the percentage of increase/decrease is the same. Which of the following is **definitely true** about the strength of the school in 2000 as compared to that in 1996?
(a) Increase approximately by 2%
(b) Decrease approximately by 2%
(c) Increase approximately by 0%
(d) Decrease approximately by 0%
(e) None of these

19. 405 sweets were distributed equally among children in such a way that the number of sweets received by each child is 20% of the total no. of children. How many sweets did each child receive?
(a) 15 (b) 45 (c) 9 (d) 18
(e) None of these

20. Mr. Sarang invests 6% of his monthly salary i.e., ₹ 2,100 on insurance policies. Also he invests 8% of his monthly salary on family mediclaim policies and another 9% of his salary on NSCs. What is the total annual amount invested by Mr. Sarang?
(a) ₹ 11,400 (b) ₹ 96.600
(c) ₹ 8,050 (d) ₹ 9,050
(e) ₹ 9,500

21. Ms. Pooja Pushpan invests 13% of her monthly salary, i.e., ₹ 8554 in Mediclaim Policies. Later she invests 23% of her monthly salary on Child Education Policies. Also she invests another 8% of her monthly salary on Mutual Funds. What is the total annual amount invested by Ms. Pooja Pushpan?
(a) ₹ 28952 (b) ₹ 43428
(c) ₹ 347424 (d) ₹ 173712
(e) None of these

22. In a vessel there is 40 litres mixture of milk and water. There is 15% water in the mixture. The milkman sells 10 litres of mixture to a customer and thereafter adds 12.5 litres of water to the remaining mixture. What is the respective ratio of milk and water in the new mixture?
(a) 2 : 3 (b) 3 : 2
(c) 3 : 4 (d) 4 : 3
(e) None of these

23. In a 90 litres mixture of milk and water, percentage of water is only 30%. The milkman gave 18 litres of this mixture to a customer and then added 18 litres of water to the remaining mixture. What is the percentage of milk in the final mixture?
(a) 64 (b) 48 (c) 52 (d) 68
(e) 56

24. Mrs. Sharma invests 15% of her monthly salary, i.e., ₹ 4428 in Mutual Funds. Later she invests 18% of her monthly salary on Pension Policies and she also invests another 9% of her salary on Insurance Policies. What is the total monthly amount invested by Mrs. Sharma?
(a) ₹ 113356.8 (b) ₹ 12398.4
(c) ₹ 56678.4 (d) Can't be determined
(e) None of these

25. A number is such that when it is multiplied by '8', it gives another number which is as much more than 153 as the original number itself is less than 153. What is 25% of the original number?
(a) 8 (b) 7.5 (c) 10 (d) 8.5
(e) 6.5

26. A number is such that when it is multiplied by 6, it gives another number which is more than 168 as the original number itself is less than 168. What is 15% of the original number?
(a) 8.4 (b) 7.8 (c) 6.6 (d) 8.8
(e) 7.2

27. Sujata scored 2240 marks in an examination that is 128 marks more than the minimum passing percentage of 64%. What is the percentage of marks obtained by Meena if she scores 907 marks less than Sujata?
(a) 35% (b) 40% (c) 45% (d) 36%
(e) 48%

28. In a village 60% votes were cast in an election. A and B were the contestants. A won by 600 votes. If B had got 40% more votes, there would have been a tie between them. Find the number of recognised voters in the village.
(a) 4500 (b) 2800 (c) 3500 (d) 3600
(e) 3900

29. An interview panel found that a candidate has given a wrong detail about his height. While filling up his form he filled up 20% more than his actual height. His actual height is 5 feet inches. By what approximate percent should be reduce his height to get actual height?
(a) 15% (b) 14% (c) 18% (d) 17%
(e) None of these

30. In an examination there are three subjects of 100 marks each. A student scores 60% in the first subject and 80% in the second subject. He scored 70% in aggregate. His percentage of marks in the third subject is
(a) 80 (b) 60 (c) 65 (d) 70

Hints & Solutions

1. **(d)** Total valid votes = 85% of 15200 = 12920

$\therefore$ Number of valid votes to other candidate

= 45% of 12920 = 5814

2. **(c)**

$$\begin{array}{rcrr} \text{1st hour} & \longrightarrow & 10 & 11 \\ \text{2nd hour} & \longrightarrow & 10 & 11 \\ \text{3rd \& 4th hour} & \longrightarrow & 10 & 9 \\ \text{5th hour} & \longrightarrow & 20 & 21 \\ \text{6th hour} & \longrightarrow & 20 & 21 \\ \hline & & 400000 & 480249 \end{array}$$

400000 Units = 40000

$$1 \text{ unit} = \frac{40000}{400000} = \frac{1}{10}$$

then 480249 → 48024.9 = 48025 (approx)

3. **(d)** Dheeru's monthly salary $= \frac{600000}{12} = ₹\ 50000$

Surya's monthly salary $= 50000 \times \frac{40}{100} = ₹\ 20000$

Pranab's monthly salary $= 20000 \times \frac{80}{25} = ₹\ 64000$

4. **(a)** If the number of trees in the garden be x, then

$$x \times \frac{60}{100} \times \frac{25}{100} \times \frac{20}{100} = 1440$$

$$\Rightarrow \quad x \times \frac{3}{5} \times \frac{1}{4} \times \frac{1}{5} = 1440$$

$$\Rightarrow \quad x = \frac{1440 \times 5 \times 4 \times 5}{3} = 48{,}000$$

5. **(a)** Let the monthly income of X be ₹ x.

Expenditure on household articles = ₹ $\frac{x}{5}$

Remaining amount = ₹ $\frac{4x}{5}$

Total percentage expenditure in the remaining amount = Remaining amount

$$= 35\% \text{ of } \frac{4x}{5} = ₹\left(\frac{35}{100} \times \frac{4x}{5}\right) = \frac{7x}{25} = \frac{7x}{25} = 9800$$

$$\Rightarrow \quad x = ₹\left(\frac{9800 \times 25}{7}\right) = ₹35000$$

6. **(b)** Let Vimal's expense be ₹ 100

$\therefore$ Aman's expense = ₹ 130

Raman's expenses $= \frac{100}{90} \times 100 = \frac{1000}{9}$

$\therefore$ Ratio of the expenses of Vimal. Aman and Raman respectively

$$= 100 : 130 : \frac{1000}{9} = 90 : 117 : 100$$

$\therefore$ Aman expense $= \frac{117}{90 + 117 + 100} \times 6447$

$$= \frac{117}{307} \times 6447 = ₹\ 2457$$

7. **(b)** Monthly salary of Raj $= \frac{1.44 \times 60}{12 \times 100} = ₹\ 0.072$ lakh

Raj's monthly salary × $\frac{3}{4}$ = Anuj's monthly salary × $\frac{1}{5}$

Anuj's monthly salary = ₹ $\left(0.072 \times \frac{3}{4} \times 5\right)$ lakh

= ₹ 27000

8. **(d)** Suresh's monthly salary $= \frac{108000}{12} = ₹\ 9000$

Nandini's monthly salary = ₹ 18000 (= 2 × 9000)

$\therefore$ Kaushal's monthly salary × $\frac{12}{100}$

$$= \frac{18000 \times 16}{100} = 2880$$

$\therefore$ Kaushal's monthly salary

$$= \left(\frac{2880 \times 100}{12}\right) = ₹\ 24000$$

9. **(d)** Girls ⇒ $\frac{2000 \times 36}{100} = 720$

Boy ⇒ 2000 – 720 = 1280

Each girl's fee = 480 × $\frac{75}{100}$ = ₹ 360

$\therefore$ Total monthly fee
= ₹ [(1280 × 480) + (720 × 360)]
= ₹ (614400 + 259200) = ₹ 873600

10. **(e)** Let C receives ₹ 100

B receives 25% less i.e. ₹ 75

A receives 25% more than $B = \frac{5}{4} \times 75 = \frac{375}{4}$

$$\begin{array}{lccc} & A & : B & : C \\ & \frac{375}{4} & : 75 & : 100 \\ \Rightarrow & 375 & : 300 & : 400 \\ \Rightarrow & 15 & : 12 & : 16 \end{array}$$

Total sum = 731

C's share $= \frac{16}{43} \times 731 = ₹272$

11. (d) Number of males in company

$= \frac{4800 \times 45}{100} = 2160$

∴ Number of males younger than 25 years.

$= \frac{2160 \times 40}{100} = 864$

12. (b) Suresh's monthly income $= \frac{22000 \times 120}{100} = ₹\ 26400$

∴ Dinesh's monthly income

= ₹ (4 × 264000) = ₹ 105600

13. (b) Gayatri's monthly income

$= \frac{32000 \times 115}{100} = ₹\ 36800$

∴ Ruby's annual income = ₹ (12 × 3 × 36800)

= ₹ 13,24,800

14. (b) Marks obtained by Akash in subject $B = \frac{150 \times 56}{100} = 84$

Total marks obtained by Akash $= \frac{450 \times 54}{100} = 243$

∴ Marks obtained in subject $C = 243 - 73 - 84 = 86$

15. (c) Number of undergraduates in Mumbai branch = 351

∴ Number of undergraduates employees

$= \frac{100}{30} \times 351 = 1170$

∴ Total graduate employees $= \frac{23}{13} \times 1170 = 2070$

16. (a) No. of candidates appeared in state A

= No. of candidates appeared in state $B = x$

$∴ \frac{7x}{100} - \frac{6x}{100} = 80$

$x = 8000$

17. (e) 40% houses have two or more people.

∴ 60% of all houses have only one person. Of these 60%, 25% have only a male.

25% of 60% = 0.25 × 0.60 = 0.15 = 15%

Rest of the houses have exactly one female and no males

= (60 – 15)% = 45%

18. (b) Let the strength of the school in 1996 be 100

The strength increases and decreases every alternate year by 10%

∴ Strength in 1997 = 110

Strength in 1998 $= 110 \times \frac{90}{100} = 99$

Strength in 1999 $= 99 \times \frac{110}{100} = 108.9$

Strength in 2000 $= 108.9 \times \frac{90}{100} = 98.1$

100 – 98.1 = 2% decrease

19. (c) Let number of children be x

∴ No. of sweets received by each child $= \frac{405}{x}$

$\Rightarrow \frac{405}{x} = 20\%$ of x

$\Rightarrow \frac{405}{x} = \frac{x}{5}$

$\Rightarrow x^2 = 405 \times 5$

$\Rightarrow x = \sqrt{405 \times 5} = \sqrt{81 \times 5 \times 5} = 9 \times 5 = 45$

∴ Required no. of sweets received by each child

$= \frac{405}{45} = 9$

20. (b) Let salary of Mr. Sarang = x

ATQ, 6% of salary = 2100

$\Rightarrow \frac{6}{100} \times x = 2100 \quad \Rightarrow x = 35{,}000$

Total investment = 6% + 8% + 9% = 23%

Total Annual amount invested

$= 12 \times \frac{23}{100} \times 35000 = ₹96600$

21. (c) Let Ms. Pooja Pushpan's monthly salary = ₹ x

According to the question, 13% of the x = ₹ 8554

$\Rightarrow x = ₹ \left(\frac{8554 \times 100}{13}\right) = ₹\ 65800$

Total monthly investment in percentage

= 13 + 23 + 8 = 44%

∴ Total monthly investment

$= 44\%$ of ₹ 65800 $= ₹ \left(\frac{44 \times 65800}{100}\right) = ₹\ 28952$

∴ Total annual investment

= ₹ (12 × 28952) = ₹ 347424

22. (b) In 30 litres of mixture.

Milk $= \frac{30 \times 85}{100} = 25.5$ litres

Water = 30 – 25.5 = 4.5 litres

On adding 12.5 litres of water total quantity of water

= 4.5 + 12.5 = 17 litres

∴ Required ratio of milk and water

= 25.5 : 17 = 1.5 : 1 = 3 : 2

23. (e) Remaining mixture = 90 – 18 = 72 litres

Milk $= \frac{70}{100} \times 72 = 50.4$

Water = 72 – 50.4 = 21.6 litres

On adding 18 litres of water. Required percentage of milk

$$= \frac{50.4}{90} \times 100 = \frac{504}{9} = 56\%$$

24. **(b)** Mrs. Sharma's monthly salary = ₹ x.

$\therefore$ 15% of $x = 4428$

$$\Rightarrow \frac{x \times 15}{100} = 4428$$

$$\Rightarrow x = \frac{4428 \times 100}{15} = ₹\ 29520$$

$\therefore$ Total investment = (15 + 18 + 9)% of 29520

$$= \frac{29520 \times 42}{100} = ₹\ 12398.40$$

25. **(d)** Let the number be x

According to the questions,

$8x - 153 = 153 - x$

$\Rightarrow 8x + x = 153 + 153$

$\Rightarrow 9x = 306$

$$\Rightarrow x = \frac{306}{9} = 34$$

$$\therefore 25\% \text{ of } 34 = \frac{34 \times 25}{100} = 8.5$$

26. **(e)** Let the original number be x.
According to the questions,
$6x - 168 = 168 - x \quad \Rightarrow 7x = 168 + 168 = 336$

$$\Rightarrow x = \frac{336}{7} = 48$$

$$\therefore 15\% \text{ of } 48 = \frac{48 \times 15}{100} = 7.2$$

27. **(b)** If total maximum marks be x, then,

$$\frac{x \times 64}{100} = 2240 - 128 = 2112$$

$$\Rightarrow x = \frac{2112 \times 100}{64} = 3300$$

Marks obtained by Meena = 2240 – 907 = 1333

$$\therefore \text{Required percentage} = \frac{1333}{3300} \times 100 = 40\%$$

28. **(c)** Let the number of recognised voters in the village be x.
For candidates B,

$\because$ 40% = 300

$$\therefore 100\% = \frac{300}{40} \times 100 = 750$$

$\therefore$ Votes got by A = 750 + 660 = 1350

According to the question,

$$\frac{60x}{100} = 1350 + 750 = 2100$$

$$\Rightarrow x = \frac{2100 \times 100}{60} = 3500$$

29. **(d)** Percentage decrease

$$= \frac{20}{100+20} \times 100 = \frac{50}{3} = 16\frac{2}{3}\% \approx 17\%$$

30. **(d)** According to the question,

First subject = 60%

Second subject = 80%

Aggregate in all subject = 3 × 70 = 210

$\therefore$ First + Second + Third = 210

60 + 80 + Third = 210

Third = 210 – 140 = 70

Chapter 4 Average and Ages

AVERAGE

Average is a very simple and effective way of representing an entire group by a single value.

Average or Mean $= \dfrac{\text{Sum of given quantities}}{\text{Number of quantities}}$

To calculate the sum of quantities, they should be in the same unit.

Note

If X is the average of $x_1, x_2, x_3 \ldots x_n$ then

- The average of $x_1 + a, x_2 + a, x_3 + a, \ldots x_n + a$ is $X + a$.
- The average of $x_1 - a, x_2 - a, x_3 - a \ldots x_n - a$ is $X - a$
- The average of $ax_1, ax_2, \ldots ax_n$ is aX, provide $a \neq 0$
- The average of $\dfrac{x_1}{a}, \dfrac{x_2}{a}, \dfrac{x_3}{a}, \ldots \dfrac{x_n}{a}$ is $\dfrac{X}{a}$, provided $a \neq 0$

Average of a Group Consisting Two Different Groups When Their Averages are Known

Let group A contains m quantities and their average is a and group B contains n quantities and their average is b, then **average of group *C*** containing these $(m + n)$ quantities $= \dfrac{ma + nb}{m + n}$

Weighted Average

If we have two or more groups of members whose individual averages are known, then combined average of all the members of all the groups is known as weighted average. Thus if there are k groups having member of number $n_1, n_2, n_3, \ldots n_k$ with averages $A_1, A_2, A_3 \ldots A_k$ respectively then weighted average.

$$A_w = \frac{n_1A_1 + n_2A_2 + n_3A_3 + \ldots + n_kA_k}{n_1 + n_2 + n_3 + \ldots + n_k}$$

Average Speed if Equal Distances are Travelled by Two Different Speeds

If a car travels at a speed S_1 from A to B and at a speed S_2 from B to A. Then

$$\text{Average speed} = \frac{2\,S_1 \,.\, S_2}{S_1 + S_2}$$

The above formula can be found out as follows:

If distance between A and B is d, then

$$\text{Average speed} = \frac{\text{Total distance}}{\text{Total time}} = \frac{2d}{\dfrac{d}{S_1} + \dfrac{d}{S_2}}$$

$$= \frac{2}{\dfrac{1}{S_1} + \dfrac{1}{S_2}} = \frac{2\,S_1 \,.\, S_2}{S_1 + S_2}$$

Average Speed if Equal Distances are Travelled by Three Different Speeds

Average speed $= \dfrac{3xyz}{xy + yz + zx}$

Where x, y and z are three different speeds.

Remember...

- Average of first n natural numbers $= \dfrac{(n+1)}{2}$
- Average of first n consecutive even numbers $= (n + 1)$
- Average of first n consecutive odd numbers $= n$
- Average of any number of consecutive numbers

  $= \dfrac{\text{First number} + \text{Last number}}{2}$
- Average of first n consecutive odd numbers

  $= \dfrac{\text{Last odd number} + 1}{2}$
- Average of first n consecutive even numbers

  $= \dfrac{\text{Last even number} + 2}{2}$
- Average of squares of first n natural numbers

  $= \dfrac{(n+1)(2n+1)}{6}$
- Average of the cubes of first n natural numbers

  $= \dfrac{n(n+1)^2}{4}$
- Average of n consecutive multiples of any number

  $= \dfrac{\text{Number} \times (n+1)}{2}$
- If n is odd, then the average of n consecutive numbers, consecutive even numbers or consecutive odd numbers is always the middle number.

AGES AND AVERAGES

If the average age of a group of persons is x years today then after n years their average age will be $(x + n)$ years because for a group of people, 1 year is added to each person's age every year. Similarly, n years ago their average age would have been $(x - n)$ years, because 1 year is subtracted from each person's age before every year.

EXERCISE

1. A cricketer whose bowling average is 24.85 runs per wicket, takes 5 wickets for 52 runs in next inning and thereby decreases his average by 0.85. The number of wickets taken by him till the last match was :
(a) 75 (b) 85 (c) 80 (d) 96

2. The arithmetic mean of the scores of a group of students in a test was 52. The brightest 20% of them secured a mean score of 80 and the dullest 25% a mean score of 31. The mean score of remaining 55% is.
(a) 45 (b) 50 (c) 51.4 (d) 54.6

3. The average monthly income (in ₹) of certain agricultural workers is S and that of other workers is T. The number of agricultural workers is 11 times that of other workers. Then the average monthly income (in ₹) of all the workers is :
(a) $\frac{S+11T}{12}$ (b) $\frac{S+T}{12}$
(c) $\frac{11S+T}{12}$ (d) $\frac{1}{11S}+T$

4. The average age of husband, wife and their child 3 years ago was 27 years and that of wife and the child 5 years ago was 20 years. The present age of the husband is :
(a) 40 years (b) 35 years
(c) None of the options (d) 50 years

5. The ratio of the number of players on the three cricket teams *A*, *B* and C is 2:5:3. If the average number of runs scored per player for each of the three teams, *A*, *B* and C, is 30 : 17 : 25 respectively, then what is the average number of runs scored per player across all three teams collectively?
(a) 20 (b) 21 (c) 22 (d) 23

6. The average of three consecutive odd numbers is 12 more than one third of the first of these numbers. What is the last of the three numbers ?
(a) 15 (b) 17
(c) 19 (d) Data inadequate

7. The average of 5 consecutive numbers is n. If the next two numbers are also included, the average of the 7 numbers will
(a) increase by 2 (b) increase by 1
(c) remain the same (d) increase by 1.4

8. A batsman in his 12th innings makes a score of 63 runs and there by increases his average scores by 2. What is his average after the 12th innings?
(a) 13 (b) 41 (c) 49 (d) 87

9. The average weight of 12 crewmen in a boat is increased by $\frac{1}{3}$ kg, when one of the crewmen whose weight is 55 kg is replaced by a new man. What is the weight of that new man ?
(a) 58 kg (b) 60 kg
(c) 57 kg (d) 59 kg

10. The batting average for 30 innings of a cricket player is 40 runs. His highest score exceeds his lowest score by 100 runs. If these two innings are not included, the average of the remaining 28 innings is 38 runs. The lowest score of the player is:
(a) 15 (b) 18 (c) 20 (d) 12

11. The average salary of all the workers in a workshop is ₹ 8,000. The average salary of 7 technicians is ₹ 12,000 and the average salary of the rest is ₹ 6,000. The total number of workers in the workshop is
(a) 20 (b) 21 (c) 22 (d) 23

12. The average of some natural numbers is 15. If 30 is added to first number and 5 is subtracted from the last number the average becomes 17.5 then the number of natural number is:
(a) 20 (b) 30 (c) 15 (d) 10

13. The average monthly income of *A* and *B* is ₹ 15,050, the average monthly income of *B* and *C* is ₹ 15,350 and the average income of *A* and *C* is ₹ 15,200. The monthly income of *A* is
(a) ₹ 15,900 (b) ₹ 15,200
(c) ₹ 14,900 (d) ₹ 15,500

14. The average weight of 45 students in a class was calculated as 36 kg. It was later found that the weight of two students in the class was wrongly calculated. The actual weight of one of the boys in the class was 32 kg., but it was calculated as 34 kg and the weight of another boy in the class was 45 kg.; whereas it was calculated as 40 kg. What is the actual average weight of the 45 students in the class? (Rounded off to two-digits after decimal).
(a) 36.07 kg. (b) 36.16 kg.
(c) 35.84 kg. (d) Cannot be determined
(e) None of these

15. Seema's present age is four times her son's present age and four-seventh of her father's present age. The average of the present age of all three of them is 32 years. What is the difference between the Seema's son's present age and Seema's father's present age?
(a) 44 years (b) 48 years
(c) 46 years (d) Cannot be determined
(e) None of these

16. The sum of 8 consecutive odd numbers is 656. Also average of four consecutive even numbers is 87. What is the sum of the smallest odd number and second largest even number?
(a) 165 (b) 175
(c) 163 (d) Cannot be determined
(e) None of these

17. In Arun's opinion his weight is greater than 65 kg but less than 72 kg. His brother does not agree with Arun and he thinks that Arun's weight is greater than 60 kg but less than 70 kg. His mother's view is that his weight

cannot be greater than 68 kg. If all of them are correct in their estimation, what is the average of different probable weights of Arun?
(a) 69 kg (b) 67 kg
(c) 68 kg (d) Data inadequate
(e) None of these

18. The average age of 80 girls was 20 years, the average age of 20 of them was 22 years and that of another 20 was 24 years. Find the average age of the remaining girls.
(a) 17 years (b) 19 years
(c) 21 years (d) 15 years
(e) None of these

19. A batsman played three matches in a tournament. The respective ratio between the scores of 1st and 2nd matches was 5 : 4 and that between the scores of 2nd and 3rd matches was 2 : 1. The difference between the 1st and 3rd matches was 48 runs. What was the batsman's average score in all the three matches?
(a) 45 (b) $58\frac{2}{3}$
(c) 70 (d) $40\frac{2}{3}$
(e) $50\frac{1}{4}$

20. After replacing an old member by a new member, it was found that the average age of five members of a club is the same as it was 3 years ago. The difference between the ages of the replaced and the new members is
(a) 2 years (b) 4 years
(c) 8 years (d) 15 years

21. The average age of a husband and wife, who were married 4 years ago, was 25 years at the time of their marriage. The average age of the family consisting of husband, wife and a child, born during the interval is 20 years today. The age of the child is :
(a) 1 years (b) 2 years
(c) 2.5 years (d) 3 years

22. A man purchases milk for three consecutive years. In the first year, he purchases milk at the rate of ₹ 7.50 per litre, in the second year, at the rate of ₹ 8.00 per litre and in the third year, at ₹ 8.50 per litre. If he purchases milk worth ₹ 4080 each year, the average price of milk per litre for the three year is :
(a) ₹ 7.68 (b) ₹ 7.98
(c) ₹ 7.54 (d) ₹ 7.83

23. The average weight of three men A, B and C is 84 kg. D joins them and the average weight of the four becomes 80 kg. If E whose weight is 3 kg more than that of D, replaces A, the average weight of B, C, D and E becomes 79 kg. The weight of A is :
(a) 65 kg (b) 70 kg
(c) 75 kg (d) 80 kg

24. An elevator can carry maximum of 16 passengers with an average weight of 80 kg. However, four boys more than the maximum carrying capacity of the elevator entered it making the average weight as 86 kg and overloading the elevator. What is the average weight of those four boys ?
(a) 112 kg (b) 108 kg
(c) 110 kg (d) 98 kg

25. Out of three given numbers, the first number is twice the second and thrice the third. If the average of the three numbers is 154, what is the difference between the first and the third number?
(a) 126 (b) 42
(c) 166 (d) 52
(e) None of these

Hints & Solutions

1. **(b)** Let the no. of wickets = x
According to question
$24.85x + 52 = 24(x + 5)$
$24.85x + 52 = 24x + 120$
$0.85x = 68$
$x = \frac{68 \times 100}{85}$
$x = 80$
No. of wickets till the last match is
$x + 5 = 80 + 5 = 85$

2. **(c)** Let the total no. of students = 100
According to question
$20 \times 80 + 25 \times 31 + 55 \times x = 52 \times 100$
$1600 + 775 + 55x = 5200$
$55x = 5200 - 1600 - 775$
$55x = 2825$
$x = 51.4$

3. **(c)** According to question
$\frac{\text{Agricultural}}{\text{other workers}} = \frac{11}{1}$
Average of monthly Income of all workers
$= \frac{11 \times S + 1 \times T}{12} = \frac{11S + T}{12}$

4. **(a)** Total age of husband, wife & their child at present
$= 3 \times 27 + 3 \times 3 = 90$ years.
Total age of wife & child at present
$= 20 \times 2 + 2 \times 5 = 50$ years
$\therefore$ Present age of husband = 90 – 50 = 40 years

5. **(c)** $A : B : C = 2 : 5 : 3$
$\text{Avg} = \frac{30 \times 2 + 17 \times 5 + 25 \times 3}{10} = \frac{60 + 85 + 75}{10} = 22$

6. **(c)** Let 3 consecutive odd no. be x, $x + 2$ and $x + 4$
ATQ
$\frac{x + x + 2 + x + 4}{3} = 12 + \frac{1}{3}x$
$\frac{3x + 6}{3} - \frac{x}{3} = 12 = 2x + 6 = 36$
$\Rightarrow x = \frac{36 - 6}{2} = 15$
last No = 15 + 4 = 19

7. **(b)** Let the numbers be $n - 2$, $n - 1$, n, $n + 1$ and $n + 2$.
Their average = n.
Next two consecutive numbers are $n + 3$ and $n + 4$.
Therefore the average of 7 consecutive numbers
$= \frac{(n-2) + (n-1) + n + (n+1) + (n+2) + (n+3) + (n+4)}{7}$
$= \frac{5n + 2n + 7}{7} = n + 1$

8. **(b)** Let the average of batsman after 11th innings = A
$\frac{\text{Total score made by batsman at the end of } 11^{\text{th}} \text{ innings}}{11} = A$
$\therefore$ Total score after 11th innings = 11 A
Now, $\frac{\text{Total score after } 11^{\text{th}} \text{ innings} + \text{score made in } 12^{\text{th}} \text{ innings}}{12} = A + 2$
$\Rightarrow 11A + 63 = (A + 2) \times 12$
$\Rightarrow 11A - 12A = 24 - 63$
$\Rightarrow A = 39$
12th innings average = 39 + 2 = 41

9. **(d)** Weight of new crewmen
= Replace man weight + [No. of crewmen × increased average]
$= 55 + 12 \times \frac{1}{3} = 59$ kg

10. **(b)** Lowest score = x
Highest score = $x + 100$
$\therefore 28 \times 38 + x + x + 100 = 30 \times 40$
$\Rightarrow 1064 + 2x + 100 = 1200$
$\Rightarrow 2x = 1200 - 1164 = 36$
$\Rightarrow x = 18$

11. **(b)** Let total number of workers be n
total salary of all workers = 8000 n
total salary of 7 technicians = 7 × 12000 = 84,000
total salary of remaining workers = $(n - 7) \times 6000$
$84000 + (n - 7) \times 6000 = 8000$ n
$84 + 6n - 42 = 8$n
$42 = 2n$
$n = 21$

12. **(d)** Let number of natural numbers be x
$\therefore 15x + 30 - 5 = 17.5x$
$25 = 2.5x$
$x = \frac{25}{2.5} = 10$
So 10 natural numbers are there.

13. **(c)** Sum of monthly income of $A + B = 30100$ ...(i)
Sum of monthly income of $B + C = 30700$ ...(ii)
Sum of monthly income of $A + C = 30400$ ...(iii)
Subtracting eqn. (i) from (ii)
$B + C - A - B = 30700 - 30100$
$C - A = 600$ ...(iv)
$C + A = 30400$ ...(v)
Subtracting eqn. (iv) from (v)
$C - A - C - A = 600 - 30400$
$-2A = -29800$
$A =$ ₹ 14900

14. (a) Actual weight of all the students.
$= (36 \times 45) - (34 - 32) - (40 - 45)$
$= 1620 + 3 = 1623$ kg
$\therefore$ Actual average weight
$= \frac{1623}{45} = 36.07$ kg

15. (b) Let Seema's son's present age = x years
$\therefore$ Seema's present age = $4x$ years
$\therefore$ Seema's father's present age
$= 4x \times \frac{7}{4} = 7x$ years
Now $x + 4x + 7x = 32 \times 3$
$\Rightarrow 12x = 96$
$\Rightarrow x = \frac{96}{12} = 8$
$\therefore$ Required difference
$= 7x - x = 6x = 6 \times 8 = 48$ years

16. (c) Average of 8 consecutive odd numbers $= \frac{656}{8} = 82$
$\therefore$ Fourth number = 82 – 1 = 81
$\therefore$ First number = 75
Average of 4 even numbers = 87
$\therefore$ Second even number = 87 – 1 = 86
Second largest even number = 88
$\therefore$ Required sum = 75 + 88 = 163

17. (b) Arun's opinion: $65 < W < 72$
Brother's opinion: $60 < W < 70$
Mother's opinion: $W \leq 68$
Probable weights = 66, 67, 68
Average $= \frac{66+67+68}{3} = 67$ kg

18. (a) Total age of remaining 40 girls
$= (80 + 20 - 20 \times 22 - 20 \times 24)$ years
$= (1600 - 440 - 480)$ years = 680 years
$\therefore$ Required average age $= \frac{680}{40} = 17$ years

19. (b) Match I : Match II = 5 : 4
Match II : Match III = 2 : 1 = 4 : 2
$\therefore$ Match I : Match II : Match III = 5 : 4 : 2
According to the question.
$5x - 2x = 48$
$\Rightarrow 3x = 48 \Rightarrow x = \frac{48}{3} = 16$
Total runs scored in three matches
$= 5x + 4x + 2x = 11x = 11 \times 16 = 176$
$\therefore$ Required average $= \frac{176}{3} = 58\frac{2}{3}$

20. (d) Let present average age is = x years
Total age = $5x$ year
According to question,
$5x - y + z = 5x - 15$
where y = Replaced member
z = New member
$-y + z = -15$
$y - z = 15$
This is required difference.

21. (b) According to question
$\frac{H+W}{2} = 25$ years
$H + W = 50$ years
$\frac{H+W+C}{3} = 20$
$H + W + C = 60$ years and
Sum of present age of $H + W$
$= 50 + 4 \times 2 = 58$ years
$\therefore$ Child age = 2 years

22. (b) According to the question
Quantity of Milk in Ist year $= \frac{4080}{7.5} = 544$ ltr
Quantity of Milk in 2nd Year $= \frac{4080}{8} = 510$ ltr
Quantity of Milk in 3rd Year $= \frac{4080}{8.5} = 480$ ltr
Total Milk = 544 + 510 + 480 = 1534 ltr
Average price in three year $= \frac{4080 \times 3}{1534}$ = ₹ 7.98

23. (c) Sum of weight of A, B & C = $84 \times 3 = 252$ kg.
Sum of weight of A, B, C & D = $80 \times 4 = 320$ kg.
D's weight = 320 – 252 = 68 kg.
E's weight = 68 + 3 = 71 kg.
Sum of weight of B, C, D & E = $4 \times 79 = 316$
$B + C + 68 + 71 = 316$
$B + C = 177$
$A + B + C = 252$
$\therefore A = 252 - 177$
$\therefore A = 75$ kg.

24. (c) Passengers weight Total weight
16 × 80 = 1280
20 × 86 = 1720
$\therefore$ Weight of 4 Boys = (1720 – 1280) = 440
$\therefore$ Average weight of 4 Boys $= \frac{440}{4} = 110$ kg.

25. (e) Let the first number be = $6x$
$\therefore$ Second number = $3x$
and the third number = $2x$
According to the question,
$6x + 3x + 2x = 154 \times 3$
or, $11x = 154 \times 3$
$\therefore x = \frac{154 \times 3}{11} = 42$
$\therefore$ Required difference
$= 6x - 2x = 4x = 4 \times 42 = 168$

Chapter 5

Profit, Loss & Discount

Cost Price

The amount paid to purchase an article or the price at which an article is made, is known as its cost price.

The cost price is abbreviated as C.P.

Selling Price

The price at which an article is sold, is known as its selling price.

The selling price is abbreviated as S.P.

Profit

If the selling price (S.P.) of an article is greater than the cost price (C.P.), then the difference between the selling price and cost price is called profit.

Thus, If S.P. > C.P., then

Profit = S.P. – C.P. ⇒ S.P. = C.P. + Profit

⇒ C.P. = S.P. – Profit.

Loss

If the selling price (S.P.) of an article is less than the cost price (C.P.), then the difference between the cost price (C.P.) and the selling price (S.P.) is called loss.

Thus, if S.P. < C.P., then

Loss = C.P. – S.P. ⇒ C.P. = S.P. + Loss

⇒ S.P. = C.P. – Loss

Profit and Loss Percentage

The profit per cent is the profit that would be obtained for a C.P. of ₹ 100.

Similarly, the loss per cent is the loss that would be made for a C.P. of ₹ 100.

$$\text{Profit per cent} = \frac{\text{Profit}}{\text{C.P.}} \times 100$$

$$\text{Loss per cent} = \frac{\text{Loss}}{\text{C.P.}} \times 100$$

Remember...

- $\text{Profit} = \dfrac{\text{C.P.} \times \text{Profit \%}}{100}$
- $\text{Loss} = \dfrac{\text{C.P.} \times \text{Loss \%}}{100}$
- $\text{S.P.} = \left(\dfrac{100 + \text{Profit\%}}{100}\right) \times \text{C.P.}$
- $\text{S.P.} = \left(\dfrac{100 - \text{Loss\%}}{100}\right) \times \text{C.P.}$
- $\text{C.P.} = \dfrac{100 \times \text{S.P.}}{100 + \text{Profit \%}}$, if S.P. > C. P.
- $\text{C.P.} = \dfrac{100 \times \text{S.P.}}{100 - \text{Loss \%}}$, if S.P. < C. P.

Note

(i) If an article is sold at a certain gain (say 45%), then SP = (100 + 45)% of CP = 145% of CP.

(ii) If an article is sold at certain loss (say 25%), then SP = (100 – 25) % of CP = 75% of CP.

Marked Price

The price printed on the item or printed on the lable pasted on the item is called the marked price or list price.

The marked price is abbreviated as M.P.

Discount

The reduction made on the 'marked price' of an article is called the discount.

When no discount is given, 'selling price' is the same as 'marked price'.

- Discount = Marked price × Rate of discount.
- S.P. = M.P. – Discount.
- $\text{Discount \%} = \dfrac{\text{Discount}}{\text{M.P.}} \times 100$.
- Buy x get y free i.e., if $x + y$ articles are sold at cost price of x articles, then the percentage discount = $\dfrac{y}{x+y} \times 100$.

Sales Tax

To meet government's expenditures like construction of roads, railway, hospitals, schools etc. the government imposes different types of taxes. Sales tax (S.T.) is one of these tax.

Sales tax is calculated on selling price (S.P.)

Note

If discount is given on selling an article, then selling price of this article is calculated after discount first and then sales tax is calculated on the new selling price of the article.

Remember...

(i) When there are two successive profits of a% and b%, then the resultant profit per cent is given by

$$\left(a+b+\frac{ab}{100}\right)\%$$

(ii) When there are two successive loss a% and b%, then the resultant loss per cent is given by $\left(-a-b+\frac{ab}{100}\right)\%$

(iii) When there is a profit of a% and loss of b% in a transaction, then the resultant profit or loss per cent is given by $\left(a-b-\frac{ab}{100}\right)\%$, according to the +ve or –ve sign respectively.

(iv) When cost price and selling price are reduced by the same amount (A) and profit increases then cost price

$$(\text{C.P.}) = \frac{[\text{Initial profit\%} + \text{Increase in profit\%}]\times A}{\text{Increase in profit\%}}$$

(v) If cost price of x articles is equal to the selling price of y articles, then profit/loss percentage = $\frac{x-y}{y}\times 100\%$, according to +ve or –ve sign respectively.

(vi) If on selling x objects, a person get the profit equal to selling price of y objects, then profit % = $\frac{y}{x-y}\times 100$

(vii) A man purchases a certain number of articles at x a rupee and the same number at y a rupee. He mixes them together and sells them at z a rupee. Then his gain or loss % = $\left[\frac{2xy}{z(x+y)}-1\right]\times 100$ according as the sign is +ve or –ve.

(viii) If two items are sold, each at ₹ x, one at a gain of p% and the other at a loss of p%, there is an overall loss given by $\frac{p^2}{100}$%. The absolute value of the loss is given by $\frac{2p^2x}{100^2-p^2}$.

(ix) If CP of two items is the same and % loss on one item is same as % gain on the other item, then net loss or net profit is zero.

(x) A businessman sells his items at a profit/loss of a%. If he had sold it for ₹ R more, he would have gained/lost b%. Then,

$$\text{CP of items} = \frac{R}{b\pm a}\times 100$$

'–' = When both are either profit or loss

'+' = When one is profit and other is loss

(xi) If A sold an article to B at a profit (loss) of r_1 % and B sold this article to C at a profit (loss) of r_2 %, then cost price of article for C is given by

$$(\text{cost price for } A)\times\left(1\pm\frac{r_1}{100}\right)\left(1\pm\frac{r_2}{100}\right).$$

'+' sign will be taken for profit and '–' sign is taken for loss.

(xii) If a man purchases m items for ₹ x and sells n items for ₹ y, then Profit or loss per cent is given by

$$\frac{my-nx}{nx}\times 100\%$$

[Positive result means profit and negative result means loss].

(xiii) If a^{th} part of some items is sold at x% loss, then required gain per cent in selling rest of the items in order that there is neither gain nor loss in whole transaction, is

$$\frac{ax}{1-a}\%$$

EXERCISE

1. During month-long annual sale, a shopkeeper sells his goods at a discount of 50%. But in the last week, he offers an additional discount of 40%. If the original price of a shirt is ₹ x, then the price, (in rupees) during the last week of the sale will be
   (a) 90% of x (b) 70% of x
   (c) 30% of x (d) 10% of x

2. A shop offers 10% discount on every purchase of an article. It also offers an additional discount of 12%, if the payment is made in cash. If the original price of an item is ₹ 250, how much a customer will pay. If he wants to pay the price is cash?
   (a) ₹ 180 (b) ₹ 192
   (c) ₹ 198 (d) ₹ 195

3. Jesmine allows 4% discount on the marked price of her goods and still earns a profit of 20%. What is the cost price of a shirt if its marked price is ₹ 850?
   (a) ₹ 650 (b) ₹ 720
   (c) ₹ 700 (d) ₹ 680

4. A shopkeeper allows a discount of 10% on the marked price of an item but charges a sales tax of 8% on the discounted price. If the customer pays ₹ 3,402 as the price including the sales tax, then the marked price is
   (a) ₹ 3,400 (b) ₹ 3,500
   (c) ₹ 3,600 (d) ₹ 3,800

5. Ramesh marks his goods 30% above cost price. If he sells the item for ₹ 910 after allowing of 15% discount find his cost price.
   (a) ₹ 823.5 (b) ₹ 758
   (c) ₹ 814.2 (d) ₹ 856.5

6. A shopkeeper bought 30 kg of wheat at the rate of ₹ 45 per kg. He sold forty percent of the total quantity at the rate of ₹ 50 per kg. Approximately, at what price per kg should he sell the remaining quantity to make 25 per cent overall profit?
   (a) ₹ 54 (b) ₹ 52
   (c) ₹ 50 (d) ₹ 60
   (e) ₹ 56

7. 'A' bought a certain quantity of oranges at total cost of ₹ 1200. He sold 1/3rd of those oranges at 20% loss. If A earns an overall profit of 10%, at what percent profit did A sell the rest of the oranges?
   (a) 16% (b) 15%
   (c) 22% (d) 25%
   (e) 20%

8. Two mobile phones were purchased at the same price. One was sold at a profit of 30% and the second was sold at a price which was ₹ 2500 less than the price at which the first was sold. If the overall profit earned by selling both the mobile phones was 5%, what was the cost price of one mobile phone?
   (a) ₹ 8000 (b) ₹ 5000
   (c) ₹ 6000 (d) ₹ 4500
   (e) ₹ 5500

9. The cost prices of two beds are equal. One bed is sold at a profit of 25% and the other one for ₹ 6596 less than the first one. If the overall profit earned after selling both the beds is 8%, what is the cost price of each bed?
   (a) ₹ 20,400 (b) ₹ 19,800
   (c) ₹ 18,600 (d) ₹ 19,400
   (e) ₹ 16,800

10. Profit earned by an organization is distributed among officers and clerks in the ratio of 5 : 3 respectively. If the number of officers is 45 and the number of clerks is 80 and the amount received by each officer is ₹ 25,000, what was the total amount of profit earned?
    (a) ₹ 22 lakhs (b) ₹ 18.25 lakhs
    (c) ₹ 18 lakhs (d) ₹ 23.25 lakhs
    (e) None of these

11. The percentage profit earned when an article is sold for ₹ 558 is double the percent profit earned when the same article is sold for ₹ 504. If the marked price of the article is 30% above the cost price, what is the marked price of the article?
    (a) ₹ 585 (b) ₹ 595
    (c) ₹ 624 (d) ₹ 590
    (e) ₹ 546

12. The cost price of article A is ₹ 200 more than the cost price of article B. Article A was sold at 10% loss and article B was sold at 25% profit. If the overall profit earned after selling both the articles is 4%. What is the cost price of article B?
    (a) ₹ 450 (b) ₹ 550
    (c) ₹ 400 (d) ₹ 500
    (e) ₹ 300

13. The cost price of article A is ₹ 100 more than the cost price of article B. Article A was sold at 40% profit and article B was sold at 40% loss. If the overall profit earned after selling both the articles is 5%. What is the cost price of article B?
    (a) ₹ 300 (b) ₹ 400
    (c) ₹ 250 (d) ₹ 350
    (e) ₹ 850

14. A trader sells an item to a retailer at 20% discount, but charges 10% on the discounted price, for delivery and packaging. The retailer sells it for ₹ 2046 more, thereby earning a profit of 25%. At what price had the trader marked the item?
    (a) ₹ 9400 (b) ₹ 9000
    (c) ₹ 8000 (d) ₹ 12000
    (e) ₹ 9300

15. A dealer allowed a discount of 25% on the marked price of ₹ 12000 on an article and incurred a loss of 10%. What discount should he allow on the marked price so that he gains ₹ 440 on the article?
(a) 11% (b) 13%
(c) 19% (d) 15%
(e) None of these

16. Ravi ate in a restaurant and got a membership discount of 30% on the original bill amount but he had to pay 10% as service tax and 8% service charge on the discounted bill amount. If Ravi paid ₹ 4,743, which included a tip of ₹ 200, how much money did he give as service charge?
(a) ₹ 324 (b) ₹ 314
(c) ₹ 296 (d) ₹ 308
(e) ₹ 272

17. On a ₹ 10,000 payment order, a person has choice between 3 successive discounts of 10%, 10%, and 30%, and 3 successive discounts of 40%, 5% and 5%. By choosing the better one he can save (in ₹):
(a) 200 (b) 255
(c) 400 (d) 433

18. A shopkeeper marks his goods at such a price that after allowing a discount of 12.5% on the marked price, he still earns a profit of 10%. The marked price of an article which costs him ₹ 4,900 is
(a) ₹ 5,390 (b) ₹ 6,160
(c) ₹ 5,490 (d) ₹ 6,260

19. The total cost price of two watches is ₹ 840. One is sold at a profit of 16 percent and the other at a loss of 12 percent. There is no loss or gain in the whole transaction. The cost price of the watch on which the shopkeeper gains, is
(a) ₹ 360 (b) ₹ 370
(c) ₹ 380 (d) ₹ 390

20. One trader calculates the percentage of profit on the buying price and another calculates on the selling price. When their selling prices are the same, then the difference of their actual profits is ₹ 85 and both claim to have made 20% profit, what is the selling price of each?
(a) ₹ 1700 (b) ₹ 2100
(c) ₹ 2550 (d) ₹ 2750

21. A person sold a TV for ₹ 9,400 then he lost a particular amount. When he sold another TV of the same type at ₹ 10,600, his gain was double the former loss. What was the cost price of each TV ?
(a) ₹ 9,800 (b) ₹ 10,000
(c) ₹ 10,200 (d) ₹ 10,400

22. A person bought some articles at the rate of 5 per rupee and the same number at the rate of 4 per rupee. He mixed both the types and sold at the rate of 9 for 2 rupees. In this business he suffered a loss of ₹ 3. The total number of articles bought by him was
(a) 1090 (b) 1080
(c) 540 (d) 545

23. A person sold an article at 20% profit on the selling price. After wards, when the cost price reduced by 10%, then he also reduced the selling price by 10%. His percentage of profit on cost price will be
(a) 30 (b) 25
(c) 22.5 (d) 12.5

24. A fruit seller buys 240 apples for ₹ 600. Some of these apples are bad and are thrown away. He sells the remaining apples at ₹ 3.50 each and makes a profit of ₹ 198. The % of apples thrown away are?
(a) 6% (b) 5% (c) 4% (d) 7%

25. A sells a car priced at ₹ 36,000. He gives a discount of 8% on the 1st ₹ 20,000 and 5% on the remaining ₹ 16,000. *B* also sells a car of the same make, period at ₹ 36,000. He gives a discount of 7% on the total prices. Calculate the actual prices charged by *A* and *B* for the cars.
(a) A = ₹ 33,500; B = ₹ 33,400
(b) A = ₹ 33,450; B = ₹ 33,650
(c) A = ₹ 33,480; B = ₹ 33,600
(d) A = ₹ 33,600; B = ₹ 33,480

26. A shopkeeper has 11 books of same cost price. He sells the first book at certain price, then he sells second book at a price which is ₹ 1 less than the selling price of first book and then he sells third book at a price which is ₹ 1 less than the selling price of second book. Following this pattern, he sold all 11 books. If he sells sixth book at its cost price. Find the overall percent profit or loss on selling all 11 books.
(a) 20% (b) 10%
(c) $\frac{1}{11}$% (d) No profit no Loss

27. Arun buys one kilogram of apples for ₹ 120 and sells it to Swati gaining 25%. Swati sells it to Divya and Divya again sells it for ₹ 198, making a profit of 10%. What is the profit percentage made by Swati?
(a) 25% (b) 20%
(c) 16.67% (d) 15%

28. Anand marks up the price of an article by 50% and then allows a discount of 20% and sells it to Balaji who sells it for ₹ 20 more than what he purchased for, this S.P is 30% more than the original C.P. of the article. Then Balaji's profit % is
(a) 7.5% (b) 6.66%
(c) 8.33% (d) 9%

29. If a person purchases a shirt, he gets 6% discount. However, if he purchases two shirts, he gets 5% on the first and 8% on the second. If the price paid by the person for two shirts is ₹ 925, then what will be the marked price of each shirt?
(a) ₹ 494 (b) ₹ 550
(c) ₹ 528 (d) ₹ 500

30. A man sells a bicycle at marked price which is 30% higher than the cost price. If he gives some discount and sells it at ₹ 150 less than the marked price, he would still gain 20%. What is the percentage of discount offered?
(a) 7.69% (b) 1.83%
(c) 7.54% (d) 7.23%

Hints & Solutions

1. **(c)** Single equivalent discount

$$= \left(50 + 40 - \frac{50 \times 40}{100}\right)\% = 70\%$$

$\therefore$ Required price of shirt

$$= (100 - 70)\% \text{ of } x = 30\% \text{ of } x$$

2. **(c)** M.P. of an item = ₹ 250

Cash Price of an item

$$= \frac{88}{100} \times \frac{90}{100} \times 250 = ₹\ 198$$

3. **(d)** C.P. of the shirt

$$= 850 \times \frac{96}{100} \times \frac{100}{120} = ₹\ 680$$

4. **(b)** Let marked price = 100

$$100 \xrightarrow[\text{Discount}]{10\%} 90 \xrightarrow[\text{Tax}]{8\%} \overset{\text{S.P (including tax)}}{97.2}$$

97.2 units = ₹ 3,402

$$1 \text{ unit} = \frac{3402}{97.2}$$

$$100 \text{ units} = \frac{3402}{97.2} \times 100 = 3500$$

5. **(a)**

C.P.	S.P.	M.P.
$10 \times_{20}$		$13 \times_{20}$
	$17 \times_{13}$	$20 \times_{13}$
200 unit	221 unit	260 unit

221 unit ——— 910

$$200 \text{ unit} ——— \frac{910}{221} \times 200 = ₹\ 823.5$$

6. **(d)** Cost price of 30 kg of wheat

$$= 30 \times 45 = ₹\ 1350$$

Total SP for an overall profit of 25%

$$= \frac{1350 \times 125}{100} = ₹\ 1687.5$$

$$\text{SP of 12 kg} = \left(\frac{30 \times 40}{100}\right) \text{ of wheat}$$

$$= 12 \times 50 = ₹\ 600$$

Expected SP of 18 kg of remaining wheat

$$= 1687.5 - 600 = ₹\ 1087.5$$

$$\text{Required selling price per kg} = \frac{1087.5}{18} = ₹\ 60$$

7. **(d)** Let C.P. of each orange be ₹ 100.

$$\therefore \text{ Number of oranges} = \frac{1200}{100} = 12$$

According to the question,

$$\text{S.P. of 12 oranges} = \frac{1200 \times 110}{100} = ₹\ 1320$$

4 oranges are sold on 20% loss.

$$\therefore \text{ Their S.P.} = \frac{400 \times 80}{100} = ₹\ 320$$

$\therefore$ Required S.P. of remaining 8 oranges

$$= 1320 - 320 = ₹\ 1000$$

$\therefore$ Required profit percent

$$= \left(\frac{1000 - 800}{800}\right) \times 100 = 25\%$$

8. **(b)** Let the C.P. of each mobile phone be ₹ x.

According to the question,

$$\frac{x \times 130}{100} + \frac{x \times 130}{100} - 2500 = \frac{2x \times 105}{100}$$

$$\Rightarrow \frac{260x}{100} - \frac{210x}{100} = 2500$$

$$\Rightarrow \frac{50x}{100} = 2500$$

$$\Rightarrow x = \frac{2500 \times 100}{50} = ₹\ 5000$$

9. **(d)** C.P. of each bed = ₹ x (let)

According to the question,

$$\frac{x}{4} + \frac{x}{4} - 6596 = \frac{2x \times 8}{100} = \frac{4x}{25}$$

$$\Rightarrow \frac{x}{2} - \frac{4x}{25} = 6596 \quad \Rightarrow \frac{25x - 8x}{50} = 6596$$

$$\Rightarrow 17x = 6596 \times 50$$

$$\Rightarrow x = \frac{6596 \times 50}{17} = ₹\ 19400$$

10. **(d)** Profit received by each officer = ₹ 25000

$\therefore$ Profit received by each clerk

$$= \frac{3}{5} \times 25000 = ₹\ 15000$$

$\therefore$ Total earned profit = ₹ (45 × 25000 + 80 × 15000)

= ₹ (1125000 + 1200000) = ₹ 23.25 lakh

11. **(a)** Difference of S.P. = ₹ (558 – 504) = ₹ 54

$\therefore$ C.P. of article = ₹ (504 – 54) = ₹ 450

$$\therefore \text{ Marked price of article} = ₹ \left(\frac{450 \times 130}{100}\right) = ₹\ 585$$

12. (c) C.P. of article B = ₹ x

∴ C.P. of article A = ₹ $(x + 200)$

According to the question,

$$\frac{x\times25}{100}-\frac{10}{100}(x+200) = (2x+200)\times\frac{4}{100}$$

$$\Rightarrow \frac{x}{4}-\frac{x}{10}-20=\frac{8x+800}{100}$$

$$\Rightarrow \frac{x}{4}-\frac{x}{10}-\frac{8x}{100}=20+8=28$$

$$\Rightarrow \frac{25x-10x-8x}{100}=28 \Rightarrow \frac{7x}{100}=28$$

$$\Rightarrow x=\frac{28\times100}{7}=\text{₹ }400$$

13. (d) C.P. of article B = ₹ x

C.P. of article A = ₹ $(x + 100)$

According to the question,

$$(x+100)\times\frac{40}{100}-\frac{x\times40}{100}=(2x+100)\times\frac{5}{100}$$

$$\Rightarrow 40x+4000-40x=10x+500$$

$$\Rightarrow 10x=4000-500=3500$$

$$\Rightarrow x=\frac{3500}{10}=\text{₹ }350$$

14. (e) Let the price marked by the trader be ₹ x.

∴ S.P. of article

$$=\text{₹ }\left(x\times\frac{80}{100}\times\frac{110}{100}\right)=\text{₹ }\frac{22x}{25}$$

For the retailer.

$$\text{S.P.}=\text{₹ }\left(\frac{22x}{25}\times\frac{125}{100}\right)=\text{₹ }\frac{11x}{10}$$

According to the question,

$$\frac{11x}{10}-\frac{22x}{25}=2046 \quad\Rightarrow\quad \frac{55x-44x}{50}=2046$$

$$\Rightarrow 11x=2046\times50 \quad\Rightarrow\quad x=\frac{2046\times50}{11}=\text{₹ }9300$$

15. (b) C.P. of article = ₹ x (let)

$$\therefore \frac{12000\times75}{100}=\frac{x\times90}{100}$$

$$\Rightarrow x=\frac{12000\times75}{90}=\text{₹ }10000$$

Again, profit = ₹ 440

∴ S.P. = 10000 + 440 = ₹ 10440

Discount = 12000 – 10440 = ₹ 1560

If discount = x%, then

$$\frac{12000\times x}{100}=1560$$

$$\Rightarrow x=\frac{1560\times100}{12000}=13\%$$

16. (d) Let the bill after 30% discount be ₹ x

According to the question,

$$\frac{x\times118}{100}=4743-200$$

$$\Rightarrow \frac{x\times118}{100}=4543$$

$$\Rightarrow x=\frac{4543\times100}{118}=\text{₹ }3850$$

$$\therefore \text{Service charge}=\frac{3850\times8}{100}=\text{₹ }308$$

17. (b) Selling price in the first case

= 70% of 90% of 90% of ₹ 10000

$$=\frac{70}{100}\times\frac{90}{100}\times\frac{90}{100}\times10000=\text{₹ }5670$$

Selling price in the second case

= 95% of 95% of 60% of ₹ 10000

$$=\frac{95}{100}\times\frac{95}{100}\times\frac{60}{100}\times10000=\text{₹ }5415$$

∴ Saving = ₹ (5670 – 5415) = ₹ 255

18. (b) SP of the article

$$=4900\times\frac{110}{100}=\text{₹ }5390$$

$$\therefore \text{Marked price}=\frac{100}{87.5}\times5390$$

= ₹ 6160 [∵ Discount being 12.5%]

19. (a) According to question,

There is no loss or gain in the whole transaction means

16% profit on watch A CP_1

12% loss on watch B $CP_2 = 0$

16% Watch A = 12% Watch B

$$\frac{\text{Watch A }(CP_1)}{\text{Watch B }(CP_2)}=\frac{12\%}{16\%}=\frac{3}{4}$$

$CP_1 + CP_2 = 3 + 4 = 7$ units

7 units → 840 (Given)

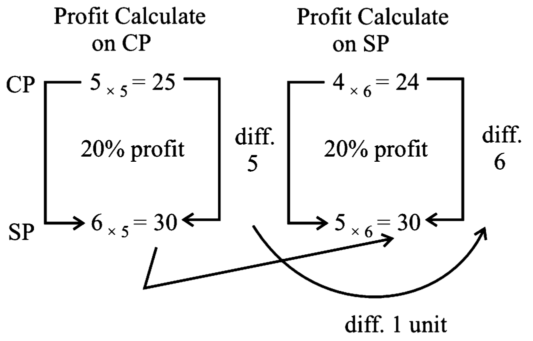
1 unit → 120

∴ 3 units → 120 × 3 = 360

CP of watch to sold at 16% profit

= ₹ 360

20. (c) According to question,



to make SP same of both cases

1 unit → ₹ 85

30 units → 30 × 85 = ₹ 2550

21. (a) According to question,

Given,

Loss : CP – 9400 = x ...(i)

Profit : 10600 – CP = $2x$ ...(ii)

Put the value of eq. (i) in eq. (ii)

$\therefore$ 10600 – CP = 2 (CP – 9400)

10600 – CP = 2CP – 18800

3CP = 29400

$$CP = \frac{29400}{3} = 9800$$

$\therefore$ CP = ₹ 9800

22. (b) Let the person buy 10 articles.

Total CP = ₹ (1 + 5/4) = ₹ 9/4

SP of 10 articles = ₹ 2/9 × 10 = ₹ 20/9

So, Loss = (9/4 – 20/9) = 1/36

Now, if loss is ₹ 1/36, Number of article = 10

So, If loss is ₹ 3, Number of articles

= 36 × 10 × 3 = 1080

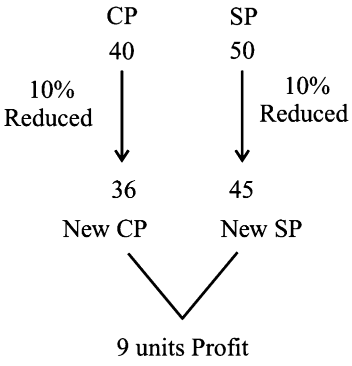
23. (b) Given :

$$20\% \text{ profit on SP means} = \frac{1}{5}$$

$$20\% \text{ profit} \Rightarrow \frac{10 \to \text{Profit}}{50 \to \text{SP}}$$

$\therefore$ CP = SP – Profit

CP = 50 – 10 = 40



$$\therefore \quad \text{Profit\%} = \frac{\text{Profit}}{\text{CP}} \times 100 = \frac{9}{36} \times 100 = 25\%$$

24. (b) Let the number of bad apples = x

C.P. of (240 – x) apples = ₹ 600

S.P. of (240 – x) apples = ₹ 3.5 × (240 – x)

According to the question,

$\Rightarrow$ 3.5 × (240 – x) – 600 = 198

$\therefore$ $x = 12$

$$\Rightarrow \quad x\% = \frac{12}{240} \times 100 = 5\%$$

25. (d) Total Discount by A

$$= 20000 \times \frac{8}{100} + 16000 \times \frac{5}{100}$$

= 1600 + 800 = ₹ 2400

Selling Price of A = 36,000 – 2,400 = ₹ 33,600

$$\text{Selling Price of } B = 36{,}000 \times \frac{(100-7)}{100}$$

$$= 36{,}000 \times \frac{93}{100} = ₹\ 33{,}480$$

26. (d) Let CP of each book = (x – 5), (x – 4) .... , x (SP of sixth book), (x + 1) (x + 2) .... (x + 5)

$$\text{Average} = \frac{\text{CP of } 1^{st} \text{ book} + \text{CP of } 11^{th} \text{ book}}{2}$$

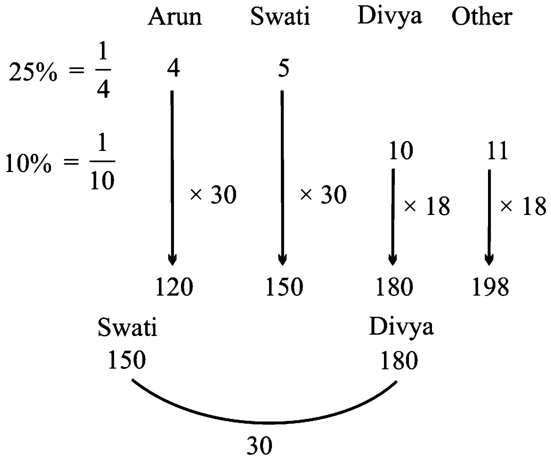
$$= \frac{x+5+x-5}{2} = x$$

$\therefore$ Total C.P. of 11 books = $11x$

Total S.P. of 11 books = $11x$

$\therefore$ Both are equal so neither profit nor loss

27. (b)



$$\text{Profit \%} = \frac{30}{150} \times 100 = 20\%$$

28. (c) Let original C.P. = 100 units

CP of Balaji $= 100\times\frac{150}{100}\times\frac{80}{100} = 120$ units

S.P. of Balaji $= \frac{130}{100}\times 100 = 130$ units

Profit of Balaji = 130 – 120 = 10 units

Profit percent $= \frac{10}{120}\times 100 = 8.33\%$

Note : There is no use of ₹ 20 given in the question

29. (a) Let marked price = $100x$

then by statement

$95x + 92x \rightarrow$ selling price of both

$187x$ ——— 925

x ——— $\frac{925}{187} = 4.94$

$\therefore$ Marked price = 4.94 × 100 = ₹ 494

30. (a)

Gain

$30\% = \frac{3}{10}$ ——— MP = 13

CP

Profit

$20\% = \frac{1}{5}$ ——— 6 SP

CP

C.P.	S.P.	M.P.
10		13
5 × 2	6 × 2	
10 unit	12	13 unit

discount = 1

discount% $= \frac{1}{13}\times 100 = 7.69\%$

Chapter 6

Ratio, Proportion & Partnership

RATIO

Ratio is strictly a mathematical term to compare two similar quantities expressed in the same units.

The ratio of two terms 'x' and 'y' is denoted by $x : y$.

In general, the ratio of a number x to a number y is defined as the quotient of the numbers x and y.

Comparison of Two or More Ratios

Method : Cross Multiplication Method

$\frac{a}{b} > \frac{c}{d}$, if $ad > bc$ and $\frac{a}{b} < \frac{c}{d}$, if $ad < bc$

For example: $\frac{6}{7} > \frac{3}{5}$ because $6 \times 5 > 7 \times 3$

and $\frac{4}{5} < \frac{7}{8}$ because $4 \times 8 < 5 \times 7$

Remember...

- In the ratio of two quantities the two quantities must be of the same kind and in same unit.
- The ratio is a pure number, i.e., without any unit of measurement.
- The ratio would stay unaltered even if both the numerator and the denominator are multiplied or divided by the same number.

PROPORTION

When two ratios are equal, the four quantities composing them are said to be in proportion.

If $\frac{a}{b} = \frac{c}{d}$, then a, b, c, d are in proportions.

This is expressed by saying that 'a' is to 'b' as 'c' is to 'd' and the proportion is written as

$$a : b :: c : d \quad \text{or} \quad a : b = c : d$$

Here 'a' is called first proportion, 'b' is called second proportion, 'c' is called third proportion and 'd' is called fourth proportion.

The terms a and d are called the extremes while the terms b and c are called the means.

Remember...

- If four quantities are in proportion, the product of the extremes is equal to the product of the means.

  i.e., $\frac{a}{b} = \frac{c}{d} \Rightarrow ad = bc$.
- If three quantities a, b and c are in continued proportion, then $a : b = b : c$

  $\therefore \quad ac = b^2$

  b is called mean proportional.
- If a, b, c, d, ... are in continue proportion, then $\frac{a}{b} = \frac{b}{c} = \frac{c}{d} \ldots$

Properties of Proportion

(i) **Invertendo :** If $\frac{a}{b} = \frac{c}{d}$, then $\frac{b}{a} = \frac{d}{c}$.

(ii) **Alternendo :** If $\frac{a}{b} = \frac{c}{d}$, then $\frac{a}{c} = \frac{b}{d}$,

(iii) **Componendo :** If $\frac{a}{b} = \frac{c}{d}$, then $\frac{a+b}{b} = \frac{c+d}{d}$.

(iv) **Dividendo :** If $\frac{a}{b} = \frac{c}{d}$, then $\frac{a-b}{b} = \frac{c-d}{d}$.

(v) **Componendo and Dividendo :** If $\frac{a}{b} = \frac{c}{d}$,

then $\frac{a+b}{a-b} = \frac{c+d}{c-d}$.

(vi) If $\frac{a}{b} = \frac{c}{d} = \frac{e}{f} = \ldots\ldots$. Then,

$$\text{Each ratio} = \frac{\text{Sum of Numerators}}{\text{Sum of Denominators}}$$

i.e. $\frac{a}{b} = \frac{c}{d} = \frac{e}{f} = \ldots = \frac{a+c+e+\ldots}{b+d+f+\ldots}$

Example **1. A man completes 5/8 of a job in 10 days. At this rate, how many more days will it take him to finish the job ?**

(a) 5 **(b)** 6 **(c)** 7 **(d)** $37\frac{1}{4}$

Sol. (b) Work done = $\frac{5}{8}$. Balance work = $1-\frac{5}{8}=\frac{3}{8}$.

Less work, Less days (Direct Variation)

Let the required number of days be x. Then,

Work ↓ days ↓
5/8 10
3/8 x

Then, $\frac{5}{8}:\frac{3}{8}::10:x \Rightarrow \frac{5}{8}\times x=\frac{3}{8}\times 10$

$\Rightarrow x=\frac{3}{8}\times 10\times\frac{8}{5}=6$

Example **2. A fort had provision of food for 150 men for 45 days. After 10 days, 25 men left the fort. The number of days for which the remaining food will last, is :**

(a) $29\frac{1}{5}$ **(b)** $37\frac{1}{4}$ **(c)** 42 **(d)** 54

Sol. (c) Suppose 125 men had food for x days. Now,

Less men, **More days (Indirect Variation)**

Then,

men ↓ days ↓
150 35
125 x

$\therefore$ 125 : 150 :: x : 35 $\Rightarrow$ 125 × x = 150 × 35

$\Rightarrow x=\frac{150\times 35}{125} \Rightarrow x=42.$

Hence, the remaining food will last for 42 days.

PARTNERSHIP

A partnership is an association of two or more persons who invest their money to start or to carry on a certain business.

A partner who manages the business is called the **working partner** and the one who simply invests the money is called the **sleeping partner.**

Partnership is of two kinds :

(i) Simple (ii) Compound.

Simple partnership: If the capitals is of the partners are invested for the same period, the partnership is called simple partnership.

Compound partnership : If the capitals of the partners are invested for different lengths of time, the partnership is called compound partnership.

Monthly Equivalent Investment

It is the product of the capital invested and the period for which it is invested.

Share of Profit or Loss in the Partnership

(i) If the period of investment is same for each partner, then the profit or loss is divided in the ratio of their investments.

(a) If A and B are partners in a business, then

$$\frac{\text{Investment of } A}{\text{Investment of } B}=\frac{\text{Profit of } A}{\text{Profit of } B} \text{ or } \frac{\text{Loss of } A}{\text{Loss of } B}$$

(b) If A, B and C are partners in a business, then

Investment of A : Investment of B : Investment of C

= Profit of A : Profit of B : Profit of C

or Loss of A : Loss of B : Loss of C

(ii) When the amount of capital invested by different partners is same (say ₹ x) for differend time periods, t_1, t_2, t_3, ..., then Ratio of profit/loss = Ratio of time period for which the capital is invested

$P_1 : P_2 : P_3 : ...$ or $L_1 : L_2 : L_3 : ... = t_1 : t_2 : t_3 : ...$

(iii) If capital investments and also period of investment are different, then the profit or loss is divided in the ratio of their Monthly Equivalent Investment.

$$\frac{\text{Monthly Equivalent Investment of } A}{\text{Monthly Equivalent Investment of } B}$$

$$=\frac{\text{Profit of } A}{\text{Profit of } B} \text{ or } \frac{\text{Loss of } A}{\text{Loss of } B}$$

i.e., $$\frac{\text{Investment of } A\times\text{Period of Investment of } A}{\text{Investment of } B\times\text{Period of Investment of } B}$$

$$=\frac{\text{Profit of } A}{\text{Profit of } B} \text{ or } \frac{\text{Loss of } A}{\text{Loss of } A}$$

EXERCISE

1. *A* and *B* started a business by investing ₹ 35,000 and ₹ 20,000 respectively. *B* left the business after 5 months and *C* joined the business with a sum of ₹ 15,000. The profit earned at the end of the year is ₹ 84,125. What is *B*'s share of profit?

(a) ₹14133 (b) ₹15,000
(c) ₹13,460 (d) Cannot be determined
(e) None of these

2. A man ordered 4 pairs of black socks and some pairs of brown socks. The price of a black socks is double that of a brown pair. While preparing the bill the clerk interchanged the number of black and brown pairs by mistake which increased the bill by 50%. The ratio of the number of black and brown pairs of socks in the original order was :

(a) 2 : 1 (b) 1 : 4 (c) 1 : 2 (d) 4 : 1

3. A vessel contains 60 litres of milk. 12 litres of milk taken out from it and replaced by water. Then again from mixture, 12 litres are again taken out and replaced by water. The ratio of milk and water in the resultant mixture is :

(a) 16 : 10 (b) 9 : 5 (c) 15 : 10 (d) 16 : 9

4. In a college the number of students studying Arts, Commerce and Science are in the ratio of 3 : 5 : 8 respectively. If the number of students studying Arts, Commerce and Science is increased by 20%, 40% and 25% respectively, what will be the new ratio of students in Arts, Commerce and Science respectively?

(a) 18 : 35 : 50 (b) 3 : 10 : 10
(c) 4 : 8 : 5 (d) 32 : 35 : 25
(e) None of these

5. The respective ratio between the monthly salary of Neil and that of Dipti is 5 : 6. Neil and Dipti, both save 40% and 25% out of their respective monthly salaries. Neil invests $\frac{5}{8}$th of his savings in LIC and Dipti invests $\frac{3}{5}$th of her savings in LIC. If Neil invests ₹ 1750 more than Dipti in LIC, what is Neil's monthly salary?

(a) ₹ 20000 (b) ₹ 25000 (c) ₹ 40000 (d) ₹ 15000
(e) ₹ 30000

6. *A*, *B* and *C* started a business with their investments in the ratio 1 : 2 : 4. After 6 months *A* invested the half amount more as before and *B* invested the same amount as before while *C* with drew one-fourth of his investment. Find the ratio of their profits at the end of the year.

(a) 5 : 12 : 13 (b) 5 : 11 : 14
(c) 5 : 12 : 14 (d) 5 : 12 : 10
(e) None of these

7. In a class of 168 students, boys and girls are in the ratio 5 : 7. 50% of the total students can speak only Hindi. The ratio of number of students speaking only Hindi to that speaking only English is 21 : 16. The ratio of boys speaking English only to that of girls speaking English only is 3 : 5. If the number of boys speaking both English and Hindi is 12, what is the number of girls speaking Hindi only? (Assume that all students speak at least one language).

(a) 48 (b) 50 (c) 52 (d) 55
(e) None of these

8. Ratio of the earnings of *A* and *B* is 4 : 7 respectively. If the earnings of *A* increase by 50% and the earnings of *B* decrease by 25% the new ratio of their earnings becomes 8 : 7 respectively. What are A's earnings.?

(a) ₹ 26, 000 (b) ₹ 28, 000
(c) ₹ 21, 000 (d) Data inadequate
(e) None of these

9. Monthly salary of Dex is $\frac{1}{4}$th of his father's monthly salary. Dex's sister's monthly salary is $\frac{2}{5}$th of their father's monthly salary. Dex's sister pays ₹ 12, 8000, which is $\frac{1}{4}$th of her monthly salary as study loan. Savings and expenses made out of the monthly salary, by Dex is in the respective ratio 3 : 5. How much does Dex save each month?

(a) ₹ 12, 000 (b) ₹ 10, 600
(c) ₹ 10, 400 (d) ₹ 10, 600
(e) ₹ 12, 400

10. Sia gave $\frac{1}{4}$th of the money she had with her to her brother. Her brother, from the money he received from Sia, spent $\frac{1}{8}$th on his bus fair, $\frac{1}{4}$th on tuition fees. After the mentioned expenses, Sia's brother had ₹ 1875 remaining with him. How much money did Sia have initially?

(a) ₹ 15000 (b) ₹ 10, 900
(c) ₹ 9, 000 (d) ₹ 4, 990
(e) ₹ 12, 000

11. Raja gives 30% of his salary to his mother, 40% of the remaining salary he invests in an insurance scheme and PPF in the respective ratio of 4 : 3 and the remaining he keeps in his bank account. If the difference between the amount he gives to his mother and that he invests in insurance scheme is ₹ 8400, how much is Raja's salary?

(a) ₹ 60,000 (b) ₹ 6,000
(c) ₹ 64,000 (d) ₹ 65,000
(e) ₹ 54,000

12. The sum of Shilpa's age after 4 years and Raghu's age 4 years ago is 63 years and the respective ratio between the Shilpa's age four years ago and Raghu's age after 3 years is 10 : 21. What is Shilpa's present age? (in years)

(a) 25 (b) 34 (c) 24 (d) 28
(e) 39

13. *A*, *B* and *C* started a business in partnership with investments of ₹ 12000, ₹ 26000 and ₹ 32000 respectively. After 4 months *A* leaves. After 6 months *B* leaves and *A* joins with an amount equal to his earlier investment. After 10 months *C* leaves and *B* joins with his prior investment. At the end of the year they earn a profit of ₹ 53622. Find the share of *B* in the annual profit.

(a) ₹ 17221 (b) ₹ 17212 (c) ₹ 17222 (d) ₹ 18212
(e) None of these

14. Two persons *A* and *B* start a business with investments of ₹ 24000 and ₹ 28000 respectively. After 4 months *C* also joined them with certain investment. Total profit at the end of the year was ₹ 19950. *C*'s share in profit was ₹ 7600. What was the *C*'s investment in the business?

(a) ₹ 48000 (b) ₹ 45000
(c) ₹ 50000 (d) ₹ 40000
(e) None of these

15. *A*, *B* and *C* started a business by investing ₹ 20,000 ₹ 28,000 and ₹ 36,000 respectively. After 6 months, *A* and *B* withdrew an amount of ₹ 8,000 each and *C* invested an additional amount of ₹ 8,000. All of them invested for equal period of time. If at the end of the year, *C* got ₹ 12,550 as his share of profit, what was the total profit earned?

(a) ₹ 25,100 (b) ₹ 26,600
(c) ₹ 24,300 (d) ₹ 22,960
(e) ₹ 21,440

16. *A* and *B* started a business with the investments in the ratio of 5 : 3 respectively. After 6 months from the start of the business, *C* joined them and the respective ratio between the investments of *B* and *C* was 2 : 3. If the annual profit earned by them was ₹ 12,300. What was the difference between *B*'s share and *C*'s share in the profit?

(a) ₹ 900 (b) ₹ 800 (c) ₹ 600 (d) ₹ 400
(e) ₹ 700

17. *A*, *B* and *C* started a business with investments of ₹ 1500, ₹ 550 and ₹ 2400 respectively. After 8 months from the start of the business, *A* and *C* left and *B* invested an additional amount of ₹ 450. If difference between the share in annual profit received by *B* and the total annual profit was ₹ 13,000, what was the total annual profit received?

(a) ₹ 16,500 (b) ₹ 18,150
(c) ₹ 13,200 (d) ₹ 19,800
(e) ₹ 16,750

18. *A* starts a business with ₹ 2500. After one month from the start of the business, *B* joined with ₹ 4500 and *A* withdrew completely after eleven months from the start of the business. If the difference between *A*'s and *B*'s respective shares in the annual profit was ₹ 4800, what was the annual profit earned?

(a) ₹ 14800 (b) ₹ 16800
(c) ₹ 14400 (d) ₹ 11400
(e) ₹ 15600

19. *A* started a business with an investment of ₹ 12,000. At the end of six months from the start of the business. *A* withdrew half of his initial investment and *B* and *C* invested in the ratio of 10 : 9 respectively. If A's share in annual profit of ₹ 14,000 was ₹ 4,500, what was the investment made by *B*?

(a) ₹ 20,000 (b) ₹ 25,000
(c) ₹ 10,000 (d) ₹ 18,000
(e) ₹ 35,000

20. Ninad, Vikash and Manav enter into a partnership. Ninad invests some amount at the beginning. Vikash invests double the amount after 6 months and Manav invests thrice the amount invested by Ninad after 8 months. They earn a profit of ₹ 45,000 at the end of the year. What is Manav's share in the profit?

(a) ₹ 25,000 (b) ₹ 15,000
(c) ₹ 12,000 (d) ₹ 9,000
(e) None of these

21. *A* started a business with an investment of ₹ 16,000. After 6 months from the start of the business, *B* and *C* joined with ₹ 12,000 and ₹ 18,000 respectively and *A* invested an additional amount of ₹ 4000. If the difference between *A*'s share and *B*'s share in the annual profit is ₹ 6000. What was the annual profit received?

(a) ₹ 17,600 (b) ₹ 13,200
(c) ₹ 14,300 (d) ₹ 16,500
(e) ₹ 11,000

22. *P* and *Q* started a business by investing ₹ 15000 and ₹ 18000 respectively. After four months *R* joined them with a capital of ₹ 10000. After two more months *Q* left the business with his capital. At the end of the year P got a share of ₹ 4500 in the profit. What is the total profit earned?

(a) ₹ 6800 (b) ₹ 7600
(c) ₹ 8600 (d) ₹ 9200
(e) ₹ 9600

23. *A* and *B* started a business by investing ₹ 18,000 and ₹ 24,000 respectively. At the end of 4th month from the start of the business, *C* joins with ₹ 15,000. At the end of 8th month *B* quits at which time *C* invests ₹ 3000 more. At the end of 10^{th} month *B* rejoins with the same investment. If profit at the end of the year is ₹ 12,005. What is *B*'s share in the profit?

(a) ₹ 4,000 (b) ₹ 4,440
(c) ₹ 4,360 (d) ₹ 4,900
(e) ₹ 3,920

24. Acid and water are mixed in a vessel *A* in the ratio of 5 : 2 and if the vessel B in the ratio 8 : 5. In what proportion should quantities be taken out from the two vessels so as to form a mixture in which the acid and water will be in the ratio of 9 : 4 ?

(a) 7 : 2 (b) 2 : 7
(c) 7 : 4 (d) 2 : 3

25. In two types of stainless steel the ratio of chromium and steel are 2 : 11 and 5 : 21 respectively. In what proportion should the two types be mixed so that the ratio of chromium to steel in the mixed type becomes 7 : 32?

(a) 2 : 3 (b) 3 : 4
(c) 1 : 2 (d) 1 : 3

26. A man divides his property so that his son's share to his wife's and wife's share to his daughter's are both as in the ratio 3 : 1. If the daughter gets ₹10,000 less than son, the value (in rupees) of the whole property is

(a) ₹16,250 (b) ₹16,000
(c) ₹18,250 (d) ₹17,000

27. *A* and *B* enter into partnership investing ₹ 48,000 and ₹ 60,000 respectively. After 3 months, *A* withdraws ₹ 8,000 while *B* invests ₹ 6,000 after 6 months of starting of business. Out of the total amount of profit, if *A* gets ₹ 12,000 as his share at the end of the year total profit is:

(a) ₹ 24,000 (b) ₹ 30,000
(c) ₹ 36,000 (d) ₹ 37,000

28. *M*, *P* and *Q* together started a business. *M* invested ₹ 6,500 for 6 months, *P* invested ₹ 8,400 for 5 months and *Q* invested ₹ 10,000 for 3 months. *M* is working member for which he gets 5% of total profit extra. If the total gain is ₹ 7,400, then *Q*'s share is:

(a) ₹ 1,900 (b) ₹ 2,100
(c) ₹ 3,200 (d) Data are incomplete

29. Three partners started a business by investing ₹ 60,000, ₹ 80,000 and ₹ 1,20,000 respectively. First partner left the business after 4 months, second after 9 months and third remained in the business for the whole year. At the end of year the total profit earned is ₹ 1,60,480, then find their shares of profit.

(a) ₹ 16840, ₹ 44188, ₹ 92686
(b) ₹ 16048, ₹ 48144, ₹ 96288
(c) ₹ 16042, ₹ 14842, ₹ 9862
(d) ₹ 15000, ₹ 13423, ₹ 7562

30. *A* started a business by investing some money and *B* invested ₹ 5000 more than that of *A*. *A* remained in business for 5 months and *B* remained in business 1 month more than *A*. Out of the total profit of ₹ 26000, *B* got ₹ 6000 more than *A*. Find the capitals invested *A* and *B*.

(a) ₹ 29,000, ₹ 18,000
(b) ₹ 25,000, ₹ 30,000
(c) ₹ 15,000, ₹ 10,000
(d) ₹ 15,000, ₹ 20,000

Hints & Solutions

1. **(c)** Ratio of equivalent capitals of A, B and C for 1 month
$= 35000 \times 12 : 20000 \times 5 : 15000 \times 7$
$= 35 \times 12 : 20 \times 5 : 15 \times 7 = 84 : 20 : 21$
Sum of the ratios = 84 + 20 + 21 = 125
$\therefore$ B's share $= ₹\left(\frac{20}{125}\times 84125\right) = ₹13460$

2. **(b)** Number of pair of brown socks = x
Price of brown socks = ₹ y per pair
Price of black socks = ₹ $2y$ per pair
$\therefore \quad 4y + x \times 2y = \frac{150}{100}(4\times 2y + xy)$
$\Rightarrow \quad 4 + 2x = \frac{3}{2}(8 + \mathrm{x}) \quad \Rightarrow \quad 8 + 4x = 24 + 3x$
$\Rightarrow \quad x = 24 - 8 = 16$
$\therefore$ Required ratio = 4 : 16 = 1 : 4

3. **(d)** 12ℓ of milk taken out of 60ℓ milk So 20% water is added to milk
Milk = 48ℓ; Water = 12ℓ
Now, again 20% water is added to this mixture
$$\underset{\text{(milk)}}{48} \xrightarrow[-9.6]{20\%} \underset{\text{(milk)}}{38.4} \text{ and } \underset{\text{(water)}}{21.6}$$
So, ratio of milk and water = 38.4 : 21.6 = 16 : 9

4. **(a)** Let the number of students in Arts, Commerce and Science be $3x$, $5x$ and $8x$ respectively. On increasing their respective numbers,
Required ratio
$= 3x\times\frac{120}{100} : 5x\times\frac{140}{100} : 8x\times\frac{125}{100}$
$= 360 : 700 : 1000 = 18 : 35 : 50$

5. **(b)** Neil's monthly salary = ₹ $5x$
Dipti's monthly salary = ₹ $6x$
Neil's savings $= \frac{5x+40}{100} = ₹\ 2x$
Dipti's savings $= \frac{6x\times 25}{100} = ₹\ \frac{3x}{2}$
According to the question.
Neil's investment – Dipti's investment = 1750
$\Rightarrow \quad 2x\times\frac{5}{8} - \frac{3x}{2}\times\frac{3}{5} = 1750 \Rightarrow \quad \frac{5x}{4} - \frac{9x}{10} = 1750$
$\Rightarrow \quad \frac{25x - 18x}{20} = 1750 \Rightarrow \quad 7x = 1750 \times 20$
$\Rightarrow \quad x = \frac{1750\times 20}{7} = 5000$
Neil's monthly salary = 5 × 5000 = ₹25,000

6. **(c)** Ratio of the equivalent capitals of A, B and C for 1 month
$= \left(x\times 6 + \frac{3x}{2}\times 6\right) : (2x\times 6 + 4x\times 6) : (4x \times 6 + 3x \times 6)$
$= (6x + 9x) : (12x + 24\,x) : (24x + 18\,x)$
$= 15x : 36x : 42x = 5 : 12 : 14$ = Ratio of shares

7. **(b)** Number of boys in class
$\left(\frac{5}{5+7}\right)\times 168 = 70$
Number of girls = 168 – 70 = 98
Number of students speaking
Hindi only $= \frac{168}{2} = 84$
$\Rightarrow$ Number of students speaking English only
$= \frac{16}{21}\times 84 = 64$
Number of girls speaking English only = 64 – 24 = 40
Number of students speaking both
= 168 – (84 + 64) = 20
Number of girls speaking both = 20 – 12 = 8
$\therefore$ Number of girls speaking only Hindi
= 98 – (40 + 8) = 50

8. **(d)** Let the earnings of A and B be ₹ $4x$ and $7x$ respectively.
After 50% increase, A's earnings = 150% of $4x$
After 5% decrease,
B's earning = 75% of $7x$
Ratio = 150% of $4x$: 75% of $7x$ = 8 : 7
But their total earnings are unknown. Hence A's earnings can't be known.

9. **(a)** Dex's sister's Monthly salary = ₹ (12800 × 4)
= ₹ 51200
Dex's father's Monthly salary
$= ₹\left(\frac{51200\times 5}{2}\right) = ₹\ 128000$
$\therefore$ Dex's Monthly Salary.
$= 128000 \times \frac{1}{4} = ₹\ 32000$
Dex's Monthly Savings $= ₹\left(\frac{3}{8}\times 32000\right) = ₹\ 12000$

10. **(e)** Initial money with Sia = ₹ x
Money given to her brother $= ₹\ \frac{x}{4}$
His expenses $= \left(\frac{1}{8}+\frac{1}{4}\right)$ parts $= \left(\frac{1+2}{8}\right) = \frac{3}{8}$ parts
Remaining part $= 1 - \frac{3}{8} = \frac{5}{8}$
$\therefore \quad \frac{5}{8}$ of $\frac{x}{4} = 1875 \Rightarrow x = \frac{1875\times 8\times 4}{5} = ₹\ 12000$

11. **(a)** Let Raja's salary = 100 unit
His mother got 30% = 30 unit
Remaining = 70 unit
40% of Remaining = 28 unit
Investment in insurance = $\frac{4}{7} \times 28 = 16$ unit
Investment in PPF = $\frac{3}{7} \times 28 = 12$ unit
ATQ
$30 - 16 \Rightarrow 84000$
14 unit ⇒ 84000
1 unit ⇒ 6000
100 unit ⇒ 60000
Raja's salary = ₹ 60000

12. **(c)** According to the question,
Sum of the present ages of Shilpa and Raghu = 63 years
Shilpa's present age = x years (let)
∴ Raghu's present age = $(63 - x)$ years
Shilpa's age 4 years ago = $(x - 4)$ years
and Raghu's age 3 years hence
= $(63 - x + 3)$ years = $(66 - x)$ years
ATQ,
$\therefore \quad \frac{x-4}{66-x} = \frac{10}{21} \Rightarrow 21x - 84 = 660 - 10x$
$\Rightarrow 21x + 10x = 660 + 84 \Rightarrow 31x = 744$
$\Rightarrow x = 744 \div 31 = 24$ years

13. **(b)** Ratio of the equivalent capitals of A, B and C for 1 month
$(12000 \times 4 + 12000 \times 6) : (26000 \times 6 + 2 \times 26000) : 32000 \times 10$
$= 120000 : 208000 : 320000$
$= 120 : 208 : 320 = 15 : 26 : 40$
Sum of ratios = $15 + 26 + 40 = 81$
$\therefore \quad B$'s share = $\frac{26}{81} \times 53622 =$ ₹ 17212

14. **(a)** 'C's investment = ₹ x thousand
∴ Ratio of their equivalent capitals for 1 month
$= 12 \times 24000 : 12 \times 28000 : 8 \times x \times 1000$
$= 36 : 42 : x$
Sum of ratios = $36 + 42 + x = 78 + x$
∴ 'C's share = $\frac{x}{78+x} \times 19950$
$\Rightarrow \frac{19950x}{78+x} = 7600 \Rightarrow 1995x = 760 \times 78 + 760x$
$\Rightarrow 1995x - 760x = 760 \times 78 \Rightarrow 1235x = 59280$
$\Rightarrow x = \frac{59280}{1235} =$ ₹ 48 thousand

15. **(a)** Ratio of the equivalent capitals of A, B and C for 1 month
$= (20000 \times 6 + 12000 \times 6) : (28000 \times 6 + 20000 \times 6) : (36000 \times 6 + 44000 \times 6)$
$= (120 + 72) : (168 + 120) : (216 + 264)$
$= 192 : 288 : 480 = 2 : 3 : 5$
If the total profit at the end of the year be ₹ x, then
C's share = $\frac{5}{10} \times x =$ ₹ $\frac{x}{2}$
$\therefore \quad \frac{x}{2} = 12550 \Rightarrow x = 2 \times 12550 =$ ₹ 25100

16. **(a)** $A : B = 5 : 3 = 10 : 6$
$B : C = 2 : 3 = 6 : 9$
$\therefore \quad A : B : C = 10 : 6 : 9$
Ratio of the equivalent capitals of A, B and C for 1 month
$= 10x \times 12 : 6x \times 12 : 9x \times 6 = 20 : 12 : 9$
Sum of the terms of ratio = $20 + 12 + 9 = 41$
∴ Difference between the shares of B and C
$= \left(\frac{12-9}{41}\right) \times 12300 =$ ₹ 900

17. **(a)** Ratio of equivalent capitals of A, B and C for 1 month
$= 1500 \times 8 : (550 \times 8 + 1000 \times 4) : 2400 \times 8$
$= 12000 : (4400 + 4000) : 19200$
$= 120 : 84 : 192 = 30 : 21 : 48$
Sum of the terms of ratio = $30 + 21 + 48 = 99$
Let the total annual profit be ₹ x
According to the question,
$x - \frac{21}{99}x = 13000 \Rightarrow \frac{99x - 21x}{99} = 13000$
$\Rightarrow 78x = 13000 \times 99 \Rightarrow x = \frac{13000 \times 99}{78} =$ ₹ 16500

18. **(b)** Ratio of equivalent capitals of A and B for 1 month
$= 2500 \times 11 : 4500 \times 11 = 5 : 9$
Sum of the terms of ratio = $5 + 9 = 14$
If total annual profit be ₹ x, then
$\frac{9x}{14} - \frac{5x}{14} = 4800 \Rightarrow \frac{4x}{14} = 4800$
$\Rightarrow 4x = 4800 \times 14$
$\Rightarrow x =$ ₹ $\left(\frac{4800 \times 14}{4}\right) =$ ₹ 16800

19. **(a)** B's investment = ₹ $10x$
C's investment = ₹ $9x$
Ratio of the equivalent capitals of A, B and C for 1 month
$= (12000 \times 6 + 6000 \times 6) : 10x \times 6 : 9x \times 6$
$= (72000 + 36000) : 60x : 54x$
$= 108000 : 60x : 54x = 18000 : 10x : 9x$
$\therefore \quad A$'s share = $\frac{18000}{19x + 18000} \times 14000 = 4500$
$\Rightarrow 19x + 18000 = 56000$
$\Rightarrow 19x = 56000 - 18000 = 38000$
$\Rightarrow x = \frac{38000}{19} = 2000$
$\therefore \quad B$'s investment = $10 \times 2000 =$ ₹ 20000

20. **(b)** Let Ninad invest ₹ x
∴ Vikash's investment = ₹ $2x$
Manav's investment = ₹ $3x$

Ratio of the equivalent capitals for 1 month of Ninad, Vikash and Manav respectively

$= x \times 12 : 2x \times 6 : 4 \times 3x = 1 : 1 : 1$

Clearly, the profit will be shared equally.

$\therefore$ Manav's share $= ₹\left(\frac{1}{3} \times 45000\right) = ₹\ 15000$

21. (d) Ratio of the equivalent capitals of A, B and C for 1 month

$= (16000 \times 6 + 20000 \times 6) : (12000 \times 6) : (18000 \times 6)$

$= (96 + 120) : 72 : 108 = 216 : 72 : 108 = 6 : 2 : 3$

Sum of the terms of ratio $= 6 + 2 + 3 = 11$

If the total annual profit be ₹ x, then

According to the question,

Difference between the shares of A and B = ₹ 6000

$\Rightarrow \frac{6x}{11} - \frac{2x}{11} = 6000 \Rightarrow \frac{4x}{11} = 6000$

$\Rightarrow 4x = 6000 \times 11 \Rightarrow x = \frac{6000 \times 11}{4} = ₹\ 16500$

22. (d) Ratio of the equivalent capitals of P, Q and R for 1 month

$= 15000 \times 12 : 18000 \times 6 : 10000 \times 8$

$= 15 \times 12 : 18 \times 6 : 10 \times 8 = 45 : 27 : 20$

Sum of the terms of ratio $= 45 + 27 + 20 = 92$

If total annual profit be ₹ x.

then P's share $= \frac{45}{92} x = 4500$

$\Rightarrow x = \frac{4500 \times 92}{45} = ₹\ 9200$

23. (d) Ratio of the equivalent capitals of A, B and C for 1 month

$= 18000 \times 12 : 24000 \times 10 : (15000 \times 4 + 18000 \times 4)$

$= 18000 \times 12 : 240000 : (60000 + 72000)$

$= 18000 \times 12 : 240000 : 132000 = 18 : 20 : 11$

Sum of the terms of ratio $= 18 + 20 + 11 = 49$

B's share $= ₹\left(\frac{20}{49} \times 12005\right) = ₹\ 4900$

24. (a) Acid : Water

A 5 : $2 = 7_{\times 13}$

B 8 : $5 = 13_{\times 7}$

New 9 : $4 = 13_{\times 7}$

Make quantities equal

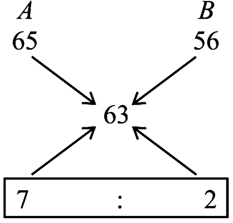
Acid : Water

A 65 : $26 = 91$

B 56 : $35 = 91$

New 63 : $28 = 91$

$\therefore$ By alligation,



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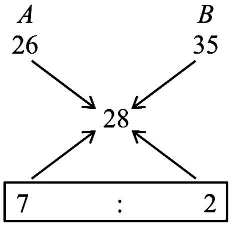


Required ratio = 7 : 2

25. (c) Chromium : Steel

A 2 : $11 = 13_{\times(2\times3)}$

B 5 : $21 = 26_{\times 3}$

New mixture 7 : $32 = 39_{\times 2}$

Make amount equal by taking LCM

$= 13, 26, 39 = 13 \times 2 \times 3$

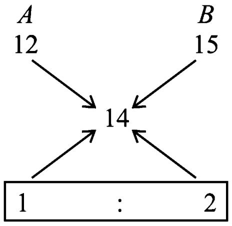
Chromium : Steel

A 12 : 66

B 15 : 63

New mixture 14 : 64

$\therefore$



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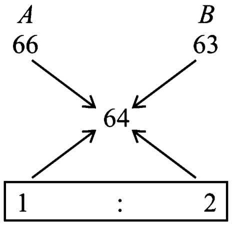


Required ratio = 1 : 2

26. (a) Share of Son : Wife : Daughter are

S : W : D

3 : 1 :

3 : 1

9 : 3 : 1

Total $\Rightarrow 9x + 3x + x = 13x \Rightarrow$ share of son $= 9x$

Share of daughter $= x$

= Difference between share of son and share of daughter

$\Rightarrow 9x - x = 8x = 10000$

$x = ₹\ 1250$

$\therefore$ Total property $= 13x = 13 \times 1250 = ₹\ 16250$

27. (b) Total capital of A invested in 1 year

$= 48,000 \times 3 + 40,000 \times 9$

$= 1,44,000 + 3,60,000 = ₹\ 5,04,000$

Total capital of B invested in 1 year

$= 60,000 \times 6 + 66,000 \times 6 = ₹\ 7,56,000$

	A	:	B
Capital →	504000	:	756000
Profit →	2	:	3
	↓× 6000		↓× 6000
	12,000		18,000

$\therefore$ Total profit $= (2 + 3) \times 6000 = ₹\ 30,000$

28. (a)

	M	P	Q
Capital ⟶	6500	8400	10,000
	×	×	×
Time ⟶	6	5	3
	390 :	420 :	300
Profit ⟶	13 :	14 :	10

M's extra share on working partner

$= 7400 \times \frac{5}{100} = ₹\ 370$

Remaining Profit = ₹ 7400 – ₹ 370 = ₹ 7030

According to the question,

(13 + 14 + 10) units = ₹ 7030

37 units = ₹ 7030

1 units = ₹ $\frac{7030}{37}$

Profit of Q = 10 units = ₹ $\frac{7030}{37} \times 10$ = ₹1900

29. (b)

$$\begin{array}{llccccc} & & A & : & B & : & C \\ \text{Capital} & \rightarrow & 60000 & : & 80000 & : & 120000 \\ \text{Time} & \rightarrow & 4 & : & 9 & : & 12 \\ \hline \text{Profit} & \rightarrow & 240{,}000 & : & 720{,}000 & : & 1440{,}000 \\ & & 1 & : & 3 & : & 6 \end{array}$$

According to the question,
(1 + 3 + 6) units = ₹1,60,480
10 units = ₹1,60,480
1 unit = ₹16,048
Share of A = 16,048 × 1 = ₹ 16,048
Share of B = 16,048 × 3 = ₹ 48,144
Share of C = 16,048 × 6 = ₹ 96,288

30. (d) Let amount invested by A = ₹ x

$$\begin{array}{lccc} & A & : & B \\ \text{Capital} \rightarrow & x & : & (x + 5000) \end{array}$$

According to the question,

Share of A in profit $= \frac{(26000 - 6000)}{2}$ = ₹10,000

Share of B in profit = (26000 – 10000) = ₹ 16,000

By using formulaes: $\boxed{\frac{C_1 \times T_1}{C_2 T_2} = \frac{P_1}{P_2}}$

$$\frac{x \times 5}{(x + 5000) \times 6} = \frac{10{,}000}{16{,}000}$$

$4x = 3x + 15000$
x = ₹ 15000
Required capital of A = ₹ 15,000
Required capital of B = (15,000 + 5000) = ₹ 20,000

Chapter 7

Simple and Compound Interest

INTEREST

Interest is the fixed amount paid on borrowed money.

The sum lent is called the **principal**.

The sum of the principal and interest is called the **amount**.

Interest is of two kinds :

(i) Simple interest

(ii) Compound interest

Simple Interest

When interest is calculated on the original principal for any length of time, it is called simple interest.

- Simple interest $= \dfrac{\text{Principal} \times \text{Time} \times \text{Rate}}{100}$

  i.e. $\text{S.I.} = \dfrac{P \times R \times T}{100}$

- Principal $(P) = \dfrac{100 \times \text{S.I.}}{R \times T}$
- Rate $(R) = \dfrac{100 \times \text{S.I.}}{T \times P}$
- Time $(T) = \dfrac{100 \times \text{S.I.}}{P \times R}$
- If rate of simple interest differs from year to year, then

  $$\text{S.I.} = P \times \frac{(R_1 + R_2 + R_3 + ...)}{100}$$

- Amount = Principal + Interest

  i.e. $A = P + I = P + \dfrac{PRT}{100} = P\left(1 + \dfrac{RT}{100}\right)$

Compound Interest

Money is said to be lent at compound interest when at the end of a year or other fixed period for which the borrower and the lender agree (called conversion period), the interest that has become due is not paid to the lender, but is added to the sum lent, and the amount thus obtained becomes the principal in the next year or period. The process is repeated until the amount for the last period has been given to the lender by the borrower. Hence, when the interest charged after a certain specified time period is added to just previous principal to form new principal for the next time period, the interest is said to be compounded and the total interest occurred is compound interest.

Note

The main difference between the simple interest and the compound interest is that the principal in the case of simple interest remains constant throughout the loan period where as in the case of compound interest, the principal changes periodically (i.e. after each conversion period) throughout the loan period.

(i) Computation of Amount when Interest is Compounded Annually :

- Amount $(A) = P\left(1 + \dfrac{r}{100}\right)^n$

  Where A is the amount, P is the principle, r is the rate of interest in percent per conversion period, (Here conversion period = 1 years) and n is the number of conversion periods in the whose loan period.

  When conversion period is one year, then in whole loan period, number of conversion periods equal to number of years in whole loan period.

  i.e., n = t, where t is the whole loan period in years.

- $\text{C.I.} = A - P = P\left[\left(1 + \dfrac{r}{100}\right)^n - 1\right]$
- If rate of compound interest differs from year to year, then

  $$\text{Amount} = P\left(1 + \frac{r_1}{100}\right)\left(1 + \frac{r_2}{100}\right)\left(1 + \frac{r_3}{100}\right).......$$

(ii) Amount When Interest is Compounded Half-yearly

Rate per cent half-yearly $= \dfrac{r}{2}\%$ and n = 2 × t in years

Hence, $A = P\left(1 + \dfrac{r}{2 \times 100}\right)^n = P\left(1 + \dfrac{r}{200}\right)^{2t}$

(iii) Amount When Interest is Compounded Quarterly

Since 1 year has 4 quarters, therefore quarterly rate of interest $= \dfrac{1}{4} r$ and n = 4t

$$A = P\left(1 + \frac{r/4}{100}\right)^n = P\left(1 + \frac{r}{400}\right)^n$$

EXERCISE

1. Anil invested an amount for three years at a simple interest rate of 9% p.a. He got an amount of ₹ 19,050 at the end of three years. What principal amount did he invest?
   (a) ₹14,500 (b) ₹11,050
   (c) ₹1,440 (d) ₹10,950
   (e) None of these
2. What will be the compound interest on an amount of ₹ 5,000 for a period of 2 years at 8% p.a?
   (a) ₹ 840 (b) ₹ 400
   (c) ₹ 823 (d) ₹ 416
   (e) None of these
3. What is the interest received on a principal of ₹ 450 for 2 years if the interest received on ₹ 1 after four years at the same rate of simple interest is ₹ 0.40?
   (a) ₹ 90 (b) ₹ 180
   (c) ₹ 36 (d) Cannot be determined
   (e) None of these
4. Ms. Sandhya deposits an amount of ₹ 31,400 to obtain a simple interest at the rate of 12 per cent per annum for 8 years. What total amount will Ms. Sandhya get at the end of 8 years?
   (a) ₹ 31,444 (b) ₹ 61,544
   (c) ₹ 41,544 (d) ₹ 31,144
   (e) None of these
5. What amount of compound interest can be obtained on the principal amount of ₹ 15800 at the rate of 6 per cent per annum at the end of 2 year ?
   (a) ₹ 1,986 (b) ₹ 2,012.48
   (c) ₹ 1,952.88 (d) ₹ 1,956
   (e) None of these
6. Sudhanshu invested ₹ 15,000 at interest @ 10% p.a for one year. If the interest is compounded every six months what amount will Sudhanshu get at the end of the year?
   (a) ₹ 16,537.50 (b) ₹ 16,5000
   (c) ₹ 16,525.50 (d) ₹ 18,150
   (e) None of these
7. Ms Suchi deposits an amount of ₹ 24,000 to obtain a simple interest at the rate of 14% p.a. for 8 years. What total amount will Ms Suchi get at the end of 8 years?
   (a) ₹52080 (b) ₹28000
   (c) ₹50880 (d) ₹26880
   (e) None of these
8. The simple interest accrued on an amount of ₹ 84,000 at the end of three year is ₹ 30,240. What would be the compound interest accrued on the same amount at the same rate in the same period?
   (a) ₹ 30,013.95 (b) ₹ 31,013.95
   (c) ₹ 32,013.95 (d) ₹ 33,013.95
   (e) ₹ 34,013.95
9. What will be the difference between the compound interest and simple interest at the rate of 5% p.a. on an amount of ₹ 4,000 at the end of two years?
   (a) ₹ 10 (b) ₹ 20
   (c) ₹ 30 (d) Data inadequate
   (e) None of these
10. If the compound interest accrued on an amount of ₹14,500 in two years is ₹ 4676.25, what is the rate of interest % p.a. ?
    (a) 11 (b) 9 (c) 15 (d) 18
    (e) None of these
11. The compound interest accrued on an amount of ₹ 25,500 at the end of three year is ₹ 8,440.5. What would be the simple interest accrued on the same amount at the same rate in the same period?
    (a) ₹ 4,650 (b) ₹ 5,650
    (c) ₹ 6,650 (d) ₹ 7,650
    (e) None of these
12. The simple interest obtained on an amount of ₹ 45,000 at the end of 4 year is ₹ 15,300. What would be the approximate compound interest obtained on the same amount at the same rate of interest in the same period ?
    (a) ₹ 18,244 (b) ₹ 18,544
    (c) ₹ 16,285 (d) ₹ 18,566
    (e) ₹ 17,364
13. The simple interest accrued on a sum of certain principal is ₹ 1,200 in four year at the rate of 8% p.a. What would be the simple interest accrued on thrice of that principal at the rate of 6% p.a in 3 year?
    (a) ₹ 2,025 (b) ₹ 3,025
    (c) ₹ 2,250 (d) ₹ 2,150
    (e) None of these
14. A sum of money at compound interest doubles itself in 15 years. It will become eight times of itself in
    (a) 45 years (b) 48 years
    (c) 54 years (d) 60 years
15. What annual payment will discharge a debt of ₹6,450 due in 4 years at 5% per annum simple interest ?
    (a) ₹1,400 (b) ₹1,500
    (c) ₹1,550 (d) ₹1,600
16. In how many years will a sum of ₹ 800 at 10% per annum compound interest, compounded semi-annually becomes ₹ 926.10 ?
    (a) $1\frac{1}{2}$ (b) $1\frac{2}{3}$ (c) $2\frac{1}{3}$ (d) $2\frac{1}{2}$
17. In how many years will a sum of money double itself at $6\frac{1}{4}\%$ simple interest per annum?
    (a) 24 years (b) 20 years
    (c) 16 years (d) 12 years
18. A sum of ₹ 12,000, deposited at compound interest becomes double after 5 years. How much will it be after 20 years ?
    (a) ₹ 1,44,000 (b) ₹ 1,20,000
    (c) ₹ 1,50,000 (d) ₹ 1,92,000
19. The simple interest on a sum for 5 years is one fourth of the sum. The rate of interest per annum is
    (a) 5% (b) 6% (c) 4% (d) 8%

20. Simple interest on a certain sum for 6 years is $\frac{9}{25}$ of the sum. The rate of interest is

(a) 6% (b) $6\frac{1}{2}\%$ (c) 8% (d) $8\frac{1}{2}\%$

21. The sum invested in scheme *B* is twice the sum invested in scheme *A*. Investment in scheme *A* is made for 3 years at 8% p.a. simple interest and in Scheme *B* for 2 years at 9% p.a. simple interest. The total interest earned from both the schemes is ₹ 1800. How much was invested in Scheme A?

(a) ₹ 4000 (b) ₹ 3500 (c) ₹ 3000 (d) ₹ 2500
(e) ₹ 4500

22. The interest earned when ₹ '*P*' is invested for four years in a scheme offering 9% p.a. simple interest is more than the interest earned when the same sum (₹ *P*) is invested for two years in another scheme offering 12% p.a. simple interest, by ₹ 360. What is the value of *P*?

(a) 2000 (b) 3500 (c) 2500 (d) 4000
(e) 3000

23. Srinivasan invests two equal amounts in two banks giving 10% and 12% rate of interest respectively. At the end of year the interest earned is ₹ 1650/-. Find the sum invested in each.

(a) ₹ 8,500/- (b) ₹ 15,000/-
(c) ₹ 7,500/- (d) ₹ 17,000/-
(e) None of these

24. Radha invests certain sums in scheme *A* (for 6 years) and *B* (for 5 years) both offering simple interest. The sum invested in scheme *B* was 25% less than that in scheme *A*. The interests received from both the schemes are equal. If the interest offered by scheme *A* is 10% per annum what is the rate of interest (per annum) offered by scheme B?

(a) 12% (b) 20% (c) 16% (d) 15%
(e) 18%

25. A sum of money lent out at compound interest increases in value by 50% in 5 years. A person wants to lend three different sum *x*, *y* and *z* for 10, 15 and 20 years respectively at the above rate in such a way that he gets back equal sum at the end of their respective periods. The ratio $x : y : z$ is

(a) 6 : 9 : 4 (b) 9 : 4 : 6 (c) 9 : 6 : 4 (d) 6 : 4 : 9

26. Mohan lent some amount of money at 9% simple interest and an equal amount of money at 10% simple interest each for two years. If his total interest was ₹ 760, what amount was lent in each case?

(a) ₹ 1700 (b) ₹ 1800 (c) ₹ 1900 (d) ₹ 2000

27. A person invests money in three different schemes for 6 years, 10 years and 12 years at 10 percent, 12 percent and 15 percent simple interest respectively. At the completion of each scheme. He gets the same interest. The ratio of his investment is

(a) 6 : 3 : 2 (b) 2 : 3 : 4 (c) 3 : 4 : 6 (d) 3 : 4 : 2

28. With a given rate of simple interest, the ratio of principal and amount for a certain period of time is 4 : 5. After 3 years, with the same rate of interest, the ratio of the principal and amount becomes 5 : 7. The rate of interest is :

(a) 4% (b) 6% (c) 5% (d) 7%

29. Out of ₹ 50,000, that a man has, he lends ₹ 8000 at $5\frac{1}{2}\%$ per annum simple interest and ₹ 24,000 at 6% per annum simple interest. He lends the remaining money at a certain rate of interest so that he gets total annual interest of ₹ 3680. The rate of interest per annum, at which the remaining money is lent, is:

(a) 5% (b) 7% (c) 10% (d) 12%

30. Ram deposited a certain sum of money in a company at 12% per annum simple interest for 4 years and deposited equal amount in fixed deposit in a bank for 5 years at 15% per annum simple interest . If the difference in the interest from two sources is ₹ 1350 then the sum deposited in each case is :

(a) ₹ 3000 (b) ₹ 4000
(c) ₹ 6500 (d) ₹ 5000

Hints & Solutions

1. (e) Let the principal be = ₹x.

$\therefore$ Interest = $(19050 - x)$

Now,

$$\text{Principal} = \frac{\text{Interest} \times 100}{\text{Time} \times \text{Rate}}$$

$$\Rightarrow x = \frac{(19050 - x) \times 100}{3 \times 9}$$

$$\Rightarrow 27x = 1905000 - 100x$$

$$\Rightarrow x = \frac{1905000}{127} = ₹15000$$

2. (e) $\text{Amount} = \text{Principal}\left(1 + \frac{\text{Rate}}{100}\right)^{\text{Time}}$

$$= 5000\left(1 + \frac{8}{100}\right)^2 = 5000\left(1 + \frac{2}{25}\right)^2$$

$$= 5000 \times \frac{27}{25} \times \frac{27}{25} = ₹5832$$

$\therefore$ CI = ₹ (5832 – 5000) = ₹ 832

3. (a) Interest on ₹ 1 in 4 years = ₹ 0.4

$\therefore$ Interest on ₹ 100 in 4 years = ₹ 40

$\therefore$ Interest on ₹ 100 in 1 year = ₹ 10

Hence, Rate = 10%

$\therefore$ Interest $= \dfrac{\text{Principal} \times \text{Time} \times \text{Rate}}{100}$

$= \dfrac{450 \times 2 \times 10}{100} = ₹\,90$

4. **(b)** Simple Interest $= \dfrac{P \times R \times T}{100}$

$\dfrac{31400 \times 8 \times 12}{100} = ₹\,30144$

$\therefore$ Required amount $= ₹\,(31400 + 30144)$

$= ₹\,61544$

5. **(c)** Compound Interest $= P\left[\left(1 + \dfrac{R}{100}\right)^T - 1\right]$

$= 15800\left[\left(1 + \dfrac{6}{100}\right)^2 - 1\right]$

$= 15800 \times [(1.06)^2 - 1)] = 15800 \times [1.1236 - 1]$

$= 15800 \times 0.1236 = ₹\,1952.88$

6. **(a)** Required Amount

$= 15000\left(1 + \dfrac{5}{100}\right)^2 = ₹\,16537.50$

7. **(c)** Required Amount $= 24000\left(1 + \dfrac{14 \times 8}{100}\right)$

$= 24000 \times \dfrac{212}{100} = ₹50880$

8. **(e)** Rate $= \dfrac{30240 \times 100}{84000 \times 3} = 12\%$

Compound interest $= 84000\left(1 + \dfrac{12}{100}\right)^3 - 84000$

$= 118013.95 - 84000 = ₹\,34013.95$

9. **(a)** Simple interest $= \dfrac{4000 \times 5 \times 2}{100} = ₹\,400$

Compound interest$= 4000\left(1 + \dfrac{5}{100}\right)^2 - 4000$

$= \dfrac{4000 \times 105 \times 105}{100 \times 100} - 4000$

$= 4410 - 4000 = ₹\,410$

$\therefore$ Difference $= 410 - 400 = ₹\,10$

Shortcut Approach

$D = \dfrac{4000 \times 5 \times 5}{100 \times 100} = 10$

10. **(c)** $14500\left(1 + \dfrac{r}{100}\right)^2 = 14500 + 4676.25$

$\Rightarrow \left(1 + \dfrac{r}{100}\right)^2 = \dfrac{19176.25}{14500} = \dfrac{529}{400}$

$\Rightarrow \left(1 + \dfrac{r}{100}\right)^2 = \left(\dfrac{23}{20}\right)^2$

$\Rightarrow 1 + \dfrac{r}{100} = \dfrac{23}{20} \Rightarrow r = \dfrac{100 \times 3}{20} = 15\%$

11. **(d)** $25500\left(1 + \dfrac{r}{100}\right)^3 - 25500 = 8440.5$

$\Rightarrow 25500\left(1 + \dfrac{r}{100}\right)^3 = 8440.5 + 25500$

$\Rightarrow \left(1 + \dfrac{r}{100}\right)^3 = \dfrac{33940.5}{25500} = \dfrac{1331}{1000} = \left(\dfrac{11}{10}\right)^3$

$\Rightarrow \left(1 + \dfrac{r}{100}\right) = \left(\dfrac{11}{10}\right)$

$\Rightarrow r = \dfrac{100}{10} = 10\%$

$\therefore$ S.I. $= \dfrac{25500 \times 10 \times 3}{100} = ₹\,7650$

12 **(e)** Rate $= \dfrac{15300 \times 100}{45000 \times 4} = 8.5\%$

$\therefore$ Compound interest $= 45000\left(1 + \dfrac{8.5}{100}\right)^4 - 45000$

$= 45000\left\{\left(\dfrac{108.5}{100}\right)^4 - 1\right\}$

$= 45000 \times 0.3858 = ₹\,17364$ (approx)

13. **(a)** Principal $= \dfrac{1200 \times 100}{4 \times 8} = ₹\,3750$

Simple interest on thrice of that principal

$= \dfrac{3750 \times 3 \times 6 \times 3}{100} = ₹\,2025$

14. **(a)** $A = P\left(1 + \dfrac{R}{100}\right)^T$

$2 = 1\left(1 + \dfrac{\text{Rate}}{100}\right)^{15}$

Cubing on both sides, we have

$8 = 1\left(1 + \dfrac{\text{Rate}}{100}\right)^{45}$

Required time = 45 years

15. (b) Let the annual instalment be ₹x.

$$\therefore \left(x+\frac{x\times3\times5}{100}\right)+\left(x+\frac{x\times2\times5}{100}\right)+\left(x+\frac{x\times1\times5}{100}\right)+x=6450$$

$$\Rightarrow \frac{115x}{100}+\frac{110x}{100}+\frac{105x}{100}+x=6450$$

$$\Rightarrow 115x+110x+105x+100x=6450\times100$$

$$\Rightarrow 430x=6450\times100$$

$$\therefore x=\frac{6450\times100}{430}=₹\,1500$$

16. (a) Rate = 10% per annum = 5% half yearly

$$A=P\left(1+\frac{R}{100}\right)^T$$

$$\Rightarrow 926.10=800\left(1+\frac{5}{100}\right)^T$$

$$\Rightarrow \frac{9261}{8000}=\left(\frac{21}{20}\right)^T \Rightarrow \left(\frac{21}{20}\right)^3=\left(\frac{21}{20}\right)^T$$

$\therefore$ Time = 3 half years = $1\frac{1}{2}$ years

17. (c) $T=\frac{\text{SI}\times100}{P\times R}$ (For double SI $=P=x$)

$$=\frac{x\times100}{x\times\frac{25}{4}}=16\text{ year.}$$

18. (d) $A=P\left(1+\frac{R}{100}\right)^T$

$$\Rightarrow 24000=12000\left(1+\frac{R}{100}\right)^5$$

$$\Rightarrow 2=\left(1+\frac{R}{100}\right)^5$$

$$\Rightarrow 2^4=\left(1+\frac{R}{100}\right)^{20}=16\text{ times}$$

so, the sum equal to 16 times in 20 years.

i.e. The sum amounts to ₹192000.

19. (a) $\frac{\text{Simple Interest}}{\text{Principal}}=\frac{1}{4}$

$$\therefore \text{Rate}=\frac{\text{S.I.}\times100}{\text{Principal }\times\text{Time}}$$

$$=\frac{1\times100}{4\times5}=5\ \%\text{ per annum}$$

20. (a) Let principle $=x$

$$\therefore \text{S.I.}=\frac{9x}{25}$$

$$\text{Rate}=\frac{\text{SI}\times100}{\text{Principal}\times\text{Time}}$$

$$=\frac{9x}{25}\times\frac{100}{6\times x}=6\%\text{ per annum}$$

21. (c) Amount invested in scheme A = ₹ x (let).

$\therefore$ Amount invested in scheme B = ₹ $2x$

$$\text{S.I.}=\frac{\text{Principal}\times\text{Time}\times\text{Rate}}{100}$$

According to the question,

$$\frac{x\times3\times8}{100}+\frac{2x\times2\times9}{100}=1800$$

$$\Rightarrow \frac{24x+36x}{100}=1800\Rightarrow 60x=180000$$

$$\Rightarrow x=\frac{180000}{60}=₹\,3000$$

22. (e) $\text{S.I.}=\frac{\text{Principal}\times\text{Time}\times\text{Rate}}{100}$

According to the question,

$$\frac{P\times4\times9}{100}-\frac{P\times2\times12}{100}=360$$

$$\Rightarrow \frac{36P}{100}-\frac{24P}{100}=360\Rightarrow \frac{12P}{100}=360$$

$$\Rightarrow P=\frac{360\times100}{12}=₹\,3000$$

23. (c) Let sum be ₹ x

According to the question,

$$\frac{x\times10\times1}{100}+\frac{x\times12\times1}{100}=1650$$

$$22x=1650\times100$$

$$x=\frac{1650\times100}{22}=₹\,7500$$

24. (c) Let the investment in scheme A be ₹ 100

$\therefore$ Investment in scheme B = ₹ 75

$$\text{S.I.}=\frac{\text{Principal}\times\text{Time}\times\text{Rate}}{100}$$

According to the question,

$$\frac{100\times10\times6}{100}=\frac{75\times5\times R}{100}$$

$$\Rightarrow 75\times5\times R=1000\times6$$

$$\Rightarrow R=\frac{1000\times6}{75\times5}=16\%\text{ per annum}$$

25. (c) According to the question,

$$\left(\frac{3}{2}\right)^2 x=\left(\frac{3}{2}\right)^3 y=\left(\frac{3}{2}\right)^4 z=k \text{ (let)}$$

$$\Rightarrow \quad x=\left(\frac{2}{3}\right)^2 k,\ y=\left(\frac{2}{3}\right)^3 k \text{ and } z=\left(\frac{2}{3}\right)^4 k$$

$$\therefore \quad x:y:z=\left(\frac{2}{3}\right)^2 k:\left(\frac{2}{3}\right)^3 k:\left(\frac{2}{3}\right)^4 k$$

$$=1:\frac{2}{3}:\left(\frac{2}{3}\right)^2=9:6:4$$

26. (d) Let the amount invested = ₹ P

According to the question,

$$\frac{P\times 9\times 2}{100}+\frac{P\times 10\times 2}{100}=760$$

$$\frac{(18P+20P)}{100}=760$$

$$38P=76000,\ P=2000$$

27. (a) Let the principal in each case = 100 units

According to the question,

		Ist part	**IInd part**	**IIIrd part**
Principal	⟶	$100_{\times 6}$	$100_{\times 3}$	$100_{\times 2}$
Rate %	⟶	10	12	15
Time	⟶	6	10	12
Interest	⟶	$60_{\times 6}$	$120_{\times 3}$	$180_{\times 2}$

Interest → Interest is same in each, so equal the interest.

Hence, required ratio of sum = 600 : 300 : 200 = 6 : 3 : 2

28. (c)

$$\begin{array}{ccccc} \text{Principal} & & \text{Amount} & & \text{Interest} \\ 4_{\times 5} & : & 5_{\times 5} & \xrightarrow[\text{diff.}]{} & 1_{\times 5} \\ 5_{\times 4} & : & 7_{\times 4} & \xrightarrow[\text{diff.}]{} & 2_{\times 4} \end{array}$$

Note : Principal will be same so equate the principal.

$$\begin{array}{ccccc} \text{Principal} & & \text{Amount} & & \text{Interest} \\ 20 & : & 25 & \xrightarrow[\text{diff.}]{} & 5 \\ 20 & : & 28 & \xrightarrow[\text{diff.}]{} & 8 \end{array} \quad +3$$

Interest in 3 years = 3 units

$$\text{Interest in 1 year} = \frac{3}{3} = 1 \text{ unit}$$

$$\text{Required rate \%} = \frac{1}{20}\times 100 = 5\%$$

29. (c) Remaining amount

= 50,000 – (8000 + 24000) = ₹ 18000

Let rate of interest = R%

According to the question,

$$\frac{8000}{100}\times\frac{11}{2}\times 1+\frac{24000\times 6}{100}\times 1+\frac{18000\times R}{100}\times 1=3680$$

$$\frac{44000}{100}+\frac{144000}{100}+\frac{18000R}{100}=3680$$

$$\frac{188000}{100}+\frac{18000R}{100}=3680$$

$$\frac{18000R}{100}=3680-1880$$

$$180R=1800$$

$$R=10\%$$

Hence, required rate % = 10%

30. (d) Difference between their rates he gained from both boys

⇒ 15 × 5% – 12 × 4%

⇒ 75% – 48%

⇒ 27% = 1350 (Given)

⇒ 100% = ₹ 5000

Chapter 8

Mixture and Alligation

MIXTURE

Mixture problems involving creating a mixture from two or more things and then determining some quantity (Percent, price etc.) of the resulting mixture.

ALLIGATION

Alligation is nothing but a faster technique of solving problems based on the weighted average situation which applied to the case of two groups being mixed together.

The word 'Alligation' literally means 'linking'.

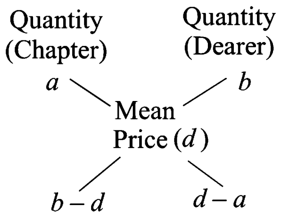
Alligation Rule

It states that when different quantities of the same or different ingredients of different costs are mixed together to produce a mixture of a mean cost, then

$$\frac{\text{Quantity of Cheaper ingredient}}{\text{Quantity of Dearer ingredient}}$$

$$= \frac{\text{Price of Dearer ingredient} - \text{Mean Price}}{\text{Mean Price} - \text{Price of Cheaper ingredient}}$$

Graphical Representation of Alligation Rule



$$\frac{\text{Quantity of } a}{\text{Quantity of } b} = \frac{b-d}{d-a}$$

REMOVAL AND REPLACEMENT

(i) Let a vessel contains Q unit of mixture of ingredients A and B. From this, R unit of mixture is taken out and replaced by an equal amount of ingredient B only.

If this process is repeated n times, then after n operations,

$$\frac{\text{Quantity of } A \text{ left}}{\text{Quantity of } A \text{ originally present}} = \left(1 - \frac{R}{Q}\right)^n$$

and Quantity of B left = Q – Quantity of A Left

(ii) Let a vessel contains Q unit of ingredient A only. From this R unit of ingredient A is taken out and replaced by an equal amount of ingredient B.

If this process is repeated n times, then after n operations,

$$\text{Quantity of } A \text{ left} = Q\left(1 - \frac{R}{Q}\right)^n$$

Quantity of B left = Q – Quantity of A left

(iii) A container has milk and water in the ratio $a : b$, a second container has milk and water in the ratio $c : d$. If both the mixtures are emptied into a third container, then the ratio of milk to water in third container is given by

$$\left(\frac{a}{a+b} + \frac{c}{c+d}\right) : \left(\frac{b}{a+b} + \frac{d}{c+d}\right)$$

(iv) If in x litres mixture of A and B, the ratio of A and B is $a : b$, the quantity of B to be added in order to make the ratio $c : d$ is $\frac{x(ad-bc)}{c(a+b)}$

(v) If x glasses of equal size are filled with a mixture of milk and water. The ratio of milk and water in each glass are as follows: $a_1 : b_1, a_2 : b_2, a_3 : b_3 ... a_x : b_x$

If the content of all the x glasses are emptied into a single large vessel, then proportion of milk and water in it is given by $\left(\frac{a_1}{a_1+b_1} + \frac{a_2}{a_2+b_2} + \ldots + \frac{a_x}{a_x+b_x}\right)$:

$$\left(\frac{b_1}{a_1+b_1} + \frac{b_2}{a_2+b_2} + \ldots + \frac{b_x}{a_x+b_x}\right)$$

(vi) A mixture contains A and B in the ratio $a : b$. If x litres of B is added to the mixture, A and B become in the ratio $a : c$. Then the quantity of A in the mixture is given by $\frac{ax}{c-b}$ and that of B is given by $\frac{bx}{c-b}$.

EXERCISE

1. In a mixture of milk and water the proportion of water by weight was 75%. If in the 60 gms mixture 15 gms. water was added, what would be the percentage of water in the new mixture?
(a) 75% (b) 88%
(c) 90% (d) 100%
(e) None of these

2. A jar has 60 litres of milk. From the jar, 12 litres of milk was taken out and replaced by an equal amount of water. If 12 litres of the newly formed mixture is taken out of the jar, what is the final quantity of milk left in the jar?
(a) 38.4 litres (b) 40 litres
(c) 36 litres (d) 28.6 litres
(e) 36.5 litres

3. Jar A has 60 litres of mixture of milk and water in the respective ratio of 2 : 1. Jar B which had 40 litres of mixture of milk and water was emptied into jar A, as a result in jar A, the respective ratio of milk and water became 13 : 7. What was the quantity of water in jar B?
(a) 8 litre (b) 15 litre (c) 32 litre (d) 7 litre
(e) 1 litre

4. A vessel contains 180 litres of mixture of milk and water in the respective ratio of 13 : 5. Fifty-four litres of this mixture was taken out and replaced with 6 litres of water, what is the approximate percentage of water in the resultant mixture?
(a) 41% (b) 31% (c) 24% (d) 9%
(e) 17%

5. When one litre of water is added to a mixture of acid and water, the new mixture contains 20% acid. When one litre of acid is added to the new mixture, then the resulting mixture contains $33\frac{1}{3}$% acid. Then percentage of acid in the original mixture was
(a) 20% (b) 22% (c) 24% (d) 25%

6. A jar contained a mixture of two liquids *A* and *B* in the ratio 4 : 1. When 10 litres of the mixture was taken out and 10 litres of liquid *B* was poured into the jar. This ratio became 2:3. The quantity of liquid *A* contained in the jar initially was
(a) 4 litres (b) 8 litres
(c) 16 litres (d) 40 litres

7. A shopkeeper bought 15 kg of rice at the rate of ₹ 29 per kg and 25 kg of rice at the rate of ₹ 20 per kg. He sold the mixture of both types of rice at the rate of ₹ 27 per kg. His profit in this transaction is
(a) ₹ 125 (b) ₹ 150
(c) ₹ 140 (d) ₹ 145

8. Nikita bought 30 kg of wheat at the rate of ₹ 9.50 per kg and 40 kg of wheat at the rate of ₹ 8.50 per kg and mixed them. She sold the mixture at the rate of ₹ 8.90 per kg. Her total profit or loss in the transaction was
(a) ₹ 2 loss (b) ₹ 2 profit
(c) ₹ 7 loss (d) ₹ 7 profit

9. Lala has lent some money to Arun at 5% p.a. and Bhatia at 8% p.a. At the end of the year, he has gained an overall interest of 6%. In what ratio has he lent the money to Arun and Bhatia ?
(a) 2 : 1 (b) 1 : 2
(c) 3 : 2 (d) 3 : 1

10. Two vessels *A* and *B* contain spirit and water mixed in the ratio 5 : 2 and 7 : 6 respectively. Find the ratio in which these mixture be mixed to obtain a new mixture in vessel *C* containing spirit and water in the ratio 8 : 5 ?
(a) 4 : 3 (b) 3 : 4
(c) 5 : 6 (d) 7 : 9
(e) None of these

11. A container has 30 litres of water. If 3 litres of water is replaced by 3 litres of spirit and this operation is repeated twice, what will be the quantity of water in the new mixture?
(a) 24 litres (b) 23 litres
(c) 24.3 litres (d) 23.3 litres
(e) None of these

12. A vessel contains 100 litres mixture of milk and water in the respective ratio of 22 : 3. 40 litres of the mixture is taken out from the vessel and 4.8 litres of pure milk and pure water each is added to the mixture. By what percent is the quantity of water in the final mixture less than the quantity of milk?
(a) $78\frac{1}{2}$ (b) $79\frac{1}{6}$ (c) $72\frac{5}{6}$ (d) 76
(e) $77\frac{1}{2}$

13. 18 litres of pure water was added to a vessel containing 80 litres of pure milk. 49 litres of the resultant mixture was then sold and some more quantity of pure milk and pure water was added to the vessel in the respective ratio of 2 : 1. If the resultant respective ratio of milk and water in the vessel was 4 : 1. If the resultant respective ratio of milk and water in the vessel was 4 : 1, what was the quantity of pure milk added in the vessel? (in litres)
(a) 4 (b) 8
(c) 10 (d) 12
(e) 2

14. A vessel contains a mixture of Grape, Pineapple and Banana juices in the respective ratio of 4 : 6 : 5. 15 litres of this mixture is taken out and 8 litres of grape juice and 2 litres of pineapple juice is added to the vessel. If the resultant quantity of grape juice is 10 litres less than the resultant quantity of pineapple juice. What was the initial quantity of mixture in the vessel? (in litres)

(a) 120 (b) 150
(c) 105 (d) 135
(e) 90

15. A container contains a mixture of milk and water in the respective ratio of 2 : 3. 20 litres of the mixture is replaced with same quantity of milk. The respective ratio of milk and water now becomes 4 : 1. Find the initial quantity of the mixture in the container. (In litres)

(a) 30 (b) 32
(c) 35 (d) 36
(e) 40

16. A jar had 120 litres mixture of milk and water in the respective ratio of 5 : 1. 30 litres of this mixture is taken out and '*X*' litres of each milk and water is added to the jar. The respective ratio between milk and water in the jar was 4 : 1 respectively. What was the total quantity of both milk and water added to the jar? (in litres)

(a) 12 (b) 10
(c) 16 (d) 20
(e) 18

17. A jar contains a mixture of milk and water in the respective ratio of 3 : 1. When 4 litres of the mixture is taken out and thereafter 3 litres of milk is added to the remaining mixture, the respective ratio of milk and water in the resultant mixture thus formed is 4 : 1. What was the initial quantity of water in the mixture?

(a) 1 litres (b) 6 litres
(c) 4 litres (d) 2 litres
(e) 3 litres

18. A vessel contains a mixture of milk and water in the respective ratio of 10 : 3. Twenty-six litres of this mixture was taken out and replaced with 10 litres of water. If the respective ratio of milk and water in the resultant mixture was 5 : 2, what was the initial quantity of mixture in the vessel? (in litres)

(a) 143 (b) 182
(c) 169 (d) 156
(e) 130

19. A jar contains mixture of milk and water in the respective ratio of 3 : 1. $\frac{1}{25}$th of the mixture is taken out and 24 litre water was added to it. If the resultant ratio between milk and water in the jar was 2 : 1, what was the initial quantity of mixture in the jar? (in litre)

(a) 160 (b) 180
(c) 200 (d) 250
(e) None of these

20. Vessel *A* contains a mixture of milk and water in the respective quantities of 20 litres and 4 litres. Vessel *B* contains a mixture of milk and water in the respective ratio of 3 : 1. Mixtures from vessel *A* and *B* are both mixed together in vessel *C*. If the resultant percentage of water in vessel *C* was 20%, what was the initial quantity of mixture in vessel *B*? (in litres)

(a) 16 (b) 20
(c) 12 (d) 24
(e) 28

21. In an alloy, zinc and copper are in the ratio 1 : 2. In the second alloy, the same elements are in the ratio 2 : 3. If these two alloys be mixed to form a new alloy in which two elements are the ratio 5 : 8, the ratio of these two alloys in the new alloys is

(a) 3 : 10 (b) 3 : 7
(c) 10 : 3 (d) 7 : 3

22. Three glasses of equal volume contain acid mixed with water. The ratio of acid and water are 2 : 3, 3 : 4 and 4 : 5 respectively. Contents of these glasses are poured in a large vessel. The ratio of acid and water in the large vessel is

(a) 417 : 564 (b) 401 : 544
(c) 407 : 560 (d) 411 : 540

23. A vessel contains 60 litre of milk. 12 litres of milk taken out from it and replaced by water. Then again from mixture, 12 litres are taken out and replaced by water. The ratio of milk and water in the resultant mixture is :

(a) 16 : 9 (b) 15 : 10
(c) 16 : 10 (d) 9 : 5

24. A can is full of a mixture of two liquids *A* and *B* in the ratio of 7 : 5. When 9 litres of mixture are drawn off from the can and replaced by the same quantity of liquid *B*, the ratio of *A* and *B* in the can becomes 7 : 9. The capacity of the can is

(a) 21 litres (b) 20 litres
(c) 10 litres (d) 36 litres

25. Three containers whose volumes are in the ratio of 2 : 3 : 4 are full of mixture of spirit and water. In the Ist container the ratio of spirit and water is 4 : 1 in 2nd container the ratio is 11 : 4 and in the 3rd container ratio is 7 : 3. All the three mixtures are mixed in a big container. The ratio of spirit and water in the resultant mixture is :

(a) 4 : 9 (b) 9 : 5
(c) 11 : 4 (d) 5 : 10

Hints & Solutions

1. (e) In 60 gm. of mixture,

Quantity of water $= 60 \times \frac{75}{100} = 45$ gm

Quantity of milk = 15 gm

After mixing 15 gm of more water.

Quantity of water in the new mixture = 45 + 15 = 60 gm

$\because$ Quantity of water in 75 gm of mixture = 60 gm

$\therefore$ 100 gm of mixture will contain

$= \frac{60}{75} \times 100 = 80\%$ of water

2. (a) Remaining quantity of milk

$$= \text{Initial quantity} \times \left(1 - \frac{\text{quantity taken out}}{\text{Initial quantity}}\right)^n$$

$$= 60\left(1 - \frac{12}{60}\right)^2 = 60\left(1 - \frac{1}{5}\right)^2 = 60\left(\frac{4}{5}\right)^2$$

$$= \frac{60 \times 4 \times 4}{5 \times 5} = 38.4 \text{ litres}$$

3. (b) In jar *A*

Quantity of milk $= \frac{2}{3} \times 60 = 40$ litres

Quantity of water = 20 litres

Let the quantity of water in jar *B* be *x* litres.

$\therefore$ Quantity of milk $= (40 - x)$ litres

According to the question,

$$\frac{40 + 40 - x}{20 + x} = \frac{13}{7} \Rightarrow \frac{80 - x}{20 + x} = \frac{13}{7}$$

$\Rightarrow 260 + 13x = 560 - 7x \Rightarrow 13x + 7x = 560 - 260$

$\Rightarrow 20x = 300 \Rightarrow x = \frac{300}{20} = 15$ litres

4. (b) Remaining mixture = 180 – 54 = 126 litres

Quantity of water $= \left(\frac{5}{18} \times 126\right)$ litres = 35 litre

On adding 6 litres of water,

Total quantity of water = 41 litres

Quantity of mixture = 126 + 6 = 132 litres

$\therefore$ Percentage of water $= \frac{41}{132} \times 100 \approx 31$

5. (d) If there be 1 litre of acid in 4 litres of mixture, then in

Case I. Percentage of acid $= \frac{1}{4 + 1} \times 100 = 20\%$

Case II. Percentage of acid $= \frac{2}{6} \times 100 = \frac{100}{3} = 33\frac{1}{3}\%$

$\therefore$ Percentage of acid in original mixture

$= \frac{1}{4} \times 100 = 25\%$

6. (c) Let the initial quantity liquid *A* and *B* = 4*x* and *x*

According to question,

$$\frac{4x - 8}{x - 2 + 10} = \frac{2}{3}$$

$12x - 24 = 2x + 16$

$10x = 40$

$x = 4$

$\Rightarrow$ Initial quantity $= 4x = 4 \times 4 = 16$ litres

7. (d) According to the question,

CP of the mixture = 15 × 29 + 25 × 20 = ₹ 935

SP of the mixture = 27 × 40 = ₹ 1080

Profit = SP – CP

Profit = 1080 – 935 = ₹ 145

8. (a) According to the question,

CP of the mixture = 30 × 9.5 + 40 × 8.5

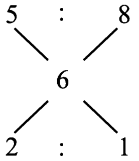
= 285 + 340 = ₹ 625

SP of the mixture = 8.90 × 70 = ₹ 623

loss = CP – SP

loss = 625 – 623 = ₹ 2

9. (a)



Required ratio = 2 : 1

10. (d) Let the C.P. of spirit be ₹ 1 per litre.

Spirit in 1 litre mix. of $A = \frac{5}{7}$ litre; C.P. of a litre mix. in $A = ₹\frac{5}{7}$.

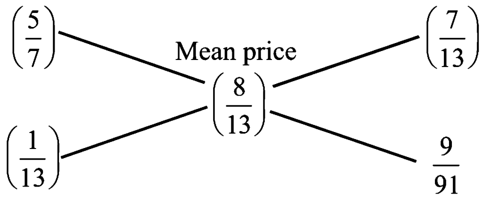
Spirit in 1 litre mix. of $B = \frac{7}{13}$ litre;

C.P. of 1 litre mix. in $B = ₹\frac{5}{13}$.

Spirit in 1 litre mix. of $C = \frac{8}{13}$ litre; Mean price $= ₹.\ \frac{8}{13}$.

By the rule of alligation, we have :

C.P. of 1 litre mixture in *A* C.P. of 1 litre mixture in *B*



$\therefore$ Required ratio $= \frac{1}{13} : \frac{9}{91} = 7 : 9.$

11. (c) Suppose a container contains *x* units of liquid from which *y* units are taken out and replaced by water. After *n* operations, the quantity of pure liquid

$= x\left(1 - \frac{y}{x}\right)^n$ units

∴ Remaining water = $30\left(1-\frac{3}{30}\right)^2 = \frac{30\times9\times9}{100}$

= 24.3 litres

12. (b) Remaining mixture in the vessel = 60 litres

Milk = $\frac{22}{25}\times 60 = 52.8$ litres

Water = 7.2 litres

On adding additional milk and water,

Milk = 52.8 + 4.8 = 57.6 litres

Water = 7.2 + 4.8 = 12 litres

∴ Required percent = $\frac{57.6-12}{57.6}\times 100$

$= \frac{45.6}{57.6}\times 100 = \frac{475}{6} = 79\frac{1}{6}\%$

13. (a) In initial mixture of the vessel,

Milk : Water = 80 : 18 = 40 : 9

In 49 litres of mixtures,

Milk = 40 litres

Water = 9 litres

Let $2x$ litres of milk and x litres of water be added.

According to the question,

$$\frac{40+2x}{9+x} = \frac{4}{1}$$

⇒ $36 + 4x = 40 + 2x$

⇒ $4x - 2x = 40 - 36$ ⇒ $2x = 4$

⇒ $x = 2$ litres ∴ Milk added = 4 litres

14. (d) Total initial quantity of juice in the vessel

$= 4x + 6x + 5x = 15x$ litres

In 15 litres of juice,

Grapes's juice = 4 litres

Pineapple's juice = 6 litres

Banana's juice = 5 litres

According to the question,

$(6x - 6 + 2) - (4x - 4 + 8) = 10$

⇒ $6x - 4 - 4x - 4 = 10$ ⇒ $2x - 8 = 10$

⇒ $2x = 10 + 8 = 18$ ⇒ $x = 9$

∴ Initial quantity of mixture = $15x$

$= 15 \times 9 = 135$ litres

15. (a) Initial quantity of milk = $2x$ litres

Water = $3x$ litres

In 20 litres of mixture,

Milk = $\frac{2}{5}\times 20 = 8$ litre

Water = $\frac{3}{5}\times 20 = 12$ litre

On adding 20 litres of milk,

$\frac{2x-8+20}{3x-12} = \frac{4}{1}$ ⇒ $2x + 12 = 12x - 48$

⇒ $12x - 2x = 12 + 48$ ⇒ $10x = 60$

⇒ $x = 6$

Initial quantity of mixture = $5x = 5 \times 6 = 30$ litres

16. (b) In 90 litres of mixture in the jar.

Milk ⇒ $\frac{5}{6}\times 90 = 75$ litres

Water ⇒ 15 litres

On adding x litres of milk and water each:

$$\frac{75+x}{15+x} = \frac{4}{1}$$

⇒ $4x + 60 = 75 + x$ ⇒ $4x - x = 75 - 60$

⇒ $3x = 15$ ⇒ $x = \frac{15}{3} = 5$

∴ Required quantity that was added = 2 × 5 = 10 litres

17. (c) Initially

Quantity of milk = $3x$ litres

Quantity of water = x litres

In four litres of mixture,

Milk = 3 litres

Water = 1 litre

According to the question,

$$\frac{3x-3+3}{x-1} = \frac{4}{1}$$

⇒ $4x - 4 = 3x$ ⇒ $x = 4$ litres

18. (d) In 26 litres of mixture,

Milk = $\frac{10}{13}\times 26 = 20$ litres

Water = 6 litres

In original mixture,

Milk = $10x$ litres

Water = $3x$ litres

According to the question,

$\frac{10x-20}{3x-6+10} = \frac{5}{2}$ ⇒ $\frac{2x-4}{3x+4} = \frac{1}{2}$

⇒ $4x - 8 = 3x + 4$ ⇒ $x = 8 + 4 = 12$

∴ Initial quantity of mixture = $13x$

$= 13 \times 12 = 156$ litres

19. (c) Let initial quantity of mixture = 25 litres

In 24 litre

Milk = 18 litres

Water = 6 litres

When, 3 litres water is added,

Milk : Water = 2 : 1

∴ If 3 litres of water is added total mixture = 25 litre

∴ If 24 litres of water is added total quantity

$= \frac{25\times 24}{3} = 200$ litres

20. (a) In vessel B,

Quantity of milk = $3x$ litres

Quantity of water = x litres

In vessel C,

Quantity of water = (4 + x) litres

Total quantity = (24 + 4x) litres

According to the question,

$$\frac{4+x}{24+4x}=\frac{20}{100}=\frac{1}{5} \quad \Rightarrow \quad 20+5x=24+4x$$

$$\Rightarrow \quad 5x-4x=24-20 \quad \Rightarrow \quad x=4$$

∴ Initial quantity of mixture in vessel B = 4 × 4 = 16 litres

21. (a) According to the question

	Zinc	:	Copper	
In first alloy	$1_{\times 65}$	:	2 × 65 = 3	65
Second alloy	$2_{\times 39}$	:	3 × 39 = 5	39 → 195
New alloy	$5_{\times 15}$	:	8 × 15 = 13	15

		:	
First alloy	65	:	130
Second alloy	78	:	117
New alloy	75	:	120

65 : 78

75

3 : 10

∴ Required ratio = 3 : 10

22. (b)

	Acid	:	Water	Mixture
Glass 1	[2	:	3 =	$5]_{\times 63}$
Glass 2	[3	:	4 =	$7]_{\times 45}$
Glass 3	[4	:	5 =	$9]_{\times 35}$
Glass 1	126	:	189	= 315
Glass 2	135	:	180	= 315
Glass 3	140	:	175	= 315
	+		+	
	$\boxed{401}$	:	$\boxed{544}$	

Required ratio = 401 : 544

23. (a) Total milk = 60 litres

Drawn off = 12 litres

$$\frac{\text{Final Quantity}}{\text{Initial Quantity}}=\left(1-\frac{x}{c}\right)^t$$

x = Replaced Quantity

C = Capacity

T = number of process

$$\frac{\text{Final Quantity}}{\text{Initial Quantity}}=\left(1-\frac{12}{60}\right)^2=\left(\frac{4}{5}\right)^2=\frac{16}{25}$$

Ratio of milk and water in the resultant mixture = 16 : 9

24. (d) According to the question

	A		B	
	7	+	5	= 12
			↓	4 units
Final Solution →	7	+	9	= 16

4 units → 9

$$1 \text{ unit} \rightarrow \frac{9}{4}$$

$$16 \text{ units} \rightarrow \frac{9}{4}\times 16=36$$

∴ The capacity of the can = 36 litres

25. (c)

	Spirit		Milk		Total	Capacity Ratio
I	4	+	1	=	5	2
II	11	+	4	=	15	3
III	7	+	3	=	10	4

			Spirit	Milk	Total
I	$4_{\times 12}$	=	48	$1_{\times 12}$ = 12	$5_{\times 6\times 2}$
II	$11_{\times 6}$	=	66	$4_{\times 6}$ = 24	$15_{\times 2\times 3}$
III	$7_{\times 12}$	=	84	$3_{\times 12}$ = 36	$10_{\times 3\times 4}$

Total Ratio 198 : 72 = 11 : 4

Chapter

9

Time, Speed and Distance (Train, Boat & Stream)

SPEED

The rate at which any moving body covers a particular distance is called its speed i.e. the distance travelled in unit time is called speed.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}\,;\ \text{Time} = \frac{\text{Distance}}{\text{Speed}}\,;$$

$$\text{Distance} = \text{Speed} \times \text{Time}$$

Average Speed

Average speed is defined as the ratio of total distance covered to the total time taken by an object *i.e.*

$$\text{Average speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}}$$

If an object travels $d_1, d_2, d_3, ..., d_n$ distances with different speeds $s_1, s_2, s_3, ..., s_n$ in time $t_1, t_2, t_3, ..., t_n$ respectively; then average speed (S_a) is given by

$$\boxed{S_a = \frac{d_1 + d_2 + d_3 + ... + d_n}{t_1 + t_2 + t_3 + ... + t_n}} \quad ...\ (1)$$

Since, Distance = Speed × Time

$$\therefore \quad d_1 = s_1t_1,\ \ d_2 = s_2t_2,\ \ d_3 = s_3t_3, ..., d_n = s_nt_n$$

$$\text{Hence from (1), } \boxed{S_a = \frac{s_1t_1 + s_2t_2 + s_3t_3 + ... + s_nt_n}{t_1 + t_2 + t_3 + ... + t_n}}$$

$$\text{Since Time} = \frac{\text{Distance}}{\text{Speed}}$$

$$\therefore \quad t_1 = \frac{d_1}{s_1},\ \ t_2 = \frac{d_2}{s_2},\ \ t_3 = \frac{d_3}{s_3}, ..., t_n = \frac{d_n}{s_n}$$

$$\text{Hence from (1), } \boxed{S_a = \frac{d_1 + d_2 + d_3 + ... + d_n}{\frac{d_1}{s_1} + \frac{d_2}{s_2} + \frac{d_3}{s_3} + ... + \frac{d_n}{s_n}}}$$

Special cases

(i) If with two different speeds s_1 and s_2 the same distance d is covered, then

$$\text{Average speed} = \frac{2s_1 \cdot s_2}{s_1 + s_2}$$

(ii) If with three different speeds s_1, s_2 and s_3 the same distance d is covered, then

$$\text{Average speed} = \frac{3s_1 \cdot s_2 \cdot s_3}{s_1 \cdot s_2 + s_2 \cdot s_3 + s_3 \cdot s_1}$$

Relative Speed

When two bodies are moving in same direction with speeds s_1 and s_2 respectively, their relative speed is the difference of their speeds. i.e., Relative Speed = $S_1 - S_2$, if $S_1 > S_2 = S_2 - S_1$, if $S_2 > S_1$

When two bodies are moving in opposite direction with speeds S_1 and S_2 respectively, then their relative speed is the sum of their speeds.

i.e., Relative Speed = $S_1 + S_2$

TRAIN

A train is said to have crossed an object (stationary or moving) only when the last coach of the train crosses the object completely. It implies that the total length of the train has crossed the total length of the object.

Concept related to motion of trains

Different situations in which Time is to be find out	Formula of time taken in different situations
(i) Time taken by a train to cross a pole, a tree or a man standing on a plateform	$= \frac{\text{Length of the train}}{\text{Speed of the train}}$
(ii) Time taken by a train to cross a man moving in the opposite direction	$= \frac{\text{Length of the train}}{(\text{Speed of the train}) + (\text{Speed of the man})}$
(iii) Time taken by a train to cross a man moving in the same direction	$= \frac{\text{Length of the train}}{(\text{Speed of the train}) - (\text{Speed of the man})}$
(iv) Time taken by a train to cross a platform, bridge or tunnel	$= \frac{(\text{Length of the plateform/bridge/terminal}) + (\text{Length of the train})}{\text{Speed of the train}}$
(v) Time taken by two trains to cross each other travelling in opposite direction	$= \frac{\text{Sum of length of two trains}}{\text{Sum of speed of two trains}}$
(vi) Time taken by a faster train to cross a slower train travelling in the same direction	$= \frac{\text{Sum of length of two trains}}{(\text{Speed of faster trains}) - (\text{Speed of slower train})}$

Note

In the case of a train crossing a man, tree or a pole, the length of the man, tree or pole is actually its diameter (or width) which is generally considered as negligible.

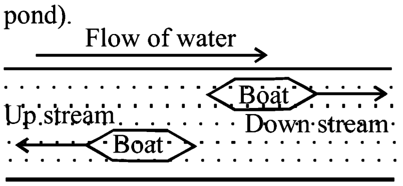
BOATS AND STREAMS

Stream : It implies that the water in the river is moving or flowing.

Upstream : Going against the flow of the river.

Downstream : Going with the flow of the river.

Still water : It implies that the speed of water is zero (generally, in a lake and pond).



Let the speed of a boat in still water be X m/sec and the speed of the stream (or current) be Y m/sec. Then,

Speed of boat with in the direction of stream (or downstream) $= (X + Y)$ m/sec.

Speed of boat in opposite direction of the stream (or upstream) $= (X - Y)$ m/sec.

Speed of boat in still water,

$$X = \frac{(X-Y)-(X+Y)}{2}$$

$$= \frac{\text{Speed of the Boat in Upstream} - \text{Speed of the Boat in Downstream}}{2}$$

Speed of the stream or current,

$$Y = \frac{(X+Y)-(X-Y)}{2}$$

$$= \frac{\text{Speed of the Boat in Downstream} - \text{Speed of the Boat in Upstream}}{2}$$

CIRCULAR MOTION

When two bodies start moving from a place on a circular track simultaneously in the same direction, the faster body keeps increasing the distance by which the slower body is behind the faster body. When this distance becomes equal to the circumference of the track, the faster body meets the slower body first time i.e. faster body comes in line with the slower body.

(i) When two bodies are moving in the opposite directions, their relative speed is equal to the sum of their individual speeds.

(ii) When two bodies are moving in the same direction, their relative speed is equal to the difference of the speeds of the two bodies.

First meeting : If A and B are two runners running in opposite direction from the same point, then time taken by A and B to meet for the first time

$$= \frac{\text{Circumference of the circular track}}{\text{Relative speed}}$$

Second meeting : If A and B are two runners running in opposite direction, then time taken by A and B to meet for the second time after first meeting

$$= \frac{\text{Circumference of the circular track}}{\text{Relative speed}}$$

EXERCISE

1. A man rides at the rate of 18 km/hr, but stops for 6 mins. to change horses at the end of every 7th km. The time that he will take to cover a distance of 90 km is

(a) 6 hrs. (b) 6 hrs. 12 min.
(c) 6 hrs. 18 min. (d) 6 hrs 24 min.

2. A man rows down a river 15 km in 3 hrs. with the stream and returns in $7\frac{1}{2}$ hrs. The rate at which he rows in still water is

(a) 2.5 km/hr (b) 1.5 km/hr
(c) 3.5 km/hr (d) 4.5 km/hr

3. By walking at $\frac{3}{4}$ of his usual speed, a man reaches his office 20 minutes later than usual. His usual time is

(a) 30 min. (b) 75 min. (c) 90 min. (d) 60 min.

4. A student goes to school at the rate of $\frac{5}{2}$ km/hr and reaches 6 minutes late. If he travels at the speed of 3 km/hr, he reaches 10 minutes earlier. The distance of the school is

(a) 45 km (b) 20 km (c) 10 km (d) 4 km

5. A is twice as fast as B and B is thrice as fast as C is. The journey covered by C in 1½ hours will be covered by A in

(a) 15 minutes (b) 20 minutes
(c) 30 minutes (d) 1 hour

5. How many seconds will a train 120 metres long running the rate of 36km/ hr take to cross a bridge of 360 metres in length?

(a) 48 sec (b) 36 sec (c) 40 sec (d) 46 sec

7. A farmer travelled a distance of 61 km in 9 hrs. He travelled partly on foot at the rate of 4 km/hr and partly on bicycle at the rate of 9 km/hr. The distance travelled on foot is

(a) 17 km (b) 16 km (c) 15km (d) 14 km

8. A man travelled a distance 72 km in 12 hour. He tavelled partly on foot at 5 km/hour and partly on bicycle at 10 km/ hour. The distance travelled foot is

(a) 46 km (b) 52 km (c) 50 km (d) 48 km

9. A man takes 6 hours 35 minutes in walking to a certain place and riding back. He would have taken 2 hours less by riding both ways. What would be the time he would take to walk both ways?

(a) 4 hours 35 minutes (b) 8 hours 35 minutes
(c) 10 hours (d) 8 hours 25 minutes
(e) None of these

10. A 240 metres long train crosses a platform twice its length in 40 seconds. What is the speed of the train?
(a) 6 metres/sec. (b) 28 metres/sec.
(c) 18 metres/sec. (d) 16 metres/sec.
(e) None of these

11. A man rows to a place 35 km in distance and back in 10 hours 30 minutes. He found that he can row 5 km with the stream in the same time as he can row 4 km against the stream. Find the rate of flow of the stream.
(a) 1 km/hrs (b) 0.75 km/hrs
(c) 1.33 km/hrs (d) 1.5 km/hrs

12. The distance between two places A and B is 140 kms. The first scooter departs from place A to B, at a speed of 50 kmph at 10 am. The second scooter departs from place B to A at a speed of 30 kmph at 12 pm. At what time will both the scooters meet each other?
(a) 12 : 30 pm (b) 01 : 50 pm
(c) 01 : 00 pm (d) 12 : 50 pm
(e) 01 : 30 pm

13. A train starts from *A* at 7 a.m. towards *B* with speed 50 km/h. Another train starts from *B* at 8 a.m. with speed 60 km/h towards *A*. Both of them meet at 10 a.m. at *C*. The ratio of the distance *AC* to *BC* is
(a) 5 : 6 (b) 5 : 4 (c) 6 : 5 (d) 4 : 5

14. A man walks a certain distance in certain time, if he had gone 3 km per hour faster, he would have taken 1 hour less than the scheduled time, if he had gone 2 km per hour slower, he would have been one hour longer on the road. The distance (in km) is :
(a) 60 (b) 45 (c) 65 (d) 80

15. Two trains started at the same time, one from *A* to *B* and the other from *B* to *A*. If they arrived at *B* and *A* respectively 4 hours and 9 hours after they passed each other, the ratio of the speed of the two trains was
(a) 2 : 1 (b) 3 : 2 (c) 4 : 3 (d) 5 : 4

16. In a kilometre race, *A* beats *B* by 30 seconds and *B* beats *C* by 15 seconds. If A beats *C* by 180 metres, the time taken by *A* to run 1 kilometre is
(a) 250 seconds (b) 205 seconds
(c) 200 seconds (d) 210 seconds

17. A man travelled a distance of 72 km. in 12 hours. He travelled partly on foot at 5 km/hour and partly on bicycle at 10 km/hour. The distance travelled on foot is
(a) 50 km (b) 48 km (c) 52 km (d) 46 km

18. Shalendra riding a bicycle at 20 km/hr can reach his office in 3 hours. If he is late by 1 hour at the start, then in order to reach his destination in time he should ride at the speed of ?
(a) 20 km/hr. (b) 25 km/hr.
(c) 30 km/hr. (d) 35 km/hr.

19. A man can row 6 km/hr in still water. If the speed of the current is 2 km/hr, it takes 4 hours more in upstream than in the downstream for the same distance. The distance is
(a) 30 km (b) 24 km (c) 20 km (d) 32 km

20. The speed of a boat downstream is 15 km/hr and the speed of current is 3 km/hr. Find the total time taken by the boat to cover 15 km upstream and 15 km downstream.
(a) 2 hours 40 minutes (b) 2 hours 42 minutes
(c) 3 hours 10 minutes (d) 2 hours 30 minutes

21. On a journey across Kolkata, a taxi averages 50 km per hour for 50% of the distance. 40 km per hour for 40% of it and 20 km per hour for the remaining. The average speed in km/hour, for the whole journey is:
(a) 42 (b) 40 (c) 35 (d) 45

22. Two cars are moving with speeds v_1, v_2 towards a crossing along two roads. If their distances from the crossing be 40 metres and 50 metres at an instant of time then they do not collide if their speeds are such that
(a) $v_1 : v_2 \neq 5 : 4$ (b) $v_1 : v_2 = 25 : 16$
(c) $v_1 : v_2 = 16 : 25$ (d) $v_1 : v_2 \neq 4 : 5$

23. Points *A* and *B* are 100 km apart on a highway. One car starts from *A* and another from *B* at the same time. If the cars travel in the same direction, they meet in 5 hours. If the cars travel towards each other, they meet in 1 hour. What is the speed of the faster car?
(a) 70 km/hour (b) 40 km/hour
(c) 60 km/hour (d) 80 km/hour

24. A bus started its journey from Ramgarh and reached Devgarh in 44 minutes with its average speed of 50 km/hour. If the average speed of the bus is increased by 5 km/hour, how much time will it take to cover the same distance?
(a) 40 minutes (b) 38 minutes
(c) 36 minutes (d) 31 minutes
(e) 49 minutes

25. The distance between two cities (*M* and *N*) is 569 km. A train starts from city *M* at 8 a.m. and travels towards city *N* at the rate of 53 kmph. Another train starts from city *N* at 9 am and travels towards city *M* at the rate of 76 kmph. At what time will the trains meet?
(a) 12 : 30 p.m. (b) 1 : 00 p.m.
(c) 2 : 30 p.m. (d) 1 : 30 p.m.
(e) 2 : 00 p.m.

26. Two cars starts at the same time from *A* and *B* which is 120 km apart. If the two cars travel in opposite direction they meet after one hour and if they travel in same direction (from *A* towards *B*) then two cars crosses after 6 hours. What is the speed of car starting from *A*?
(a) 70 kmph (b) 120 kmph
(c) 60 kmph (d) Data inadequate
(e) None of these

27. The distance between 2 places *R* and *S* is 42 km. Anita starts from *R* with a uniform speed of 4 km/h towards *S* and at the same time Romita starts form *S* towards *R* also with same uniform speed. They meet each other after 6 hours. The speed of Romita is
(a) 18 km/hour (b) 20 km/hour
(c) 3 km/hour (d) 8 km/hour

28. A thief is noticed by a policeman from a distance of 200 m. the thief starts running and the policeman chases him. The thief and the policeman run at the rate of 10 km/hr. and 11 km/hr. respectively. What is the distance between them after 6 minutes ?
(a) 100 m (b) 190 m (c) 200 m (d) 150 m

29. Points 'A' and 'B' are 70 km apart on a highway and two cars start at the same time. If they travel in the same direction, they meet in 7 hours, but if they travel towards each other they meet in one hour. Find the speed of the tow cars (in km/hr).
(a) 20, 30 (b) 40, 30
(c) 30, 50 (d) 20, 40

30. A thief steals a car at 1.30 P.M. and drive it off at 40 km/hr. The thieft is discovered at 2 P.M. and the owner sets off in another car at 50 km/hr. he will overtake the thief at
(a) 5 p.m. (b) 4 p.m. (c) 4.30 p.m. (d) 6 p.m.

31. A train covers a distance of 3584 km in 2 days 8 hours. If it covers 1440 km on the first day and 1608 km on the second day, by how much does the average speed of the train for the remaining part of the journey differ from that for the entire journey?
(a) 3 km/hr (b) 4 km/hr
(c) 10 km/hr (d) 2 km/hr

32. A car driver leaves Bangalore at 8 : 30 A.M. and expects to reach a place 300 km from Bangalore at 12:30 P.M. At 10:30 he finds that he has covered only 40% of the distance. By how much he has to increase the speed of the car in order to keep up his schedule ?
(a) 45 km/hr (b) 40 km/hr
(c) 35 km/hr (d) 30 km/hr

33. If a man walks at the rate of 5 km/hour, he misses a train by 7 minutes. However if he walks at the rate of 6 km/hour, he reaches the station 5 minutes before the arrival of the train. The distance covered by him to reach the station is
(a) 7 km (b) 6.25 km (c) 6 km (d) 4 km

34. Ravi travels 300 km partly by train and partly by car. He takes 4 hours to reach. If he travels 60 km. by train and rest by car. He will take 10 minutes more if he were to travel 100 km by train and rest by car. The speed of the train is :
(a) 50 km/hr (b) 60 km/hr
(c) 100 km/hr (d) 120 km/hr

35. *A*, *B* and *C* walk 1 km. in 5 minutes, 8 minutes and 10 minutes respectively. *C* starts walking from a point at a certain time, *B* starts from the same point 1 minutes later and *A* starts from the same point 2 minutes later then *C*, then *A* meets *B* and *C* after.
(a) $\frac{5}{3}$ min, 2 min (b) 1 min, 2 min
(c) 2 min, 3 min (d) $\frac{4}{3}$ min, 3 min

36. Points *A* and *B* are 100 km apart on a highway. One car starts from *A* and another from *B* at the same time. If the cars travel in the same direction, they meet in 5 hours. If the cars travel towards each other, they meet in 1 hour. What is the speed of the faster car ?
(a) 70 km/hr. (b) 60 km/hr.
(c) 80 km/hr. (d) 40 km/hr.

37. A man goes downstream with a boat to some destination and returns upstream to his original place in 5 hours. If the speed of the boat in still water and the stream are 10 km/hr and 4 km/hr respectively, the distance of the destination from the starting place is :
(a) 16 km (b) 18 km
(c) 21 km (d) 25 km

38. A man rows to a place 60 km distance and back in 13 hours 30 minutes. He finds that he can row 5 km with the stream in the same time as he can row 4 km against the stream. Find the rate of the stream.
(a) 8 km/hr (b) 1/2 km/hr
(c) 10 km/hr (d) 1 km/hr

Hints & Solutions

1. **(b)** Number of stoppages = $\frac{90}{7} \cong 12$

$\therefore$ Total time = $\left(\frac{90}{18}\right)$ hours + 12 × 6 minutes

= 6 hours 12 minutes

2. **(c)** Speed of person in still water = x kmph and speed of current = y kmph

$$\therefore \quad x+y=\frac{15}{3}=5 \text{ kmph} \qquad \text{...(i)}$$

$$x-y=\frac{15}{\frac{15}{2}}=2 \text{ kmph} \qquad \text{...(ii)}$$

On adding both eq. (i) and (ii) $2x = 7$

$$\Rightarrow \quad x=\frac{7}{2}=3.5 \text{ km/hr}$$

3. **(d)** New speed = $\frac{3}{4}$ × usual speed

$\therefore$ New time = $\frac{4}{3}$ × usual time

$\therefore$ $\frac{1}{3}$ × usual time = 20 minutes

$\Rightarrow$ Usual time = 3 × 20 = 60 minutes

4. **(d)** Let original time taken by student be x hours.

$$\frac{5}{2}\times\left(x+\frac{6}{60}\right)=3\times\left(x-\frac{10}{60}\right)$$

$5x+\frac{1}{2}=6x-1$ or $x=\frac{3}{2}$ hours

$\therefore$ Distance of school = $\frac{5}{2}\times\left(\frac{3}{2}+\frac{1}{10}\right)=4\,\text{km}$

5. **(a)** Let *C*'s speed = x km/h
Then, *B*'s speed = $3x$ km/h and *A*'s speed = $6x$ km/h
Ratio of speeds of *A*, *B*, *C* = $6x : 3x : x = 6 : 3 : 1$

Ratio of time taken $=\frac{1}{6}:\frac{1}{3}:1 = 1 : 2 : 6$

It C's 90 minutes

Hence, $6x = 90$ or $x = 15$ minutes

Hence, A should take 15 minutes.

6. (a) Total distance = Length of train + Length of bridge

$= 120 + 360 = 480$ m

Speed = 36 km/h = $36 \times \frac{5}{18} = 10$ m/sec

So time = $\frac{\text{Distance}}{\text{Speed}} = \frac{480}{10} = 48$ sec

7. (b) Let the distance travelled by foot be x km.

Then, distance travelled by bicycle = $(61 - x)$ km

So, $\frac{x}{4} + \frac{61-x}{9} = 9$

$9x + 4(61 - x) = 9 \times 36$

$9x - 4x = 324 - 244$

$5x = 80$ or $x = 16$ km

8. (d) Let distance travelled by foot = x km/hr

Let distance travelled by bicycle = $72 - x$ km/hr

$\frac{x}{5} + \frac{(72-x)}{10} = 12$

$2x + 72 - x = 120$

$x = 120 - 72 = 48$ km

9. (b) Time taken in walking one way + riding other way

= 6 hours 35 minutes ...(i)

Time taken in riding both ways

= 4 hours 35 minutes ...(ii)

By equation (i) × 2 – (ii),

2 × Time taken in walking one way

= 13 hours 10 minutes – 4 hours 35 minutes

= 8 hours 35 minutes

10. (c) Length of the train = 240 metre

∴ Length of the platform = 480 metre

We know that when a train crosses a platform, it covers a distance equal to the sum of its length and that of platform.

∴ Speed of train = $\left(\frac{240+480}{40}\right)$ m/sec.

$= \frac{720}{40} = 18$ m/sec.

11. (b) Let speed of man and stream is 'V' and 'U' respectively

Then, $\frac{5}{V+U} = \frac{4}{V-U}$

[Travelling distance in same time]

$5V - 5U = 4V + 4U$

$V = 9U \Rightarrow \frac{V}{U} = \frac{9}{1}$

Let $U = x$, $V = 9x$

$\frac{35}{2x}\left(\frac{1}{5} + \frac{1}{4}\right) = \frac{21}{2} \Rightarrow \frac{5}{x} \times \frac{9}{20} = 3$

$x = \frac{3}{4} = 0.75$

Speed of stream = 1 × 0.75 = 0.75 km/hr.

12. (a) Let both scooters meet after t hours from 10 a.m.

∴ Distance = Speed × Time

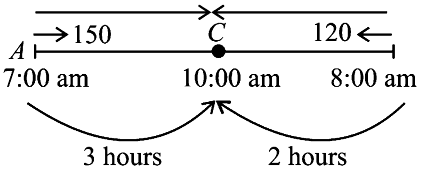
∴ Distance covered by scooter A in t hours + distance covered by scooter B in $(t - 2)$ hour = 140

$\Rightarrow 50t + 30(t - 2) = 140 \Rightarrow 80t - 60 = 140$

$\Rightarrow 80t = 200 \Rightarrow t = \frac{200}{80} = \frac{5}{2}$ hours

i.e., after 2 hours 30 minutes i.e. at 12 : 30 p.m.

13. (b)



⇒ Distance, covered by A in 3 hours with the speed of 50 km/h = 50 × 3 = 150 km.

⇒ Distance covered by B in 2 hours with the speed of 60 km/h = 60 × 2 ⇒ 120 km.

then $AC : BC = 150 : 120 = 5 : 4$

14. (a) Let the speed = x km/hr

then time = y hr.

A.T.O.

$x \times y = (x + 3)(y - 1)$

$xy = xy + 3y - x - 3$

$x - 3y = -3$ ...(i)

$x \times y = (x - 2)(y + 1)$

$xy = xy - 2y + x - 2$

$x - 2y = 2$ ...(ii)

Solve equation (i) and (ii)

$x = 12$, $y = 5$

Distance = Speed × time = 12 × 5 = 60 km.

15. (b) As speed is inversely proportional to time

$\frac{\text{Speed of } A}{\text{Speed of } B} = \sqrt{\frac{\text{Time of } B}{\text{Time of } A}} = \sqrt{\frac{9}{4}} = \frac{3}{2}$

⇒ Speed of A : Speed of B = 3 : 2

16. (b) Let time taken by A to cover 1 km. = x sec.

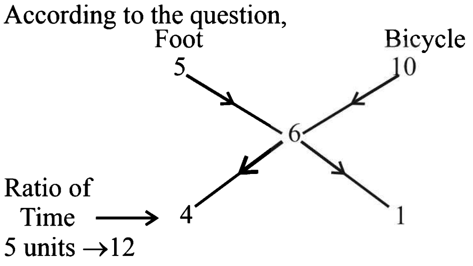
Time taken by B and C = $x + 30$ and $x + 45$ sec

$\frac{x}{x+45} = \frac{(1000-180)}{1000} = \frac{41}{50}$

$50x = 41x + 1845$

$x = 205$ sec.

17. (b) According to the question,



5 units → 12

1 unit → $\frac{12}{5}$

4 units = $\frac{12}{5} \times 4 = \frac{48}{5}$

Distance travelled on foot $= \frac{48}{5} \times 5 = 48\,\text{km}$

18. (c) Distance = 20 × 3 = 60 km.
When 1 hour late then reducing time = 3 – 1 = 2 hours
Then increasing speed $= \frac{60}{2} = 30\,\text{km/hr}$

19. (d) Speed of man in still water, (x) = 6 km/hr
Speed of current (y) = 2 km/hr
Let Distance = M
ATQ
Upstream time = Downstream time + 4

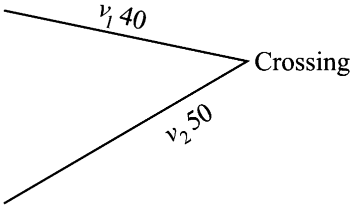
$$\frac{M}{4} = \frac{M}{8} + 4$$
$$\frac{M}{4} = \frac{M+32}{8}$$
$$\frac{M}{1} = \frac{M+32}{2}$$
$$M = 32$$

∴ Distance = 32 km.

20. (a) Given,
Speed of boat down stream = 15 km/hr
Speed of current = 3 km/hr
Speed of boat in still water = 12 km/hr
Time taken at upstream $= \frac{15}{12-3} = \frac{15}{9}$ h = 1 h 40 min
Time taken at downstream $= \frac{15}{12+3} = 1$ h
Total time = 2h 40 min

21. (b) Total distance = 100 km.
$$\text{Total time} = \frac{50}{50} + \frac{40}{40} + \frac{10}{20}$$
$$= 1 + 1 + \frac{1}{2} = \frac{5}{2} \text{ hours}$$
∴ Average speed $= \frac{100 \times 2}{5} = 40$ kmph

22. (d)



If $\frac{40}{v_1} = \frac{50}{v_2}$ then they will collide i,e. cars will reach at the same time.
$$\therefore \quad \frac{v_1}{v_2} \neq \frac{40}{50} = \frac{4}{5}$$

23. (c) Let the speed of car be x and other be y
Distance covered from A in 5 hrs = $5x$
Distance covered from B in 5 hrs = $5y$
ATQ
when they travel in same direction

$5x - 5y = 100$
$x - y = 20$ ...(i)

When they travel towards each other
ATQ,
$x + y = 100$ ...(ii)

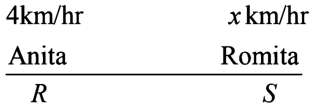
Now, adding eqn (i), & (ii)
$2x = 120$
$x = 60$ km/hr

24. (a) Distance between Ramgarh and Devgarh
$$= \frac{50 \times 44}{60} = \frac{110}{3} \text{ km}$$
New speed = 55 kmph $= \frac{55}{60}$ km/minute
$$\therefore \quad \text{Required time} = \frac{\text{Distance}}{\text{time}} = \frac{110}{3} \times \frac{60}{55}$$
$$= 40 \text{ minutes}$$

25. (b) Let the trains meet after t hours from 8 a.m.
Distance = speed × time
According to the question,
$53 \times t + 76(t - 1) = 569 \Rightarrow 53t + 76t - 76 = 569$
$\Rightarrow 129t = 569 + 76 = 645$
$\Rightarrow t = \frac{645}{129} = 5$ hours
∴ Required time = 8 a.m. + 5 hours = 1 p.m.

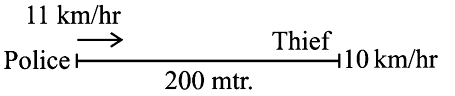
26. (a) Let speed of car starting at $A = x$ km/hr
and speed of car starting at $B = y$ km/hr
∴ $x + y = 120$ ...(i)
$6x - 6y = 120$ ...(ii)
$\Rightarrow x = 70$ km/hr.
$y = 50$ km/hr

27. (c) Let speed of Romita be x km/hr
According to question,



$d = 42$ km
$t = 6$h
$$(4 + x) = \frac{42}{6} \qquad \left(\because S = \frac{d}{t}\right)$$
$4 + x = 7$
$x = 3$ km/h

28. (a)



$$V_{\text{rel}} = (11 - 10) = 1 \text{ km/hr} = \frac{1 \times 1000}{60} \text{ mt/min}$$
Distance between them after 6 min.
$$= 200 - \frac{1000}{60} \times 6 = 100 \text{ mtr.}$$

29. (b) Let the speed of the cars be S_1 and S_2

$$= S_1 - S_2 = \frac{70}{7} = 10 \qquad \text{...(i)}$$

and $S_1 + S_2 = \frac{70}{1} = 70$ ...(ii)

from equation (i) and (ii)

$$S_1 = \frac{10+70}{2} = 40 \text{ km/hr and } S_2 = \frac{70-10}{2} = 30 \text{ km/hr}$$

$\therefore$ Required speeds are 40 km/hr and 30 km/hr

30. (b) Distance, covered by thief in (2 pm – 1:30 pm)

$= \frac{1}{2}$ hr at speed of 40 km/hr $= 40 \times \frac{1}{2} = 20$ kms.

$\Rightarrow$ Their relative speed in same direction
= (50 – 40) = 10 km/hr

$\Rightarrow$ According to question,
20 km, is the distance that has to cover by owner to over take the thief.

$\Rightarrow$ Required time $= \frac{20 \text{ km}}{10} = 2$ hours

$\Rightarrow$ Therefore, he will overtake the thief at
= 2 pm + 2 hr. = 4 pm.

31. (a) Given : Train covers 3584 kms in 2 day 8 hour

(2 days 8 hours $= \frac{7}{3}$ days)

Average speed $= \frac{3584}{\frac{7}{3}} = 1536$ km./day

$= \frac{1536}{24} = 64$ km/hr

Distance covered in two days = 1440 + 1608 = 3048 km.

Remaining distance for third day = 3584 –3048 = 536 km.

Third day 536 km is covered in 8 hour with speed of

$= \frac{536}{8} = 67$ km./h

Difference of Average speed = (67 – 64) = 3 km./hr

32. (d) Distance travelled by driver in 2 hours

$= 300 \times \frac{40}{100} = 120$ km

Distance to be covered in 2 hours = 300 – 120 = 180 km

Required speed $= \frac{180}{2} = 90$ km/h

Required difference $= 90 - \frac{120}{2} = 30$ km/hr

So increased speed = 30 km/hr.

33. (c) Diff. of time = (6 – 5) hours

$\Rightarrow$ 1 hour

Actual diff. of time

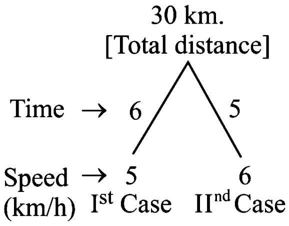
= 7 min. – (– min)

$\Rightarrow$ (7 + 5) min.

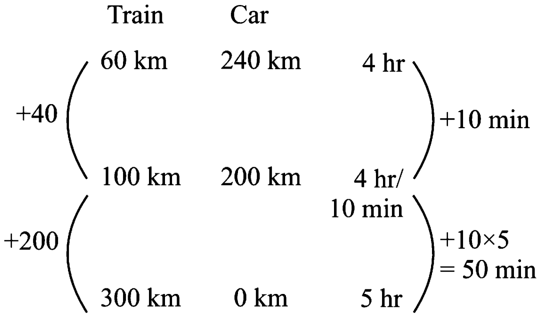
$\Rightarrow$ 12 min.

$$1 \text{ hour} \xrightarrow{1/5} 12 \text{ min.}$$

$$30 \text{ km} \xrightarrow{1/5} 6 \text{ km}$$



34. (b)



= Speed of train $= \frac{300}{5} = 60$ km/hr

35. (a) Speed of *A*, *B* and *C* $= \frac{1000}{5}, \frac{1000}{8}, \frac{1000}{10}$

= 200 m/ min., 125 m/min., 100 m/min.

Distance travelled by *B* and *C* before *A* starts
= 125, 200 metres

Time taken by *A* to meet *B* and *C*

$= \frac{125}{200-125}, \frac{200}{200-100} = \frac{5}{3}$ min., 2 min

36. (b) According to the question,

Let the speed of fastest car = x km/h

the speed of slower car = y km/hr.

Speed $= \frac{\text{Distance}}{\text{time}}$

$x + y = \frac{100}{1}$ km/hr and $x - y = \frac{100}{5} = 20$ km/hr

$x + y = 100$ ...(i)

$x - y = 20$ ...(ii)

Solve eqn. (i) and (ii) we get

$x = 60$ km/hr

$y = 40$ km/hr

Speed of fastest car = 60 km/hr.

37. (c) $T = \frac{2xD}{x^2 - y^2}$

$$D = \frac{(10^2 - 4^2)\,5}{2 \times 10} = \frac{84 \times 5}{20} = 21 \text{ km.}$$

38. (d) ATQ

$$\frac{60}{x+y} + \frac{60}{x-y} = \frac{27}{2} \qquad \text{...(i)}$$

and $\frac{5}{x+y} = \frac{4}{x-y}$

$5x - 5y = 4x + 4y$

$x = 9y$ ...(ii)

Put this in equation (i)

$$\frac{60}{10y} + \frac{60}{8y} = \frac{27}{2}$$

Or $\frac{27}{2y} = \frac{27}{2}$ or $y = 1$ km/hr

Chapter 10

Time & Work and Pipes & Cisterns

CONCEPT OF EFFICIENCY

Efficiency means rate of doing work. This means that more the efficiency, less will be the number of days required to complete a certain work and less the efficiency, more will be the number of days required to complete a certain work.

Aliza is twice as efficient as Binny.

⇒ Aliza does twice as much work as Binny in the same time interval

⇒ Aliza will require half the time as required by Binny to do the same work.

CONCEPT OF NEGATIVE WORK

Suppose two persons *A* and *B* are working to build a wall while *C* is working to demolish the wall. If we consider the work as the construction of the wall, then breaking the wall (by *C*) is negative work.

The concept of negative work generally appears in the problems based on pipes and cisterns, where there are inlet pipes and outlet pipes/leaks, which are working against each other.

If we consider the work of filling a tank, the inlet pipe does positive work while the outlet pipe/leak does negative work.

CONCEPT OF MAN-DAYS

If '*M*' men working together can complete a work in '*D*' days, then the product of number of men (*M*) and number of days (*D*) i.e. $M \times D$ is known as the number of MAN-DAYS. Number of man days to complete a specific task always remains constant.

Suppose 30 persons working together for 20 days to complete a job, then the total work done is equal to $(30 \times 20 = 600)$ man-days. If we change the number of days (*D*) in which the work is to be completed, then the other factor i.e. the number of persons (*M*) will change accordingly, so that the product $(M \times D)$ of the factors becomes equal to 600 man-days.

WORK DONE

Consider a whole work as the unit work.

1. Work Done by Two Persons

Let *A* can do a whole work in *x* days and *B* can do the same work in *y* days.

Hence work done by *A* in one day = $\frac{1}{x}$.

and work done by *B* in one day = $\frac{1}{y}$

Then work done in one day when *A* and *B* work together

$$= \frac{1}{x} + \frac{1}{y} = \frac{y+x}{xy} \quad \text{or} \quad \frac{x+y}{xy}$$

Whole work = (Work done in one day) × (Number of days required to complete the whole work)

Hence, number of days required to complete the whole work

$$= \frac{\text{Whole work}}{\text{Work done in one day}}$$

⇒ Number of days required to complete the whole work when *A* and *B* are working together

$$= \frac{1}{\frac{x+y}{xy}} = \frac{xy}{x+y},$$

because a whole work is considered as one unit of work.

2. Work Done by Three Persons

As we derived the formula for two persons, you can also derived the formula for three persons in the same way.

If *A*, *B*, *C* can do a work in *x*, *y* and *z* days respectively, then all of them working together can finish the work in $\frac{xyz}{xy + yz + zx}$ days.

Work Done Equation

If M_1 men each of efficiency E_1 can do W_1 works in D_1 days working T_1 hours per day and M_2 men each of efficiency E_2 can do W_2 works in D_2 days working T_2 hours per day, then

$$M_1D_1T_1E_1W_2 = M_2D_2T_2E_2W_1$$

This is the general equation in two work situations. Suffix 1 indicate first work situation while the suffix 2 indicate the second work situation.

If one or more items in both work situations are same, then no need to write them in the general equation in two work situations.

For examples :

(i) If E_1 and E_2 are same, then $M_1D_1T_1W_2 = M_2D_2T_2W_1$

(ii) If E_1 & E_2 and T_1 & T_2 are same, then $M_1D_1W_2 = M_2D_2W_1$

(iii) If E_1 & E_2, T_1 & T_2 and W_1 & W_2 are same, then $M_1D_1 = M_2D_2$.

Remember...

- If A can do a piece of work in x days, then A's one day's work = $\frac{1}{x}$th part of whole work.
- If A's one day's work = $\frac{1}{x}$th part of whole work, then A can finish the work in x days.
- If A and B together can do a piece of work in x days and A alone can do it in y days, then B alone can do the work in $\frac{xy}{y-x}$ days.
- If A, B and C can complete a work in x days and B & C can complete the same work in y days, then A alone will complete the same work in $\frac{xy}{y-x}$ days
- If 'A' is 'a' times efficient than B and A can finish a work in x days, then working together, they can finish the work in $\frac{ax}{a+1}$ days.
- If A is 'a' times efficient than B and working together they finish a work in z days then, time taken by A = $\frac{z(a+1)}{a}$ days and time taken by $B = z(a + 1)$ days.
- If A working alone takes 'x' days more than A and B together, and B working along takes 'y' days more than A and B together then the number of days taken by A and B working together is given by $\sqrt{xy}$ days.
- If the number of men to do a job is changed in the ratio $a : b$, then the time required to do the work will be in the ratio $b : a$, assuming the amount of work done by each of them in the given time is the same, or they are identical.
- If A is n times as efficient than B, i.e. A has n times as much capacity to do work as B, A will take $\frac{1}{n}$ of the time taken by B to do the same amount of work.

WORK AND WAGES

Wages are distributed in proportion to the work done and in indirect proportion to the time taken by the individual to complete a work.

PIPES AND CISTERNS

The same principle of Time and Work is employed to solve the problems on pipes and cisterns. The only difference is that in this case, the work done is in terms of filling or emptying a cistern (tank) and the time taken is the time taken by a pipe or a leak (crack) to fill or empty a cistern respectively.

Inlet pipe : A pipe connected with a tank (or a cistern or a reservoir) is called an inlet, if it fills it.

Outlet pipe : A pipe connected with a tank is called an outlet, if it empties it.

Remember...

- If a pipe can fill a tank in x hours, then the part of the tank filled in 1 hour $= \frac{1}{x}$
- If a pipe can empty a tank in y hours, then the part of the full tank emptied in 1 hour $= \frac{1}{y}$.
- A pipe can fill a tank in x hrs. Due to a leak in the bottom it is filled in y hrs. If the tank is full, the time taken by the leak to empty the tank $= \frac{xy}{y-x}$ hrs.
- A cistern is filled by three pipes whose diameters are x cm., y cm. and z cm. respectively (where $x < y < z$). Three pipes are running together. If the largest pipe alone will fill it in P minutes and the amount of water flowing in by each pipe is proportional to the square of its diameter, then the time in which the cistern will be filled by the three pipes is $\left[\frac{Pz^2}{x^2+y^2+z^2}\right]$ minutes.
- If one filling pipe A is n times faster and takes x minutes less time than the other filling pipe B, then the time they will take to fill a cistern, if both the pipes are opened together, is $\left[\frac{\text{nx}}{(\text{n}^2-1)}\right]$ minutes. A will fill the cistern in $\left(\frac{x}{n-1}\right)$ minutes and B will take to fill the cistern $\left(\frac{nx}{n-1}\right)$ minutes.
- Two filling pipes A and B opened together can fill a cistern in t minutes. If the first filling pipe A alone takes x minutes more or less than t and the second fill pipe B along takes y minutes more or less than t minutes, then t is given by $\text{t} = \sqrt{\text{xy}}$ minutes.

EXERCISE

1. B and C together can complete a work in 8 days, A and B together can complete the same work in 12 days and A and C together can complete the same work in 16 days. In how many days can A, B and C together complete the same work?

(a) $3\frac{9}{13}$ days (b) $7\frac{5}{13}$ days
(c) $7\frac{5}{12}$ days (d) $3\frac{5}{12}$ days
(e) None of these

2. Three men, four women and six children can complete a work in 7 days. A women does double the work a man does and a child does half the work a men does. How many women alone can complete this work in 7 days?

(a) 8 (b) 7
(c) 12 (d) Cannot be determined
(e) None of these

3. 12 men take 36 days to do a work while 12 women complete $\frac{3}{4}$th of the same work in 36 days. In how many days 10 men and 8 women together will complete the same work?

(a) 6 days (b) 27 days
(c) 12 days (d) Data inadequate
(e) None of these

4. A man and a woman working together can do a certain work in 18 days. Their skills in doing the work are in the ratio 3 : 2. How many days will the woman take to finish the work alone ?

(a) 45 days (b) 36 days (c) 27 days (d) 30 days

5. A particular job can be completed by a team of 10 men in 12 days, The same job can be completed by a team of 10 women in 6 days. How many days are needed to complete the job if the two teams work together ?

(a) 4 days (b) 6 days (c) 9 days (d) 18 days

6. A man undertakes to do a certain work in 150 days. He employees 200 men. He finds that only a quarter of the work is done in 50 days. The number of additional men that should be appointed so that the whole work will be finished in time is :

(a) 75 (b) 100 (c) 125 (d) 50

7. A, B and C completed a work costing ₹1,800. A worked for 6 days, B for 4 days and C for 9 days. If their daily wages are in the ratio of 5 : 6 : 4, how much amount will be received by A?

(a) ₹ 800 (b) ₹ 600 (c) ₹ 900 (d) ₹ 750

8. A man is twice as fast as a woman and a woman is twice as fast as a boy in doing a work. If all of them, a man, a woman and a boy can finish the work in 7 days, A boy will do it alone ?

(a) 49 (b) 47 (c) 46 (d) 42

9. If 4 men and 6 women can complete a work in 8 days while 3 men and 7 women can complete it in 10 days, then 10 women complete it in

(a) 35 days (b) 50 days (c) 45 days (d) 40 days

10. A can do a job in 10 days and B can do the same job in 15 days. They start working together, but B leaves after 5 days. In how many more days A will finish the remaining work ?

(a) 2 days (b) $1\frac{2}{3}$ days (c) 3 days (d) $2\frac{2}{3}$ days

11. Pipes P and Q can fill a tank in 10 hours and 12 hours respectively and C can empty it in 6 hours. If all the three are opened at 7 am, at what time will one-fourth of the tank be filled ?

(a) 10 am (b) 10 pm (c) 11 pm (d) 11 am

12. A water tank can be filled by a tap in 30 minutes and another tap can fill it in 60 minutes. If both the taps are kept open for 5 minutes and then the first tap is closed, how long will it take for the tank to be full ?

(a) 20 minutes (b) 25 minutes
(c) 30 minutes (d) 45 minutes

13. Two pipes A and B can fill a tank in 36 min. and 45 min. respectively. Another pipe C can empty the tank in 30 min. First A and B are opened. After 7 minutes, C is also opened. The tank is filled up in

(a) 39 minutes. (b) 46 minutes
(c) 40 minutes (d) 45 minutes

14. A contractor was engaged to construct a road in 16 days. After working for 12 days with 20 labours it was found that only 5/8th of the road had been constructed. To complete the work in stipulated time the number of extra labours required is :

(a) 12 (b) 10 (c) 18 (d) 16

15. A water reservoir has two inlets and one outlet. Through the inlet it can be filled in 3 hours and 3 hours 45 minutes respectively. It can be emptied completely in 1 hour by the outlet. If the two inlets are opened at 01:00 pm and 02:00 pm respectively and the outlet at 03:00 pm then it will be emptied at.

(a) 05:55 pm (b) 05:00 pm
(c) 05:20 pm (d) 05:30 pm

16. Two pipes can independently fill a bucket in 20 minutes and 25 minutes. Both are opened together for 5 minutes after which the second pipe is turned off. What is the time taken by the first pipe alone to fill the remaining portion of the bucket?

(a) 11 min (b) 16 min (c) 20 min (d) 15 min

17. 8 men can complete a place of work in 4 days. 12 women can complete the same piece of work in 4 days whereas 8 children can complete the same piece of work in 8 days. 2 men, 8 children and 3 women work together for 2 days. If only women were to finish the remaining work in 2 days, how many total women would be required?

(a) 12 (b) 18 (c) 24 (d) 20
(e) None of these

18. 8 men and 4 women together can complete a piece of work in 6 days. Work done by a man in one day is double the work done by a woman in one day. If 8 men and 4 women started working and after 2 days, 4 men left and 4 new women joined, in how many more days will the work be completed?
(a) 5 days (b) 8 days (c) 6 days (d) 4 days
(e) 9 days

19. 24 workers working 13 hours daily make a wall of dimensions 224 m × 16 m × 52 m in 32 days. In how many days will 36 workers working 18 hours daily make a wall of dimensions 432 m × 21 m × 64 m?
(a) 58 days (b) 42 days
(c) 48 days (d) 60 days
(e) None of these

20. 28 men can complete a piece of work in 15 days and 15 women can complete the same piece of work in 24 days. What is the respective ratio between the amount of work done by 30 men in 1 day and the amount of work done by 18 women in 1 day?
(a) 10 : 7 (b) 3 : 5
(c) 5 : 4 (d) 9 : 5
(e) None of these

21. The time taken by 24 children to complete a project is twice the time taken by 16 women to complete the same project. If 28 women complete the project in 8 days, how many days will 28 women and 24 children together take to complete the project?
(a) $6\frac{2}{9}$ days (b) $5\frac{2}{9}$ days
(c) $5\frac{1}{3}$ days (d) $6\frac{1}{3}$ days
(e) None of these

22. *B* is $\frac{4}{3}$ times as efficient as *A*. If A can complete $\frac{5}{8}$th of a given task in 15 days, what fraction of the same task would remain incomplete if *B* works on it independently for 10 days only?
(a) $\frac{3}{4}$ (b) $\frac{2}{3}$ (c) $\frac{5}{8}$ (d) $\frac{4}{9}$
(e) $\frac{2}{3}$

23. 10 men can finish a piece of work in 15 days. 8 women can finish the same piece of work in 25 days. Only 10 women started working and in few days completed certain amount of work. After that 3 men joined them. The remaining work was completed by 10 women and 3 men together in 5 days. After how many days 3 men joined 10 women?
(a) 11 (b) 13 (c) 15 (d) 10
(e) 12

24. *A* and *B* can complete a piece of work in 80 days and 120 days respectively. They started working together but *A* left after 20 days. After another 12 days *C* joined *B* and they completed the remaining work in 28 more days. In how many days can *C* alone complete the work?
(a) 110 days (b) 112 days
(c) 114 days (d) 120 days
(e) None of these

25. Time taken by *A* alone to finish a piece of work is 60% more than that taken by *A* and *B* together to finish the same piece of work. *C* is twice as efficient as *B*. If *B* and *C* together can complete the same piece of work in $13\frac{1}{3}$ days, in how many days can *A* alone finish the same piece of work?
(a) 36 (b) 24 (c) 16 (d) 28
(e) Other than those given as options

26. 8 men can finish a piece of work in 21 days. 14 men started working and after 3 days they were replaced by 9 women. These 9 women finished the remaining work in 24 days. In how many days 9 women can finish the whole work?
(a) 24 (b) 26 (c) 36 (d) 32
(e) 30

27. *A* and *B* together can complete a piece of work in 8 days and *B* and *C* together in 12 days. All of the three together can complete the work in 6 days. *A* and *C* together complete the work in ?
(a) 8 days (b) 10 days
(c) 12 days (d) 20 days

28. Three persons undertake to complete a piece of work for ₹1200. The first person can complete the work in 8 days, second person in 12 days and third person in 16 days. They complete the work with the help of a fourth person in 3 days. What does the fourth person get ?
(a) ₹ 180 (b) ₹ 200 (c) ₹ 225 (d) ₹ 250

29. A 10 hectare field is reaped by 2 men, 3 women and 4 children together in 10 days . If working capabilities of a man, a woman and a child are in the ratio 5 : 4 : 2, then a 16 hectare field will be reaped by 6 men, 4 women and 7 children in
(a) 5 days (b) 6 days (c) 7 days (d) 8 days

30. *A* and *B* together can complete a job in 8 days. Both *B* and *C*, working alone can finish the same job in 12 days, *A* and *B* commence work on the job and work for 4 days, where upon *A* leaves, *B* continues for 2 more days, and then he leaves too, *C* now starts working, and finishes the job. How many days will *C* require ?
(a) 5 days (b) 8 days
(c) 3 days (d) 4 days

31. *A*, *B* and *C* can complete a piece of work in 10, 12 and 15 days respectively. *A* left the work 5 days before the work was completed and *B* left 2 days after *A* had left. Number of days required to complete the whole work was :
(a) $8\frac{2}{3}$ days (b) 6 days
(c) $6\frac{2}{3}$ days (d) 7 days

32. Amit, Bhawna and Chandan can do a piece of work, working together in one day only. Amit is 5 times efficient than Bhawna and Chandan takes half of the number of days taken by Bhawna to do the same work. What is the difference between the number of days taken by Amit and Chandan when they work alone ?

(a) 4 (b) 5

(c) 3 (d) $2\frac{2}{5}$

33. *A* can do a piece of work in 12 days and *B* in 20 days. If they together work on it for 5 days and remaining work is completed by *C* in 3 days, then in how many days can *C* do the same work alone ?

(a) 10 days (b) 9 days

(c) 12 days (d) 15 days

34. *A* and *B* work together to complete the rest of a job in 7 days, when 37/100 of the job was already done. Also the work done by *A* in 5 days is equal to the work done by *B* in 4 days. How many days would be required by the fastest worker to complete the entire work ?

(a) 20 (b) 25 (c) 30 (d) 10

35. A group of workers can complete a piece of work in 50 days, when they are working individually. On the first day one person works, on the second day another person joins him, on the third day one more person joins them and this process continues till the works completed. How many approximate days are needed to complete the work?

(a) 8 days (b) 9 days

(c) 10 days (d) 11 days

36. A boy and girl together fill a cistern with water. The boy pours 4 litres of water every 3 minutes and the girl pours 3 litres of water every 4 minutes. How much time will it take to fill 100 litres of water in the cistern?

(a) 36 minutes (b) 42 minutes

(c) 48 minutes (d) 44 minutes

37. A tap can fill a cistern in 40 minutes and a second tap can empty the filled cistern in 60 minutes. By mistake without closing the second tap, the first tap was opened. In how many minutes will the empty cistern be filled ?

(a) 72 (b) 84 (c) 108 (d) 120

38. A tank can be filled by pipe *A* in 2 hours and pipe *B* in 6 hours. At 10 A.M. pipe A was opened. At what time will the tank be filled if pipe B is opened at 11 A.M.?

(a) 12.45 A.M. (b) 5 P.M.

(c) 11.45 A.M. (d) 12 P.M.

39. Three pipes, *A*, *B* and *C* can fill a tank in 6 hours, 9 hours and 12 hours respectively. *B* and *C* are opened for half an hour, then *A* is also opened. The time taken by the three pipes together to fill the remaining part of the tank is :

(a) 3 hours (b) 2 hours

(c) $2\frac{1}{2}$ hours (d) $3\frac{1}{2}$ hours

40. Two pipes *A* and *B* can fill a tank with water in 30 minutes and 45 minutes respectively. The third pipe *C* can empty the tank in 36 minutes. First *A* and *B* are opened. After 12 minutes *C* is opened. Total time (in minutes) in which the tank will be filled up is :

(a) 12 (b) 24

(c) 30 (d) 36

Hints & Solutions

1. **(b)** $(B + C)$'s 1 day's work $= \frac{1}{8}$ ...(i)

$(A + B)$'s 1 day's work $= \frac{1}{12}$ ...(ii)

$(A + C)$'s 1 day's work $= \frac{1}{16}$ ...(iii)

On adding all these three equations,
$2(A + B + C)$'s 1 day's work

$$= \frac{1}{8}+\frac{1}{12}+\frac{1}{16} = \frac{6+4+3}{48} = \frac{13}{48}$$

$\Rightarrow$ $(A + B + C)$'s 1 day's work $= \frac{13}{96}$

$\therefore$ A, B and C together can complete the work in $\frac{96}{13} = 7\frac{5}{13}$ days

2. **(b)** 2 men = 1 woman

$\Rightarrow$ 1 man $= \frac{1}{2}$ woman

$\Rightarrow$ 3 men $= \frac{3}{2}$ women

Again, 2 children = 1 man $= \frac{1}{2}$ woman

$\Rightarrow$ 1 child $= \frac{1}{4}$ woman

$\Rightarrow$ 6 children $= \frac{6}{4} = \frac{3}{2}$ women

Now, three men, four women and six children

$= \frac{3}{2}+4+\frac{3}{2} = 7$ women

Hence, 7 women complete the work in 7 days.

3. **(b)** In 36 days, 12 men can do 1 complete work.

In 36 days, 12 women can do $\frac{3}{4}$th of the work

Since time and the no. of persons is the same is both cases,

$\therefore$ 1 woman's daily work

$= \frac{3}{4}$th of 1 man's daily work

8 women's daily work

$= \frac{3}{4} \times 8 = 6$ men's daily work

(10 men + 8 womens daily work)
= (10 men + 6 men) = 16 men's daily work.
12 men can do the work is 36 days
$\therefore$ 16 men can do the work in

$36 \times \frac{12}{16} = 27$ days

4. **(a)** Man : Woman
efficiency 3 : 2
one day's work of a man and a woman
$(3 + 2) = 5$ units
Total work $= 18 \times 5 = 90$ units
a woman can complete the whole work in
$\frac{90}{2} = 45$ days

5. **(a)** $10M \times 12$ days $= 10W \times 6$ days
$2M = 1W$
$\frac{M}{W} = \frac{1}{2}$
$1M$ work = 1 unit/day
$1W$ work = 2 unit/day
Total work $= 10M \times 12$ days $= 10 \times 1 \times 12 = 120$ unit
Time required $(10M + 10W)$

$$= \frac{\text{Total work}}{\text{eff.}} = \frac{120}{10\times1+10\times2} = \frac{120}{30} = 4\,\text{days}$$

6. **(b)** Let 'n' number of men are required.

$$\frac{200_{men} \times 50_{days}}{\frac{1}{4}} = \frac{(200+n)_{men} \times 100_{\ days}}{\frac{3}{4}}$$

$3 \times 100 = 200 + n$
$n = 100$

7. **(b)** If their daily wages are in ratio
$(A : B : C) = 5 : 6 : 4$.

So wages of A for 6 days $= 6 \times 5 = 30$

So wages of B for 4 days $= 4 \times 6 = 24$

So wages of C for 9 days $= 9 \times 4 = 36$

$A : B : C$ Total
$\Rightarrow$ $30 : 24 : 36$ ↓
$\Rightarrow$ $5 : 4 : 6 = 15$

Amount received by $A = \frac{5}{15} \times 1800 =$ ₹600

8. **(a)** Man Woman Boy
efficiency 4 : 2 : 1
total work = time × (Efficiency of man + woman + boy)
$\Rightarrow$ 7 days × (4 + 2 + 1) = 49 units

Boy can do this work in $= \frac{49}{1} = 49$ day

9. **(d)** According to the question

4m + 6w = 8 days or 32m + 48w = 1 day

3m + 7w = 10 days or 30 m + 70w = 1 day

$\therefore$ 32 m + 48w = 30m + 70w

$2m = 22w$

$m = 11w$

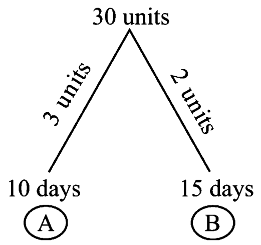
$4m = 44w$

$\therefore \quad (44w + 6w) \times 8 = 10w \times x$

$50w \times 8 = 10w \times x$

$x = 40$ days

10. (b) According to question,

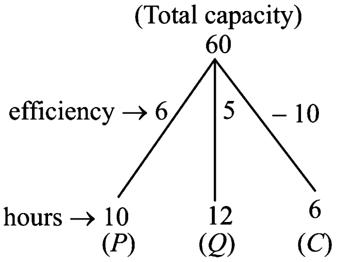


$(A + B) = 5$ days work $= 5 \times 5 = 25$ units

Remaining work $= 30 - 25 = 5$ units

A will finish the remaining work $= \frac{5}{3} = 1\frac{2}{3}$ days

11. (b)



$(P + Q)$ fills $(6 + 5) = 11$ units/hr

C empties $= 10$ units/hr

If all pipes are open

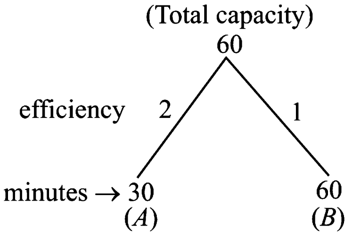
So, only $11 - 10 = 1$ unit of water can be filled in tank

$\frac{1}{4}$ of tank will be filled in

$$\frac{\text{T.C.}}{\text{Efficiency}} = \frac{\left(\frac{1}{4} \times 60\right)}{1} = \frac{15}{1} = 15\,\text{hrs}$$

$= 7$ am $+ 15$ hr $= 10$ pm

12. (d)



$(A + B)$'s filling $(2 + 1) = 3$ units/min

In 5 minutes, they will fill $3 \times 5 = 15$ units

Capacity left $= 60 - 15 = 45$ units

Second pipe (B) fills it in

$$\frac{\text{T.C}}{\text{efficiency of B}} = \frac{45}{1} = 45 \text{ minutes}$$

13. (a) In one minute $(A + B)$ can together fill $\frac{1}{36} + \frac{1}{45} = \frac{1}{20}$ part.

In 7 minutes part of tank filled $= \frac{7}{20}$

Remaining part $= 1 - \frac{7}{20} = \frac{13}{20}$

In 8th minutes, part filled by A, B and C altogether

$$= \frac{1}{36} + \frac{1}{45} - \frac{1}{30} = \frac{1}{20} - \frac{1}{30} = \frac{1}{60}$$

$\frac{13}{20}$ part of tank filled by $(A + B + C)$

$$= 60 \times \frac{13}{20} = 39 \text{ minutes}$$

14. (d)

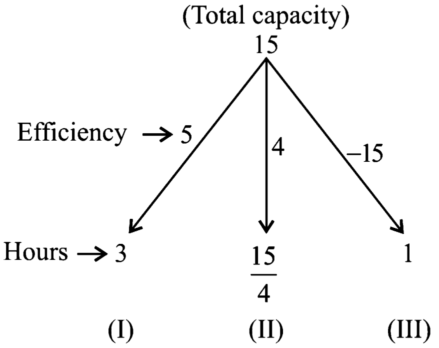
Days	No. of Labourers	Work done
12	20	5/8
4	?	$1 - \frac{5}{8} = \frac{3}{8}$

$M_1 D_1 . W_2 = M_2 D_2 W_1$

$$20 \times 12 \times \frac{3}{8} = M_2 \times 4 \times \frac{5}{8} \Rightarrow M_2 = \frac{20 \times 12 \times 3 \times 8}{4 \times 5 \times 8} = 36$$

Hence, $36 - 20 = 16$ more men needed to complete the remaining work in 4 days.

15. (c)



Ist pipe fills till 3pm $= 5 \times 2 = 10$ units

IInd pipe fills till 3pm $= 4 \times 1 = 4$ units

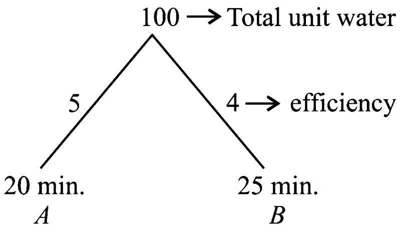
Total filled $= 10 + 4 = 14$ units

Net pipe (III) efficiency $= 15 - 9 = 6$ units/hrs

Tank will be empty in $= \frac{14}{6} = 2$ hr 20 min.

3hr + 2hr 20min = 5:20 pm

16. (a)



After '5' min the water fill by $(A + B) = 5 \times 9$

= 45 unit water

Then remaining water unit = 100 – 45 = 55

Remaining unit water fill by $A = \frac{55}{5} = 11$ minutes

17. (a) As per given information,

8 × 4 men = 12 × 4 women = 8 × 8 children

⇒ 32 men = 48 women = 64 children

⇒ 2 men = 3 women = 4 children

∴ 2 men + 8 children + 3 women

= (3 + 6 + 3) women = 12 women

12 women's 2 day's work = $\frac{1}{2}$

Remaining work = $\frac{1}{2}$

∴ Required number of women = 12

18. (a) According to the question,

1 man = 2 women

∴ 8 men + 4 women

= (16 + 4) women = 20 women

4 men + 8 women = 16 women

20 women's 2 days' work = $\frac{2}{6} = \frac{1}{3}$

Remaining work = $1 - \frac{1}{3} = \frac{2}{3}$

∵ 20 women complete 1 work in 6 days.

∴ 16 women will do $\frac{2}{3}$ work in

$= \frac{20 \times 6}{16} \times \frac{2}{3} = 5$ days

19. (c)

Workers	Working hours	Length	Width	Height	Days
24 ↑	13 ↑	224	16	52	32
36	18	432 ↓	21 ↓	64 ↓	x ↓

$$\left.\begin{array}{l} 36:24 \\ 18:13 \\ 224:432 \\ 16:21 \\ \therefore\ 52:64 \end{array}\right\} :: 32:x$$

∴ 36 × 18 × 224 × 16 × 52 × x

= 24 × 13 × 432 × 21 × 64 × 32

$\Rightarrow x = \frac{24 \times 13 \times 432 \times 21 \times 64 \times 32}{36 \times 18 \times 224 \times 16 \times 52} = 48$ days

20. (a) ∵ 28 men do 1 work in 15 days.

∴ Time taken by 30 men = $\frac{15 \times 28}{30}$ = 14 days

∵ 15 women do the work in 24 days.

∴ Time taken by 18 women = $\frac{15 \times 24}{18}$ = 20 days

∴ Required ratio

$= \frac{1}{14} : \frac{1}{20} = 20 : 14 = 10 : 7$

21. (a) According to the question,

48 children ≡ 16 women

⇒ 3 children ≡ 1 woman

∴ 28 women + 24 children

≡ (28 + 8) women ≡ 36 women

∴ $M_1D_1 = M_2D_2$

⇒ $28 \times 8 = 36 \times D_2$

⇒ $D_2 = \frac{28 \times 8}{36} = \frac{56}{9}$ days $= 6\frac{2}{9}$ days

22. (d) B is $\frac{4}{3}$ times as efficient as A

∵ A completes $\frac{5}{8}$th work in 15 days.

∴ Time taken by A in doing 1 work

$= \frac{15 \times 8}{5}$ = 24 days

∴ Time taken by B in doing whole work

$= 24 \times \frac{3}{4}$ = 18 days

∵ B's 1 day's work = $\frac{1}{18}$

∴ B's 10 days' work = $\frac{10}{18} = \frac{5}{9}$

∴ Remaining work = $1 - \frac{5}{9} = \frac{4}{9}$

23. (b) 10 × 15 men ≡ 8 × 25 women

⇒ 3 men ≡ 4 women

3 men + 10 women ≡ (10 + 4) women ≡ 14 women

8 women's 1 day's work = $\frac{1}{25}$

∴ 10 women's 1 day's work = $\frac{10}{25 \times 8} = \frac{1}{20}$ part

∴ $\frac{M_1D_1}{W_1} = \frac{M_2D_2}{W_2} \Rightarrow \frac{10 \times 20}{W_1} = \frac{14 \times 5}{W_2}$

⇒ $W_2 = \frac{14 \times 5}{10 \times 20} = \frac{7}{20}$ part

Remaining work = $1 - \frac{7}{20} = \frac{13}{20}$

∴ This part of work is done by 10 women.

∴ Required time = $\frac{13}{20} \times 20 = 13$ days.

24. (b) Work done by A and B is 20 days

$$= 20\left(\frac{1}{80}+\frac{1}{120}\right) = 20\left(\frac{3+2}{240}\right) = \frac{5}{12}$$

Work done by B in 12 days = $\frac{12}{120} = \frac{1}{10}$

Remaining work = $1-\frac{5}{12}-\frac{1}{10} = \frac{60-25-6}{60} = \frac{29}{60}$

Let C alone do the work in x days.

$$\therefore \quad \frac{28}{120}+\frac{28}{x} = \frac{29}{60}$$

$$\Rightarrow \quad \frac{28}{x} = \frac{29}{60}-\frac{28}{120} = \frac{58-28}{120} = \frac{30}{120}$$

$$\Rightarrow \quad \frac{28}{x} = \frac{1}{4} \quad \Rightarrow \quad x = 28 \times 4 = 112 \text{ days}$$

25. (b) C is twice as good as B.

∴ If time taken by B be $2x$ days,

Time taken by $C = x$ days

$$\therefore \quad \frac{1}{2x}+\frac{1}{x} = \frac{3}{40} \quad \Rightarrow \quad \frac{1+2}{2x} = \frac{3}{40}$$

$$\Rightarrow \quad \frac{3}{2x} = \frac{3}{40} \quad \Rightarrow \quad 2x = 40 \quad \Rightarrow \quad x = 20$$

∴ Time taken by B = 40 days

If A takes y days, then

$$y = \left(\frac{1}{\frac{1}{y}+\frac{1}{40}}\right) \times \frac{160}{100} \quad \Rightarrow \quad y = \left(\frac{1}{\frac{40+y}{40y}}\right) \times \frac{8}{5}$$

$$\Rightarrow \quad \frac{5}{8}y = \frac{40y}{40+y} \quad \Rightarrow \quad \frac{1}{8} = \frac{8}{40+y}$$

$$\Rightarrow \quad 40+y = 64 \quad \Rightarrow \quad y = 64-40 = 24 \text{ days.}$$

26. (d) Part of work done by 14 men in 3 days = W_2

$W_1 = 1$

$$\therefore \quad \frac{M_1D_1}{W_1} = \frac{M_2D_2}{W_2} \quad \Rightarrow \quad \frac{8\times 21}{1} = \frac{14\times 3}{W_2}$$

$$\Rightarrow \quad 8 \times 21 \times W_2 = 14 \times 3 \quad \Rightarrow \quad W_2 = \frac{14\times 3}{8\times 21} = \frac{1}{4}$$

∴ Remaining work = $1-\frac{1}{4} = \frac{3}{4}$

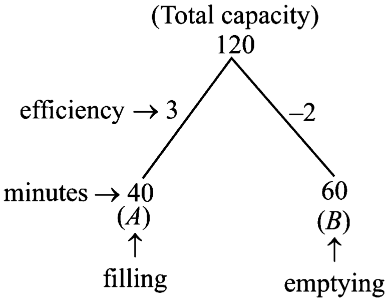
∵ Time taken by 9 women in doing $\frac{3}{4}$th work

= 24 days

∴ Time taken by them in doing whole work

$$= \frac{24\times 4}{3} = 32 \text{ days}$$

27. (a)



A's one day work = 4 – 2 = 2 units

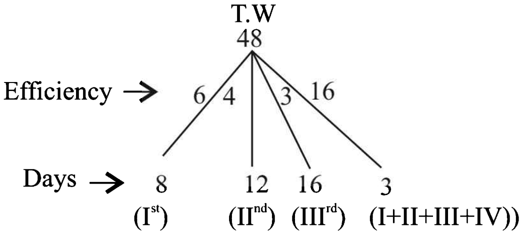
B's one day work = 3 – 2 = 1 unit

C's one day work = 2 – 1 = 1 unit

A and C complete the whole work in

$$\frac{\text{T.W.}}{\text{eff. of } A+C} = \frac{24}{2+1} = 8 \text{ days}$$

28. (c)



⇒ IVth person efficiency = 16 – 6 – 4 – 3 = 3 units

16 units → 1200

1 unit → 75

3 units → 225

29. (d) According to question,

efficiency of a man, a woman and a child are 5 : 4 : 2. units/days.

one day work of 2 men = 2 × 5 = 10 units

one day work of 3 women = 3 × 4 = 12 units

one day work of 4 children = 4 × 2 = 8 units.

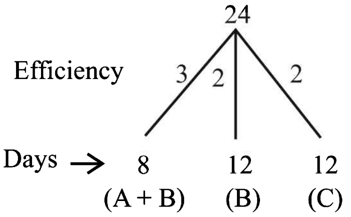
Applying formula, let time taken is 'D'days.

$$\frac{(10+12+8)\times 10_{\text{days}}}{10_{\text{hectare}}}$$

$$= \left[\frac{(6_{men}\times 5)+(4_{women}\times 4)+(7_{children}\times 2)\times D}{16_{hectare}}\right]$$

$$\frac{(30)\times 10}{10} = \frac{[60]\times D}{16} \Rightarrow \quad D = 8 \text{ days}$$

30. (d)



A and B work for 4 days

they completed

3 × 4 = 12 units

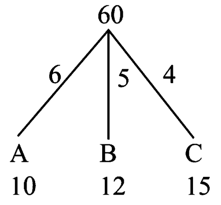
work left = 24 – 12 = 12 units

B's 2 days work = 2 × 2 = 4 units

work left = 12 – 4 = 8 units

Now C's complete the work in $\frac{8}{2} = 4$ days

31. (d) According to question,



A leave the work 5 days before completion and B after 2 days when A leave. So C work alone for the last three days.

$C = 4 \times 3 = 12$ unit

Before it $(B + C)$ work for 2 days = $9 \times 2 = 18$ unit

Remaining = $(60 – 30) = 30$ unit done by $(A + B + C)$

No. of days taken by them $(A + B + C)$

$\frac{30}{15} = 2$ days {$\because$ (6 + 5 + 4 = 15)}

Total days = 3 + 2 + 2 = 7 days.

32. (d)

	Amit	Bhawana	Chandan
Efficiency →	$5x$	x	$2x$

Let total work = 1

Efficiency of $(A + B + C) = 1$

Then $5x + x + 2x = 1$

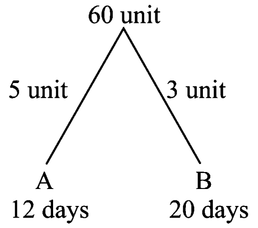
$$x = \frac{1}{8}$$

Days taken by Amit $= \frac{1}{5/8} = \frac{8}{5}$

Days taken by Chandan $= \frac{1}{2/8} = 4$

Difference of days $= 4 - \frac{8}{5} = \frac{20-8}{5} = 2\frac{2}{5}$ days.

33. (b)



$5(A + B) + 3C = 60$ units

$5 \times 8 + 3C = 60$

$3C = 20$

$C = \frac{20}{3}$ unit

Time taken by $C = \frac{60}{\frac{20}{3}} = \frac{60 \times 3}{20} = 9$ days

34. (a) Total work = 100

Remaining work = 100 – 37 = 63

$5A = 4B$

$\frac{A}{B} = \frac{4}{5}$ ← efficiency

Total efficiency of $(A + B) = 9$

Work done by them in 7 days = $9 \times 7 = 63$

Time taken by B to complete entire work

$= \frac{100}{5} = 20$ days

35. (c) Let a man complete '1' piece of work in a day.

Then total work = 50 units

Then by statement 1st day

= one man × 1 work/per day = 1

2nd day = two man × 1 work/per day = 2

3rd day = 3 man × 1 work/per day = 3

Let the whole work will be completed in N day.

then total work = $1 + 2 + 3 \ldots\ldots + N = 50$

$\frac{N(N+1)}{2} = 50$

$N(N + 1) = 100$

Then $N = 10$ days (approx)

36. (c)

Quantity	Time (in minutes)
Boy → 4 litres	3
Girl → 3 litres	4

Boy → (4 3) × 4 = 16 litres in 12 minutes

Girl → (3 4) × 3 = 9 litres in 12 minutes

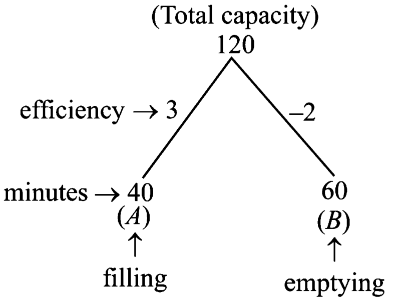
(Boy + Girl) pour

25 litres 12 minutes

×4↓ ×4↓

100 litres **48 minutes**

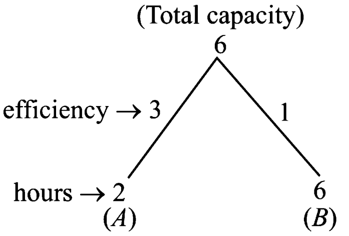
37. (d)



Total unit of water filled is = 3 – 2 = 1 unit/min.

Tank will be filled in $= \frac{120}{1} =$ **120 minutes**

38. (c)



Pipe A will fill 3 units till 11 A.M.

Capacity left = 6 – 3 = 3 units

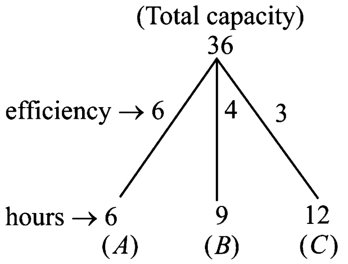
Now both pipes will fill and they will take

$\frac{\text{T.C.}}{\text{Efficiency}} = \frac{3}{(3+1)} = \frac{3}{4}$ hours

So, $\left(11+\frac{3}{4}\right)$A.M., tank will be filled

= 11 : 45 A.M.

39. (c)



In half an hour $(B + C)$ must have filled

$=\frac{4}{2}+\frac{3}{2}=\frac{7}{2}$units

Capacity left $=36-\frac{7}{2}=\frac{65}{2}$units

Now, all pipes will fill the remaining tank

$=\frac{65}{2\times(6+4+3)}=\frac{65}{2\times13}=\frac{5}{2}=2\frac{1}{2}$hrs

40. (b) According to question,

A .... (+) 30 minutes
B .... (+) 45 minutes
C .... (–) 36 minutes

Filled water by $(A + B)$ in 12 min.

= 12 × (6 + 4) = 12 × 10 = 120 litre

⇒ Remaining capacity = 180 – 120 = 60 litre

⇒ After 12 min. emptied pipe C is also opened

⇒ Total capacity $(A + B - C) = (6 + 4 - 5) = 5$ *l.*/m.

⇒ Time taken by $(A + B - C)$ with capacity 5 *l.*/m. to fill the remaining part

$=\frac{60l.}{5l./m.}=12\text{min}$

⇒ Therefore, total time in which the tank will be filled up is = 12 + 12 = 24 minutes

Chapter 11 Mensuration

MENSURATION

Mensuration is the science of measurement of the lengths of lines, areas of surfaces and volumes of solids.

Perimeter

Perimeter of a polygon is the sum of its all the sides. It is measured in cm, m, etc.

Area

The area of any figure is the amount of surface enclosed within its boundary lines. This is measured in square unit like cm^2, m^2, etc.

Volume

If an object is solid, then the space occupied by such an object is called its volume. This is measured in cubic unit like cm^3, m^3, etc.

PART I: PLANE FIGURES

TRIANGLE

Perimeter $(P) = a + b + c$

Area $(A) = \sqrt{s(s-a)(s-b)(s-c)}$,

where $s = \dfrac{a+b+c}{2}$ and a, b and c are three sides of the triangle.

Also, $A = \dfrac{1}{2} \times bh$; where b = base, h = altitude

Equilateral Triangle

Perimeter = $3a$

Area $= \dfrac{\sqrt{3}}{4}a^2$; where a = side

Right Triangle

Area $= \dfrac{1}{2}pb$ and $h^2 = p^2 + b^2$ (Pythagoras theorem)

where p = perpendicular

b = base

h = hypotenuse

Shapes	**Area (a)**	**Perimeter (P)**	**Diagonal (d)**	**Nomenclature**
Square	a^2	$4a$	√2a	Side = a
Rectangle	$1 \times b$	$2\ (l + b)$	$\sqrt{2}\ (l^2 + b^2)$	Length = l, Breadth = b
Rhombus	$1/2 \times d_1 \times d_2$	$4a$	$2A/d_2$	Diagonals = d_1 and d_2

Parallelogram	$p \times h$	$2\ (p + q)$	$\sqrt{p^2 + q^2 - 2pqcos\beta}$	Base = P
				Side = q
				Angle = β

Circle	πr^2	$2\pi r$	–	Radius = r
Semi-Circle	$(\pi r^2)/2$	R (π+ 2)	–	

Shape	**Volume**	**Surface Area**
Cude	x^2	$6x^2$
Cuboid	$l \times b \times h$ l : length b: breadth h: height	$2lb + 2bh + 2lh$
Prism	Cross – section × Height	Add up areas of each sides
Cylinder	$\pi r^2 h$	$2\ \pi r^2 + 2\pi rh$
Pyramid	$\dfrac{1}{3}$ × base area × height	Add up areas of each sides
*Cone	$\dfrac{1}{3}\pi r^2 h$	$\pi r^2 + 2\pi rl$ l : slant height
*Sphere	$\dfrac{4}{3}\pi r^2$	$4\ \pi r^2$

EXERCISE

1. The length of a rectangular plot is thrice its breadth. If the area of the rectangular plot is 7803 sq. mts., what is the breadth of the rectangular plot?
(a) 51 metre (b) 153 metre
(c) 104 metre (d) 88 metre
(e) None of these
2. Area of a rectangle is equal to the area of the circle whose radius is 21 cm. If the length and the breadth of the rectangle are in the ratio of 14 : 11 respectively, what is its perimeter?
(a) 142 cm. (b) 140 cm.
(c) 132 cm. (d) 150 cm.
(e) None of these
3. The total area of a circle and a square together are equal to 2611 sq. cm. The diameter of the circle is 42 cms. What is the sum of the circumference of the circle and the perimeter of the square ?
(a) 272 cms. (b) 380 cms.
(c) 280 cms. (d) Cannot be determined
(e) None of these
4 The area of a rectangle is 4 times the area of a square. The length of the rectangle is 90 cm and the breadth of the rectangle is $\frac{2}{3}$ of the side of the square. What is the side of the square ?
(a) 10 cm (b) 20 cm
(c) 9 cm (d) Cannot be determined
(e) None of these
5. An equilateral triangle of side 6 cm has its corners cut off to form a regular hexagon. Area (in cm^2) of this regular hexagon will be
(a) $3\sqrt{3}$ (b) $3\sqrt{6}$ (c) $6\sqrt{3}$ (d) $\frac{5\sqrt{3}}{2}$
6. If the circumference of a circle is decreased by 50% then the percentage of decrease in its area is
(a) 25 (b) 50 (c) 60 (d) 75
7. A copper wire of length 36 m and diameter 2 mm is melted to form a sphere. The radius of the sphere (in cm) is
(a) 2.5 (b) 3 (c) 3.5 (d) 4
8. A copper wire is bent in the shape of a square of area 81 cm^2. If the same wire is bent form of a semicircle, the radius (in cm) of the semicircle is
(Take $\pi = \frac{22}{7}$)
(a) 16 (b) 14 (c) 10 (d) 7
9. The volume (in m^3) of rain water that can be collected from 1.5 hectares of ground in a rainfall of 5 cm is
(a) 75 (b) 750 (c) 7500 (d) 75000
10. A river 3 m deep and 40 m wide is flowing at the rate of 2 km per hour. How much water (in litres) will fall into the sea in a minute?
(a) 4,00,000 (b) 40,00,000
(c) 40,000 (d) 4,000
11. The perimeter of a triangle is 40cm and its area is 60 cm^2. If the largest side measures 17cm, then the length (in cm) of the smallest side of the triangle is
(a) 4 (b) 6 (c) 8 (d) 15
12. A copper wire is bent in the form of square with an area of 121 cm^2. It the same wire is bent in the form of a circle, the radius (in cum) of the circle is (Take $\pi = \frac{22}{7}$)
(a) 7 (b) 10 (c) 11 (d) 14
13. Water is flowing at the rate of 5 km/h through a pipe of diameter 14cm into a rectangular tank which is 50 m long, 44m wide. The time taken, in hours, for the rise in the level of water in the tank to be 7 cm is
(a) 2 (b) $1\frac{1}{2}$ (c) 3 (d) $2\frac{1}{2}$
14. The wheel of a motor car makes 1000 revolutions in moving 440 m. The diameter (in metre) of the wheel is
(a) 0.44 (b) 0.14 (c) 0.24 (d) 0.34
15. The sides of a triangles are in the ratio 2:3:4. the perimeter of the triangle is 18cm. The area (in cm^2) of the triangle is
(a) 9 (b) 36 (c) $\sqrt{42}$ (d) $3\sqrt{15}$
16. Diagonal of a cube is $6\sqrt{3}$ cm. Ratio of its total surface area and volume (numerically) is:
(a) 2 : 1 (b) 1 : 6 (c) 1 : 1 (d) 1 : 2
17. The ratio of in radius and circumradius of a square is :
(a) 1 : 2 (b) 1 : $\sqrt{2}$
(c) $\sqrt{2}$: $\sqrt{3}$ (d) 1 : 3
18. If area of an equilateral triangle is a and height b, then value of $\frac{b^2}{a}$ is:
(a) 3 (b) $\frac{1}{3}$ (c) $\sqrt{3}$ (d) $\frac{1}{\sqrt{3}}$
19. A godown is 15 m long and 12 m broad. The sum of the areas of the floor and the ceiling is equal to the sum of areas of the four walls. The volume (in m^3) of the godown is:
(a) 900 (b) 1200
(c) 1800 (d) 720
20. If the volumes of two right circular cones are in the ratio 4 : 1 and their diameters are in the ratio 5 : 4 then the ratio of their heights is :
(a) 25: 16 (b) 25: 64
(c) 64 : 25 (d) 16: 25
21. The four equal circles of radius 4 cm. drawn on the four corners of a square touch each other externally. Then the area of the portion between the square and the four sectors is
(a) $9(\pi - 4)$ sq. cm (b) $16(4 - \pi)$ sq. cm
(c) $99(\pi - 4)$ sq. cm (d) $169(\pi - 4)$ sq. cm

22. *ABCD* is a parallelogram in which diagonals *AC* and *BD* intersect at *O*. If *E*, *F*, *G* and *H* are the mid-points of *AO*, *DO*, *CO* and *BO* respectively, then the ratio of the perimeter of the quadrilateral *EFGH* to the perimeter of parallelogram ABCD is
(a) 1 : 4 (b) 2 : 3 (c) 1 : 2 (d) 1 : 3

23. The length of a room floor exceeds its breadth by 20m. The area of the floor remains unaltered when the length is decreased by 10 m but the breadth is increased by 5 m. The area of the floor (in square meters) is:
(a) 280 (b) 325 (c) 300 (d) 420

24. Three solid iron cubes of edges 4 cm, 5 cm and 6 cm are melted together to make a new cube. 62 cm^3 of the melted material is lost due to improper handing. The area (in cm^2) of the whole surface of the newly formed cube is
(a) 294 (b) 343 (c) 125 (d) 216

25. A cylindrical can whose base is horizontal and is of internal radius 3.5 cm contains sufficient water so that when a solid sphere is placed inside, water just covers the sphere. The sphere fits in the can exactly. The depth of water in the can before the sphere was put, is
(a) $\frac{35}{3}$ cm (b) $\frac{17}{3}$ cm (c) $\frac{7}{3}$ cm (d) $\frac{14}{3}$ cm

26. A conical cup is filled with ice-cream. The ice-cream forms a hemispherical shape on its open top. The height of the hemispherical part is 7 cm. The radius of the hemispherical part equals the height of the cone. Then the volume of the ice-cream is $\left[\pi = \frac{22}{7}\right]$
(a) 1078 cubic cm (b) 1708 cubic cm
(c) 7108 cubic cm (d) 7180 cubic cm

27. The portion of a ditch 48 m long. 16.5 m wide and 4 m deep that can be filled with stones and earth available during excavation of a tunnel, cylindrical in shape, of diameter 4 m and length 56 m is $\left[\text{Take } \pi = \frac{22}{7}\right]$
(a) $\frac{1}{9}$ Part (b) $\frac{1}{2}$ Part
(c) $\frac{1}{4}$ Part (d) $\frac{2}{9}$ Part

28. Assume that a drop of water is spherical and its diameter is one tenth of a cm. A conical glass has a height equal to the diameter of its rim. If 32000 drops of water fill the glass completely, then the height of the glass (in cm.) is
(a) 3 (b) 4 (c) 1 (d) 2

29. Water flows at the rate of 10 metres per minute from cylindrical pipe 5 mm in diameter. How long it will take to fill up a conical vessel whose diameter at the base is 30 cm and depth is 24 cm?
(a) 28 minutes 48 seconds
(b) 51 minutes 12 seconds
(c) 51 minutes 24 seconds
(d) 28 minutes 36 seconds

30. The length, breadth and height of a cuboid are in the ratio 1 : 2 : 3. If they are increased by 100%, 200% and 200% respectively. then compared to the original volume the increase in the volume of the cuboid will be
(a) 5 times (b) 18 times
(c) 12 times (d) 17 times

31. A hemispherical cup of radius 4 cm is filled to the brim with coffee. The coffee is then poured into a vertical cone of radius 8 cm and height 16 cm. The percentage of the volume of the cone that remains empty is:
(a) 87.5% (b) 80.5% (c) 81.6% (d) 88.2%

32. The shape of an object is a right circular cylinder with a hemisphere on bottom and a right circular cone on the top. The radius of the cylinderical part is 5 cm and the height of cylinder part is 2.6 times the radius. What is the total height of the object, if the surface area of the object is770 cm^2?
(a) 18 cm (b) 35 cm (c) 12 cm (d) 30 cm

33. Two concentric circles are drawn with radii 12 cm and 13 cm. What will be the length of any chord of the larger circle that is tangent to the smaller circle?
(a) 5 cm (b) 8 cm (c) 10 cm (d) 25 cm

34. A cylindrical tank of radius 5.6 m and depth of 'h' m is built by digging out earth. The sand taken out is spread all around the tank to form a circular embankment to a width of 7 m. What is the depth of the tank. If the height of the embankment is 1.97 m?
(a) 4.2 m (b) 7 m (c) 8 m (d) 6.7 m

Hints & Solutions

1. **(a)** Let the breadth be x metres.
Then, length = $3x$ metres
$\therefore$ Area $\Rightarrow 3x \times x = 7803$
$\Rightarrow x^2 = \frac{7803}{3} = 2601$
$\Rightarrow x = \sqrt{2601} = 51$ metres

2. **(d)** Area of rectangle = Area of circle
$= \frac{22}{7} \times 21 \times 21 = 1386$ cm^2
Let the length and breadth of rectangle be $14x$ and $11x$ respectively.
Then $14x \times 11x = 1386$
$\Rightarrow x^2 = \frac{1386}{14 \times 11} = 9 \Rightarrow x = \sqrt{9} = 3$

Perimeter of rectangle = 2 (14x + 11x)

$\Rightarrow$ 2 × 25 × 3 = 150 cm.

3. **(a)** Area of circle $= \frac{22}{7}\times\left(\frac{42}{2}\right)^2 = 1386\ \text{cm}^2$

Area of square = 2611 – 1386 = 1225 cm^2

Side of square = $\sqrt{1225}$ = 35 cm.

$\therefore$ Required sum $= 2\times\frac{22}{7}\times 21+4\times 35$

$= 132 + 140 = 272$ cm.

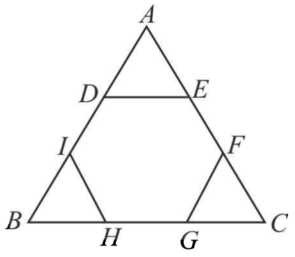
4. **(e)** Let the side of the square be x cm.

Area of square = x^2

Area of rectangle $= 90\times\frac{2}{3}x$

$90\times\frac{2}{3}x = 4x^2 \Rightarrow x = 15$ cm

5. **(c)**



Side of the regular hexagon $=\frac{1}{3}\times 6 = 2$ cm

$\therefore$ Area of the hexagon $=\frac{3\sqrt{3}}{2}a^2$

$=\frac{3\sqrt{3}}{2}\times 2\times 2 = 6\sqrt{3}$ sq. cm.

6. **(d)** Circumference = 2πr (one variable)

$\therefore$ The decrease in area $=-50-50+\frac{50\times 50}{100}=-75\%$

7. **(b)** Volume of the wire = $\pi r^2 h$

$\therefore$ $\pi\times 0.1\times 0.1\times 3600\ \text{cm}^3 \Rightarrow 36\pi\ \text{cm}^3$

Volume cylinder = vol. sphere

Volume of the sphere $=\frac{4}{3}\pi R^3 = 36\pi$

$\Rightarrow R^3 = \frac{36\times 3}{4} = 27 \quad\therefore\quad R = \sqrt[3]{27} = 3$ cm

8. **(d)** Side of a square = $\sqrt{81}$ = 9 cm

$\therefore$ Length of the wire = 4 × 9 = 36 cm.

$\therefore$ Perimeter of semi-circle = (π + 2)r

where r = radius

$\Rightarrow \left(\frac{22}{7}+2\right)r = 36 \Rightarrow \frac{36}{7}r = 36$

$\Rightarrow r = \frac{36\times 7}{36} = 7$ cm.

9. **(b)** 1 hectare = 10000 sq. metre

$\therefore$ Area of the ground = 15000 sq. metre

$\therefore$ Required volume $= 15000\times\frac{5}{100} = 750\ \text{m}^3$

10. **(b)** Volume of water flowed in an hour

$= 2000\times 40\times 3\ \text{m}^3 = 240000\ \text{m}^3$

$\therefore$ Volume of water flowed in 1 minute.

$=\frac{240000}{60} = 4000\ \text{m}^3 = 4000000$ litre

11. **(c)** Smallest side of the triangle = x cm (let)

$\therefore$ Second side of triangle = 40 – 17 – x = 23 – x

Semi-perimeter, $= s = \frac{40}{2} = 20$

$\therefore$ $\sqrt{s(s-a)(s-b)(s-c)} = 60$

$\Rightarrow \sqrt{20(20-17)(20-x)(20-23+x)} = 60$

$\Rightarrow (20-x)(x-3) = 60$

$\Rightarrow x^2 - 23x + 120 = 0$

$\Rightarrow (x-8)(x-15) = 0$

$\Rightarrow x = 8$ or 15

12. **(a)** Side of square = $\sqrt{121}$ = 11 cm

$\therefore$ Length of wire = 4 × 11 = 44 cm

$\therefore$ $2\pi r = 44$

$\Rightarrow 2\times\frac{22}{7}\times r = 44 \Rightarrow r = \frac{44\times 7}{2\times 22} = 7$ cm

13. **(a)** Water flowed by the pipe in 1 hr. = $\pi r^2 h$

$=\frac{22}{7}\times\frac{7\times 7}{100\times 100}\times 5000\ \text{metre}^3 = 77\ \text{m}^3$

Volume of expected water in the tank

$=\frac{50\times 44\times 7}{100} = 154\ \text{m}^3$

$\therefore$ Required time $=\frac{154}{77} = 2$ hr.

14. **(b)** Distance covered by wheel in one revolution = Circumference of wheel

$\therefore$ $\pi\times\text{diameter} = \frac{440}{1000}$

$\Rightarrow \frac{22}{7}\times\text{diameter} = \frac{440}{1000}$

$\Rightarrow \text{Diameter} = \frac{440}{1000}\times\frac{7}{22} = 0.14$ cm

15. **(d)** Ratio = 2 : 3 : 4 = 4 : 6 : 8 Perimeter = 18 cm

$\therefore$ Semi-perimeter(s) $=\frac{4+6+8}{2} = 9$

$\therefore$ Area of triangle $=\sqrt{s(s-a)(s-b)(s-c)}$

$=\sqrt{9(9-4)(9-6)(9-8)}$

$=\sqrt{9\times 5\times 3\times 1} = 3\sqrt{15}$ sq. cm.

16. **(c)** Diagonal of a cube = $6\sqrt{3}$

$\sqrt{3}\times\text{side} = 6\sqrt{3}$

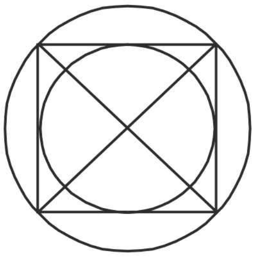
$\therefore$ Side of a cube = 6

Surface area of cube = 6 × (side)^2 = 6 × 6^2

Volume of cube = (side)^3 = $(6)^3$

Required ratio = $\dfrac{6\times 6^2}{6^3}=\dfrac{1}{1}$ or 1 : 1

17. (b)



$$\text{Radius of circum-circle}=\frac{\text{Diagonal}}{2}=\frac{\sqrt{2}\times\text{Side}}{2}=\frac{\text{Side}}{\sqrt{2}}$$

Radius of in-circle = $\dfrac{\text{Side}}{2}$

$\therefore$ Ratio = $\dfrac{\text{Side}}{2}:\dfrac{\text{Side}}{\sqrt{2}}=1:\sqrt{2}$

18. (c) Let side of triangle = x

$$\therefore \quad \frac{\sqrt{3}}{4}x^2=a \qquad \text{...(i)}$$

and $\dfrac{\sqrt{3}}{2}x=b$

$$x=\frac{2b}{\sqrt{3}} \qquad \text{...(ii)}$$

Putting x in equation (i)

$$\frac{\sqrt{3}}{4}\left(\frac{2b}{\sqrt{3}}\right)^2=a$$

$$\frac{b^2}{a}=\sqrt{3}$$

19. (b) If the height of the godown be h meter, then

2(15 × 12) = 2 × h(15 + 12)

$\Rightarrow$ $27h = 15 \times 12$

$\Rightarrow$ $h=\dfrac{15\times 12}{27}=\dfrac{20}{3}$ meter

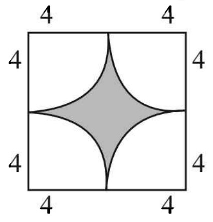
$\therefore$ Volume of the godown

$=\dfrac{15\times 12\times 20}{3}$ = 1200 cu. meter

20. (c) $\dfrac{V_1}{V_2}=\dfrac{r_1^2h_1}{r_2^2h_2}$

$\Rightarrow$ $\dfrac{4}{1}=\dfrac{25}{16}\times\dfrac{h_1}{h_2}$ $\Rightarrow$ $\dfrac{h_1}{h_2}=\dfrac{16\times 4}{25}=\dfrac{64}{25}$

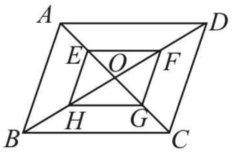
21. (b)



Area of shaded portion = 8 × 8 – p × 4^2

= 64 – 16π = 16(4 – π)cm^2

22. (c) In Δ OBC,



H and G are the midpoints of OB and OC

$\therefore$ $HG=\dfrac{1}{2}BC$

Similarly, $FG=\dfrac{1}{2}CD$ and $EF=\dfrac{1}{2}AD$,

$HE=\dfrac{1}{2}AB$

On adding,

$$HE+HG+FG+EF=\frac{1}{2}(AB+BC+CD+AD)$$

perimeter of $EFGH$ $=\dfrac{1}{2}\times$ perimeter of $ABCD$

$$\frac{\text{Perimeter of } EFGH}{\text{Perimeter of } ABCD}=\frac{1}{2}$$

23. (c) Let the breadth = x cm

$\Rightarrow$ length = $(x + 20)$ cm

According to the question,

$5(x + 20) = (x + 10)(x + 5)$

$\Rightarrow$ $x^2 + 20x = x^2 + 15x + 50$

$\Rightarrow$ $5x = 50$ $\Rightarrow$ $x = 10$

$\Rightarrow$ Area = 10(10 + 20) = 300 m^2

24. (a) Volume of all three cube = $4^3 + 5^3 + 6^3$

= 64 + 125 + 216 cm^3 = 405 cm^3

Now, 62 cm^3 is lost

$\therefore$ Volume of new cube = 405 – 62 = 343

(side of new cube)^3 = 343

side of new cube = $\sqrt[3]{343}$ = 7

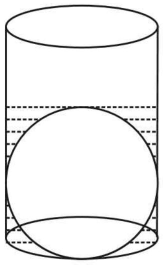
Total surface area of new cube

= 6 (side)^2 = 6 × $(7)^2$ = 6 × 49 = 294 cm^2

25. (c) Height of water after ball is immersed

= 3.5 × 2 = 7 cm

$\Rightarrow$ Volume of water



$$=\pi r^2h-\frac{4}{3}\pi r^3$$

$$=\pi r^2\left(h-\frac{4}{3}r\right)$$

$$=\frac{22}{7}\times 3.5\times 3.5\left(7-\frac{4}{3}\times 3.5\right)$$

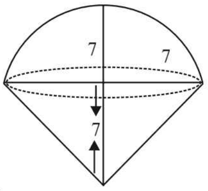
$$=11\times 3.5\left(\frac{7}{3}\right)=\frac{269.5}{3}\text{ cm}^3$$

Volume of water before ball was immersed

$$=\pi(3.5)^2\times h=\frac{269.5}{3}$$

$$=h=\frac{269.5\times 7}{3\times 3.5\times 3.5\times 22}=\frac{7}{3}\text{ cm}$$

26. (a)



In the question,
Radius of hemisphere = Radius of cone
= height of cone = 7 cm
∴ Height of hemisphere
= radius of hemisphere
Volume of ice-cream
= Volume of hemisphere part
+ Volume of conical part

$$=\frac{2}{3}\times\frac{22}{7}\times(7)^3+\frac{1}{3}\times\frac{22}{7}\times7^3$$

$$=\frac{22}{7}\times7^3=22\times7^2=1078\text{ cm}^3$$

27. (d) Let part filled be 'x'
ATQ,

$$x\times(48\text{m}\times16.5\text{m}\times4\text{m})=\pi(2)^2\times56$$

$$x=\frac{22\times4\times56}{7\times48\times16.5\times4}$$

$$x=\frac{2}{9}$$

28. (b) According to the question,

Radius of the drop of water $=\frac{1}{20}$ cm

∴ Volume of drop of water $=\frac{4}{3}\times\frac{1}{20\times20\times20}\times\pi$

Volume of 32000 drops $=\frac{4}{3}\times\frac{\pi}{8000}\times32000=\frac{16}{3}\pi$

∴ Volume of 32000 drops of water
= Volume of cone

$$\Rightarrow\ \frac{16\pi}{3}=\frac{1}{3}\times\pi r^2\times h$$

and from question $2r = h$

$$\therefore\ r=\frac{h}{2}$$

$$\frac{16\pi}{3}=\frac{1}{3}\pi\times\frac{h^2}{4}\times h$$

$16\times4=h^3 \Rightarrow h=4$ cm

29. (a) Diameter = 5 mm = 0.5 cm
Radius = 0.25 cm
Volume of water flowing from the pipe in 1 minute
$=\pi\times0.25\times0.25\times1000\text{ cm}^3$

Volume of conical vessel $=\frac{1}{3}\pi\times15\times15\times24\text{ cm}^3$

$$\therefore\ \text{Time}=\frac{\frac{1}{3}\times\pi\times15\times15\times24}{\pi\times0.25\times0.25\times1000}=28\frac{4}{5}\text{ minutes}$$

= 28 minutes 48 second

30. (d)

Length	1	→	2
Breadth	2	→	6
Height	3	→	9
Volume	6	→	108

⇒ New volume = 18 times the original volume
⇒ Increase in volume = 18 – 1 = 17 times

31. (a) Volume of coffee $=\frac{2}{3}\pi r^3=\frac{2}{3}\times\pi\times(4)^3$

$$=\frac{128}{3}\pi\text{ cm}^3$$

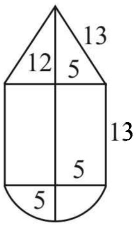
Volume of cone $=\frac{1}{3}\pi r^2\times h$

$$=\frac{1}{3}\pi(8)^2\times16=\frac{1024}{3}\pi$$

∴ Required percentage

$$=\frac{\left(\frac{1024}{3}-\frac{128}{3}\right)\pi}{\frac{1024}{3}\pi}\times100=87.5\%$$

32. (d) $\pi rl+2\pi rh+2\pi r^2=770$



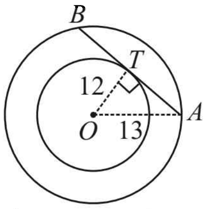
$\pi r(l+2h+2r)=770$

$\frac{22}{7}\times5(l+13\times2+10)=770$

$l+26+10=49 \Rightarrow l=13$

Height of cone = 12 (pythagours)
Total height = 12 + 5 + 13 = 30 cm.

33. (c)



Line *BTA* is the tangent of small circle
OT will make ⊥ on line *AB*
Then in right angle Δ *OTA*

$$(\text{AT})=\sqrt{(13)^2-(12)^2}=\sqrt{25}$$

$AT=5 \Rightarrow AB=10$ cm

34. (c) Volume of soil $=\pi r^2h=\pi\times5.6\times5.6\times h$
Area of Platform $=\pi R^2-\pi r^2=\pi(R^2-r^2)$
Height of Platform = 1.97 m
$R=12.6\ m \Rightarrow r=5.6$
Now, $\pi(R^2-r^2)\times\text{height}=\pi\times5.6\times5.6\times h$
$\Rightarrow\ \pi(R-r)(R+r)\times1.97=\pi\times5.6\times5.6\times h$
$\Rightarrow\ 7\times(18.2)\times1.97=5.6\times5.6\times h$
$\Rightarrow\ 250.98=31.36\times h$

$$\therefore\ h=\frac{250.98}{31.36}=8.0031\text{ m. or }8\text{ m. (Approx)}$$

Chapter 12

Algebraic Expression, Polynomial & Rational Expression

CONSTANT

A symbol having a fixed numerical value is called a **constant**.

For example : $5, -2, 3.14, \frac{7}{9}, \sqrt{3}, 0, \pi$ or $\frac{22}{7}$ etc. are constant.

VARIABLES

A symbol which may be assigned different numerical values is known as a **variable**.

For example : In the formula of circumference of a circle, $C = 2\pi r$, 2 and π are constants and C and r are variables. Here, C is the circumference and r is the radius of the circle.

ALGEBRAIC EXPRESSIONS

A combination of variables and constants connected by some or all of the mathematical operations +, –, × and ÷ is known as an **algebraic expression**.

For example : $2x + 7, x^2 - 3x, 2y^3 - 7xy + 5$ etc.

Algebraic Expression	Term	Coefficient
$4x + 3y$	$4x$	4
	$3y$	3
$3xy^2 - 4x$	$3xy^2$	3
	$-4x$	-4
$3p^2q + 7pq - 8pq^2$	$3p^2q$	3
	$7pq$	7
	$-8pq^2$	-8

POLYNOMIALS

A polynomial is an algebraic expression in which no variable is in denominator and the variables involved have only non-negative integral powers.

For example : $2x^2 + 3x + 4, \frac{2}{5}y^2 + 6, \sqrt{3}x^2 + y^2$ are polynomials.

Example **1. Find the sum of $5x^3 - 2x^2 + x + 7$, $4x^2 - 3x + 2$ and $x^4 + 3x^2 - x - 3$.**

Sol. Required sum $= (5x^3 - 2x^2 + x + 7) + (4x^2 - 3x + 2) + (x^4 + 3x^2 - x - 3)$.

$= x^4 + 5x^3 + (-2x^2 + 4x^2 + 3x^2) + (x - 3x - x) + (7 + 2 - 3)$

$= x^4 + 5x^3 + (-2 + 4 + 3)x^2 + (1 - 3 - 1)x + 6$

$= x^4 + 5x^3 + 5x^2 + (-3x) + 6 = x^4 + 5x^3 + 5x^2 - 3x + 6$

Multiplication of Polynomials

In the multiplication of algebraic expressions, we are using the following rules :

(i) The product of two factors with like signs is positive and the product of two factors with unlike signs is negative

i.e. (+) × (+) = + ; (+) × (–) = –

(–) × (+) = – ; (–) × (–) = +

(ii) If a is any variable and m, n are positive integers, then $a^m \times a^n = a^{(m+n)}$

For example : $x^3 \times x^6 = x^{3+6} = x^9$

(iii) Distributive law of multiplication

i.e. $a(b + c) = ab + ac$

$(a + b)(c + d + e) = ac + ad + ae + bc + bd + be$

Example **2. Multiply :**

(i) $5x^2, 17x^8$ **(ii)** $-3y^3, y^2$

(iii) $2p, p^2q^3$ **(iv)** $3x^4, -3x, 2xy^3$

Sol. (i) $5x^2 \times 17x^8 = (5 \times 17) \times (x^2 \times x^8) = 85 \times x^{2+8} = 85x^{10}$

(ii) $-3y^3 \times y^2 = -3 \times y^{3+2} = -3y^5$

(iii) $2p \times p^2q^3 = 2 \times (p \times p^2q^3) = 2 \times (p^{1+2}q^3) = 2p^3q^3$

(iv) $3x^4 \times (-3x) \times 2xy^3 = \{3 \times (-3) \times 2\} \times (x^4 \times x \times xy^3)$

$= -18 \times (x^{4+1+1}y^3) = -18x^6y^3$

REMAINDER THEOREM

Let $f(x)$ be a polynomial of degree greater than or equal to 1. Then if $f(x)$ is divided by $(x - a)$, where a be any real number, then the remainder is $f(a)$.

Note that in $f(a)$, a is the value of x when $x - a = 0$.

Example **3. Find the remainder when**

(i) $x^3 + 2x^2 - 5x + 3$ **is divided by** $(x - 2)$

(ii) $-x^4 - x^2 + 1$ **is divided by** $(x + 1)$

(iii) $2x^3 - x^2 + 5x$ **is divided by** $(2x - 1)$

Sol. (i) Let $p(x) = x^3 + 2x^2 - 5x + 3$

Put $x - 2 = 0 \Rightarrow x = 2$

Remainder $= p(2) = 2^3 + 2 \times 2^2 - 5 \times 2 + 3$

$= 8 + 8 - 10 + 3 = 9.$

(ii) Let $p(x) = -x^4 - x^2 + 1$

Put $x + 1 = 0 \Rightarrow x = -1$

Hence remainder $= p(-1) = -(-1)^4 - (-1)^2 + 1 = -1$

(iii) Let $p(x) = 2x^3 - x^2 + 5x$

Put $2x - 1 = 0$, then $x = \frac{1}{2}$

So, remainder $= p\left(\frac{1}{2}\right) = 2\left(\frac{1}{2}\right)^3 - \left(\frac{1}{2}\right)^2 + 5\left(\frac{1}{2}\right)$

$= 2 \times \frac{1}{8} - \frac{1}{4} + \frac{5}{2} = \frac{1}{4} - \frac{1}{4} + \frac{5}{2} = \frac{5}{2}$

FACTOR THEOREM

Let $p(x)$ be a polynomial of degree greater than or equal to 1 and a be any real number such that $p(a) = 0$, then $(x - a)$ is a factor of $p(x)$.

Conversely, if $(x - a)$ is a factor of $p(x)$, then $p(a) = 0$.

Let us understand this through the following example.

Example 4. Is $(x - 2)$ is a factor of $x^3 + 3x^2 - 12x + 4$?

Sol. Let $p(x) = x^3 + 3x^2 - 12x + 4$

Now $p(2) = (2)^3 + 3(2)^2 - 12 \times 2 + 4 = 8 + 12 - 24 + 4 = 0$.

Hence $(x - 2)$ is a factor of $x^3 + 3x^2 - 12x + 4$.

ZERO OF A POLYNOMIAL

A number α is a zero of a polynomial $f(x)$, if $f(\alpha) = 0$.

Number of zero(s) of a polynomial = Degree of the polynomial.

Hence number of zero(s) of a linear polynomial, quadratic polynomial, cubic polynomial are 1, 2, 3 respectively.

Relation Between Zero(s) and Coefficient of a Polynomial

(i) **Linear Polynomial ($ax + b, a \neq 0$) :**

If α be the zero of linear polynomial $ax + b$, then $\alpha = -\frac{b}{a}$.

(ii) **Quadratic Polynomial ($ax^2 + bx + c, a \neq 0$):**

If α and β are zeros of quadratic polynomial $ax^2 + bx + c$, then

$\alpha + \beta = -\frac{b}{a}$ and $\alpha \cdot \beta = \frac{c}{a}$

(iii) **Cubic Polynomial ($ax^3 + bx^2 + cx + d, a \neq 0$) :**

If α, β, γ are the zeros of the cubic polynomial $ax^3 + bx^2 + cx + d$; then

$\alpha + \beta + \gamma = -\frac{b}{a}$; $\alpha\beta + \beta\gamma + \gamma\alpha = \frac{c}{a}$ and $\alpha\beta\gamma = -\frac{d}{a}$

Factorisation of Polynomial using Algebraic Identities

You can also factorise the polynomial using the algebraic identities:

(i) $a^2 - b^2 = (a + b)(a - b)$

(ii) $a^2 + b^2 + 2ab = (a + b)^2$

(iii) $a^2 + b^2 - 2ab = (a - b)^2$

(iv) $a^3 + b^3 + 3a^2b + 3ab^2 = a^3 + b^3 + 3ab(a + b) = (a + b)^3$

(v) $a^3 - b^3 - 3a^2b + 3ab^2 = a^3 - b^3 - 3ab(a - b) = (a - b)^3$

(vi) $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$

(vii) $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$

(viii) $a^2 + b^2 + c^2 + 2ab + 2bc + 2ca = (a + b + c)^2$

(ix) $a^3 + b^3 + c^3 - 3abc = (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ca)$

(x) If $a + b + c = 0$, then $a^3 + b^3 + c^3 = 3abc$

HCF (OR GCD) OF TWO POLYNOMIALS

HCF of two polynomials $p(x)$ and $q(x)$ is that divisor which has the highest degree among all common divisors.

Note that the coefficient of the highest degree divisor is positive.

Example 5. Find the HCF of following pair of polynomials:

$p(x) = (x^2 - 9)(x - 3)$; $q(x) = x^2 + 6x + 9$

Sol. $p(x) = (x^2 - 9)(x - 3)$

$= (x + 3)(x - 3)(x - 3) = (x + 3)(x - 3)^2$

$q(x) = x^2 + 6x + 9$

$= x^2 + 3x + 3x + 9$

$= (x + 3)(x + 3) = (x + 3)^2$

HCF of $p(x)$ and $q(x) = x + 3$

LCM OF TWO POLYNOMIALS

LCM of two polynomials $p(x)$ and $q(x)$ is a polynomial of lowest degree of which $p(x)$ and $q(x)$ both are multiples.

Example 6. Find the LCM of $p(x) = (x + 3)(x - 2)^2$ and $q(x) = (x - 2)(x - 6)$.

Sol. $p(x) = (x + 3)(x - 2)^2$

$q(x) = (x - 2)(x - 6)$

HCF of $p(x)$ and $q(x) = (x - 2)$

LCM of $p(x)$ and $q(x) = (x + 3)(x - 2)^2(x - 6)$

EXERCISE

1. If $\frac{4x-3}{x}+\frac{4y-3}{y}+\frac{4z-3}{z}=0$ then the value of $\frac{1}{x}+\frac{1}{y}+\frac{1}{z}$ is

(a) 9 (b) 3 (c) 4 (d) 6

2. If $2+x\sqrt{3}=\frac{1}{2+\sqrt{3}}$, then the simplest value of x is :

(a) 1 (b) –2 (c) 2 (d) –1

3. If $x-\sqrt{3}-\sqrt{2}=0$ and $y-\sqrt{3}+\sqrt{2}=0$, then value of $(x^3-20\sqrt{2})-(y^3+2\sqrt{2})$

(a) 2 (b) 3 (c) 1 (d) 0

4. If $\frac{2p}{P^2-2P+1}=\frac{1}{4}$, then the value of $\left(p+\frac{1}{p}\right)$ is

(a) 7 (b) 1 (c) $\frac{2}{5}$ (d) 10

5. If $x^2+\frac{1}{x^2}=1$ then the value of $x^{102}+x^{96}+x^{90}+x^{84}+x^{78}$ $+x^{72}+5$ is

(a) 0 (b) 5 (c) 3 (d) 1

6. If $a^2 + b^2 + c^2 = 2a - 2b - 2$, then the value of $3a - 2b + c$ is

(a) 0 (b) 3 (c) 5 (d) 2

7. If $x = 2 + \sqrt{3}$, then $x^2 + \frac{1}{x^2}$ is equal to

(a) 10 (b) 12 (c) –12 (d) 14

8. If $x + y + z = 0$, then the value of $\frac{x^2+y^2+z^2}{x^2-yz}$ is

(a) –1 (b) 0 (c) 1 (d) 2

9. If $p = \frac{5}{18}$ then $27p^3 - \frac{1}{216} - \frac{9}{2}p^2 + \frac{1}{4}p$ is equal to

(a) $\frac{4}{27}$ (b) $\frac{5}{27}$ (c) $\frac{8}{27}$ (d) $\frac{10}{27}$

10. If $a^x = b$, $b^y = c$ and $c^z = a$; then the value of xyz =

(a) 0 (b) 1 (c) – 1 (d) 2

11. If $x+\frac{1}{x}=5$, then the value of $x^3+\frac{1}{x^3}$ is :

(a) 125 (b) 110 (c) 45 (d) 75

12. If $x + \frac{1}{y} = 1$ and $y + \frac{1}{z} = 1$, what is the value of xyz?

(a) 1 (b) – 1 (c) 0 (d) $\frac{1}{2}$

13. If $x + \frac{4}{x} = 4$, find the value of $x^3 + \frac{4}{x^3}$.

(a) 8 (b) $8\frac{1}{2}$ (c) 16 (d) $16\frac{1}{2}$

14. If $x = 3 + 2\sqrt{2}$, then the value of $\left(\sqrt{x}-\frac{1}{\sqrt{x}}\right)$ is

(a) 1 (b) 2
(c) $2\sqrt{2}$ (d) $3\sqrt{3}$

15. If $x+\frac{1}{x} = 2$, then $x^{2013} + \frac{1}{x^{2014}} = ?$

(a) 0 (b) 1 (c) –1 (d) 2

16. If $x+\frac{1}{x}=2$, then the value of $\left(x^2+\frac{1}{x^2}\right)\left(x^3+\frac{1}{x^3}\right)$ is

(a) 20 (b) 4 (c) 8 (d) 16

17. If $x=\frac{1}{2+\sqrt{3}}, y=\frac{1}{2-\sqrt{3}}$, then the value of $8xy\,(x^2+y^2)$ is

(a) 112 (b) 194 (c) 290 (d) 196

18. If $x+\frac{1}{x}=3$, where $x \neq 0$, then the value of

$$\frac{x^4+3x^3+5x^2+3x+1}{x^4+1}$$

(a) 3 (b) 5 (c) 7 (d) 2

19. If $x^2+x+\frac{1}{x^2}+\frac{1}{x}<0$, then which of the following is true?

(a) $x+\frac{1}{x}>-2$ (b) $x+\frac{1}{x}<-2$
(c) $x+\frac{1}{x}<1$ (d) Both (a) and (c)

20. If $x=\frac{4ab}{a+b}$, then the value of $\frac{x+2a}{x-2a}+\frac{x+2b}{x-2b}$ is equal to:

(a) 0 (b) 1
(c) 2 (d) None of these

21. If $x + \frac{1}{x} = \sqrt{3}$, then the value of $x^{18} + x^{12} + x^6 + 1$ is

(a) 0 (b) 1 (c) 2 (d) 3

22. If $5a+\frac{1}{3a}=5$, then the value of $9a^2+\frac{1}{25a^2}$ is

(a) $\frac{51}{5}$ (b) $\frac{29}{5}$ (c) $\frac{52}{5}$ (d) $\frac{39}{5}$

Hints & Solutions

1. **(c)** $\frac{4x-3}{x}+\frac{4y-3}{y}+\frac{4z-3}{z}=0$

$\Rightarrow \frac{4x}{x}-\frac{3}{x}+\frac{4y}{y}-\frac{3}{y}+\frac{4z}{z}-\frac{3}{z}=0$

$\Rightarrow 4-\frac{3}{x}+4-\frac{3}{y}+4-\frac{3}{z}=0$

$\Rightarrow 12-3\left(\frac{1}{x}+\frac{1}{y}+\frac{1}{z}\right)=0$

$-3\left(\frac{1}{x}+\frac{1}{y}+\frac{1}{z}\right)=-12$

$\therefore \frac{1}{x}+\frac{1}{y}+\frac{1}{z}=4$

2. **(d)** From question, $2+x\sqrt{3}=\frac{1}{2+\sqrt{3}}$

$\Rightarrow 2+\sqrt{3}x=\frac{1}{2+\sqrt{3}}$

$\Rightarrow 2+\sqrt{3}\times x=\frac{2-\sqrt{3}}{1}$

$\Rightarrow 2+x\sqrt{3}=2-\sqrt{3} \Rightarrow x=-1$

3. **(d)** According to the question

$x=\sqrt{3}+\sqrt{2}$

$y=\sqrt{3}-\sqrt{2}$

$\therefore (x^3-20\sqrt{2})-(y^3+2\sqrt{2})$

$=[(\sqrt{3}+\sqrt{2})^3-20\sqrt{2}-(\sqrt{3}-\sqrt{2})^3-2\sqrt{2}]$

$=3\sqrt{3}+2\sqrt{2}+9\sqrt{2}+6\sqrt{3}-20\sqrt{2}-3\sqrt{3}+2\sqrt{2}+9\sqrt{2}-6\sqrt{3}-2\sqrt{2}$

$=9\sqrt{3}-9\sqrt{2}-9\sqrt{3}+9\sqrt{2}=0$

4. **(d)** $\frac{2p}{p^2-2p+1}=\frac{1}{4}$

(Divide p both in nu. & de.)

$\frac{2}{p-2+\frac{1}{p}}=\frac{1}{4}$

$p+\frac{1}{p}-2=8$

$p+\frac{1}{p}=10$

5. **(b)** If $x^2+\frac{1}{x^2}=1$

Then, $x+\frac{1}{x}=\sqrt{3}$

$\Rightarrow x^3+\frac{1}{x^3}=(\sqrt{3})^3-3\sqrt{3}=0$

$\Rightarrow x^6=-1$, or $x^6+1=0$

then $x^{102}+x^{96}+x^{90}+x^{84}+x^{78}+x^{72}+5$

$x^{96}(x^6+1)+x^{84}(x^6+1)+x^{72}(x^6+1)+5=5$

6. **(c)** $a^2+b^2+c^2=2a-2b-2$

$(a^2-2a+1)+(b^2+2b+1)+c^2=0$

$(a-1)^2+(b+1)^2+c^2=0$

This equation is possible if

$a-1=0$, $b+1=0$ and $c=0$

$a=1$, $b=-1$, $c=0$

$3a-2b+c=3\times1-2\times(-1)+0=3+2=5$

7. **(d)** $x=2+\sqrt{3}$

$\frac{1}{x}=\frac{1}{2+\sqrt{3}}\times\frac{2-\sqrt{3}}{2-\sqrt{3}}=2-\sqrt{3}$

$x^2+\frac{1}{x^2}=\left(x+\frac{1}{x}\right)^2-2$

$=\left(2+\sqrt{3}+2-\sqrt{3}\right)^2-2$

$=16-2=14$

8. **(d)** $x+y+z=0$

$y+z=-x$

$y^2+z^2+2yz=x^2$

$\Rightarrow y^2+z^2=x^2-2yz$ ...(1)

$\frac{x^2+y^2+z^2}{x^2-yz}=\frac{x^2-2yz+x^2}{x^2-yz}=\frac{2(x^2-yz)}{x^2-yz}=2$

9. **(c)** $27p^3-\frac{1}{216}-\frac{9}{2}p^2+\frac{1}{4}p$

$=(3p)^3-\left(\frac{1}{6}\right)^3-3(3p)^2.\frac{1}{6}+3(3p)\left(\frac{1}{6}\right)^2$

$=\left(3P-\frac{1}{6}\right)^3=\left(3\times\frac{5}{18}-\frac{1}{6}\right)^3=\frac{8}{27}$

10. **(b)** $a^x=b$, $b^y=c$ and $c^z=a$

$\Rightarrow a^xb^yc^z=abc$

On comparing the powers of a, b, c we get $x=1, y=1$ and $z=1 \Rightarrow xyz=1$

11. (b) Using $(a+b)^3 = a^3 + b^3 + 3ab(a+b)$

$$\left(x+\frac{1}{x}\right)^3 = x^3 + \frac{1}{x^3} + 3\left(x+\frac{1}{x}\right)$$

$$\Rightarrow \quad (5)^3 = \left(x^3 + \frac{1}{x^3}\right) + 15$$

or $\quad x^3 + \dfrac{1}{x^3} = 125 - 15 = 110$

12. (b) Given that, $x + \dfrac{1}{y} = 1$

$\Rightarrow \quad xy + 1 = y \qquad$ ...(i)

and $y + \dfrac{1}{z} = 1$

$\Rightarrow \quad 1 - \dfrac{1}{z} = y \Rightarrow \quad \dfrac{z-1}{z} = y \qquad$ ...(ii)

From eq. (ii),

$y = \dfrac{z-1}{z}$

Comparing eqn. (i) with (ii)

$$xy + 1 = \frac{z-1}{z}$$

$\Rightarrow \quad xyz + z = z - 1 \Rightarrow \quad xyz = -1$

13. (b) $x + \dfrac{4}{x} = 4$

$x^2 + 4 = 4x \;\Rightarrow\; x^2 - 4x + 4 = 0 \;\Rightarrow\; (x-2)^2 = 0$

$x = 2$

$$x^3 + \frac{4}{x^3} = (2)^3 + \frac{4}{(2)^3} \Rightarrow 8 + \frac{4}{8} \Rightarrow 8 + \frac{1}{2} \Rightarrow 8\frac{1}{2}$$

14. (b) $x = 3 + 2\sqrt{2}$

$x = 2 + 1 + 2\sqrt{2}$

$x = (\sqrt{2})^2 + (1)^2 + 2.1.\sqrt{2}$

$x = (\sqrt{2}+1)^2$

$\sqrt{x} = (\sqrt{2}+1) \qquad$ ...(1)

$$\frac{1}{\sqrt{x}} = \frac{1}{\sqrt{2}+1} \times \frac{\sqrt{2}-1}{\sqrt{2}-1} = \frac{\sqrt{2}-1}{2-1} = \sqrt{2}-1$$

Now,

$$\sqrt{x} - \frac{1}{\sqrt{x}} = \sqrt{2}+1-\left(\sqrt{2}-1\right) = \sqrt{2}+1-\sqrt{2}+1$$

$$\sqrt{x} - \frac{1}{\sqrt{x}} = 2$$

15. (d) $x + \dfrac{1}{x} = 2 \;\Rightarrow\; x + \dfrac{1}{x} - 2 = 0$

$\Rightarrow \quad x^2 - 2x + 1 = 0\,;\; (x-1)^2 = 0\,;\; x = 1$

Now, $x^{2013} + \dfrac{1}{x^{2014}} = 1 + 1 = 2$

16. (b) $x + \dfrac{1}{x} = 2 \qquad$ ...(I)

Squaring both sides

$$\Rightarrow x^2 + \frac{1}{x^2} + 2 = 4 \;\Rightarrow x^2 + \frac{1}{x^2} = +2$$

Cubing equation (I)

$$\Rightarrow \quad x^3 + \frac{1}{x^3} + 3\left(x+\frac{1}{x}\right) = 8$$

$$x^3 + \frac{1}{x^3} + 6 = 8$$

$$x^3 + \frac{1}{x^3} = 2$$

$$\therefore \quad \left(x^2 + \frac{1}{x^2}\right)\left(x^3 + \frac{1}{x^3}\right) = 2 \times 2 = 4$$

17. (a) According to the question,

$$\Rightarrow \quad x = \frac{1}{2+\sqrt{3}}, y = \frac{1}{2-\sqrt{3}}$$

$$\Rightarrow \quad x = \frac{1}{2+\sqrt{3}} \times \frac{2-\sqrt{3}}{2-\sqrt{3}} = 2-\sqrt{3}$$

$$y = \frac{1}{2-\sqrt{3}} \times \frac{2+\sqrt{3}}{2+\sqrt{3}} = 2+\sqrt{3}$$

$\Rightarrow \quad x = 2-\sqrt{3}, y = 2+\sqrt{3}$

$\therefore \quad 8xy\,(x^2 + y^2)$

$$= 8(2-\sqrt{3})(2+\sqrt{3})\left[(2-\sqrt{3})^2 + (2+\sqrt{3})^2\right]$$

$$\Rightarrow \quad 8 \times 1\,[7 - 4\sqrt{3} + 7 + 4\sqrt{3}] = 112$$

18. (a) $x + \dfrac{1}{x} = 3$

$x^2 + 1 = 3x \qquad$ ...(i)

$(x^2+1)^2 = 9x^2$

$x^4 + 1 + 2x^2 = 9x^2$

$x^4 + 1 = 7x^2 \qquad$ ...(ii)

$$\therefore \frac{x^4 + 3x^3 + 5x^2 + 3x + 1}{x^4 + 1}$$

$$\frac{12x^2 + 3x^3 + 3x}{7x^2}$$

From equation (i)

$$\Rightarrow \quad \frac{12x + 3(x \quad +1)}{}$$

$$\Rightarrow \quad \frac{12x + 3 \times 3x}{7x} \;\Rightarrow\; \frac{21x}{7x} \;\Rightarrow\; 3$$

19. (d) Given that $\left(x^2 + \dfrac{1}{x^2}\right) + \left(x + \dfrac{1}{x}\right) < 0$

$$\left(x + \frac{1}{x}\right)^2 + \left(x + \frac{1}{x}\right) - 2 < 0$$

Substituting $x + \dfrac{1}{x} = y$, we get

$y^2 + y - 2 < 0$

$\Rightarrow \ (y - 1)(y + 2) < 0$

$\therefore$ either $y - 1 < 0; y + 2 > 0$

or $y + 2 < 0; y - 1 > 0.$

i.e., $y < 1, y > -2$ or $y < -2;$ $\underset{\text{(not possible)}}{\overset{y>1}{\Downarrow}}$

Therefore, $-2 < y < 1$

i.e. $-2 < \left(x + \frac{1}{x}\right) < 1.$

20. **(c)** Given, $x = \frac{4ab}{a+b} \quad \Rightarrow \quad \frac{x}{2a} = \frac{2b}{a+b}$

Applying componendo and dividendo, we get

$$\frac{x+2a}{x-2a} = \frac{2b+a+b}{2b-a-b} = \frac{a+3b}{b-a} \qquad \ldots\text{(i)}$$

Also, $\frac{x}{2b} = \frac{2a}{a+b}$

Applying componendo and dividendo, we get

$$\frac{x+2b}{x-2b} = \frac{2a+a+b}{2a-a-b} = \frac{3a+b}{a-b} \qquad \ldots\text{(ii)}$$

Add (i) & (ii),

$$\frac{x+2a}{x-2a} + \frac{x+2b}{x-2b} = \frac{a+3b}{b-a} + \frac{3a+b}{a-b}$$

$$= \frac{1}{b-a}[a + 3b - 3a - b] = \frac{2(b-a)}{(b-a)} = 2$$

21. **(a)** $x + \frac{1}{x} = \sqrt{3}$

Cubing both sides,

$$x^3 + \frac{1}{x^3} + 3\left(x + \frac{1}{x}\right) = \left(\sqrt{3}\right)^3$$

$$\Rightarrow \ x^3 + \frac{1}{x^3} + 3\sqrt{3} = 3\sqrt{3} \ \Rightarrow \ x^3 + \frac{1}{x^3} = 0$$

Now,

$$x^{18} + x^{12} + x^6 + 1 = x^{12}(x^6 + 1) + 1(x^6 + 1)$$

$$= (x^{12} + 1)(x^6 + 1)$$

$$= (x^{12} + 1).\, x^3\left(x^3 + \frac{1}{x^3}\right) = 0$$

22. **(d)** $5a + \frac{1}{3a} = 5$

Multiply by $\frac{3}{5}$ on both sides

$$\frac{3}{5}\left(5a + \frac{1}{3a}\right) = 5 \times \frac{3}{5}$$

$$3a + \frac{1}{5a} = 3$$

Squaring on both sides

$$9a^2 + \frac{1}{25a^2} + 2 \times 3a \times \frac{1}{5a} = 9$$

$$\Rightarrow \ 9a^2 + \frac{1}{25a^2} = 9 - \frac{6}{5} = \frac{39}{5}$$

Chapter 13

Sequence and Series (AP & GP)

SEQUENCE

An arrangement of numbers x_1, x_2, x_3, ..., x_n according to definite rule or a set of rules is called a **sequence**. The various numbers x_1, x_2, x_3, ..., x_n, ... occuring in a sequence are called its **terms**.

For example :

(i) $\frac{1}{2}, \frac{2}{3}, \frac{3}{4}, \frac{4}{5}, ...$

(ii) 1, 1, 2, 3, 5, 8, ...

(iii) 3, 5, 7, 9, ...

SERIES

By adding or subtracting the terms of a sequence, we get an expression, which is called a **series**. If a_1, a_2, a_3, ..., a_n is a sequence, then the expression $a_1 + a_2 + a_3 + ... + a_n$ is a series.

Arithmetic Progressions (A.P.)

A sequence of numbers which are either continuously increased or continuously decreased by a common difference, found by subtracting any term from the just next term is called Arithmetic Progression, and that difference is called common difference.

The following sequences of numbers are arithmetic progressions:

(i) 5, 8, 11, 14, ...

(ii) – 6, – 1, 4, 9, 14, ...

(iii) 10, 7, 4, 1, – 2, – 5, ...

(iv) $p, p + q, p + 2q, p + 3q, ...$

In the arithmetic progression (i); 5, 8, 11 and 14 are first term, second term, third term and fourth term respectively. Common difference of this A.P. is found out either by subtracting 5 from 8, 8 from 11 or 11 from 14. Thus common difference = 3. Similarly, common difference of arithmetic progression (ii), (iii) and (iv) are 5, – 3 and q respectively. First term and common difference of an A.P. are denoted by a and d respectively. Hence, d of (i) A.P.= 3, d of (ii) A.P.= 5,

d of (iii) A.P. = – 3 and d of (iv) A.P. = q

n^{th} Term of an A.P.

To find an A.P. if first term and common difference are given, we add the common difference to first term to get the second term and add the common difference to second term to get the third term and so on.

The standard form of an A.P. is

$$a, a + d, a + 2d, a + 3d, ...$$

Here 'a' is the first term and 'd' is the common difference. Also we see that coefficient of d is always less by one than the position of that term in the A.P. Thus nth term of the A.P. is given by

$$T_n = a + (n - 1)\, d \qquad ...(1)$$

This equation (1) is used as a formula to find any term of the A.P. If l be the last term of a sequence containing n terms, then

$$l = T_n = a + (n - 1)\, d$$

To find any particular term of any A.P., generally we put the value of a, n and d in the formula (1) and then calculate the required term.

For example: To find the 25th term of the A.P. 6, 10, 14,18, ... ; using the formula (1), we put the value of $a = 6$, $n = 25$ and $d = 4$ in formula and calculate as

$$T_{25} = 6 + (25 - 1)\, 4 = 102$$

Example **1. In an A.P. if $a = -7.2$, $d = 3.6$, $a_n = 7.2$, then find the value of n.**

Sol. $a_n = a + (n - 1)\, d \Rightarrow 7.2 = -7.2 + (n - 1)(3.6)$

$\Rightarrow 14.4 = (n - 1)(3.6) \Rightarrow n - 1 = 4 \Rightarrow n = 5.$

Example **2. Which term of the A.P. 21, 42, 63, ... is 420 ?**

Sol. $420 = a_n = a + (n - 1)\, d$ [Here $a = 21$, $d = 42 - 21 = 21$]

$420 = 21 + (n - 1)\, 21 \Rightarrow 21n = 420$

$\Rightarrow n = \frac{420}{21} = 20$

$\therefore$ required term is 20th term.

Example **3. Is – 150 a term of the A.P. 11, 8, 5, 2, ... ?**

Sol. Here $a = 11$, $d = -3$

$-150 = a_n = a + (n - 1)\, d$

$= 11 + (n - 1)(-3) = 11 - 3n + 3 = 14 - 3n$

$3n = 14 + 150 \Rightarrow n = \frac{164}{3} = 54\frac{2}{3}$, which is not possible.

$\therefore$ – 150 is not a term of the given A.P.

Sum of First n Terms of an A.P.

Sum of first n terms means sum of from first term to n^{th} term.

Consider an A.P. whose first term and common difference are 'a' and 'd' respectively.

Sum of first n terms S_n of this A.P. is given by

$$S_n = \frac{n}{2}\, [2a + (n - 1)\, d]$$

If last term of an A.P. containing n terms be l, then nth term, $l = a + (n - 1)\, d$.

$$\therefore \quad S_n = \frac{n}{2}\,[2a + (n - 1)\, d] = \frac{n}{2}\,[a + \{a + (n - 1)\, d\}]$$

$$\Rightarrow \quad S_n = (a + l)$$

Considering the Terms in an A.P.

If sum of three consecutive terms of an A.P. is given, then if required consider the three consecutive terms of an A.P. as $(a - d)$, a and $(a + d)$. This reduces one unknown d thereby making the solution easier.

For example, if it is given that sum of three consecutive terms of an A.P. is 20. Then $(a - d) + a + (a + d) = 20$

$$\Rightarrow \quad 3a = 20 \quad \Rightarrow \quad a = \frac{20}{3}.$$

Similarly, we consider the four consecutive terms as $(a - 3d)$, $(a - d)$, $(a + d)$, $(a + 3d)$ and five consecutive terms as $(a - 2d)$, $(a - d)$, a, $(a + d)$ and $(a + 2d)$; if their sums are given otherwise consider three terms as a, $a + d$, $a + 2d$; four terms as a, $a + d$, $a + 2d$, $a + 3d$ and five terms as a, $a + d$, $a + 2d$, $a + 3d$, $a + 4d$.

Arithmetic Mean of n Numbers

Arithmetic mean of n numbers $a_1, a_2, a_3, a_4, \ldots, a_n$

$$= \frac{a_1 + a_2 + a_3 + a_4 + \ldots + a_n}{n}$$

Geometric Progression (G.P.)

A sequence of numbers whose each term (except first term) is found out by multiplying the just previous term by the same number is called a G.P. The number by which we multiply to any term to get its just next term is called **common ratio** of the G.P.

***For example*:**

5, 10, 20, 40, ... is a G.P. whose first term is 5, second term is 10, third term is 20 and so on. Its common ratio is 2, because to get any term (except first term) we multiply its just previous term by 2.

Common ratio is also found out by dividing any term (except first term) by its just previous term, thus common ratio

$$= \frac{10}{5} = \frac{20}{10} = \frac{40}{20} = \ldots = 2$$

First term of a G.P. is denoted by 'a' and its common ratio is denoted by 'r'.

$\therefore \quad a = 5, r = 2$

Standard form of a G.P. is

$a, ar, ar^2, ar^3, ar^4, \ldots$

(i) n^{th} term of a G.P., $a_n = ar^{n-1}$

(ii) Sum of first n terms of a G.P.,

$$S_n = \frac{a\,(r^n - 1)}{r - 1}, \text{ if } |r| > 1 \text{ and } S_n = \frac{a\,(1 - r^n)}{1 - r}, \text{ if } |r| < 1$$

(iii) If $|r| < 1$, then sum of infinite terms of the G.P.,

$$S_\infty = \frac{a}{1 - r}$$

If $|r| > 1$, then sum of infinite terms cannot exist.

Considering the Terms in a G.P.

If product of three consecutive terms of a G.P. is given, then if required consider the three consecutive term of the G.P. as, $\frac{a}{r}$, a and ar. This reduces one unknown r, which makes the solution easier.

For example, if product of three consecutive terms of a G.P. is given by 125. Then

$$\frac{a}{r}.\, a.\, ar = 125 \quad \Rightarrow \quad a^3 = 125 \Rightarrow \quad a = 5$$

Similarly, we consider the four consecutive terms as $\frac{a}{r^3}, \frac{a}{r}, ar, ar^3$ and five consecutive terms as $\frac{a}{r^2}, \frac{a}{r}, a, ar, ar^2$; if their products are given. Otherwise we consider three terms as a, ar, ar^2; four terms as a, ar, ar^2, ar^3 and five terms as a, ar, ar^2, ar^3, ar^4.

Example **4. If the sum of three consecutive terms of a G.P. is 38 and their product is 1728, then find these three consecutive terms.**

Sol. Let the three consecutive terms be $\frac{a}{r}$, a, ar.

Then, $\frac{a}{r}\, a \cdot ar = 1728 \Rightarrow a^3 = 1728 \quad \Rightarrow \quad a = 12$

And $\frac{a}{r} + a + ar = 38$

$$a\left(\frac{1}{r} + 1 + r\right) = 38$$

$$6r^2 - 13r + 6 = 0$$

$r = 3/2$ or $r = 2/3$

$\therefore$ Numbers are 8, 12, 18 or 18, 12, 8.

Geometric Mean of n Numbers

Geometric mean of n positive numbers

$a_1, a_2, a_3, a_4, \ldots, a_n = (a_1 \,.\, a_2 \,.\, a_3 \,.\, a_4 \ldots a_n)^{1/n}$.

Relation between Arithmetic mean and Geometric Mean

Arithmetic mean is always greater than or equal to the Geometric mean. i.e. A.M. ≥ G.M.

Some Important Series:

1. Sum of n natural numbers

$$1 + 2 + 3 + \text{-----} + n = \frac{n(n+1)}{2}$$

2. Sum of squares of n natural numbers

$$1^2 + 2^2 + 3^2 + \text{--------}\; n^2 = \frac{n(n+1)(2n+1)}{6}$$

3. Sum of cubes of n natural numbers

$$1^3 + 2^3 + 3^3 + \text{--------}\; n^3 = \left[\frac{n(n+1)}{2}\right]^2$$

EXERCISE

1. If the 4th term of an arithmetic progression is 14 and 12th term is 70, then the first term is
   (a) – 10 (b) – 7 (c) + 7 (d) + 10
2. Find the sum of all numbers in between 10–50 excluding all those numbers which are divisible by 8. (include 10 and 50 for counting.)
   (a) 1070 (b) 1220 (c) 1320 (d) 1160
3. How many 3-digit numbers are completely divisible by 6?
   (a) 149 (b) 150 (c) 151 (d) 166
4. $(11^2 + 12^2 + 13^2 + ... + 20^2) = ?$
   (a) 385 (b) 2485 (c) 2870 (d) 3255
5. On March 1st 2016, Sherry saved ₹ 1. Everyday starting from March 2nd 2016, he save ₹ 1 more than the previous day. Find the first date after March 1st 2016 at the end of which his total savings will be a perfect square.
   (a) 17th March 2016 (b) 18th April 2016
   (c) 26th March 2016 (d) None of these
6. A man arranges to pay off a debt of ₹ 3,600 in 40 annual instalments which form an AP. When 30 of the instalments are paid, he dies leaving one-third of the debt unpaid. Find the value of the first instalment.
   (a) 55 (b) 53 (c) 51 (d) 49
7. A number 15 is divided into three parts which are in AP and the sum of their squares is 83. Find the smallest number.
   (a) 5 (b) 3 (c) 6 (d) 8
8. A boy agrees to work at the rate of one rupee on the first day, two rupees on the second day, four rupees on the third day and so on. How much will the boy get if he starts working on the 1st of February and finishes on the 20th of February?
   (a) 2^{20} (b) $2^{20} – 1$ (c) $2^{19} – 1$ (d) 2^{19}
9. What is the sum of all the two-digit numbers which when divided by 7 gives a remainder of 3?
   (a) 94 (b) 676
   (c) 696 (d) None of these
10. The sum of the 6th and 15th terms of an arithmetic progression is equal to the sum of 7th, 10th and 12th terms of the same progression. Which term of the series should necessarily be equal to zero ?
    (a) 10th (b) 8th
    (c) 1st (d) None of these
11. The sum of the squares of three consecutive natural numbers is 194. The sum of the numbers is
    (a) 24 (b) 27 (c) 21 (d) 30
12. Find the value of 1– 2 – 3 + 2 – 3 – 4 + ... + upto 100 terms.
    (a) –694 (b) –626 (c) –624 (d) –549
13. The sum of all terms of the arithmetic progression having ten terms except for the first term, is 99, and except for the sixth term, 89. Find the third term of the progression if the sum of the first and the fifth term is equal to 10.
    (a) 15 (b) 5 (c) 8 (d) 10
14. There are 4 terms in an A.P. such that the sum of two means is 110 and product of their extremes is 2125. The 3rd term is
    (a) 65 (b) 75 (c) 55 (d) 45
15. The first term of an Arithmetic Progression is 22 and the last term is –11. If the sum is 66, the number of terms in the sequence are :
    (a) 10 (b) 12 (c) 9 (d) 8
16. What would be the sum of
    1 + 3 + 5 + 7 + 9 + 11 + 13 + 15 + ... up to 15th term?
    (a) 250 (b) 240 (c) 225 (d) 265
17. If $1^3 + 2^3 + ... + 9^3 = 2025$, then the approx. Value of $(0.11)^3 + (0.22)^3 + ... + (0.99)^3$ is
    (a) 0.2695 (b) 0.3695 (c) 2.695 (d) 3.695
18. The next term of the sequence,
    $\left(1+\frac{1}{2}\right), \left(1+\frac{1}{2}\right)\left(1+\frac{1}{3}\right), \left(1+\frac{1}{2}\right)\left(1+\frac{1}{3}\right)\left(1+\frac{1}{4}\right),$ — is
    (a) 3 (b) $\left(1+\frac{1}{5}\right)$
    (c) 5 (d) $\left(1+\frac{1}{2}\right)\left(1+\frac{1}{5}\right)$
19. If $1^3 + 2^3 + ... + 10^3 = 3025$, then the value of $2^3 + 4^3 + ... + 20^3$ is:
    (a) 5060 (b) 12100 (c) 24200 (d) 7590

Hints & Solutions

1. **(b)** $a_4 = a + (4 – 1) \times d$
   $14 = a + 3d \Rightarrow a = 14 – 3d$ ...(1)
   $70 = a + 11d$ ...(2)
   After putting the value of a from equation (1) in equation (2)
   $14 – 3d + 11d = 70$
   $8d = 70 – 14 \quad \therefore \quad d = 7$
   $\therefore \quad a = 14 – 21 = – 7$
2. **(a)** The answer will be given by:
   [10 + 11 + 12 + ... + 50] – [16 + 24 + ... + 48]
   = 41 × 30 – 32 × 5 = 1230 – 160 = 1070.
3. **(b)** 3-digit numbers divisible by 6 are
   102, 108, 114, ..., 996
   This is an A.P. in which $a = 102$, $d = 6$ and $\ell = 996$
   Let the number of terms be n. Then $t_n = 996$.
   $\therefore \quad a + (n – 1) d = 996 \Rightarrow 102 + (n – 1) \times 6 = 996$

$\Rightarrow$ $6 \times (n-1) = 894 \Rightarrow (n-1) = 149 \Rightarrow n = 150$

$\therefore$ Number of terms = 150.

4. **(b)** $(11^2 + 12^2 + 13^2 + ... + 20^2) = (1^2 + 2^2 + ... + 20^2) - (1^2 + 2^2 + .. + 10^2)$

$$= \frac{20 \times 21 \times 41}{6} - \frac{10 \times 11 \times 21}{6}$$

$$\left[\because (1^2 + 2^2 + ... + n^2) = \frac{1}{6} n(n+1)(2n+1)\right]$$

$= 2870 - 385 = 2485$

5. **(d)** $n(n+1)/2$ should be a perfect square. The first value of n when this occurs would be for $n = 8$. Thus, on the 8th of March the required condition would come true.

6. **(c)** Sum of 40 instalments $= S_{40} = 3600 = 20\,(2a + 39d)$

$2a + 39d = 180$ ...(1)

Sum of 30 instalments $= S_{30} = 2400 = 15\,(2a + 29d)$

$2a + 29d = 160$ ...(2)

From (1) and (2), we get $a = 51$ and $d = 2$

The value of first instalment = ₹ 51

7. **(b)** The three parts are 3, 5 and 7 since $3^2 + 5^2 + 7^2 = 83$. Since, we want the smallest number, the answer would be 3.

8. **(b)** Sum of a G.P. with first term 1 and common ratio 2 and number of terms 20.

$$\frac{1 \times \left(2^{20} - 1\right)}{(2-1)} = 2^{20} - 1$$

9. **(b)** This series is like → 10, 17, 21, ...94.

Here $n = 13$, $d = 7$ and $a = 10$

Using the formula for the sum

$S_n = \frac{n}{2}[2a + (n-1)d]$, sum = 676

Alternatively, using the average method,

average = (1st number + last number)/2

$$\text{Average} = \frac{10 + 94}{2} = 52$$

So, the sum = average × number of numbers

$= 52 \times 13 = 676$

10. **(b)** Let the first term and common difference of the AP be a and d, respectively.

Now, $(a + 5d) + (a + 14d)$

$= (a + 6d) + (a + 9d) + (a + 11d)$

$2a + 19d = 3a + 26d \quad a + 7d = 0$

i.e., 8th term is 0.

11. **(a)** $(a-1)^2 + a^2 + (a+1)^2 = 194$

$(a^2 - 2a + 1) + a^2 + (a^2 + 2a + 1) = 194$

$3a^2 + 2 = 194$

$3a^2 = 192$

$a^2 = 64$

$a = 8$

Number are 7, 8, 9

Sum of numbers = 7 + 8 + 9 = 24

12. **(b)** The first 100 terms of this series can be viewed as:

$(1 - 2 - 3) + (2 - 3 - 4) + ... + (33 - 34 - 35) + 34$

The first 33 terms fo the above series (indicated inside the brackets) will give an A.P: – 4, – 5, –6 ... –36

Sum of this A.P. = 33 × –20 = –660

Answer = –660 + 34 = – 626

13. **(b)** Sum of the first term and the fifth term = 10

or $a + a + 4d = 10$

or $a + 2d = 5$; which is 3rd term.

14. **(a)** Let the 4 terms in A.P are a – 3d, a – d, a + d, a + 3d

According to question

$a - d + a + d = 110$ ... (1)

$(a - 3d)(a + 3d) = 2125$ ... (2)

From equation (1)

$a - d + a + d = 110$

$2a = 110 \Rightarrow a = 55$

From equation (2)

$(a - 3d)(a + 3d) = 2125$

$\Rightarrow a^2 - 9d^2 = 2125 \quad \Rightarrow (55)^2 - 9d^2 = 2125$

$\Rightarrow 3025 - 9d^2 = 2125 \Rightarrow 900 = 9d^2$

$\Rightarrow d^2 = 100 \quad \Rightarrow d = 10$

$\therefore$ a = 55, d = + 10

series would be : 25, 45, 65, 85

IIIrd term would be 65.

15. **(b)** The sum of Arithmetic Progression is given by

$$s = \frac{n}{2}(a + l)$$

$$66 = \frac{n}{2}(22 - 11) = \frac{n}{2} \times 11$$

n = 12

16. **(c)** The sum forms A.P.

First term (a) = 1

Common difference (d) = 2

$$\text{Sum of 15 term} = \frac{n}{2}(2a + (n - 1d)$$

$$\text{Sum} = \frac{15}{2}(2 \times 1 + (15-1)2) = \frac{15}{2} \times 30 = 225$$

17. **(c)** $1^3 + 2^3 + ... + 9^3 = 2025$

$(0.11)^3 + (0.22)^3 + ... (0.99)^3$

$= (0.11)^3\,[1^3 + 2^3 + ... 9^3]$

$= 0.001331 \times 2025 = 2.695$

18. **(a)** Next term will be

$$\left(1 + \frac{1}{2}\right)\left(1 + \frac{1}{3}\right)\left(1 + \frac{1}{4}\right)\left(1 + \frac{1}{5}\right) = \frac{3}{2} \times \frac{4}{3} \times \frac{5}{4} \times \frac{6}{5} = 3$$

19. **(c)** $2^3 + 4^3 + 6^3 + ... + 20^3$

$= 2^3\,(1^3 + 2^3 + 3^3 + ... + 10^3)$

$$= 2^3 \times \left(\frac{(n)(n+1)}{2}\right)^2 = 8 \times \left(\frac{10 \times 11}{2}\right)^2 = 8 \times 3025$$

$= 24200$

Chapter 14

Statistics and Set Theory

MEAN, MEDIAN, MODE

Mean, median and mode are the three measures of central tendency of the data.

MEAN

Mean is actually the average. An average of a group of numbers (or data or values or observations) is a number that is the best representative of the group of numbers because it tells a lot about the entire numbers of the group.

Mean of a group of numbers $=\frac{\text{Sum of all numbers}}{\text{Number of numbers}}$

Thus if A is the mean of n numbers $a_1, a_2, a_3, ..., a_n$; then

$$A=\frac{a_1+a_2+a_3+...+a_n}{n}$$

$$\Rightarrow \quad a_1+a_2+a_3+.....+a_n=A.n$$

Hence, Sum of numbers = (Number of numbers) × (Average)

For example, average of 6 to 10 natural numbers

$$=\frac{6+7+8+9+10}{5}=\frac{40}{5}=8$$

Some Important Results About Mean

(i) If each observation is increased by 'a', then the mean is also increased by 'a'. If $\bar{x}$ is the mean of n observations $x_1, x_2, ..., x_n$, then the mean of observations $(x_1 + a)$, $(x_2 + a)$, $(x_3 + a)$, ..., $(x_n + a)$ is $(\bar{x} + a)$.

(ii) If each observation is decreased by 'a', then the mean is also decreased by 'a'. If $\bar{x}$ is the mean of n observations $x_1, x_2, ..., x_n$, then mean of observations $(x_1 - a)$, $(x_2 - a)$, ...,$(x_n - a)$ is $(\bar{x} - a)$.

(iii) If each observation is multiplied by a non-zero number 'a', Then, mean is also multiplied by 'a'.

If $\bar{x}$ is mean of n observations $x_1, x_2, ..., x_n$, then mean of $ax_1, ax_2, ..., ax_n$ is $a.\bar{x}$.

(iv) If each observation is divided by a non-zero number 'a', then, mean is also divided by the non-zero number 'a'.

If $\bar{x}$ is mean of n observations $x_1, x_2, ..., x_n$, then the mean of $\frac{x_1}{a}, \frac{x_2}{a}, ... \frac{x_n}{a}$, is $\frac{\bar{x}}{a}$.

MEDIAN

Median of a set of numbers (or data or values or observation) is the middle most number (or data or value or observation) in a set of numbers, when the numbers are arranged either in ascending or in descending order of their magnitude.

Method to Find The Median

When the numbers (or data) is arranged in ascending or descending order, then median is calculated as follows:

(i) When the number of data (n) is odd, then the median is the value of the $\left(\frac{n+1}{2}\right)^{\text{th}}$ data.

(ii) When the number of data (n) is even, then the median is the mean of $\frac{n}{2}^{\text{th}}$ and $\left(\frac{n}{2}+1\right)^{\text{th}}$ data.

i.e. median $=\frac{1}{2}\left[\frac{n}{2}^{\text{th}}\text{ data}+\left(\frac{n}{2}+1\right)^{\text{th}}\text{ data}\right]$

Example **1. The monthly salaries (in ₹) of 10 employees of a factory are: 12000, 8500, 9200, 7400, 11300, 12700, 7800, 11500, 10320, 8100. Find the median salary.**

Sol. Arranging the observation in ascending order:

7400, 7800, 8100, 8500, 9200, 10320, 11300, 11500, 12000, 12700

Total number of observations (n) = 10 (even)

$$\therefore \quad \text{median}=\frac{1}{2}\left[\left(\frac{n}{2}\right)^{th}\text{observation}+\left(\frac{n}{2}+1\right)^{th}\text{observation}\right]$$

$$=\frac{1}{2}\left[\left(\frac{10}{2}\right)^{th}\text{observation}+\left(\frac{10}{2}+1\right)^{th}\text{observation}\right]$$

$$=\frac{1}{2}\left[5^{th}\text{observation}+6^{th}\text{observation}\right]$$

$$\text{Median}=\frac{1}{2}[9200+10320]=\frac{19520}{2}=9760$$

Median Salary = ₹ 9760

MODE

The mode of a group of numbers (or data or observations) is that number (or data or observation) which occurs most frequently i.e. which comes maximum number of times.

Example **2. Find the value of mode of the following data**

50, 70, 50, 70, 80, 70, 70, 80, 70, 50

Sol. To find mode, we prepare ungrouped (or discrete) frequency table.

Observation	Frequency
50	3
70	5
80	2

In the above table we see that observation 70 is repeating maximum number of times i.e. frequency of 70 is maximum. Hence the mode of the given set of observation is 70.

Relationship Between Mean, Mode and Median

Mode = 3 Median – 2 Mean

Example **3. If the value of mode and mean is 60 and 66 respectively, then find the value of median.**

Sol. Mode = 3 Median – 2 Mean

$$\therefore \quad \text{Median } = \frac{1}{3}(\text{mode} + 2 \text{ mean}) = \frac{1}{3}(60 + 2 \times 66) = 64$$

SETS

A set is a well-defined collection of different objects. In everyday life, we often speak about the collection of objects of particular kind such as a cricket team, the rivers of India, the vowels in the English alphabet etc. Each of these collection is well-defined collection of objects in the sense that we can definitely decide whether a given particular object belongs to the given collection or not.

For example: We say that 10 does not belongs to the given collection of all odd natural numbers. On the other hand, 15 belongs to this given collection of all odd natural number.

Note that

(i) Sets are usually denoted by capital letters *A, B, C, D, E, F,* etc.

(ii) The elements of a set are represented by small letters *a, b, c, d, e, f,* etc.

(iii) Each element in a set comes only once i.e. repetition of any element is not allowed.

Types of Sets

Empty Set :

A set which does not contain any element is called an **empty set**.

Finite and Infinite Sets :

A set which is non-empty or consists of a definite number of elements is called **finite** otherwise, the set is called **infinite sets.**

Equal Sets :

Two sets *A* and *B* are said to be equal if they have exactly the same elements.

SUBSETS

Set *A* is said to be a subset of a set *B* if every element of set *A* is also an element of set *B*. Here set *B* is called **superset** of set *A*.

For example : If *A* is the set of all divisors of 56 and *B* the set of all prime divisors of 56, then *B* is a subset of *A*, because all element of set *A* belongs to set *B*.

UNIVERSAL SET

If there are some sets under consideration, and out of these sets, there is a set in which elements of all other sets under consideration are present, then this set is known as the universal set, denoted by *U*.

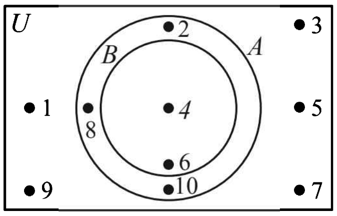
For example,

(i) In the context of human population studies, the universal set consists of all the people in the world.

(ii) If {1, 2, 3, 4}, {2, 5, 6}, {1, 3, 7, 8, 9} and {1, 2, 3, 4, 5, 6, 7, 8, 9} are the sets under consideration, then set {1, 2, 3, 4, 5, 6, 7, 8, 9} can be considered as universal set because elements of all other three sets are present in this set.

VENN DIAGRAMS

In order to illustrate universal sets, subsets and certain operations on sets in a clear and simple way, we use geometric figures. These figures are called Venn-Diagrams. In Venn Diagrams, a universal set is represented by a rectangle and any other set is represented by a circle.



In the Venn-diagrams, the elements of the sets are written in their respective circles. Here, $U = \{1, 2, 3, \ldots\ldots\ldots, 10\}$ is the universal set of which $A = \{2, 4, 6, 8, 10\}$ and $B = \{4, 6\}$ are subsets of *U*. Also *B* is the subset of *A*.

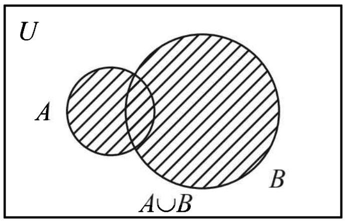
Operation on sets

Union of Sets

Union of two sets *A* and *B* is the set which consists of all those elements which are either in *A* or in *B* (including those which are in both sets *A* and *B*). In symbols, union of two sets *A* and *B* are represented by

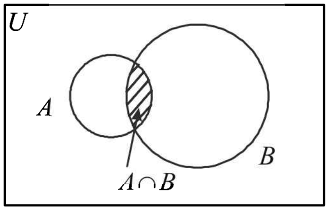
$$A \cup B$$

The union of two sets *A* and *B* can be represented by a Venn diagram as shown in the figure by shaded portion



Intersection of Sets

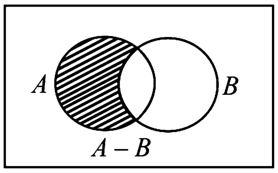
The intersection of two sets A and B is the set of all those elements which belong to both sets A and B. Symbolically, intersection of two sets A and B is denoted by $A \cap B$.



The shaded portion in figure indicates the intersection of sets A and B.

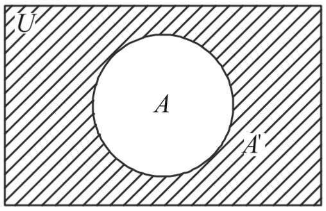
Difference of Sets

The difference of the sets A and B (in the order A minus B) is the set of elements which belong to A but not to B. The difference of two sets A and B (i.e. $A - B$) is represented in Venn diagram by shaded portion.



Complements of a Set

Let U be the universal set and A be a subset of U. Then the complement of A is the set of all elements of U which are not the elements of set A. Symbolically, we write A' or A^C to denote the complement of set 5.



Complement of set A i.e. A' is represented in Venn diagram by shaded region.

Example **4. Let $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$, $A = \{1, 2, 3, 4\}$, $B = \{2, 4, 6, 8\}$ and $C = \{3, 4, 5, 6\}$. Find**

(i) A' **(ii) $(A \cup B)'$**

(iii) $(A')'$ **(iv) $(B - C)'$**

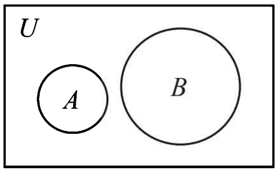
Sol. (i) $\{5, 6, 7, 8, 9\}$ (ii) $\{5, 7, 9\}$

(iii) A (iv) $\{1, 3, 4, 5, 6, 7, 9\}$

Disjoint sets

If A and B are two sets such that they have no common elements, then A and B are called **disjoint sets**.

For example, let $A = \{2, 4, 6, 8\}$ and $B = \{1, 3, 5, 7\}$. Here A and B are disjoint sets, because there is no element common to both sets A and B.



In the Venn diagram, A and B are disjoint sets.

NUMBER OF ELEMENTS IN A SET

Number of elements in a set A is represented by $n(A)$. If $A = \{a, b, c, d, e, f\}$, then $n(A) = 6$

1. If A and B are finite sets then $n(A \cup 5)$

$= n(A) + n(B) - n(A \cap B)$

2. If A, B and C are three finite sets, then

$n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B)$

$- n(B \cap C) - n(C \cap A) + n(A \cap B \cap C)$

Example **5. In a political survey, 78% of the politicians favour at least one proposal, 50% of them are in favour of proposal *A*, 30% are in favour of proposal *B* and 20% are in favour of proposal *C*. 5% are in favour of all three proposals. What is the percentage of people favouring more than one proposal?**

(a) **16%** **(b)** **17%**

(c) **18%** **(d)** **19%**

Sol. (b) $n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B)$

$- n(B \cap C) - n(A \cap C) + n(A \cap B \cap C)$

or $78 = 50 + 30 + 20 - \Sigma n(A \cap B) + 5$

or $\Sigma n(A \cap B) = 27$

This includes $n(A \cap B \cap C)$ three times.

$\therefore$ Percentage of people favouring more than one proposal $= 27 - 5 \times 2 = 17$

Example **6. If X and Y are two sets such that $X \cup Y$ has 50 elements, X has 28 elements and Y has 32 elements, how many elements does $X \cap Y$ have?**

Sol. Given that $n(X \cup Y) = 50$,

$n(X) = 28$, $n(Y) = 32$, $n(X \cap Y) = ?$

By using the formula,

$n(X \cup Y) = n(X) + n(Y) - n(X \cap Y)$,

$n(X \cap Y) = n(X) + n(Y) - n(X \cup Y)$

$= 28 + 32 - 50 = 10$

EXERCISE

1. In a group of students, 100 students know Hindi, 50 know English and 25 know both. Each of the students knows either Hindi or English. How many students are there in the group?
(a) 100 (b) 115
(c) 110 (d) 125

2. If X and Y are two sets such that $n(X) = 17$, $n(Y) = 23$ and $n(X \cup Y) = 38$, then $n(X \cap Y)$
(a) 2 (b) 1
(c) 3 (d) 4

3. If X and Y are two sets such that X has 40 elements, $X \cup Y$ has 60 elements and $X \cap Y$ has 10 elements, how many elements does Y have ?
(a) 25 (b) 35
(c) 30 (d) 40

4. Let $S = \{0, 1, 5, 4, 7\}$. Then the total number of subsets of S is
(a) 64 (b) 32
(c) 40 (d) 20

5. If two sets A and B are having 99 elements in common, then the number of elements common to each of the sets $A \times B$ and $B \times A$ are
(a) 2^{99} (b) 99^2
(c) 100 (d) 19

6. In an examination out of 100 students, 75 passed in English 60 passed in Mathematics and 45 passed in both English and Mathematics. What is the number of students passed in exactly one of the two subjects?
(a) 45 (b) 60
(c) 75 (d) 90

7. 72% of the students of a certain class took Biology and 44% took Mathematics. If each student took at least one subject from Biology or Mathematics and 40 took both, the total number of students in the class is
(a) 200 (b) 230
(c) 250 (d) 320

8. $A \cup B = A$, then
(a) $A \subset B$ (b) $B \subset A$
(c) $A \not\subset B$ and $B \not\subset A$ (d) None of these

9. The median of the data 11, 12, 13, 14, 15, 26, 27, 28, 29, 30 is
(a) 15 (b) 21.5
(c) 23 (d) 22.5

10. The mean of the data 110, 120, 130, 140, 150, 220, 270, 290 is
(a) 178.75 (b) 176.25
(c) 168.65 (d) 188.25

11. The median of the data 21, 32, 27, 17, 19, 31, 46, 20, 43 is
(a) 32 (b) 21 (c) 27 (d) 31

12. The mean of the data 23, 35, 22, 18, 19, 33, 46, 20, 44 is
(a) 32.22 (b) 26.44
(c) 27.53 (d) 28.88

13. The median of the data 100, 200, 450, 290, 1020, 380, 2010 is
(a) 380 (b) 200 (c) 1020 (d) 290

14. The mean of the data 120, 220, 420, 320, 520, 580, 610 is
(a) 396.34 (b) 412.24
(c) 398.57 (d) 394.54

15. The median of the data 105, 220, 350, 295, 1029, 300, 2020 is
(a) 220 (b) 300 (c) 350 (d) 1029

16. The mean of the data 115, 225, 355, 295, 185, 325, 285, 210 is
(a) 283.34 (b) 247.43 (c) 253.23 (d) 249.37

17. The median of the data 1100, 1200, 1450, 1290, 1525, 1300, 1575, 1475, 2425 is
(a) 1525 (b) 1300 (c) 1450 (d) 1475

18. The mean of the data 1150, 1250, 1450, 1350, 1550, 1650, 1750 is
(a) 1450 (b) 1350 (c) 1550 (d) 1250

19. The median of the data 34, 28, 45, 29, 59, 30, 42, 38, 54, 58 is
(a) 42 (b) 40 (c) 38 (d) 36

20. The mean of the data 340, 280, 450, 290, 590, 380, 420, 360, 540 is
(a) 405.55 (b) 415.45
(c) 425.35 (d) 505.15

21. The median of the data 134, 128, 145, 129, 159, 130, 142, 138, 154 is
(a) 154 (b) 14 (c) 138 (d) 134

22. The mean of the data 1304, 1208, 1405, 1209, 1059, 1030, 1042 is
(a) 1143.37 (b) 1189.77
(c) 1224.27 (d) 1179.57

23. The median of the data 44, 68, 35, 49, 59, 50, 72, 48, 54 is
(a) 48 (b) 50 (c) 49 (d) 54

24. The mean of the data 44, 68, 75, 84, 53, 57, 74, 48, 57 is
(a) 59.32 (b) 67.24 (c) 62.22 (d) 63.33

25. The median of the data 234, 228, 145, 329, 459, 530, 342, 238, 454, 486 is
(a) 425 (b) 337.5
(c) 345.5 (d) 335.5

26. The mean of the data 238, 228, 248, 258, 452, 252, 342, 232 is
(a) 281.5 (b) 284.5
(c) 312.25 (d) 287.75

27. The median of the data 734, 628, 445, 529, 1590, 1350, 1428, 318, 1154, 1265 is
(a) 944 (b) 986 (c) 1024 (d) 946

28. The mean of the data 74, 68, 45, 59, 79, 39, 42, 39, 54 is

(a) 56.25 (b) 55.44

(c) 58.46 (d) 62.46

DIRECTIONS (Qs. 29–31) : *Read the information given below and answer the questions that follow.*

The result of an exam is given below. Out of 1000 students who appeared

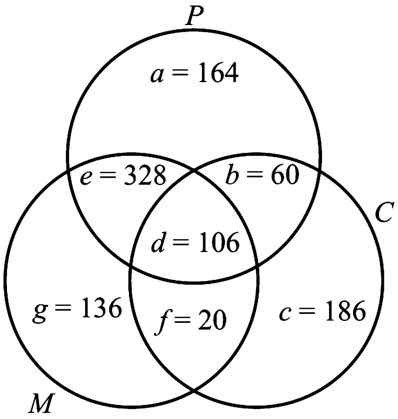
(i) 658 failed in Physics

(ii) 166 failed in Physics and Chemistry

(iii) 372 failed in Chemistry, 434 failed in Physics and Maths

(iv) 590 failed in Maths, 126 failed in Maths & Chemistry.

Find the number of people who failed in (assuming that none is passed in all subjects).



We have the following equations :

$a + b + c + d + e + f + g = 1000$

$a + b + d + e = 658$, $b + d = 166$

$b + d + c + f = 372$.

$d + e = 434$ as in the figure.

$d + e + f + g = 590$, $d + f = 126$. Find the values.

29. Chemistry but not in Physics.

(a) 318 (b) 198 (c) 213 (d) 206

30. Physics or Maths but not in Chemistry.

(a) 558 (b) 718

(c) 628 (d) None of these

31. Physics but neither Chemistry nor Maths.

(a) 164 (b) 228

(c) 196 (d) None of these

32. 70 per cent of the employees in a multinational corporation have VCD players, 75 per cent have microwave ovens, 80 per cent have ACs and 85 per cent have washing machines. At least what percentage of employees has all four gadgets?

(a) 15 (b) 5

(c) 10 (d) Cannot be determined

33. If $A = \{1, 2, 5, 6\}$ and $B = \{1, 2, 3\}$, then $(A \times B) \cap (B \times A)$ is equal to?

(a) $\{(1, 1), (2, 1), (6, 1), (3, 2)\}$

(b) $\{(1, 1), (1, 2), (2, 1), (2, 2)\}$

(c) $\{(1, 1), (2, 2)\}$

(d) $\{(1, 1), (1, 2), (2, 5), (2, 6)\}$

34. Which one of the following is a null set ?

(a) $\{0\}$ (b) $\{\{\{\}\}\}$

(c) $\{\{\}\}$ (d) $\{x \mid x^2 + 1 = 0, x \in R\}$

35. In a certain office, 72% of the workers prefer tea and 44% prefer coffee. If each of them prefers tea or coffee and 40 like both, the total number of workers in the office is :

(a) 200 (b) 240 (c) 250 (d) 320

Hints & Solutions

1. **(d)** Total number of students = 100 + 50 – 25 = 125

2. **(a)** **3.** **(c)** **4.** **(b)** **5.** **(b)**

6. **(a)** Total number of students = 100

Let E denote the students who have passed in English.

Let M denote the students who have passed in Maths.

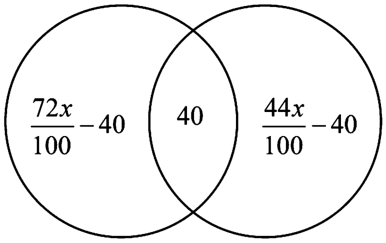
$\therefore$ $n(E) = 75$, $n(M) = 60$ and $n(E \cap M) = 45$

we know $n(E \cup M) = n(E) + n(M) - n(E \cap M)$

$= 75 + 60 - 45 = 90$

Required number of students = 90 – 45 = 45

7. **(c)** Let the total number of students in the class be x.



$$\because \frac{72x}{100} - 40 + 40 + \frac{44x}{100} - 40 = x$$

$$\Rightarrow \frac{72x}{100}x + \frac{44x}{100} - x = 40$$

$$\Rightarrow x = 250$$

8. **(b)**

9. **(d)** Arranging the data in ascending order of observations, we have

11, 12, 13, 14, 15, 26, 27, 28, 29, 30

Since, there are 10 i.e., an even number of observations. Therefore,

$$\text{Median} = \text{Mean of} \left(\frac{n}{2}\right)^{th} \text{and} \left(\frac{n+1}{2}\right)^{th} \text{observation}$$

$$\text{So, Median is } \frac{10}{2} + \frac{10+1}{2} \text{ observation}$$

$$= \frac{(15+26)}{2} = \frac{41}{2} = \mathbf{22.5}$$

10. (a) Required mean value

$$=\frac{(110+120+130+140+150+220+270+290)}{8}$$

$$=\frac{1430}{8}=178.75$$

11. (c) Arranging the data in ascending order of observations, we have

17, 19, 20, 21, 27, 31, 32, 43, 46

Since, there are 9 i.e., an odd number of observations. Therefore,

$$\text{Median}=\left(\frac{n+1}{2}\right)^{\text{th}}\text{ observation}$$

So, Median is observation is 27

12. (d) Required mean value $=\frac{9+1}{2}$

$$=\frac{(23+35+22+18+19+33+46+20+44)}{9}$$

$$=\frac{260}{9}=\mathbf{28.88}$$

13. (a) Arranging the data in ascending order of observations, we have

100, 200, 290, 380, 450, 1020, 2010

Since, there are 7 i.e., an odd number of observations. Therefore,

$$\text{Median}=\left(\frac{n+1}{2}\right)^{\text{th}}\text{ observation}$$

So,

$$\text{Median is }\left(\frac{7+1}{2}\right)^{\text{th}}\text{ observation is 380}$$

14. (c) Required mean value

$$=\frac{(120+220+420+320+520+580+610)}{7}$$

$$=\frac{2790}{7}=398.57$$

15. (b) Arranging the data in ascending order of observations, we have

105, 220, 295, 300, 350, 1029, 2020

Since, there are 7 i.e., an odd number of observations. Therefore,

$$\text{Median}=\left(\frac{n+1}{2}\right)^{\text{th}}\text{ observation}$$

So, Median is $\frac{7+1}{2}$ observation is 300

16. (d) Required mean value

$$=\frac{(115+225+355+295+185+325+285+210)}{8}$$

$$=\frac{1995}{8}=249.37$$

17. (c) Arranging the data in ascending order of observations, we have

1100, 1200, 1290, 1300, 1450, 1475, 1525, 1575, 2425

Since, there are 9 i.e., an odd number of observations. Therefore,

$$\text{Median}=\left(\frac{n+1}{2}\right)^{\text{th}}\text{ observation}$$

So, Median is $\frac{9+1}{2}$ observation is 1450

18. (a) Required mean value

$$=\frac{(1150+1250+1450+1350+1550+1650+1750)}{7}$$

$$=\frac{10150}{7}=1450$$

19. (b) Arranging the data in ascending order of observations, we have

28, 29, 30, 34, 38, 42, 45, 54, 58, 59

Since, there are 10 i.e., an even number of observations. Therefore,

$$\text{Median}=\text{Mean of}\left(\frac{n}{2}\right)^{\text{th}}\text{ and}\left(\frac{n+1}{2}\right)^{\text{th}}\text{ observation}$$

So, Median is $\frac{10}{2}+\frac{10+1}{2}$ observation

$$=\frac{(38+42)}{2}=\frac{80}{2}=40$$

20. (a) Required mean value

$$=\frac{(340+280+450+290+590+380+420+360+540)}{9}$$

$$=\frac{3650}{9}=405.55$$

21. (c) Arranging the data in ascending order of observations, we have

128, 129, 130, 134, 138, 142, 145, 154, 159

Since, there are 9 i.e., an odd number of observations. Therefore,

$$\text{Median}=\left(\frac{n+1}{2}\right)^{\text{th}}\text{ observation}$$

So, Median is $\frac{9+1}{2}$ observation is 138

22. (d) Required mean value

$$=\frac{(1304+1208+1405+1209+1059+1030+1042)}{7}$$

$$=\frac{8257}{7}=1179.57$$

23. (b) Arranging the data in ascending order of observations, we have

35, 44, 48, 49, 50, 54, 59, 68, 72

Since, there are 9 i.e., an odd number of observations.

Therefore,

$$\text{Median} = \left(\frac{n-1}{2}\right)^{th} \text{ observation}$$

So, Median is

So, Median is $\frac{9+1}{2}$ observation is 50

24. (c) Required mean value

$$= \frac{(44+68+75+84+53+57+74+48+57)}{9}$$

$$= \frac{560}{9} = 62.22$$

25. (d) Arranging the data in ascending order of observations, we have

145, 228, 234, 238, 329, 342, 454, 459, 486, 530

Since, there are 10 i.e., an even number of observations. Therefore,

$$\text{Median} = \text{Mean of}\left(\frac{n}{2}\right)^{th} \text{and}\left(\frac{n+1}{2}\right)^{th} \text{observation}$$

$$\text{So, Median is } \frac{10}{2} + \frac{10+1}{2} \text{ observation}$$

$$= \frac{(329+342)}{2} = \frac{671}{2} = 335.5$$

26. (a) Required mean value

$$= \frac{(238+228+248+258+452+252+342+232)}{8}$$

$$= \frac{2250}{8} = 281.25$$

27. (a) Arranging the data in ascending order of observations, we have

318, 445, 529, 628, 734, 1154, 1265, 1350, 1428, 1590

Since, there are 10 i.e., an even number of observations. Therefore,

$$\text{Median} = \text{Mean of}\left(\frac{n}{2}\right)^{th} \text{and}\left(\frac{n+1}{2}\right)^{th} \text{observation}$$

$$\text{So, Median is } \frac{10}{2} + \frac{10+1}{2} \text{ observation}$$

$$= \frac{(734+1154)}{2} = \frac{1888}{2} = 944$$

28. (b) Required mean value

$$= \frac{(74+68+45+59+79+39+42+39+54)}{9}$$

$$= \frac{499}{9} = 55.44$$

29. (d) Chemistry but not Physics = $c + f = 206$.

30. (c) Physics and Maths but not Chemistry = $a + e + g = 628$.

31. (a) Physics but neither Maths nor Chemistry = $a = 164$.

32. (c) Employees who doesn't have VCD = 100 – 70 = 30%

Employees who doesn't have MWO = 100 – 75 = 25%

Employees who doesn't have AC = 100 – 80 = 20%

Employees who doesn't have WM = 100 – 85 = 15%

$\therefore$ Total employees who doesn't have atleast one of the four equipments = 30 + 25 + 20 + 15 = 90%

$\therefore$ Percentage of employees having all four gadgets = 100 – 90 = 10%.

33. (b) Let $A = \{1, 2, 5, 6\}$ and $B = \{1, 2, 3\}$

$\therefore A \times B = \{(1, 1), (1, 2), (1, 3), (2, 1), (2, 2), (2, 3), (5, 1), (5, 2), (5, 3), (6, 1), (6, 2), (6, 3)\}$

and $B \times A = \{(1, 1), (1, 2), (1, 5), (1, 6), (2, 1), (2, 2), (2, 5), (2, 6), (3, 1), (3, 2), (3, 5), (3, 6)\}$

$\Rightarrow (A \times B) \cap (B \times A)$

$= \{(1, 1), (1, 2), (2, 1), (2, 2)\}$

34. (d) Consider the set given in option 'd'.

$\{x \mid x^2 + 1 = 0, x \in R\}$

Let $x^2 + 1 = 0 \Rightarrow x^2 = -1 \Rightarrow x = \pm i$ which is complex.

But $x \in R$. Hence for, any $x \in R$, $x^2 + 1$ can not be zero.

35. (c) Let total number be x. Then

$\Rightarrow n(A \cap B) = 72\% + 44\% - 100\%$

$\Rightarrow n(A \cap B) = 16\% = 40$

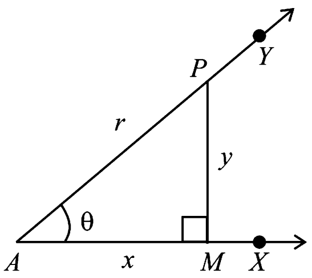
$\Rightarrow x = 250$

Chapter 15

Trigonometry

In this chapter we will study an important branch of mathematics called '**Trigonometry**'. It is the science of measuring angle of triangles, side of triangles, height of a tree, width of a river, height of a hill, height of a minar, etc.

TRIGONOMETRIC RATIOS



$$\sin\theta = \frac{\text{Perpendicular}}{\text{Hypotenuse}} = \frac{y}{r} \qquad \cos\theta = \frac{\text{Base}}{\text{Hypotenuse}} = \frac{x}{r}$$

$$\tan\theta = \frac{\text{Perpendicular}}{\text{Base}} = \frac{y}{x} \qquad \operatorname{cosec}\theta = \frac{\text{Hypotenuse}}{\text{Perpendicular}} = \frac{r}{y}$$

$$\sec\theta = \frac{\text{Hypotenuse}}{\text{Base}} = \frac{r}{x} \qquad \cot\theta = \frac{\text{Base}}{\text{Perpendicular}} = \frac{x}{y}$$

IMPORTANT FORMULAS

- $\sin\theta = \frac{1}{\operatorname{cosec}\theta}$
- $\operatorname{cosec}\theta = \frac{1}{\sin\theta}$
- $\cos\theta = \frac{1}{\sec\theta}$
- $\sec\theta = \frac{1}{\cos\theta}$
- $\tan\theta = \frac{1}{\cot\theta}$
- $\cot\theta = \frac{1}{\tan\theta}$
- $\sin^2\theta + \cos^2\theta = 1$
- $\operatorname{cosec}^2\theta - \cot^2\theta = 1$
- $\sec^2\theta - \tan^2\theta = 1$
- $\sin(90° - \theta) = \cos\theta.$
- $\cos(90° - \theta) = \sin\theta.$
- $\tan(90° - \theta) = \cot\theta$
- $\cot(90° - \theta) = \tan\theta.$
- $\operatorname{cosec}(90° - \theta) = \sec\theta.$
- $\sec(90° - \theta) = \operatorname{cosec}\theta.$
- $\sin^2\theta + \cos^2\theta = 1$, $\sin^2\theta = 1 + \tan^2\theta$ & $\cos^2\theta = 1 - \sin^2\theta$
- $\sec^2\theta - \tan^2\theta = 1$, $\sec^2\theta = 1 - \cos^2\theta$ & $\tan^2\theta = \sec^2\theta - 1$
- $\operatorname{cosec}^2\theta - \cot^2\theta = 1$, $\operatorname{cosec}^2\theta = 1 + \cot^2\theta$ & $\cot^2\theta = \operatorname{cosec}^2\theta - 1$
- $\sin(A + B) = \sin A\cos B + \cos A\sin B$
- $\sin(A - B) = \sin A\cos B - \cos A\sin B$
- $\cos(A + B) = \cos A\cos B - \sin A\sin B$
- $\cos(A - B) = \cos A\cos B + \sin A\sin B$
- $\tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A\tan B}$
- $\tan(A - B) = \frac{\tan A - \tan B}{1 + \tan A\tan B}$

MAXIMUM & MINIMUM VALUE

	max^m	min^m
$\sin\theta$ or $\cos\theta$	1	–1
$\sin^2\theta$ or $\cos^2\theta$	1	0
$\sin^3\theta$ or $\cos^3\theta$	1	–1
$\tan\theta$ or $\cot\theta$	∞	–∞

EXERCISE

1. tan 7° tan 23° tan 60° tan 67° tan 83° is equal to

(a) $\frac{1}{\sqrt{3}}$ (b) 1 (c) 0 (d) $\sqrt{3}$

2. The value of $(\sec\theta - \cos\theta)(\operatorname{cosec}\theta - \sin\theta)(\tan\theta + \cot\theta)$ is

(a) 2 (b) 0 (c) 1 (d) $\frac{3}{2}$

3. If $\frac{2\sin\theta - \cos\theta}{\cos\theta + \sin\theta} = 1$, then value of $\cot\theta$ is:

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$ (c) 3 (d) 2

4. If $4x = \sec\theta$ and $\frac{4}{x} = \tan\theta$ then $8\left(x^2 - \frac{1}{x^2}\right)$ is

(a) $\frac{1}{16}$ (b) $\frac{1}{8}$ (c) $\frac{1}{2}$ (d) $\frac{1}{4}$

5. If $\sin\theta + \cos\theta = \sqrt{2}\cos(90 - \theta)$, then $\cot\theta$ is

(a) $\sqrt{2} + 1$ (b) 0 (c) $\sqrt{2}$ (d) $\sqrt{2} - 1$

6. If $\cos A + \cos^2 A = 1$, then $\sin^2 A + \sin^4 A$ is equal to

(a) 1 (b) $\frac{1}{2}$ (c) 0 (d) –1

7. The simplified value of

$$1-\frac{\sin^2 A}{1+\cos A}+\frac{1+\cos A}{\sin A}-\frac{\sin A}{1-\cos A}\text{ is:}$$

(a) $\cos A$ (b) 0 (c) 1 (d) $\sin A$

8. If $\tan\theta - \cot\theta = a$ and $\cos\theta - \sin\theta = b$, then the value of $(a^2 + 4)(b^2 - 1)^2$ is:

(a) 4 (b) 1 (c) 2 (d) 3

9. If $\sin\theta + \sin^2\theta = 1$, then the value of $\cos^{12}\theta + 3\cos^{10}\theta + 3\cos^8\theta + \cos^6\theta - 1$ is

(a) 0 (b) 1 (c) –1 (d) 2

10. The radian measure of 63°14'51" is

(a) $\left(\frac{2811\pi}{8000}\right)^c$ (b) $\left(\frac{3811\pi}{8000}\right)^c$

(c) $\left(\frac{4811\pi}{8000}\right)^c$ (d) $\left(\frac{5811\pi}{8000}\right)^c$

11. If $\sin^2\alpha = \cos^3\alpha$, then the value of $(\cot^6\alpha - \cot^2\alpha)$ is

(a) 1 (b) 0 (c) – 1 (d) 2

12. The simplified value of $(1 + \tan\theta + \sec\theta)(1 + \cot\theta - \operatorname{cosec}\theta)$ is

(a) – 2 (b) 2 (c) 1 (d) – 1

13. Minimum value of $4\tan^2\theta + 9\cot^2\theta$ is :

(a) 12 (b) 1 (c) 6 (d) 13

14. If $\sin\theta - \cos\theta = \frac{1}{2}$, then the value of $\sin\theta + \cos\theta$ is :

(a) – 2 (b) ± 2 (c) $\frac{\sqrt{7}}{2}$ (d) 2

15. $2\operatorname{cosec}^2 23° \cot^2 67° - \sin^2 23° - \sin^2 67° - \cot^2 67°$ is equal to

(a) 0 (b) 1

(c) $\sec^2 23°$ (d) $\tan^2 23°$

16. If $5\tan\theta = 4$, then $\frac{5\sin\theta - 3\cos\theta}{5\sin\theta + 2\cos\theta}$ is

(a) $\frac{1}{3}$ (b) $\frac{2}{3}$ (c) $\frac{1}{4}$ (d) $\frac{1}{6}$

17. Evaluate : tan 1° tan 2° tan 3° .... tan 89°.

(a) 0 (b) 1 (c) –1 (d) 2

18. Maximum value of $(2\sin\theta + 3\cos\theta)$ is

(a) 2 (b) $\sqrt{13}$ (c) $\sqrt{15}$ (d) 1

19. If $\cos^4\theta - \sin^4\theta = \frac{2}{3}$, then the value of $1 - 2\sin^2\theta$ is

(a) $\frac{2}{3}$ (b) $\frac{1}{3}$ (c) $\frac{4}{3}$ (d) 0

20. The value of $\frac{\sin 53°}{\cos 37°} \div \frac{\cot 65°}{\tan 25°}$ is

(a) 2 (b) 1

(c) 3 (d) 0

21. The value of

$$\frac{\cot 5°.\cot 10°.\cot 15°.\cot 60°.\cot 75°.\cot 80°.\cot 85°}{(\cos^2 20° + \cos^2 70°) + 2}\text{ is}$$

(a) $\frac{9}{\sqrt{3}}$ (b) $\frac{1}{9}$ (c) $\frac{1}{\sqrt{3}}$ (d) $\frac{\sqrt{3}}{9}$

22. If $x = a\cos\theta - b\sin\theta$, $y = b\cos\theta + a\sin\theta$, then find the value of $x^2 + y^2$.

(a) a^2 (b) b^2

(c) $\frac{a^2}{b^2}$ (d) $a^2 + b^2$

23. The simplest value of $\sin^2 x + 2\tan^2 x - 2\sec^2 x + \cos^2 x$ is

(a) 1 (b) 0 (c) –1 (d) 2

24. The value of $\sin^2 1° + \sin^2 2° + \sin^2 3° + ... + \sin^2 89°$ is

(a) 22 (b) 44

(c) $22\frac{1}{2}$ (d) $44\frac{1}{2}$

25. If $\sin 17° = \frac{x}{y}$ then $\sec 17° - \sin 73°$ is equal to

(a) $\frac{y}{\sqrt{y^2 - x^2}}$ (b) $\frac{y^2}{\left(x\sqrt{y^2 - x^2}\right)}$

(c) $\frac{x}{\left(y\sqrt{y^2 - x^2}\right)}$ (d) $\frac{x^2}{\left(y\sqrt{y^2 - x^2}\right)}$

26. If $\alpha + \beta = 90°$ then the expression $\frac{\tan\alpha}{\tan\beta} + \sin^2\alpha + \sin^2\beta$ is equal to :

(a) $\sec^2\beta$ (b) $\tan^2\beta$

(c) $\sec^2\alpha$ (d) $\tan^2\alpha$

27. The maximum value of $\sin^4\theta + \cos^4\theta$ is

(a) 1 (b) 2 (c) 3 (d) $\frac{1}{3}$

28. The distance between the two pillars of length 16 metres and 9 metres is x metres. If the angles of elevation of their respective top from the bottom of the other are complementary to each other then the value of x (in metres) is

(a) 15 (b) 16

(c) 12 (d) 9

29. The angle of elevation of the top of a chimney and roof of the building from a point on the ground are x and 45° respectively. The height of building is h metre. Then the height of the chimney, (in metre) is

(a) $h\cot x + h$ (b) $h\cot x - h$

(c) $h\tan x - h$ (d) $h\tan x + h$

30. There are two vertical posts, one on each side of a road, just opposite to each other. One post is 108 metre high. From the top of this post the angle of depression of the top and foot of the other post are 30° and 60° respectively. The height of the other post (in metre) is

(a) 36 (b) 72 (c) 108 (d) 110

Hints & Solutions

1. (d) $\tan 7° \tan 23° \tan 60° \tan 67° \tan 83°$

$\Rightarrow \tan(90° - 83°)\tan(90° - 67°)\tan 60° \tan 67° \tan 83°$

$\Rightarrow \cot 83° \cot 67° \tan 60° \tan 67° \tan 83°$

$[\because \tan(90° - \theta) = \cot\theta]$

$$\Rightarrow \frac{1}{\tan 83°} \times \frac{1}{\tan 67°} \times \tan 60° \times \tan 67° \times \tan 83°$$

$\Rightarrow \tan 60° = \sqrt{3}$

2. (c) $(\sec\theta - \cos\theta)(\operatorname{cosec}\theta - \sin\theta)(\tan\theta + \cot\theta)$

$$\Rightarrow \left(\frac{1}{\cos\theta} - \cos\theta\right)\left(\frac{1}{\sin\theta} - \sin\theta\right)\left(\frac{\sin\theta}{\cos\theta} + \frac{\cos\theta}{\sin\theta}\right)$$

$$\Rightarrow \frac{1-\cos^2\theta}{\cos\theta} \times \frac{1-\sin^2\theta}{\sin\theta} \times \frac{\sin^2\theta + \cos^2\theta}{\sin\theta\cos\theta}$$

$$\Rightarrow \frac{\sin^2\theta}{\cos\theta} \times \frac{\cos^2\theta}{\sin\theta} \times \frac{1}{\sin\theta\cos\theta} \quad [\because \sin^2\theta + \cos^2\theta = 1]$$

$\Rightarrow 1$

3. (a) $\dfrac{2\sin\theta - \cos\theta}{\cos\theta + \sin\theta} = 1$

Dividing numerator and denominator by $\cos\theta$.

$$\frac{\frac{2\sin\theta}{\cos\theta} - \frac{\cos\theta}{\cos\theta}}{\frac{\cos\theta}{\cos\theta} + \frac{\sin\theta}{\cos\theta}} = 1 \Rightarrow \frac{2\tan\theta - 1}{1 + \tan\theta} = 1$$

$\Rightarrow 2\tan\theta - 1 = 1 + \tan\theta$

$\Rightarrow \tan\theta = 2$

Hence, $\cot\theta = \dfrac{1}{\tan\theta} = \dfrac{1}{2}$

4. (c) $4x = \sec\theta \Rightarrow x = \dfrac{\sec\theta}{4}$

Again, $\dfrac{4}{x} = \tan\theta \Rightarrow \dfrac{1}{x} = \dfrac{\tan\theta}{4}$

$$\therefore 8\left(x^2 - \frac{1}{x^2}\right)$$

$$= 8\left(\frac{\sec^2\theta}{16} - \frac{\tan^2\theta}{16}\right) = \frac{8}{16}\left(\sec^2\theta - \tan^2\theta\right) = \frac{1}{2}$$

5. (d) $\sin\theta + \cos\theta = \sqrt{2}\cos(90 - \theta)$

$\sin\theta + \cos\theta = \sqrt{2}\sin\theta$

Divide both sides by $\sin\theta$

$1 + \cot\theta = \sqrt{2}$

$\cot\theta = \sqrt{2} - 1$

6. (a) $\cos A = 1 - \cos^2 A = \sin^2 A$

$\therefore \sin^2 A + \sin^4 A = \sin^2 A + \cos^2 A = 1$

7. (a) $1 - \dfrac{\sin^2 A}{1 + \cos A} + \dfrac{1 + \cos A}{\sin A} - \dfrac{\sin A}{1 - \cos A}$

$$1 - \frac{(1 - \cos A)(1 + \cos A)}{1 + \cos A} + \frac{1^2 - \cos^2 A - \sin^2 A}{\sin A(1 - \cos A)}$$

$$1 - 1 + \cos A + \frac{\sin^2 A - \sin^2 A}{\sin A(1 - \cos A)} = \cos A$$

8. (a) Put $\theta = 45°$

$a = \tan 45° - \cot 45°$, $a = 1 - 1 = 0$

$b = \cos 45° - \sin 45°$, $b = \dfrac{1}{\sqrt{2}} - \dfrac{1}{\sqrt{2}} = 0$

Put in equation, $(a^2 + 4)(b^2 - 1)^2 = (0 + 4)(0 - 1)^2 = 4$

9. (a) $\sin\theta + \sin^2\theta = 1$

$\Rightarrow \sin\theta = 1 - \sin^2\theta \quad \Rightarrow \sin\theta = \cos^2\theta$

$\therefore \cos^{12}\theta + 3\cos^{10}\theta + 3\cos^8\theta + \cos^6\theta - 1$

$= (\cos^4\theta + \cos^2\theta)^3 - 1$

$= (\sin^2\theta + \cos^2\theta)^3 - 1 = 1 - 1 = 0$

10. (a) $63°\ 14'\left(\dfrac{51}{60}\right)'$ [1 minute = 60 seconds]

$$\Rightarrow 63°\left[14 + \frac{17}{20}\right]' = 63°\left[\frac{297}{20}\right]' = 63° + \left(\frac{297}{20 \times 60}\right)°$$

[1 degree = 60 minutes]

$$\Rightarrow \left(\frac{75897}{1200}\right)° = \frac{75897}{1200} \times \frac{\pi}{180} \text{radian}$$

$$\Rightarrow \left(\frac{2811}{8000}\pi\right)^c$$

11. (a) If $\sin^2\alpha = \cos^3\alpha$

$\tan^2\alpha = \cos\alpha \qquad \ldots(1)$

Now consider, $\cot^6\alpha - \cot^2\alpha = \dfrac{1}{\tan^6\alpha} - \dfrac{1}{\tan^2\alpha}$

Since $\cot\alpha = \dfrac{1}{\tan\alpha}$

Substituting for $\tan^2\alpha$ with $\cos\alpha$ from (1) above equation will be

$$= \frac{1}{\cos^3\alpha} - \frac{1}{\cos\alpha} = \frac{1 - \cos^2\alpha}{\cos^3\alpha} = \frac{\sin^2\alpha}{\cos^3\alpha} = \frac{\tan^2\alpha}{\cos\alpha} = 1$$

12. (b) $(1 + \tan\theta + \sec\theta)(1 + \cot\theta - \operatorname{cosec}\theta)$

$$\Rightarrow \left(1 + \frac{\sin\theta}{\cos\theta} + \frac{1}{\cos\theta}\right)\left(1 + \frac{\cos\theta}{\sin\theta} - \frac{1}{\sin\theta}\right)$$

$$\Rightarrow \left(\frac{\sin\theta + \cos\theta + 1}{\cos\theta}\right)\left(\frac{\sin\theta + \cos\theta - 1}{\sin\theta}\right)$$

$$= \frac{(\sin\theta + \cos\theta)^2 - 1}{\sin\theta\cos\theta}$$

$$= \frac{\sin^2\theta + \cos^2\theta + 2\sin\theta\cos\theta - 1}{\sin\theta\cos\theta} = \frac{2\sin\theta\cos\theta}{\sin\theta\cos\theta} = 2$$

13. (a) $4\tan^2\theta + 9\cot^2\theta \Rightarrow (2\tan\theta)^2 + (3\cot\theta)^2$

$(2\tan\theta)^2 + (3\cot\theta)^2 - 12 + 12 = (2\tan\theta - 3\cot\theta)^2 + 12$

∴ Minimum Value = 12 because $(2\tan\theta - 3\cot\theta)^2 \geq 0$

14. (c) $\sin\theta - \cos\theta = \frac{1}{2}$

$\sin\theta + \cos\theta = x.$

On squaring and adding.

$2(\sin^2\theta + \cos^2\theta) = \frac{1}{4} + x^2$

$\Rightarrow\ x^2 = 2 - \frac{1}{4} = \frac{7}{4} \Rightarrow x = \frac{\sqrt{7}}{2}$

15. (c) $\frac{2}{\sin^2 23°}.\frac{\sin^2 23°}{\cos^2 23°} - (\sin^2 23 + \cos^2 23°) - \tan^2 23°$

$= 2\sec^2 23° - 1 - \tan^2 23°$

$= (\sec^2 23° - 1) + (\sec^2 23° - \tan^2 23°)$

$= \tan^2 23° + 1 = \sec^2 23°$

16. (d) $\frac{\frac{5\sin\theta - 3\cos\theta}{\cos\theta}}{\frac{5\sin\theta + 2\cos\theta}{\cos\theta}} = \frac{5\tan\theta - 3}{5\tan\theta + 2} = \frac{5\times\frac{4}{5} - 3}{5\times\frac{4}{5} + 2} = \frac{1}{6}$

17. (b) $\tan 89° = \tan(90° - 1°) = \cot 1°$

$\tan 88° = \tan(90° - 2°) = \cot 2°$

∴ Expression $= \tan 1°.\cot 1°.\tan 2°.\cot 2°.... \tan 45° = 1$

[∵ $\tan\theta . \cot\theta = 1$]

18. (b) Maximum value of $a\sin\theta + b\cos\theta = \sqrt{a^2 + b^2}$

∴ Maximum value of $2\sin\theta + 3\cos\theta$

$= \sqrt{2^2 + 3^2} = \sqrt{13}$

19. (a) $\cos^4\theta - \sin^4\theta = \frac{2}{3}$

$\Rightarrow\ (\cos^2\theta + \sin^2\theta)(\cos^2\theta - \sin^2\theta) = \frac{2}{3}$

$\Rightarrow\ \cos^2\theta - \sin^2\theta = \frac{2}{3} \Rightarrow 1 - \sin^2\theta - \sin^2\theta = \frac{2}{3}$

$\Rightarrow 1 - 2\sin^2\theta = \frac{2}{3}$

20. (b) $\frac{\sin 53°}{\cos 37°} \div \frac{\cot 65°}{\tan 25°}$

$\frac{\sin 53°}{\cos 37°} \times \frac{\tan 25°}{\cot 65°} \Rightarrow \frac{\sin 53°}{\cos(90° - 53°)} \times \frac{\tan 25°}{\cot(90° - 25°)}$

$\Rightarrow\ \frac{\sin 53°}{\sin 53°} \times \frac{\tan 25°}{\tan 25°} = 1$

[∵ $\cos(90° - \theta) = \sin\theta$ and $\cot(90° - \theta) = \tan\theta$]

21. (d) $\frac{\cot 5°.\cot 10°.\cot 15°.\cot 60°.\cot 75°.\cot 80°.\cot 85°}{(\cos^2 20 + \cos^2 70°) + 2}$

$\cot(90° - 85°).\cot(90° - 80°).\cot(90° - 75°).$

$\Rightarrow\ \frac{\cot 60°.\cot 75°.\cot 80°\cot 85°}{(\cos^2(90° - 70°) + \cos^2 70°) + 2}$

$\Rightarrow\ \frac{\cot 60°}{(1+2)} = \frac{\frac{1}{\sqrt{3}}}{3} = \frac{1}{3\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{3}}{9}$

22. (d) $x = a\cos\theta - b\sin\theta$

$y = b\cos\theta + a\sin\theta$

$x^2 + y^2 = (a\cos\theta - b\sin\theta)^2 + (b\cos\theta + a\sin\theta)^2$

$\Rightarrow\ a^2\cos^2\theta + b^2\sin^2\theta - 2ab\cos\theta\sin\theta + b^2\cos^2\theta + a^2\sin^2\theta + 2ab\cos\theta\sin\theta$

$\Rightarrow\ (a^2 + b^2)\cos^2\theta + (a^2 + b^2)\sin^2\theta$

$\Rightarrow\ (a^2 + b^2)(\cos^2\theta + \sin^2\theta)$

$\Rightarrow\ (a^2 + b^2).(1) \Rightarrow a^2 + b^2$

23. (c) $\sin^2 x + \cos^2 x - 2(\sec^2 x - \tan^2 x) = 1 - 2(1) = -1$

24. (d) $(\sin^2 1° + \sin^2 89°) + (\sin^2 2° + \sin^2 88°) + ...$
$+ (\sin^2 44° + \sin^2 48°) + \sin^2 45°$

$= (\sin^2 1° + \cos^2 1°) + (\sin^2 2° + \cos^2 2°) + ...$
$+ (\sin^2 44° + \cos^2 44°) + \sin^2 45°$

$= 1 + 1 + ... + 1$ (44 times) $+ \frac{1}{2} = 44\frac{1}{2}$

25. (d) $\sin 17° = \frac{x}{y}$

$\cos 17° = \sqrt{1 - \frac{x^2}{y^2}} = \frac{\sqrt{y^2 - x^2}}{y}$

$\sec 17° - \sin 73° = \sec 17° - \cos 17°$

$= \frac{y}{\sqrt{y^2 - x^2}} - \frac{\sqrt{y^2 - x^2}}{y} = \frac{y^2 - y^2 + x^2}{y\sqrt{y^2 - x^2}} = \frac{x^2}{y\sqrt{y^2 - x^2}}$

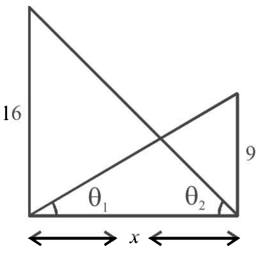
26. (c) $\alpha + \beta = 90°\ \therefore\ \beta = 90° - \alpha = \frac{\tan\alpha}{\tan\beta} + \sin^2\alpha + \sin^2\beta$

$= \frac{\tan\alpha}{\tan(90° - \alpha)} + \sin^2(90° - \beta) + \sin^2\beta$

$= \frac{\tan\alpha}{\cot\alpha} + \cos^2\beta + \sin^2\beta = \tan^2\alpha + 1 = \sec^2\alpha$

27. (a) The maximum value of $\sin^4\theta + \cos^4\theta$ is 1.

28. (c)

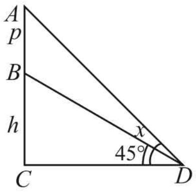


If $\theta_1 + \theta_2 = 90°$ then $x = \sqrt{h_1 \times h_2}$

($h_1\ h_2$ = height of pillars)

$x = \sqrt{16 \times 9} = \sqrt{144} = 12$mtr

29. (c)



Let AB is a Chimney of height P and BC is the building of height h.

ATQ, $\angle BDC = 45°$ and $\angle ADC = x°$

From, ΔBCD, $\tan 45° = \dfrac{BC}{CD} \Rightarrow 1 = \dfrac{h}{CD}$

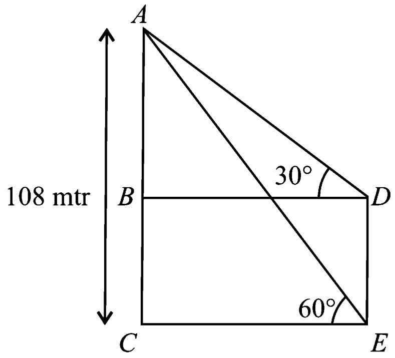
$\therefore \; CD = h.$

From ΔACD, $\tan(x) = \dfrac{AC}{CD} = \dfrac{P+h}{h}$

$h \, . \tan x = P + h$

$P = h(\tan x - 1)$

30. (b)



In ΔACE

$$\tan 60° = \frac{AC}{CE}$$

$$\frac{\sqrt{3}}{1} = \frac{AC}{CE} = AC : CE = \sqrt{3} : 1 \qquad \text{...(i)}$$

In ΔABD

$$\tan 30° = \frac{AB}{BD}$$

$$\frac{1}{\sqrt{3}} = \frac{AB}{BD} \Rightarrow AB : BD = 1 : \sqrt{3} \qquad \text{...(ii)}$$

Since $BD = CE \;\; \Rightarrow CE : AB = \sqrt{3} : 1$

$\therefore \;\; AC \; : CE \; : \; AB$

equation (I) → $\sqrt{3} \; : 1$

equation (II) → : 1 : $\sqrt{3}$

$3 \; : \; \sqrt{3} \; : \; 1$

↓ × 36 ↓ × 36

actual height → 108 36

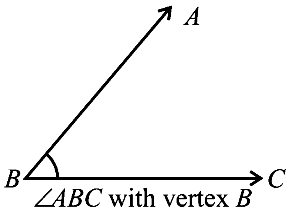
$\Rightarrow DE = AC - AB = 108 - 36 = 72$ metre

Chapter 16

Geometry

ANGLES

An angle is the union of two non-collinear rays with a common initial point. The common origin is called the vertex and the two rays are called the two arms of the angle.



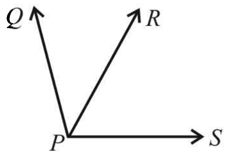
$\angle ABC$ with vertex B

Pairs of angles

Adjacent Angles

Two angles are called adjacent angles if they have a common side and their interiors are disjoint.

$\angle QPR$ and $\angle RPS$ are adjacent angle.



Linear Pair

Two angles are said to form a linear pair if they have a common side and their other two sides are opposite rays. The sum of the measures of the angles is 180°.

Complementary Angles

Two angles whose sum is 90°, are complementary, each one is the complement of the other.

Supplementary Angles

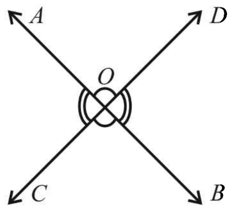
Two angles whose sum is 180° are supplementary, each one is the supplement of the other.

Vertically Opposite Angles

Two angles are called vertically opposite angles if their sides form two pairs of opposite rays. Vertically opposite angles are equal to each other.

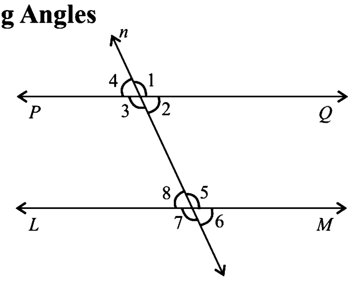
$\angle AOD$ and $\angle COB$ are vertically opposite angles

Also $\angle AOC$ and $\angle BOD$ are vertically opposite angles



$\therefore\quad \angle AOD = \angle COB$ and $\angle AOC = \angle BOD$

Corresponding Angles



Here, $PQ \parallel LM$ and n is transversal. Then, $\angle 1$ & $\angle 5$, $\angle 2$ & $\angle 6$, $\angle 3$ & $\angle 7$ & $\angle 4$ & $\angle 8$ are corresponding angles.

The pairs of corresponding angles thus formed are equal to each other.

i.e. $\angle 1 = \angle 5$; $\angle 2 = \angle 6$; $\angle 4 = \angle 8$; $\angle 3 = \angle 7$.

Alternate Interior Angles

In the above figure, $\angle 3$ and $\angle 5$, $\angle 2$ and $\angle 8$ are alternate interior angles.

The pairs of alternate angles thus formed are equal to each other i.e. $\angle 3 = \angle 5$ and $\angle 2 = \angle 8$

Interior Angles

In the above figure, $\angle 2$, $\angle 5$, $\angle 3$ and $\angle 8$ are Interior angles.

Sum of interior angles on one side of the transversal is 180°.

Hence in the above figure, $\angle 2 + \angle 5 = \angle 3 + \angle 8 = 180°$

Classification of triangles

Based on Sides

Scalene triangle: A triangle in which none of the three sides are equal is called a scalene triangle.

Isosceles triangle: A triangle in which at least two sides are equal is called an isosceles triangle.

Equilateral triangle: A triangle in which all the three sides are equal is called an equilateral triangle. In an equilateral triangle, each of the angles is equal to 60°.

Based on Angles

Right triangle: If any one angle of a triangle is a right angle, i.e., 90° then the triangle is called a right-angled triangle.

Acute triangle: If all the three angles of a triangle are acute, i.e., less than 90°, then the triangle is called an acute angled triangle.

Obtuse triangle: If any one angle of a triangle is obtuse, i.e., greater than 90°, then the triangle is called an obtuse-angled triangle.

CONGRUENCY OF TRIANGLES

Two triangles are congruent if the sides and angles of one triangle are equal to the corresponding sides and angles of the other triangle.

Criteria for congurency :

(i) **SAS Congruence rule :** Two triangles are congruent if two sides and the included angle of one triangle are equal to two sides and the included angle of the other triangle.

(ii) **ASA Congruence rule :** Two triangles are congruent if two angles and the included side of one triangle are equal to two angles and the included side of other triangle.

(iii) **SSS Congruence rule :** If three sides of one triangle are equal to the three sides of another triangle, then the two triangles are congruent.

(iv) **RHS Congruence rule :** If in two right triangles, the hypotenuse and one side of the triangle are equal to the hypotenuse and one side of the other triangle, then the two triangles are congruent.

SIMILARITY OF TRIANGLES

In two triangles, if the corresponding angles are congruent and their corresponding sides are in proportion, then the two triangles are said to be similar.

Criteria for similarity :

(i) **AAA (or AA) Similarity :** If two angles of one triangle are equal to the corresponding two angles of the other triangle, then the two triangles are similar.

(ii) **SSS Similarity :** If the corresponding sides of two triangles are proportional, then the two triangles are similar.

(iii) **SAS Similarity :** If one angle of a triangle is equal to one angle of the other and the sides including these angles are proportional, then triangles are similar.

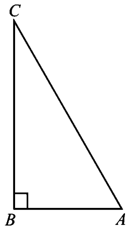
(iv) **RHS Similarity :** Two right triangles are similar if ratio of hypotenuse and one side of one triangle is equal to the ratio of corresponding hypotenuse and one side of the other triangle.

Properties of similar triangles

1. If two triangles are similar,
   Ratio of sides = Ratio of height = Ratio of Median = Ratio of angle bisectors = Ratio of inradii = Ratio of circumradii.
2. The ratio of the areas of two similar triangles is equal to the ratio of the squares of the corresponding sides.
3. If $\Delta ABC \sim \Delta PQR$, then

$$\frac{Ar(\Delta ABC)}{Ar(\Delta PQR)} = \frac{(AB)^2}{(PQ)^2} = \frac{(BC)^2}{(QR)^2} = \frac{(AC)^2}{(PR)^2}$$

PYTHAGORAS THEOREM



In a right triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides.

If a right triangle ABC right angled at B. Then, by Pythagoras theorem,

$AC^2 = AB^2 + BC^2$

INEQUALITIES IN A TRIANGLE

(i) If two sides of a triangle are unequals, the angle opposite to the longer side is larger.
Conversely, in any triangle, the side opposite to the larger angle is longer.

(ii) The sum of any two side of a triangle is greater than the third side.

QUADRILATERALS

A figure formed by joining four points is called a quadrilateral.

A quadrilateral has four sides, four angles and four vertices.

In quadrilateral $PQRS$; PQ, QR, RS and SP are the four sides; P, Q, R and S are four vertices and $\angle P$, $\angle Q$, $\angle R$ and $\angle S$ are the four angles.

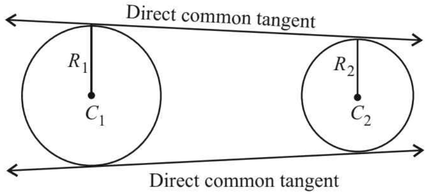
Sum of the angles of a qudrilateral is 360°.

$\angle P + \angle Q + \angle R + \angle S = 360°$

COMMON TANGENTS FOR A PAIR OF CIRCLE

(a) Length of Direct Common Tangent

$$L_1 = \sqrt{(C_1C_2)^2 - (R_1 - R_2)^2}$$

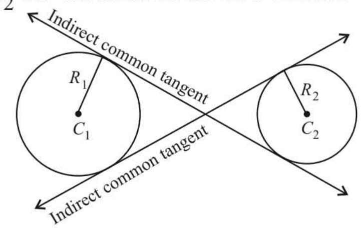


where C_1C_2 = Distance between the centres, and R_1 and R_2 are the radii of the two circles.

(b) Length of Indirect Common Tangent

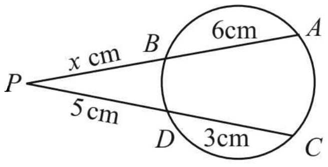
$$L_2 = \sqrt{(C_1C_2)^2 - (R_1 + R_2)^2}$$

where C_1C_2 = Distance between the centres, and R_1 and R_2 are the radii of the two circles.



Example **1. In the given figure, chords *AB* and *CD* of a circle when produced intersect externally at *P*. If *AB* = 6cm, *CD* = 3cm and *PD* = 5cm then *PB* = ?**

(a) 5 cm (b) 6.25 cm (c) 6 cm (d) 4 cm



Sol. (d) $PA \times PB = PC \times PD$

$\Rightarrow (x + 6)\,x = 8 \times 5$

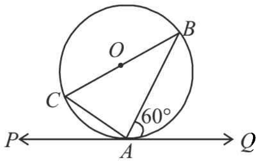
$\Rightarrow x^2 + 6x - 40 = 0$

$\Rightarrow (x + 10)(x - 4) = 0$

$\Rightarrow x = 4$

$\therefore PB = 4$ cm

Example **2. In the given figure, *PAQ* is the tangent. *BC* is the diameter of the circle. *m* ∠*BAQ* = 60°, find *m* ∠*ABC* :**



(a) 25° (b) 30° (c) 45° (d) 60°

Sol. (b) $\angle BAC = 90°$

$\angle BCA = 60° \quad (\because \angle BCA = \angle BAQ)$

$\therefore \angle ABC = 180° - (90° + 60°)$

$\therefore \angle ABC = 30°$

EXERCISE

1. In ΔABC, $\angle B = 60°$, $\angle C = 40°$. If AD bisects $\angle BAC$ and $AE \perp BC$, then $\angle EAD$ is
(a) 40° (b) 80° (c) 10° (d) 20°

2. If ΔABC is an isosceles triangle with $\angle C = 90°$ and $AC = 5$ cm, then AB is :
(a) 5 cm (b) 10 cm (c) $5\sqrt{2}$ cm (d) 2.5 cm

3. The length of the two sides forming the right angle of a right-angled triangle are 6 cm and 8 cm. The length of its circum-radius is :
(a) 5 cm (b) 7 cm (c) 6 cm (d) 10 cm

4. The external bisectors of $\angle B$ and $\angle C$ of ΔABC meet at point P. If $\angle BAC = 80°$, then $\angle BPC$ is
(a) 50° (b) 40° (c) 80° (d) 100°

5. In a triangle ABC, BC is produced to D so that $CD = AC$. If $\angle BAD = 111°$ and $\angle ACB = 80°$, then the measure of $\angle ABC$ is:
(a) 31° (b) 33° (c) 35° (d) 29°

6. If in ΔABC, $\angle ABC = 5\angle ACB$ and $\angle BAC = 3\ \angle ACB$, then $\angle ABC =$
(a) 120° (b) 130° (c) 80° (d) 100°

7. The perpendiculars, drawn from the vertices to the opposite sides of a triangle, meet at the point whose name is
(a) orthocentre (b) incentre
(c) circumcentre (d) centroid

8. ABC is an isosceles triangle such that $AB = AC$ and $\angle B = 35°$. AD is the median to the base BC. Then $\angle BAD$ is:
(a) 55° (b) 70° (c) 35° (d) 110°

9. $ABCD$ is a cyclic trapezium with $AB \parallel DC$ and AB is the diameter of the circle. If $\angle CAB = 30°$ then $\angle ADC$ is
(a) 60° (b) 120° (c) 150° (d) 30°

10. ABC is a triangle. The bisectors of the internal angle $\angle B$ and external angle $\angle C$ intersect at D. If $\angle BDC = 50°$, then $\angle A$ is
(a) 100° (b) 90° (c) 120° (d) 60°

11. In a circle of radius 17 cm, two parallel chords of lengths 30 cm and 16 cm are drawn. If both the chords are on the same side of the centre, then the distance between the chords is
(a) 9 cm (b) 7 cm (c) 23 cm (d) 11 cm

12. In a triangle ABC, $\angle A = 90°$, $\angle C = 55°$, $AD \perp BC$. What is the value of $\angle BAD$?
(a) 45° (b) 55° (c) 35° (d) 60°

13. The diagonals AC and BD of a cyclic quadrilateral $ABCD$ intersect each other at the point P. Then, it is always true that
(a) $AP \,.\, BP = CP \,.\, DP$ (b) $AP \,.\, CD = AB \,.\, CP$
(c) $BP.\, AB = CD.\, CP$ (d) $AP \,.\, CP = BP \,.\, DP$

14. If O be the circumcentre of a triangle PQR and $\angle QOR = 110°$, $\angle OPR = 25°$, then the measure of $\angle PRQ$ is
(a) 55° (b) 60° (c) 65° (d) 50°

15. In a triangle, if three altitudes are equal, then the triangle is
(a) Right (b) Isoceles
(c) Obtuse (d) Equilateral

16. In ΔABC, $\angle A + \angle B = 65°$, $\angle B + \angle C = 140°$, then find $\angle B$.
(a) 40° (b) 25° (c) 35° (d) 20°

17. In ΔABC, $DE \parallel AC$. D and E are two points on AB and CB respectively. If $AB = 10$ cm and $AD = 4$ cm, then BE: CE is
(a) 2 : 3 (b) 2 : 5 (c) 5 : 2 (d) 3 : 2

18. A, B and C are the three points on a circle such that the angles subtended by the chords AB and AC at the centre O are 90° and 110° respectively. $\angle BAC$ is equal to
(a) 70° (b) 80° (c) 90° (d) 100°

19. Two isosceles triangles have equal vertical angles and their areas are in the ratio 9:16. Then the ratio of their corresponding heights is:
(a) 4.5 : 8 (b) 8 : 4.5 (c) 3 : 4 (d) 4 : 3

20. The perimetres of two similar triangles are 30 cm and 20cm respectively. If one side of the first triangle is 9cm. Determine the corresponding side of the second triangle:
(a) 15 cm (b) 5 cm (c) 6 cm (d) 13.5 cm

21. The diagonal of a quadrilateral shaped field is 24m and the perpendiculars dropped on it from the remaining opposite vertices are 8m and 13m. The area of the field is:
(a) 252 m^2 (b) 1152 m^2
(c) 96 m^2 (d) 156 m^2

22. Two circles of radii 5 cm and 3 cm touch externally, then the ratio in which the direct common tangent to the circles divides externally the line joining the centres of the circles is :
(a) 2.5 : 1.5 (b) 1.5 : 2.5
(c) 3 : 5 (d) 5 : 3

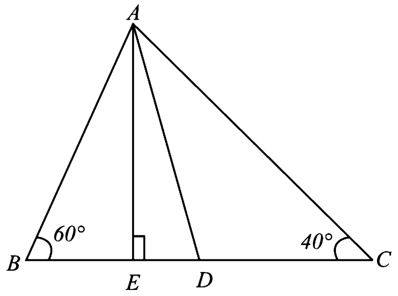
23. A tangent is drawn to a circle of radius 6cm from a point situated at a distance of 10 cm from the centre of the circle. The length of the tangent will be
(a) 4 cm (b) 5 cm (c) 8 cm (d) 7 cm

24. Internal bisectors of $\angle Q$ and $\angle R$ of ΔPQR intersect at O. If $\angle ROQ = 96°$ then the value of $\angle RPQ$ is :
(a) 12° (b) 6° (c) 36° (d) 24°

25. If the measure of three angles of a triangle are in the ratio 2 : 3 : 5, then the triangle is :
(a) equilateral (b) isocsceles
(c) Obtuse angled (d) right angled

Hints & Solutions

1. (c)



In ΔABC, $\angle A + \angle B + \angle C = 180°$

$\angle A + 60° + 40° = 180°$

$\angle A = 180° - 60° - 40° = 80°$

AD bisects $\angle BAC$

$\therefore \quad \angle A = \angle BAD + \angle DAC$

$\angle BAD = \angle DAC = 40°$

Now, In ΔABE

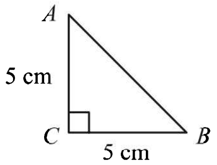
$\angle B + \angle E + \angle BAE = 180°$

$60° + 90° + \angle BAE = 180°$

$\angle BAE = 30°$

$\therefore \quad \angle EAD = \angle BAD - \angle BAE = 40° - 30° = 10°$

2. (c) ΔABC is an isosceles triangle.
Therefore, $AC = BC = 5$ cm
Now, $AB^2 = AC^2 + BC^2$
$AB^2 = 5^2 + 5^2$
$\Rightarrow \quad \sqrt{25+25} = 5\sqrt{2}$ cm



3. (a) In a right angled Δ, the length of circumradius is half the length of hypotenuse.

$\therefore \quad H^2 = 6^2 + 8^2$

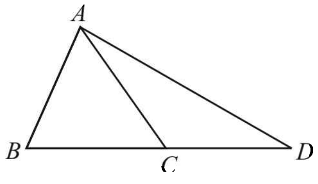
$H^2 = 36 + 64 \Rightarrow 100$

$H = 10$ cm

Circumradius = 5 cm

4. (a) $\angle BPC = 90° - \dfrac{A}{2} = 90° - 40° = 50°$

5. (d) $\angle ACB = 80°$



$\angle ACD = 180° - 80° = 100°$

$\therefore \quad \angle CAD = \angle CDA = \dfrac{80}{2} = 40°$

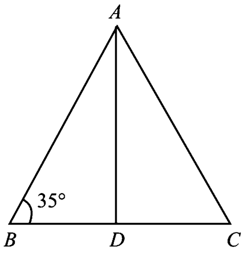
$\angle BAC = 111° - 40° = 71°$

$\angle ABC = 180° - 71° - 80° = 29°$

6. (d) $\angle A + \angle B + \angle C = 180°$
$3\angle C + 5\angle C + \angle C = 180°$
$9\angle C = 180°$
$\angle C = 20°, \angle B = 100°$

7. (a) From the definition of the orthocentre it is a point of intersections of altitude.

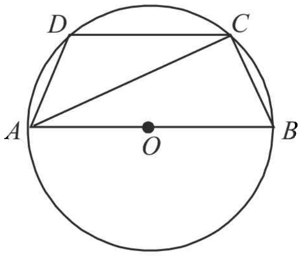
8. (a)



$AB = AC \qquad \therefore \quad \angle ABC = \angle ACB = 35°$

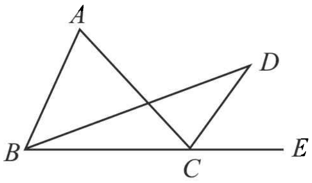
$\therefore \quad \angle ADB = 90° \quad \therefore \quad \angle BAD = 55°$

9. (b)



$\angle ACB = 90°$ (Angle in semi–circle)
$\angle CAB = 30° \quad \therefore \quad \angle CBA = 180° - 90° - 30° = 60°$
$\angle ADC + \angle ABC = 180°$
$\therefore \quad \angle ADC = 180° - 60° = 120°$

10. (a)



$\angle ACE = \angle BAC + \angle ABC$ ...(i)

$\angle DCE = \angle DBC + \angle BDC = \angle DBC + 50°$

$\Rightarrow \quad \dfrac{\angle ACE}{2} = \dfrac{\angle B}{2} + 50°$

$\angle ACE = \angle B + 100$ ...(ii)

From (i) and (ii) $\angle BAC = 100°$

11. (b) $AE = 15$ cm

$OA = 17$ cm

$\therefore \quad OE = \sqrt{17^2 - 15^2}$

$= \sqrt{(17+15)(17-15)}$

$= \sqrt{32 \times 2} = 8$ cm

$CF = 8$ cm

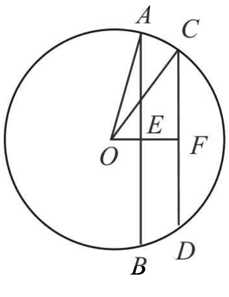
$OC = 17$ cm

$\therefore \quad OF = \sqrt{17^2 - 8^2}$

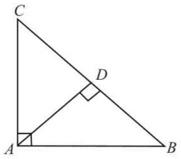
$= \sqrt{(17+8)(17-8)} = \sqrt{25 \times 9} = 15$ cm

Difference between chord

$EF = OF - OE = 15 - 8 = 7$ cm



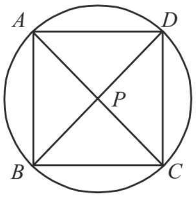
12. (b)



$\angle A = 90°, \angle C = 55° \quad \therefore \quad \angle B = 90° - 55° = 35°$

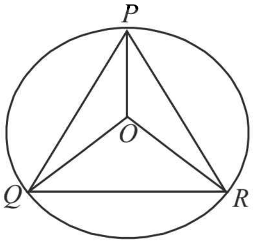
$\angle ADB = 90° \quad \therefore \quad \angle BAD = 90° - 35° = 55°$

13. (d)



Here, AC and BD are chords of the circle. So, by theorem $AP \,.\, CP = BP \,.\, DP$

14. (b) $\angle QOR = 110°$



$\angle OPR = 25°$

$\therefore \quad \angle QPR = 110° \div 2 = 55°$

$OR = OP$

$\therefore \quad \angle OPR = \angle PRO = 25°$

$\therefore \quad \angle OQR = \angle ORQ$

$= \frac{70}{2} = 35°$

$\therefore \quad \angle PRQ = 25° + 35° = 60°$

15. (d) Triangle will be equilateral.

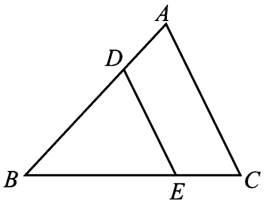
16. (b) $\angle A + \angle B = 65°$

$\therefore \quad \angle C = 180° - 65° = 115°$

$\angle B + \angle C = 140°$

$\therefore \quad \angle B = 140° - 115° = 25°$

17. (d) $DE \,||\, AC$



$\Delta ABC \sim \Delta DBE$

$\therefore \quad \frac{AB}{BD} = \frac{BC}{BE}$

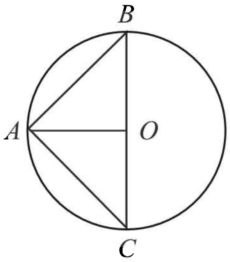
$\Rightarrow \quad \frac{AB}{BD} - 1 = \frac{BC}{BE} - 1$

$\Rightarrow \quad \frac{AD}{BD} = \frac{CE}{BE} \Rightarrow \frac{BD}{AD} = \frac{BE}{CE}$

$\Rightarrow \quad \frac{10-4}{4} = \frac{BE}{CE}$

$\Rightarrow \quad \frac{BE}{CE} = \frac{3}{2}$

18. (b) $\angle AOB = 90°$; $OA = OB = r$



$\therefore \quad \angle BAO = \angle ABO = 45°$

and, $\angle AOC = 110°$;

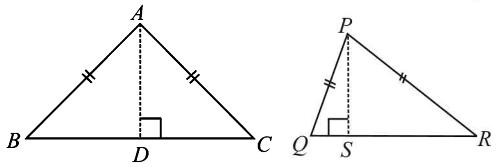
$OA = OC = r$

$\therefore \quad \angle OAC = \angle OCA$

$= \frac{70}{2} = 35°$

$\therefore \quad \angle BAC = 45° + 35° = 80°$

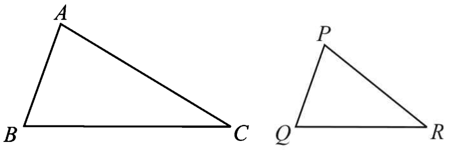
19. (c)



$$\frac{\text{Perimeter } \Delta ABC}{\text{Perimeter } \Delta PQR} = \frac{(AD)^2}{(PS)^2}$$

$$\frac{AD}{PS} = \sqrt{\frac{9}{16}} = \frac{3}{4}$$

20. (c)

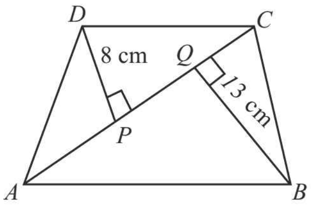


$$\frac{\text{Perimeter } \Delta ABC}{\text{Perimeter } \Delta PQR} = \frac{AB}{PQ}$$

$$\frac{30}{20} = \frac{9}{PQ}$$

$$PQ = \frac{20 \times 9}{30} = 6 \text{ cm}$$

21. (a) In ΔADC



Area of $\Delta\, ADC$

$= \frac{1}{2} \times DP \times AC$

Area of ΔADC

$= \frac{1}{2} \times 8 \times 24 = 96 \text{ m}^2$

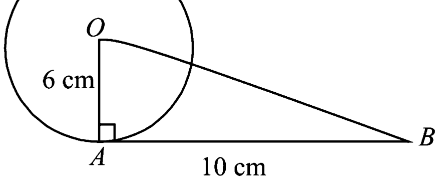
Area of $\Delta BAC = \frac{1}{2} \times 13 \times 24 = 156 \text{ m}^2$

Area of Quadrilateral $= 96 + 156 = 252 \text{ m}^2$

22. (d) Using property of direct common tangent

Required ratio = Ratio of radii = 5 : 3

23. (c)

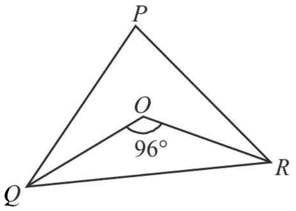


$AB^2 + OA^2 = OB^2$

$AB^2 = (10)^2 - (6)^2 = 100 - 36 = 64$

$AB = 8$ cm

24. (a) $\angle QPR = 90 + \frac{\angle P}{2}$



$\Rightarrow \quad 96° = 90° + \frac{\angle P}{2}$

$\Rightarrow \quad \frac{\angle P}{2} = 6°$

$\therefore \quad \angle P = 12°$

25. (d) Sum of the angle of a triangle = 180°

$\Rightarrow \quad 2x° + 3x° + 5x° = 180° \quad \Rightarrow \quad 10x° = 180°$

$x° = 18°$

Angle are = 36°, 54°, 90° So, this is right angled triangle.

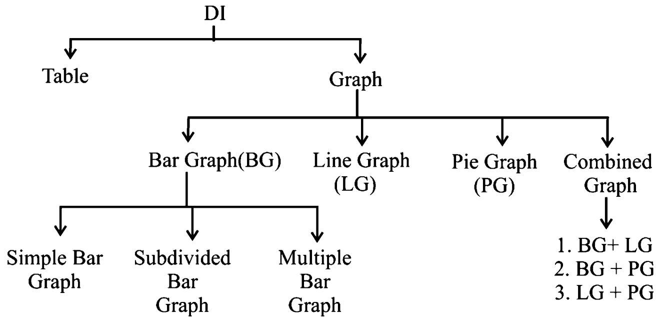
Chapter 17

Data Interpretation

INTRODUCTION

Data Interpretation questions are based on the information given in the tables and graphs.

Classification of Data Interpretation



Table

A table is one of the easiest way for summarising data.

A statistical table is the logical listing of related quantitative data in vertical columns and horizontal rows of numbers with sufficient explanatory and qualifying words, phrases and statements in the form of heading and notes to make clear the meaning of data.

Graph

Graphs are a convenient way to represent information. The graphs should be labelled properly to show what part of the graphs shows what a value.

Bar Graph

Bar diagram consists of a number of equidistant rectangles. One for each category of the data in which the magnitudes are represented by the length or height of rectangle, whereas width of rectangles are immaterial. Thus, a bar is just one dimensional as only the length of the bar is to be considered and not the width. All the bars drawn in a diagram are generally of uniform width which depends on the number of bars to be constructed and the availability of the space.

Line Graph (LG)

Very often the quantity is measured as time changes. LG are used to show how a quantity changes. If the line goes up, the quantity is increasing and the line goes down, the quantity is decreasing. If the line is horizontal, the quantity is not changing.

Pie Graph (PG)

It is a pictorial representation of numerical data by non-intersecting adjacent sectors of a circle. Central angle of each sector is proportional to the magnitude of the data represented by the sector.

Value of central angle of the sector representing 1% of total value of the data = $\frac{360^\circ}{100} = 3.6^\circ$

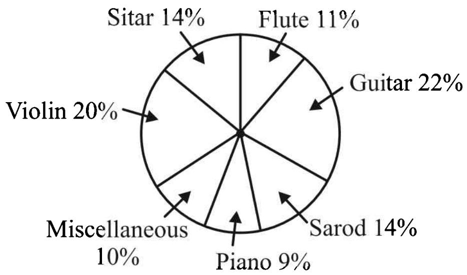
The % of components parts can be converted to central angle in degree of the sector repersenting this components part by multiplying 3.6°.

Central angle in degree of any component part which is $x\%$ If the total value of data $= 3.6x^\circ$.

EXERCISE

DIRECTIONS (Qs. 1 - 5) : *Read the following chart and answer the questions that follows*

The following pie-chart shows the preference of musical instruments of 60,000 people surveyed over whole India.



1. If 2100 people be less from the number of people who prefer Flute, the percentage of people who prefer Flute would have been:

(a) 9.5% (b) 6.5%
(c) 7.5% (d) 8.5%

2. The total number of people who prefer either Sarod or Guitar, is greater than the total number of people who prefer either Violin or Sitar by:

(a) 1200 (b) 1600 (c) 1100 (d) 1400

3. The number of people who prefer the musical instrument Sarod is:

(a) 7400 (b) 8400 (c) 6400 (d) 8600

4. If $16\frac{2}{3}\%$ of the people who prefer Piano, would go with the people who prefers Flute, the percentage of people who prefer Flute would have been :

(a) 13.5% (b) 14.5% (c) 15.5% (d) 12.5%

5. The number of people who prefer Guitar is greater than the total number of people who prefer either Flute or Piano by:

(a) 1200 (b) 1100 (c) 1300 (d) 1400

DIRECTIONS (Qs. 6 - 9) : *The following table shows the productions of food-grains (in million tons) in a state for the period 1999 - 2000 to 2003 - 2004. Read the table and answer the questions.*

Years	**Production (in million tons)**			
	Wheat	**Rice**	**Barley**	**Other cereals**
1999-2000	680	270	250	450
2000-2001	800	420	440	300
2001-2002	680	350	320	460
2002-2003	720	400	380	500
2003-2004	820	560	410	690

6. In 2002 - 2003, the percentage increase in the production of barley as compared to the previous year was:

(a) 14.20% (b) 17.85% (c) 18.75% (d) 7.90%

7. During the period 1999 - 2000 to 2003 - 2004, *x* per cent of the total production is production of wheat. The value of x is about:

(a) 12.6% (b) 37.37%
(c) 37.8% (d) 20.2%

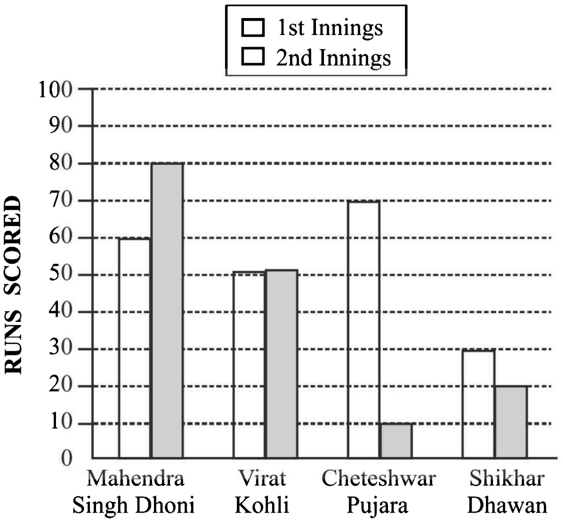
8. In the year 2003 - 2004, the increase in production was maximum over the previous year for:

(a) Rice (b) Barley
(c) Other cereals (d) Wheat

9. The difference of average production of rice and the average production of barley over the years is :

(a) 50 (b) 60
(c) 80 (d) 40

DIRECTIONS (Qs. 10-13) : *Given here a multiple bar diagram of the scores of four players in two innings. Study the diagram and answer the questions.*



10. The average runs of two innings of the player who scored highest in average is :

(a) 75 (b) 85
(c) 80 (d) 70

11. The average runs in two innings of the player who has scored minimum at the second innings is :

(a) 50 (b) 60
(c) 40 (d) 30

12. The average score in second innings contributed by the four players is :

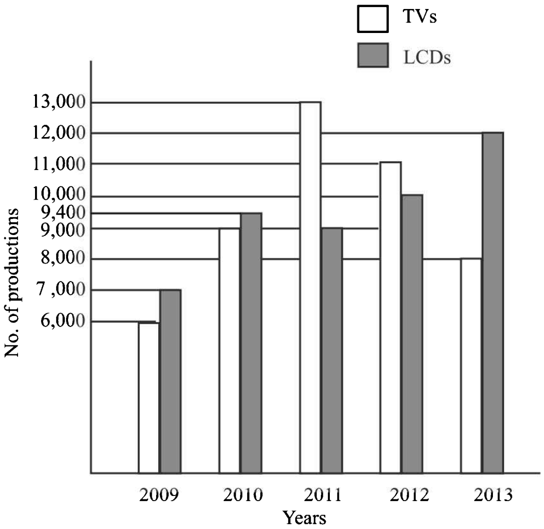
(a) 30 (b) 60
(c) 40 (d) 50

13. The total scores in the first innings contributed by the four players is :

(a) 220 (b) 200
(c) 210 (d) 190

DIRECTIONS (Qs. 14-17) : *Study the following bar diagram carefully and answer the following Four Questions.*

The number of the production of electronic items (TVs and LCDs) in a factory during the period from 2009 to 2013.



14. The total number of production of electronic items is maximum in the year
(a) 2009
(b) 2010
(c) 2011
(d) 2013

15. The ratio of production of LCDs in the year 2011 and 2013 is
(a) 3 : 4 (b) 4 : 3
(c) 2 : 3 (d) 1 : 4

16. The difference between averages of production of TVs and LCDs from 2009 to 2012 is
(a) 600
(b) 700
(c) 800
(d) 900

17. The ratio of production of TVs in the years 2009 and 2010 is
(a) 7 : 6
(b) 6 : 7
(c) 2 : 3
(d) 3 : 2

Hints & Solutions

1. **(c)** No. of people who prefer flute = 11% of 60,000

$= \frac{11}{100} \times 60000 = 6600$

2100 people be less from the people who prefer flute.
Therefore, 6600 – 2100 = 4500

Required percentage = $\frac{4500}{60000} \times 100 = 7.5\%$

2. **(a)** Total number of people who prefer either Sarod or Guitar = 14% of 60000 + 22% of 60000

$\Rightarrow$ 8400 + 13200 = 21600

Total number of people of who prefer violin or Sitar = 20% of 60000 + 14% of 60000

$\Rightarrow$ 12000 + 8400 = 20400

Required difference = 21600 – 20400 = 1200

3. **(b)** Required number = 14% of 60000

$= \frac{14}{100} \times 60000 = 8400$

4. **(d)** No. of people who prefer piano = 9% of 60000 = 5400

According to question, $16\frac{2}{3}\%$ no. of the people who prefer piano would go with flute.

Therefore, $\frac{50}{3}\%$ of 5400 = 900

Hence, the required percentage

$= \frac{900 + 11\% \text{ of } 60000}{60000} \times 100$

$= \frac{900 + 6600}{60000} \times 100 = 12.5\%$

5. **(a)** No. of people who prefer guitar

= 22% of 60000 = 13200

No. of people who prefer Flute or Piano = (11 + 9)% of 60000 = 12000

Required difference = 13200 – 12000 = 1200.

6. **(c)** Percent increase = $\frac{380 - 320}{320} \times 100 = 18.75\%$

7. **(b)** **Total production:**

Wheat $\Rightarrow$ 3700 million tonnes
Rice $\Rightarrow$ 2000 million tonnes
Barley $\Rightarrow$ 1800 million tonnes
Other cereals $\Rightarrow$ 2400 million tonnes

Total production of all products
= 3700 + 2000 + 1800 + 2400 = 9900
and production of wheat = 3700

$\therefore$ ATQ, x % of 9900 = 3700

$\frac{x}{100} \times 9900 = 3700, x = \frac{370000}{9900}$

$x = 37.37\%$

8. **(a)** Percentage increase:

Rice = $\frac{160}{400} \times 100 = \boxed{40}$

Other Cereals = $\frac{190}{500} \times 100 = 38$

Barley = $\frac{30}{380} \times 100 = 7.8$

Wheat = $\frac{100}{720} \times 100 = 13.8$

9. **(d)** Required difference = $\frac{2000}{5} - \frac{1800}{5} = 400 - 360$

= 40 million tonnes

10. **(d)** Highest Average in two Innings = $\frac{60+80}{2} = 70.$

11. **(c)** Less score in second innings by player pujara = 10

Average score in two innings = $\frac{70+10}{2} = 40$

12. **(c)** Average score in second Innings

$= \frac{80+50+10+20}{4} = \frac{160}{4} = 40.$

13. **(c)** Total score in Ist Innings = 60 + 50 + 70 + 30 = 210.

14. **(c)** Production of electronic items maximum in 2011 i.e. 13,000 + 9,000 = 22,000

15. **(a)** Production of LCD in 2011 = 9,000
Production of LCD in 2013 = 12,000

Ratio = $\frac{9,000}{12,000} = \frac{3}{4}$

16. **(d)** Total production of TV from 2009 to 2012 = 39,000
Average of TV production = 9,750
Total production of LCD from 2009 to 2012 = 35,400
Average of LCD production = 8,850
Their difference = 9,750 – 8,850 = 900

17. **(c)** Ratio of production of TV = $\frac{6,000}{9,000} = 2 : 3$

Chapter 18

Permutations & Combinations & Probability

PERMUTATION & COMBINATION

Permutation is the different arrangement of a given number of things by taking some or all at a time and on the other hand **combinations** are the selection which can be done by taking some or all from a number of objects.

FUNDAMENTAL PRINCIPLE OF COUNTING

Multiplication Principle

If a certain task can be done in 'm' different ways; followed by an another task in 'n' different ways, then the two operations in succession can be performed in $m \times n$ ways. This can be extended to any finite number of tasks.

Illustration – 1

A person wants to go from station P to station R via station Q. There are 4 routes from P to Q and 5 routes from Q to R. In how many ways can he travel from P to R via Q?

Solution : He can go from P to Q in 4 ways and Q to R in 5 ways. So number of ways of travel from P to R via Q is $4 \times 5 = 20$.

Illustration – 2

A college offers 6 courses in the morning and 4 in the evening. Find the possible number of choices with the student if he wants to study one course in the morning and one in the evening.

Solution : The college has 6 courses in the morning out of which the student can select one course in 6 ways.

In the evening the college has 4 courses out of which the student can select one in 4 ways.

Hence the required number of ways $= 6 \times 4 = 24$.

Illustration – 3

In how many ways can 5 prizes be distributed among 4 boys when every boy can take one or more prizes ?

Solution : First prize may be given to any one of the 4 boys, hence first prize can be distributed in 4 ways.

Similarly every one of second, third, fourth and fifth prizes can also be given in 4 ways.

$\therefore$ The number of ways of their distribution

$= 4 \times 4 \times 4 \times 4 \times 4 = 4^5 = 1024$

Addition Principle

If a certain task can be done in 'm' different ways and an another task, which is independent of the first task, can be done in 'n' different ways. Then either of the two operations can be performed in $(m + n)$ ways. This can be extended to any finite number of independent operations.

Illustration – 4

A college offers 6 courses in the morning and 4 in the evening. Find the number of ways a student can select exactly one course, either in the morning or in the evening.

Solution : The college has 6 courses in the morning out of which the student can select one course in 6 ways.

In the evening the college has 4 courses out of which the student can select one in 4 ways.

Hence the required number of ways $= 6 + 4 = 10$.

Illustration – 5

A person wants to leave station Q. There are 4 routes from station Q to P and 5 routes from Q to R. In how many ways can he travel from the station Q ?

Solution : He can go from Q to P in 4 ways and Q to R in 5 ways. To go from Q to P and Q to R are independent to each other. Hence the person can leave station Q in $4 + 5 = 9$ ways.

Note that whenever the concept in the question is the same as 'and' we will use multiplication and whenever the concept is same as 'or' we will use addition.

FACTORIALS

If n is a natural number then the product of all natural numbers upto n is called **factorial** n and it is denoted by $n\,!$ or

Thus, $n\,! = n(n-1)(n-2)\,.....\,3.2.1$

Note that $0! = 1 = 1!$

$$\begin{aligned} n! &= n(n-1)! \\ &= n(n-1)(n-2)! \\ &= n(n-1)(n-2)(n-3)!, \text{ etc.} \end{aligned}$$

For example : $6! = 6 \times 5 \times 4 \times 3 \times 2 \times 1$

But $4! = 4 \times 3 \times 2 \times 1$

$\therefore$ $6! = 6 \times 5 \times 4!$ or $6 \times 5 \times 4 \times 3!$

Remember that

$0\,! = 1, 1\,! = 1, 2\,! = 2, 3\,! = 6, 4\,! = 24, 5\,! = 120, 6\,! = 720$, etc.

MEANING OF PERMUTATION AND COMBINATION

Each of the different arrangements which can be made by taking some or all of a number of things is called a **permutation**.

Note that in an arrangement, the order in which the things arranged is considerable i.e., arrangement *AB* and *BA* of two letters *A* and *B* are different because in *AB*, *A* is at the first place and *B* is at the second place from left whereas in *BA*, *B* is at the first place and *A* is at the second place.

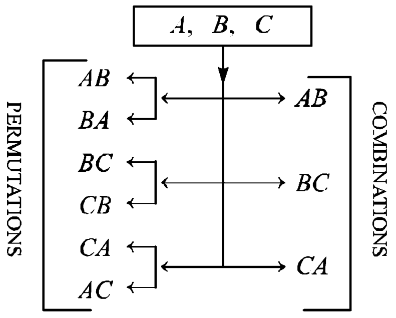
The all different arrangements of three letters *A*, *B* and *C* are *ABC*, *ACB*, *BCA*, *BAC*, *CAB* and *CBA*.

Here each of the different arrangements *ABC*, *ACB*, *BCA*, *BAC*, *CAB* and *CBA* is a *permutation* and number of different arrangement i.e. 6 is the *number of permutations*.

ABC, *ACB*, *BCA*, *BAC*, *CAB* and *CBA* are different arrangements of three letters *A*, *B* and *C*, because in each arrangement, order in which the letters arranged, is considered. But if the order in which the things are arranged is not considered; then *ABC*, *ACB*, *BCA*, *BAC*, *CAB* and *CBA* are not different but the same.

As in arrangements, order in which things are arranged is considered. Hence all arrangements of two letters out of the three letters *A*, *B* and *C* are *AB*, *BA*, *BC*, *CB*, *CA* and *AB*.

∴ Number of permutations (or arrangements) of two letters out of three letters *A*, *B* and *C* = 6.



Each of the different selections or groups which can be made by some or all of a number of given things without consideration of the order of things in any selection or group is called a **combination**.

As in selection order in which things are selected is not considered; hence, selections of two letters *AB* and *BA* out of three letters *A*, *B* and *C* are the same. Similarly selections of *BC* and *CB* are the same. Also selections of *CA* and *AC* are the same.

Hence selection of two letters out of the three letters *A*, *B* and *C* can be made as *AB*, *BC* and *CA* only.

Number of combinations (or groups) of two letters out of three letters *A*, *B* and *C* = 3.

You can easily identify the given problem is of permutation or combination (where the word permutation or combination is not mentioned) using the following classifications of problems:

Problems of Permutations

(i) Problems based on arrangements
(ii) Problems based on standing in a line
(iii) Problems based on seated in a row
(iv) Problems based on digits
(v) Problems based on arrangement letters of a word
(vi) Problems based on rank of a word (in a dictionary)

Problems of Combinations

(i) Problems based on selections or choose
(ii) Problems based on groups or committee
(iii) Problems based on geometry

If in any problem, it is neither mentioned that the problem is of permutation or combination nor does the problem fall in the categories mentioned above for the problems of permutations or problems of combinations, then you think whether arrangement (i.e. order) is considerable or not? If arrangement (i.e., order) is considerable in the given problem, then the problem is of permutation otherwise it is of combination.

COUNTING FORMULA FOR LINEAR PERMUTATIONS

Without Repetition

1. Number of permutations of n different things, taking r at a time is denoted by ${}^nP_r$ or $P(n, r)$, which is given by

$${}^nP_r = \frac{n!}{(n-r)!}\ (0 \le r \le n),$$

where n is a natural number and r is a whole number.

2. Number of arrangements of n different objects taken all at a time is ${}^nP_n = n\,!$

Note : ${}^nP_1 = n$ and ${}^nP_n = {}^nP_{n-1}$

Illustration – 6

Find the number of ways in which four persons can sit on six chairs.

Solution : ${}^6P_4 = 6.5.4.3 = 360$

With Repetition

1. Number of permutations of n things taken all at a time, if out of n things p are alike of one kind, q are alike of second kind, r are alike of a third kind and the rest $n - (p + q + r)$ are all different is $\dfrac{n!}{p!\,q!\,r!}$

2. Number of permutations of n different things taken r at a time when each thing may be repeated any number of times is n^r.

Illustration – 7

Find the number of words that can be formed out of the letters of the word COMMITTEE taken all at a time.

Solution : There are 9 letters in the given word in which two T's, two M's and two E's are identical. Hence the required number of

words $= \frac{9!}{2!2!2!} = \frac{9!}{(2!)^3} = \frac{9!}{8} = 45360$

Number of Linear Permutations under Certain Conditions

1. Number of permutations of n different things taken all together when r particular things are to be placed at some r given places $= {}^{n-r}P_{n-r} = (n-r)!$
2. Number of permutations of n different things, taken r at a time, when a particular thing is to be always included in each arrangement, is $r.\ {}^{n-1}P_{r-1}$.

Illustration – 8

How many different words can be formed with the letters of the word 'JAIPUR' which start with '*A*' and end with '*I*'?

Solution : After putting A and I at their respective places (only in one way) we shall arrange the remaining 4 different letters at 4 places in 4! ways. Hence the required number = 1 × 4! = 24.

Illustration – 9

How many different 3 letter words can be formed with the letters of word 'JAIPUR' when *A* and *I* are always to be excluded?

Solution : After leaving A and I, we are remained with 4 different letters which are to be used for forming 3 letters words.
Hence the required number
$= {}^4P_3 = 4 \times 3 \times 2 = 24$.

CIRCULAR PERMUTATIONS

Total number of ways in which n different things can be arranged in a circle = $(n-1)!$

For example: If six persons are to be seated on a circular table for dinner, the number of ways of doing so is (6–1)! = 5! = 5×4×3×2×1 = 120 ways.

COUNTING FORMULA FOR COMBINATION

1. **Selection of Objects Without Repetition**

The number of combinations or selections of n different things taken r at a time is denoted by ${}^nC_r$ or $C(n, r)$ or $C\binom{n}{r}$

where ${}^nC_r = \frac{n!}{r!(n-r)!}$; $(0 \le r \le n)$,

where n is a natural number and r is a whole number.

Some Important Results

(i) ${}^nC_n = 1$ **(ii)** ${}^nC_0 = 1$ **(iii)** ${}^nC_r = {}^nC_{n-r}$

Illustration – 10

How many different 4-letter words can be formed with the letters of the word 'JAIPUR' when *A* and *I* are always to be included ?

Solution : Since A and I are always to be included, so first we select 2 letters from the remaining 4, which can be done in ${}^4C_2 =$ 6 ways. Now these 4 letters can be arranged in 4! = 24 ways, So the required number
$= 6 \times 24 = 144$.

Illustration – 11

How many combinations of 4 letters can be made of the letters of the word 'JAIPUR' ?

Solution : Here 4 things are to be selected out of 6 different things. ∴ number of combinations $= {}^6C_4 = \frac{6.5.4.3}{4.3.2.1} = 15$

2. Selection of Objects with Repetition

The total number of selections of r things from n different things when each thing may be repeated any number of times is ${}^{n+r-1}C_r$

3. Restricted Selection

(i) Number of combinations of n different things taken r at a time when k particular things always occur is ${}^{n-k}C_{r-k}$

(ii) Number of combinations of n different things taken r at a time when k particular things never occur is ${}^{n-k}C_r$.

4. Selection From Distinct Objects

Number of ways of selecting at least one thing from n different things is

${}^nC_1 + {}^nC_2 + {}^nC_3 + \ldots\ldots + {}^nC_n = 2^n - 1$.

This can also be stated as the total number of combination of n different things is $2^n - 1$.

Illustration – 12

Ramesh has 6 friends. In how many ways can he invite one or more of them at a dinner ?

Solution : He can invite one, two, three, four, five or six friends at the dinner. So total number of ways of his invitation

$= {}^6C_1 + {}^6C_2 + {}^6C_4 + {}^6C_5 + {}^6C_6 = 2^6 - 1 = 63$

DIVISION AND DISTRIBUTION OF OBJECTS

1. The number of ways in which $(m + n)$ different things can be divided into two groups which contain m and n things respectively is

$$^{m+n}C_m \, ^nC_n = \frac{(m+n)!}{m!n!}, \ m \neq n$$

Particular case:

When $m = n$, then total number of ways is $\frac{(2m)!}{(m!)^2}$, when order of groups is considered and $\frac{(2m)!}{2!(m!)^2}$, when order of groups is not considered.

2. The number of ways in which $(m + n + p)$ different things can be divided into three groups which contain m, n and p things respectively is

$$^{m+n+p}C_m \cdot {}^{n+p}C_p \cdot {}^pC_p = \frac{(m+n+p)!}{m!n!p!}, \ m \neq n \neq p$$

Particular case:

When $m = n = p$, then total number of ways is $\frac{(3m)!}{(m!)^3}$, when order of groups is considered and $\frac{(3m)!}{3!(m!)^3}$, when order of groups is not considered.

3. (i) Total number of ways to divide n identical things among r person is $^{n+r-1}C_{r-1}$
   (ii) Also total number of ways to divide n identical things among r persons so that each gets atleast one is $^{n-1}C_{r-1}$.

Illustration – 13

In how many ways 20 identical mangoes may be divided among 4 persons if each person is to be given at least one mango?

Solution : If each person is to be given at least one mango, then number of ways will be

$^{20-1}C_{4-1} = {}^{19}C_3 = 969.$

IMPORTANT RESULTS ABOUT POINTS

1. If there are n points in a plane of which m ($< n$) are collinear, then
   (i) Total number of different straight lines obtained by joining these n points is $^nC_2 - {}^mC_2 + 1$.
   (ii) Total number of different triangles formed by joining these n points is $^nC_3 - {}^mC_3$
2. Number of diagonals of a polygon of n sides is $^nC_2 - n$ *i.e.*, $\frac{n(n-3)}{2}$
3. Given n points on the circumference of a circle, then
   (i) Number of straight lines obtained by joining these n points $= {}^nC_2$
   (ii) Number of triangles obtained by joining these n points $= {}^nC_3$
   (iii) Number of quadrilaterals obtained by joining these n points $= {}^nC_4$

FINDING THE RANK OF A WORD

We can find the rank of a word out of all the words with or without meaning formed by arranging all the letters of a given word in all possible ways when these words are listed as in a dictionary. You can easily understand the method to find the above mentioned rank by the following illustrations.

Illustration – 14

If the letters of the word RACHIT are arranged in all possible ways and these words (with or without meaning) are written as in a dictionary, then find the rank of this word RACHIT.

Solution : The order of the alphabet of RACHIT is *A*, *C*, *H*, *I*, *R*, *T*.

The number of words beginning with *A* (i.e. the number of words in which *A* comes at first place) is $^5P_5 = 5!$.

Similarly, number of words beginning with *C* is 5!, beginning with *H* is 5! and beginning with *I* is also 5!.

So before *R*, four letters *A*, *C*, *H*, *I* can occur in $4 \times (5!) = 480$ ways.

Now the word RACHIT happens to be the first word beginning with *R*.

$\therefore$ the rank of this word RACHIT $= 480 + 1 = 481$.

Illustration – 15

The letters of the word MODESTY are written in all possible orders and these words (with or without meaning) are listed as in a dictionary then find the rank of the word MODESTY.

Solution : The order of the alphabet of MODESTY is D, E, M, O, S, T, Y.

Number of words beginning with *D* is $^6P_6 = 6!$

Number of words beginning with *E* is $^6P_6 = 6!$

Number of words beginning with *MD* is $^5P_5 = 5!$

Number of words beginning with *ME* is $^5P_5 = 5!$

Now the first word start with *MO* is MODESTY.

Hence rank of the word MODESTY

$= 6! + 6! + 5! + 5! + 5! + 1$

$= 720 + 720 + 120 + 120 + 1 = 1681.$

PROBABILITY

Probability is the most important concept that we use in our day to day life. A mathematically measure of uncertainty is known as **probability**.

In probability, concept of permutation and combination are used, therefore students would need to master the concepts of combination and permutation before starting probability.

CONCEPT OF PROBABILITY

If you go to buy 10 kg of sugar at ₹ 40 per kg, you can easily find the exact price of your purchase is ₹ 400. On the other hand, the shopkeeper may have a good estimate of the number of kg of sugar that will be sold during the day, but it is impossible to predict the exact amount, because the number of kg of sugar that the consumers will purchase during a day is random.

There are various phenomenon in nature, leading to an outcome, which cannot be predicted in advance. **For example**, we cannot exactly predict that

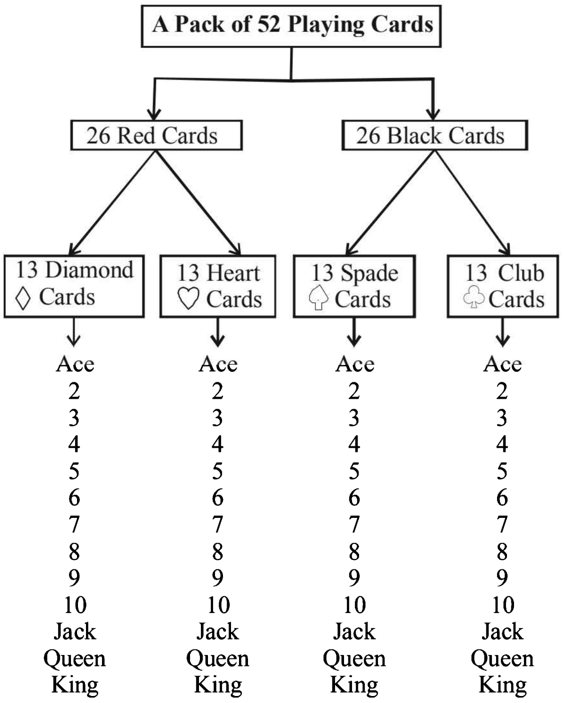
(i) a head will occur on tossing a coin,

(ii) India will win the cricket match against Pakistan, etc. But we can measure the amount of certainty of occurrence of an outcome of a phenomenon. This amount of certainty of occurrence of an outcome of a phenomenon is called **probability**. **For example**, on tossing a coin certainty of occurrence of each of a head and a tail are the same. Hence amount certainty of occurrence of each of a head and a tail is 50% i.e., $\frac{50}{100}=\frac{1}{2}$. Therefore $\frac{1}{2}$ is the amount of certainty of occurrence of a head (or a tail) on tossing a coin and hence $\frac{1}{2}$ is the probability of occurrence of a head (or a tail) on tossing a coin.

On throwing a dice (a dice is a cuboid having one of the numbers 1, 2, 3, 4, 5 and 6 on each of its six faces), certainty of occurrence of each of the numbers 1, 2, 3, 4, 5 and 6 on its top face are the same. Therefore certainty of occurrence of each of the numbers 1, 2, 3, 4, 5 and 6 is $\frac{1}{6}$. Therefore $\frac{1}{6}$ is the amount of certainty of occurrence of each of the numbers 1, 2, 3, 4, 5 or 6 on the top face of the dice on throwing the dice and hence $\frac{1}{6}$ is the probability of occurrence of each of the numbers 1, 2, 3, 4, 5 or 6 on the top face of the dice.

Basic Terms

1. **An Experiment:** An action or operation resulting in two or more outcomes is called an **experiment**.
   For example:
   (i) Tossing of a coin is an experiment because there are two possible outcomes head and tail.
   (ii) Drawing a card from a pack of 52 cards is an experiment because there are 52 possible outcomes.
2. **Sample Space:** The set of all possible outcomes of an experiment is called the **sample space**, denoted by S. An element of S is called a **sample point**.
   For example :
   (i) In the experiment of tossing a coin, the sample space has two points corresponding to head (H) and Tail (T) i.e., $S\{H, T\}$.
   (ii) When we throw a dice then any one of the numbers 1, 2, 3, 4, 5 and 6 will come up. So the sample space, $S = \{1, 2, 3, 4, 5, 6\}$
   (iii) When we throw two coins simultaneously, then sample space, S = {HT, TH, TT, HH}
   (iv) When we throw three coins simultaneously, then sample space, S = {HHT, HTH, THH, HTT, THT, TTH, TTT, HHH}
   (v) When we throw two dice simultaneously then sample space, S = {(1, 1), (1, 2), (1, 3), ..., (1, 6), (2, 1), (2, 2), (2, 3), ..., (2, 6), (3, 1), (3, 2), ..., (3, 6), (4, 1), ..., (4, 6), (5, 1), ..., (5, 6), (6, 1), ..., (6, 6)}



- Diamond, Heart, Spade and Club are called **four suits**.
- Number of Ace cards = 4 (1 Diamond, 1 Heart, 1 Spade, 1 Club)
- Jack, Queen and King are called **Face cards**.
  There are 4 Jacks, 4 Queens and 4 Kings

∴ Number of face cards = 4 + 4 + 4 = 12

Mathematical Definition of Probability

Probability of occuring an event E of an experiment, P(E)

$$= \frac{\text{Number of outcomes favourable to the event E}}{\text{Total number of outcomes}}$$

OR

$$P(E)=\frac{n(E)}{n(S)}$$

Here, n(E) is the number of outcomes favourable to the event and n(S) is the total number of outcomes i.e. number of outcomes in the sample space of the experiment.

- Probability of not occuring an event E = 1 – P(E)

Illustration – 16

Two dice are thrown at a time. Find the probability of the following :

(i) the numbers shown are equal

(ii) the difference of numbers shown is 1

Solution : The sample space in a throw of two dice

S = {(1, 1), (1, 2), ..., (1, 6), (2, 1), (2, 2), ..., (2, 6), (3, 1), ..., (3, 6), (4, 1), ..., (4, 6), (5, 1), ..., (5, 6), (6, 1), ..., (6, 6)}

∴ total no. of outcomes, $n(S) = 36$

(i) Here E_1 = the event of showing equal number on both dice

Favourable outcomes = {(1, 1) (2, 2) (3, 3) (4, 4) (5, 5) (6, 6}

$$\therefore\ n(E_1)=6 \Rightarrow P(E_1)=\frac{n(E_1)}{n(S)}=\frac{6}{36}=\frac{1}{6}$$

(ii) Here E_2 = the event of showing numbers whose difference is 1.

Favourable outcomes t = {(1, 2) (2, 1) (2, 3) (3, 2) (3, 4) (4, 3) (4, 5) (5, 4) (5, 6) (6, 5)}

$$\therefore\quad n(E_2)=10 \Rightarrow P(E_2)=\frac{n(E_2)}{n(S)}=\frac{10}{36}=\frac{5}{18}.$$

Illustration – 17

If three cards are drawn from a pack of 52 cards, what is the chance that all will be queen?

Solution : If the sample space be S, then $n(S)$ = the total number of ways of drawing 3 cards out of 52 cards = ${}^{52}C_3$. Now, if A = the event of drawing three queens, then $n(A)$ = ${}^{4}C_3$

$$\therefore\ P(E)=\frac{n(A)}{n(S)}=\frac{{}^{4}C_3}{{}^{52}C_3}=\frac{4}{\frac{52\times51\times50}{3\times2}}=\frac{1}{5525}$$

Range of Probability of any Event

As the number of favourable outcomes cannot be less than zero (0), $0 \le P(E)$ ...(i)

Also the number of favourable outcomes cannot be greater than the total outcomes

$\therefore\quad P(E) \ge 1$ ...(ii)

From (i) and (ii), $\boxed{0 \le P(E) \le 1}$

Odds Against and Odds in Favour of an Event

(i) Odds in favour of an event

$$=\frac{\text{Number of favourable outcomes}}{\text{Number of unfavourable outcomes}}$$

(ii) Odds against an event

$$=\frac{\text{Number of unfavourable outcomes}}{\text{Number of favourable outcomes}}$$

Illustration – 18

In a single toss of two dice, find the odds against drawing 7 as the sum of numbers on two dice.

Solution : Total number of outcomes = $(6)^2 = 36$

Favourable outcomes = (1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1)

No. of favourable outcomes = 6

No. of unfavourable outcomes = 36 – 6 = 30

Illustration – 19

Find the odds in favours of getting a king when a card is drawn from a well shuffled pack of 52 cards.

Solution : Required probability $=\frac{4}{48}=\frac{1}{12}$.

Mutually Exclusive Events

Any two events are said to be mutually exclusive events if they cannot occur together.

For any two mutually exclusive events A and B

P (A or B) = P(A) + P(B)

and if events A and B are not mutually exclusive, then

P (A or B) = P(A) + P(B) – P(A and B)

In these expressions, P (A or B) represents the probability of either event A happening or event B happening.

Illustration – 20

A bag contains 6 white, 5 black and 4 red balls. Find the probability of getting either a white or a black ball in a single draw.

Solution : Let A = Event that we get a white ball.

B = Event that we get a black ball.

Two events A and B are mutually exclusive.

So, $P(A \text{ or } B)=P(A)+P(B)=\frac{6}{15}+\frac{5}{15}=\frac{11}{15}$.

Illustration – 21

One digit is selected from first 20 positive integers. What is the probability that it is divisible by 3 or 4?

Solution : Let A = Event that the selected number is divisible by 3

B = Event that the selected number isdivisible by 4 Here, the events A and B are not mutually exclusive because 12 is divisible by both 3 and 4.

$\therefore P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

$= \frac{6}{20} + \frac{5}{20} - \frac{1}{20} = \frac{10}{20} = \frac{1}{2}$.

Illustration – 22

The probability that at least one of the events *A* and *B* occurs is 0.7 and they occur simultaneously with probability 0.2. Then $P(\bar{A}) + P(\bar{B}) =$

(a) 1.8 (b) 0.6 (c) 1.1 (d) 0.4

Solution : (c)

We have $P(A \cup B) = 0.7$ and $P(A \cap B) = 0.2$

Now, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$\Rightarrow P(A) + P(B) = 0.9 \Rightarrow 1 - P(\bar{A}) + 1 - P(\bar{B}) = 0.9$

$\Rightarrow P(\bar{A}) + P(\bar{B}) = 1.1$

Independent Events

Two or more events are said to be *independent* if occurrence or non-occurrence of any of them does not influence the probability of occurrence or non-occurrence of other events.

For example: When two cards are drawn one by one from a pack of 52 playing cards with replacement (i.e., the first card drawn is put back in the pack and then the second card is drawn), then the event of occurrence of a king in the first draw and the event of occurrence of a king in the second draw are *independent events* because the occurrence or non-occurrence of a king in first draw does not influence the probability of occurrence or non-occurrence of the king in second draw.

But if the second card is drawn without replacement of first card, then the two events are not independent, because in this case probability of drawing a king in the second draw depends on weather a king is drawn in first draw or not. If a king is drawn in first draw, then probability of drawing a king in second draw will be $\frac{3}{51}$ but if a king is not drawn in first draw, then the probability of drawing a king in second draw will be $\frac{4}{51}$.

- For any two independent events A and B P(A and B) = P(A) × P(B). The above result will be true for any number of independent events
- For any three independent events A, B and C P(A, B and C) = P(A) × P(B) × P(C)

Illustration – 23

A fair coin is tossed repeatedly. If the tail appears on first four tosses, then the probability of the head appearing on the fifth toss equals

(a) $\frac{1}{2}$ (b) $\frac{1}{32}$ (c) $\frac{31}{32}$ (d) $\frac{1}{5}$

Solution : (a) The event that the fifth toss results a head is independent of the event that the first four tosses results tails.

$\therefore$ Probability of the required event = 1/2.

Geometrical Applications

The following statements are axiomatic:

1. If a point is taken at random on a given line segment *AB*, the probability that it fails on a particular segment *PQ* of the line segment is *PQ*/*AB*

   i.e. probability $= \frac{\text{favourable area}}{\text{total area}}$

2. If a point is taken at random on the area *S* which includes an area *P*, the probability that the point falls on *P* is *P*/*S*.

   i.e. probability $= \frac{\text{favourable area}}{\text{total area}}$

Probability Regarding *n* Letters and Their Envelopes

If *n* letters corresponding to *n* envelopes are placed in the envelopes at random, then

Probability that all letters are in right envelopes $= \frac{1}{n!}$

Probability that no letters is in right envelopes

$= \frac{1}{2!} - \frac{1}{3!} + \frac{1}{4!} - \ldots + (-1)^n \frac{1}{n!}$

Probability that exactly *r* letters are in right envelopes

$= \left[\frac{1}{2!} - \frac{1}{3!} + \frac{1}{4!} - \ldots + (-1)^{n-r} \frac{1}{(n-r)!}\right]$

Illustration – 24

There are four letters and four envelopes, the letters are placed into the envelopes at random, find the probability that all letters are placed in the wrong envelopes.

Solution : Since all letters are to be placed in wrong envelopes, hence required probability

$= \left[\frac{1}{2!} - \frac{1}{3!} + \frac{1}{4!}\right] = \frac{1}{2} - \frac{1}{6} + \frac{1}{24} = \frac{3}{8}$.

EXERCISE

1. Two dice are thrown simultaneously. The probability of obtaining a total score of seven is

(a) $\frac{1}{6}$ (b) $\frac{1}{3}$ (c) $\frac{2}{7}$ (d) $\frac{5}{6}$

2. If A and B are two independent events with $P(A) = 0.6, P(B) = 0.3$, then $P(A' \cap B')$ is equal to :

(a) 0.18 (b) 0.28 (c) 0.82 (d) 0.72

3. Anil can kill a bird once in 3 shots. On the assumption that he fires 3 shots, find the probability that the bird is killed.

(a) $\frac{1}{3}$ (b) $\left(\frac{1}{3}\right)^3$ (c) $\frac{19}{27}$ (d) $\frac{8}{9}$

4. A pair of dice is thrown thrice. The probability of throwing doublets at least once is

(a) $\frac{1}{36}$ (b) $\frac{25}{216}$

(c) $\frac{125}{216}$ (d) None of these

5. A die is thrown once. What is the probability of occurrence of an odd number on the upper face?

(a) $\frac{2}{3}$ (b) $\frac{1}{2}$ (c) $\frac{1}{4}$ (d) $\frac{1}{8}$

6. A die is thrown once. Find the probability that 3 or greater than 3 turns up.

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$ (c) $\frac{1}{4}$ (d) $\frac{2}{3}$

7. The probability that the two digit number formed by digits 1, 2, 3, 4, 5 is divisible by 4 is

(a) $\frac{1}{30}$ (b) $\frac{1}{20}$

(c) $\frac{1}{5}$ (d) None of these

8. A card is drawn at random from a pack of 100 cards numbered 1 to 100. The probability of drawing a number which is a square, is

(a) $\frac{1}{10}$ (b) $\frac{1}{100}$ (c) $\frac{9}{10}$ (d) $\frac{90}{100}$

9. The probability that a leap year will have 53 Friday or 53 Saturday, is

(a) $\frac{2}{7}$ (b) $\frac{3}{7}$ (c) $\frac{4}{7}$ (d) $\frac{1}{7}$

10. What is the probability that in a family of 4 children there will be at least one boy?

(a) $\frac{15}{16}$ (b) $\frac{3}{8}$ (c) $\frac{1}{16}$ (d) $\frac{7}{8}$

11. In tossing three coins at a time, what is the probability of getting at most one head?

(a) $\frac{3}{8}$ (b) $\frac{7}{8}$ (c) $\frac{1}{2}$ (d) $\frac{1}{8}$

12. In a single throw with four dice, the probability of throwing seven is

(a) $\frac{4}{6^4}$ (b) $\frac{8}{6^4}$ (c) $\frac{16}{6^4}$ (d) $\frac{20}{6^4}$

13. The probability that the birth days of six different persons will fall in exactly two calendar months is

(a) $\frac{1}{6}$ (b) ${}^{12}C_2 \times \frac{2^6}{12^6}$

(c) ${}^{12}C_2 \times \frac{2^6 - 1}{12^6}$ (d) $\frac{341}{12^5}$

14. Three integers are chosen at random from the first 20 integers. The probability that their product is even, is

(a) $\frac{2}{19}$ (b) $\frac{3}{29}$ (c) $\frac{17}{19}$ (d) $\frac{4}{29}$

15. The probability of getting 10 in a single throw of three fair dice is :

(a) $\frac{1}{6}$ (b) $\frac{1}{8}$ (c) $\frac{1}{9}$ (d) $\frac{1}{5}$

16. A speaks truth in 75% of the cases and B in 80% of the cases. In what percentage of cases are they likely to contradict each other in stating the same fact?

(a) 15% (b) 20% (c) 5% (d) 35%

17. How many words beginning with vowels can be formed with the letters of the word EQUATION?

(a) 25200 (b) 15200 (c) 25300 (d) 35200

18. The number of words that can be formed out of the letters of the word COMMITTEE is

(a) $\frac{9!}{(2!)^3}$ (b) $\frac{9!}{(2!)^2}$ (c) $\frac{9!}{2!}$ (d) 9!

19. How many different letter arrangements can be made from the letter of the word EXTRA in such a way that the vowels are always together?

(a) 48 (b) 60 (c) 40 (d) 30

20. Every body in a room shakes hands with every else. If total number of hand-shaken is 66, then number of persons in the room is

(a) 11 (b) 12 (c) 13 (d) 14

21. The number of words from the letters of the words BHARAT in which B and H will never come together, is

(a) 360 (b) 240

(c) 120 (d) None of these

22. How many different ways are possible to arrange the letters of the word "MACHINE" so that the vowels may occupy only the odd positions?

(a) 800 (b) 125 (c) 348 (d) 576

23. In how many ways a hockey team of eleven can be elected from 16 players?
(a) 4368 (b) 4267 (c) 5368 (d) 4166

24. If a secretary and a joint secretary are to be selected from a committee of 11 members, then in how many ways can they be selected?
(a) 110 (b) 55 (c) 22 (d) 11

25. In a company, each employee gives a gift to every other employee. If the number of gifts is 61, then the number of employees in the company is :
(a) 11 (b) 13 (c) 12 (d) 8

26. Number of ways in which the letters of word GARDEN can be arranged with vowels in alphabetical order, is
(a) 360 (b) 240 (c) 120 (d) 480

27. The number of ways in which a couple can sit around a table with 6 guests if the couple take consecutive seat is
(a) 1440 (b) 720
(c) 5040 (d) None of these

28. How many different words beginning with O and ending with E can be formed with the letters of the word ORDINATE, so that the words are beginning with O and ending with E?
(a) 8! (b) 6! (c) 7! (d) 7!/2!

29. If two dices are tossed simultaneously, the number of elements in the resulting sample space is
(a) 6 (b) 8 (c) 36 (d) 24

30. 4 boys and 2 girls are to be seated in a row in such a way that the two girls are always together. In how many different ways can they be seated?
(a) 1200 (b) 7200 (c) 148 (d) 240

Hints & Solutions

1. **(a)** When two dice are thrown then there are 6 × 6 exhaustive cases $\therefore n = 36$.

Let A denote the event "total score of 7" when 2 dice are thrown then

$A = [(1,6),(2,5),(3,4),(4,3),(5,2),(6,1)]$.

Thus there are 6 favourable cases. $\therefore m = 6$

By definition $P(A) = \dfrac{m}{n}$

$\therefore P(A) = \dfrac{6}{36} = \dfrac{1}{6}$.

2. **(b)** Since, A and B are independent events

$\therefore A'$ and B' are also independent events

$\Rightarrow P(A' \cap B') = P(A').P(B')$

$= (0.4)(0.7) = 0.28$

$[\because P(A') = 1 - P(A),\ P(B') = 1 - P(B)]$

3. **(c)** $P(A) = \dfrac{1}{3}$; $P(\bar{A}) = \dfrac{2}{3}$

P (bird killed) = 1 – P (none of 3 shots hit)

$= 1 - \dfrac{2}{3} \times \dfrac{2}{3} \times \dfrac{2}{3} = \dfrac{19}{27}$.

4. **(d)** Doublets occur when the numbers thrown are (1, 1), (2, 2), ..., (6, 6). Therefore the probability of a doublet occurring in single throw $= \dfrac{6}{36} = \dfrac{1}{6}$.

The probability of a doublet not occurring at all in three throws $= \left(\dfrac{5}{6}\right)^3 = \dfrac{125}{216}$.

Required probability $= 1 - \dfrac{125}{216} = \dfrac{91}{216}$.

5. **(b)** Any of the six numbers 1, 2, 3, 4, 5, 6 may appear on the upper face. ($\therefore n = 6$)

Number of odd numbers = 3, since the odd numbers are 1, 3, 5. ($\therefore m = 3$).

$\therefore$ The required probability

$= \dfrac{\text{number of favourable cases}}{\text{number of all cases}} = \dfrac{m}{n} = \dfrac{3}{6}$

$= \dfrac{1}{2}$

6. **(d)** n = Number of all cases = 6

m = Number of favourable cases = 4 (since the numbers that appear are 3, 4, 5, 6)

$\therefore$ The required probability $= p = \dfrac{m}{n}$

$= \dfrac{4}{6} = \dfrac{2}{3}$

7. **(c)** Given digits are 1, 2, 3, 4, 5

Total no. of 2 digits numbers formed

$= (5)^2 = 25$

Favourable cases are 12, 24, 32, 44, 52

No. of favourable cases = 5

$\therefore$ Required probability $= \dfrac{5}{25} = \dfrac{1}{5}$

8. **(a)** $n(S) = 100$

E = square of terms lies between 1 to 100.

$= 1, 4, 9, 16, 25, 36, 49, 64, 81, 100$

$n(E) = 10$

$\therefore$ Required probability $= \frac{n(E)}{n(S)}$

$= \frac{10}{100} = \frac{1}{10}$

9. **(b)** In a leap year there are 366 days in which 52 weeks and two days. The combination of 2 days may be : Sun-Mon, Mon-Tue, Tue-Wed, Wed-Thu, Thu-Fri, Fri-Sat, Sat-Sun.

P (53 Fri) $= \frac{2}{7}$; P (53 Sat) $= \frac{2}{7}$ and P (53 Fri and 53 Sat) $= \frac{1}{7}$

$\therefore P(\text{53 Fri or Sat}) = P(\text{53 Fri}) + P(\text{53 Sat}) - P(\text{53 Fri and Sat})$

$= \frac{2}{7} + \frac{2}{7} - \frac{1}{7} = \frac{3}{7}$

10. **(a)** Total possibility of 4 children, either girl or boy is 2^4 = 16. Out of these there is one possibility in which there will be no boy and only girls. So, total possibility of at least one boy is 16 – 1 = 15

$\Rightarrow$ P (at least one boy) $= \frac{15}{16}$.

11. **(c)** Possible samples are as follows
{HHH, HTH, HHT, THH, TTH, THT, HTT, TTT}
Let A be the event of getting one head.
Let B be the event of getting no head.
Favourable outcome for

$A = \{TTH, THT, HTT\}$

Favourable outcome for $B = \{TTT\}$

Total no. of outcomes = 8

$\therefore \; P(A) = \frac{3}{8}, \; P(B) = \frac{1}{8}$

$\therefore$ Required probability = Probability of getting one head + Probability of getting no head, = $P(A) + P(B)$

$= \frac{3}{8} + \frac{1}{8} = \frac{4}{8} = \frac{1}{2}$

12. **(d)** Total of seven can be obtained in the following ways

1, 1, 1, 4 in $\frac{4!}{3!} = 4$ ways

[there are four objects, three repeated]
Similarly,

1, 1, 2, 3 in $\frac{4!}{2!} = 12$ ways

1, 2, 2, 2 in $\frac{4!}{3!} = 4$ ways

Hence, required probability

$= \frac{4+12+4}{6^4} = \frac{20}{6^4}$

[$\because$ Exhaustive no. of cases $= 6 \times 6 \times 6 \times 6 = 6^4$]

13. **(d)** Exhaustive number of cases = 12
Favourable cases = ${}^{12}C_2\,(2^6 - 2)$

$\therefore$ Probabiltity $= \frac{{}^{12}C_2(2^6 - 2)}{12^6} = \frac{341}{12^5}$

14. **(c)** The total number of ways in which 3 integers can be chosen from first 20 integers is ${}^{20}C_3$.
The product of three integers will be even if at least one of the integers is even. Therfore, the required probability
= 1 – Prob.
So that none of the three integers is even

$= 1 - \frac{{}^{10}C_3}{{}^{20}C_3} = 1 - \frac{2}{19} = \frac{17}{19}$.

[Three odd integers can be chosen in ${}^{10}C_3$ ways as there are 10 even and 10 odd integers.]

15. **(b)** Exhaustive no. of cases $= 6^3$
10 can appear on three dice either as distinct number as following (1, 3, 6) ; (1, 4, 5); (2, 3, 5) and each can occur in 3! ways. Or 10 can appear on three dice as repeated digits as following (2, 2, 6), (2, 4, 4), (3, 3, 4)

and each can occur in $\frac{3!}{2!}$ ways.

$\therefore$ No. of favourable cases

$= 3 \times 3! + 3 \times \frac{3!}{2!} = 27$

Hence, the required probability $= \frac{27}{6^3} = \frac{1}{8}$

16. **(d)** Contradiction can occur if A speaks truth and B lies, B speaks truth and A lies.
So, required probability

$= 0.75 \times 0.2 + 0.8 \times 0.25 = 0.35$

Req% $= 0.35 \times 100$

$= 35\%$

17. **(a)** There are 8 letters in the word EQUATION.

A/E/I/O/U							
5 ways	$^7P_7 = 7! = 5040$						

$\therefore$ Reqd. no. $= 5 \times 5040 = 25200$

18. **(a)** There are 9 letters in the given word in which two T's, two M's and two E's are identical. Hence the required number of words

$$= \frac{9!}{2!2!2!} = \frac{9!}{(2!)^3}$$

19. **(a)** Considering the two vowels E and A as one letter, the total no. of letters in the word 'EXTRA' is 4 which can be arranged in $^4P_4$, i.e. 4! ways and the two vowels can be arranged among themselves in 2! ways.

$\therefore$ reqd. no. $= 4! \times 2!$

$= 4 \times 3 \times 2 \times 1 \times 2 \times 1 = 48$

20. **(b)** If number of persons be n, then total number of hand-shaken $= {}^nC_2 = 66$

$\Rightarrow n(n-1) = 132 \Rightarrow (n+11)(n-12) = 0$

$\therefore n = 12 \qquad (\because n \neq -11)$

21. **(b)** There are 6 letters in the word BHARAT, 2 of them are identical.

Hence total number of words with these letter = 360

Also the number of words in which B and H come together = 120

$\therefore$ The required number of words $= 360 - 120$

$= 240$

22. **(d)** MACHINE has 4 consonants and 3 vowels.

The vowels can be placed in position no.

1, 3, 5, 7

$\Rightarrow$ Total number of ways possible $= {}^4P_3 = 24$.

For each of these 24 ways the 4 consonants can occupy the other 4 places in $^4P_4$ ways

$\Rightarrow$ Total $= 24 \times 24 = 576$

23. **(a)** Total number of ways $= {}^{16}C_{11} = \dfrac{16!}{11! \times 5!}$

$$= \frac{16 \times 15 \times 14 \times 13 \times 12}{5 \times 4 \times 3 \times 2 \times 1} = 4368.$$

24. **(b)** Selection of 2 members out of 11 has $^{11}C_2$ number of ways $^{11}C_2 = 55$

25. **(c)** Let the total number of employees in the company be n. Total number of gifts

$= {}^nC_2 = \dfrac{n(n-1)}{2} = 66 \Rightarrow n^2 - n - 132 = 0$ or $(n+11)(n - 12) = 0$ or $n = 12$

[– 11 is rejected]

26. **(a)** Order of vowels is fixed

$\therefore$ Required number of ways are $\dfrac{6!}{2!} = 360$

27. **(a)** A couple and 6 guests can be arranged in (7 – 1)! ways. But in two people forming the couple can be arranged among themselves in 2! ways.

$\therefore$ the required number of ways $= 6! \times 2! = 1440$

28. **(b)** 6! ways, O fixed 1st and E fixed in last.

29. **(c)** Number of elements in the sample space

$= 6 \times 6 = 36$

30. **(d)** Assume the 2 given students to be together (i.e. one). Now these are five students.

Possible ways of arranging them are $= 5! = 120$

Now they (two girls) can arrange themselves in 2! ways.

Hence total ways $= 120 \times 2 = 240$

SECTION-C : ENGLISH LANGUAGE

Chapter 1

Grammar

NOUN

NOUNS are words that name (a person, place, animal, object, material, idea, emotion, day, etc.)

KINDS OF NOUN

Common nouns

Name a general kind, category, or species; e.g., boy, cow, day, school, village, country, shop, mall, museum, fish, snake, monkey, book, pen, toy.

Proper nouns

Name a specific one; e.g., Shishir, Ameena, Kerala, Sunday, Max Hospital, Times of India.

Collective nouns

Name a group or collection; e.g., class, flock, bunch, army, herd, pack, swarm, crowd, gang, staff, crew, choir, panel, board, set, pride (of ions), shoal(of fish), fleet, horde, mob.

Abstract nouns

Nameabstract(i.e.,notphysicallyexistent)ideasthatcanbesensed, but not seen or touched; e.g., youth, love, thought, childhood, justice, hatred, envy, admiration, poverty, honesty, sorrow.

1. Proper nouns are sometimes used as common nouns.

   For example :

   (a) Amitabh is **Gandhiji** of our class. (Incorrect)

   (b) Amitabh is the **Gandhiji** of our class, (Correct)

   Here Gandhiji does not mean Mahatma Gandhi. The word here stands for the possessor of the qualities that Gandhiji is most known for - truth and non-violence. Thus Gandhiji is being used as a metaphorical common noun.

Cases/Functions of Noun

1. **Nominative :** As the subject of the verb

Examples:

- ♦ Rohan is leaving no stone unturned to make amends for his lapses.
- ♦ Air India has grounded its entire fleet because of a technical snag.

2. **Objective:** As the object of the verb or preposition

Examples:

- ♦ She will tell Hardik to prepare the design. [**Hardik** is the object of the verb **tell**]
- ♦ Pour some water from the jar into the glass. [**jar** is the object of the preposition **from**; and, **glass** is the object of the preposition **into**]

3. **Possessive**: That shows possession

Examples:

- ♦ We received Seema's invitation on time.
- ♦ The players' kits were arranged by the wall.

4. **Vocative**: As an address to someone

***Examples*:**

- ♦ Naina, get me a pen and a sheet of paper, please.
- ♦ Friends, Romans, Countrymen, lend me your ears.

5. **Appositive**: As a parallel description (juxtaposed with main noun and demarcated by commas)

***Examples*:**

- ♦ Mahira Sheikh, the poet, is from Mauritius.
- ♦ The Statue of Unity is a magnificent tribute to Sardar Patel, the Ironman of India.

6. **Subject complement**: As a complement after linking verbs *be* (is, am, are, was, were…), *become, appear, seem, feel, grow, look, prove, remain,* etc.

Examples:

- ♦ His parents are doctors.
- ♦ He seems (to be) a sportsperson.
- ♦ They appear (to be) gypsies.

7. **Object complement**: As a complement after a direct object of a verb.

Examples:

- ♦ The committee elected Mr. Sandhu its president. [**Mr Sandhu** is the direct object of the verb *elected*]
- ♦ The Police branded him an imposter. [**him** is the direct object of the verb *branded*]
- ♦ They declared Ravi the Man of the Match. [***Ravi*** is the direct object of the verb *declared*]

COUNTABLE AND UNCOUNTABLE NOUNS

Some nouns can be counted, others, cannot. Abstract nouns, as they have no concrete form, are generally ***uncountable.*** The other kinds of nouns, which exist in concrete form, are mostly ***countable.***

Countable nouns are preceded by indefinite articles a/an and other determiners, such as many, few, number of, each, every, etc.

Examples: A few migratory birds have already nested though winter is yet to set in.

Each student was given a chance to speak. Uncountable nouns take determiners such as much, little, some, any, a piece of, bags of, scores of, etc.

***Examples**:* Some milk is still left in the bottle. Much water has flowed under the bridge.

NUMBER OF NOUNS

Countable nouns can be *singular* (one) or *plural* (more than one). Uncountable nouns are treated as singular only.

Nouns make their plural in different ways.

1. By adding–s: cats, boys, girls, knives, wives {the –f or –fe endings are often changed to –ve before adding –s}
2. By adding–es (to singular nouns ending in s, -ss, -sh, -ch, -x, -o, or –z): buses, classes, marshes, bunches, taxes, mangoes,
3. By changing –on ending to –a: phenomenon-phenomena; criterion-criteria
4. By changing – um to – a : medium-media; stadium-stadia, forum-fora; addendum -addenda ; erratum- errata
5. By changing – is to – es: crisis-crises; analysis-analyses; oasis-oases
6. By changing – a to – ae: -alumna-alumnae; formula-formulae; lacuna-lacunae
7. By changing – us to – i: syllabus-syllabi; radius-radii; alumnus-alumni
8. Some words remain unchanged in their plural form: sheep, series, species, deer, fish, etc.
9. Some words change irregularly: man-men; woman-women; child-children; goose-geese; tooth-teeth; foot-feet; mouse-mice
10. Compound words make their plural by changing their keyword into plural form.

Commander-in-chief	Commanders-in-chief
Major General	Major Generals
Attorney General	Attorneys General
Maid servant	Maid servants
Looker-on	Lookers-on
Passer by	Passers by
Mother-in-law	Mothers-in-law
Man servant	Men servants
Woman servant	Women servants

Rules Governing The Number Of The Noun

1. Some nouns have the same form in singular as well as plural.

   Examples :

   (a) A deer **was** caught.

   (b) Some deer **were** caught.

   Here, the singular and plural form of the noun Deer is the same. Some other nouns that have the same form **in singular as well as plural form** are sheep, apparatus, species, series, hundred, dozen, hair, offspring, fish, etc. Preceding adjectives or the use of singular or plural verb only decides their number.

   ***Example**s* :

   (a) Eight **hundred** rupees were paid for this **pair** of shoes.

   (b) India again won the **series** that **was** played in England.

2. When words like hundred, dozen, thousand, pair, score are not preceded by any word denoting number then they take the plural form, otherwise not.

   Examples :

   (a) 1. Three **hundred** people attended the function.

   2. **Hundreds** of people attended the party.

   In sentence (1), 'hundred' is preceded by number 'three'. So 'hundred' will take no plural form. The word 'three hundred' indicates plurality. But in sentence (2), 'hundred' is not preceded by any number. So, to indicate plurality, we will write 'hundreds'.

   (b) Coca-Cola paid **lakhs** of rupees to Aamir Khan for promoting their product.

   (c) I brought two **dozen** bananas.

   Tell which sentence is correct:

3. **Some nouns are always used as singular though they look like plural nouns.** That's why we should never use the plural verb with these words. These words are politics, mathematics, physics, gallows, means, series, ethics, innings, mumps, measles, rickets, billiards, gymnastics, athletics, news, summons (plural summonses), etc.

   Examples :

   (a) **Politics** is not my cup of tea.

   (b) I received **summons**.

   (c) Sachin once again played a superb **innings.**

   (d) Since long no news **has** been heard.

4. **Some nouns** such as trousers, arms, drawers, assets, scales, alms, thanks, cards; ashes, riches, annals, arrears, savings, statistics, stairs, outskirts, refreshments, premises, scissors, credentials, proceeds **are always used in the plural form**.

   Example**s:**

   (a) The spectacles that you are wearing **are** really nice. (correct)

   (b) The spectacles that you are wearing **is** really nice. (incorrect)

5. **Some nouns are always used as plurals though they look like singular**. Such nouns are public, people, folk, mankind, poultry, sheep, police, gentry, peasantry, bulk, majority, etc.

   Example**s:**

   (a) The majority **are** with the leader.

   (b) Police, though late, **have** come.

   (c) Public wants results.

   (d) The cattle **were** grazing in the field.

6. **Some nouns are always used as singular**. **Preceding adjectives or the verb form indicates the singularity or plurality**.

   Examples :

   (a) All the **furniture** was bought last year.

   (b) All the **Information** was given to him.

   (c) This project will lead to lots of **expenditure**.

   Other such nouns are expenditure, furniture, information, machinery, issue, offspring, alphabet, scenery, poetry.

7. The meaning of some nouns in plural form is very **different** from their meaning in their singular form.

   Examples:

   (a) I opened the letter and read its **contents**.
   Her mouth was fixed in a smile of pure **content**.

   (b) The conflict between **good** and evil is age-old.
   We must produce **goods** at competitive prices.

   (c) Delhiites breathe the most polluted **air** in the world.
   She was just putting on **airs** when she came to visit me.

   (d) We should renounce the use of **force** to settle our dispute.
   Families of people who died as a result of services in the **forces** should not be ignored.

   (e) I was very excited on my **return** to my home village.
   Early **returns** in the ballot indicate majority for opposition.

   Other nouns having different meanings in their is singular and plural forms are:

Singular with meaning	Plural with meaning
Advice - counsel	Advices - notice (of financial transaction)
Arm - limb	Arms - weapons
Wood - material	Woods-forest
Blind - without vision	Blinds - window screen
Fruit - natural eatable	Fruits - gains
Water - material	Waters - stretch of water (sea)
Asset - quality	Assets - properties
Work - labour	Works - factory, etc.
Compass - extent or range	Compasses - instrument
Custom - habit	Customs - duties levied on
Ground - Earth	Grounds - reasons
Iron - metal	Irons - fetters made of iron
Mean - average	Means - way or method
Respect - regard	Respects - polite greetings
Colour - hue	Colours - flag
Physic - medicine	Physics - natural science
Manner - method	Manners - correct behaviour
Pain - suffering	Pains - careful efforts
Spectacle - sight	Spectacles - eye-glasses

8. Only the plural forms of the following nouns are commonly known.

Singular Form	Plural Form	Singular Form	Plural Form
Agendum	Agenda	Alumnus	Alumni
Index	Indices	Phenomenon	Phenomena
Criterion	Criteria	Radius	Radii
Formula	Formulae	Memorandum	Memoranda

9. Some nouns have **two plurals with different meanings**.

   Examples :

   (a) I have two **brothers** and a sister (meaning- male children of the same parents).

   (b) Why should only select **brethren** be allowed to attend the meeting? (meaning - members of the same society, organisation)

   (c) I took off my shoes and **clothes** (meaning- things that people wear).

   (d) Cotton, Nylon, Silk are different kinds of **cloths** (meaning- kinds or pieces of cloth).

   Other nouns having two plurals with different meanings are:

Singular	Plural with different meaning
Die	Dies - stamps Dice - small cubes used in games
Genius	Geniuses-persons of great talent Genii - plural of genie (spirit)
Quarter	Quarter - fourth parts Quarters - lodging
Penny	Pence - amount of money Pennies - number of coins
Staff	Staffs - bodies of employees Staves - planks or sticks
Index	Indexes - lists of contents; Indeces - power/exponent of a number.

GENDER OF NOUNS

With the advancement of human society, there remains no distinction of male and female nouns in the English language today. However, different forms or words have traditionally been in use depicting gender of nouns with reference to people or animals.

Masculine gender: representing the male of a species

Feminine gender: representing the female of a species

Common gender: common word for male as well as female

Examples:

	Masculine	Feminine	Common
1.	man	woman	person
2.	father	mother	parent
3.	boy	girl	child
4.	uncle	aunt	--
5.	nephew	niece	--
6.	husband	wife	spouse
7.	stallion	mare	horse
8.	boar	sow	pig
9.	drake	duck	--
10.	goose	gander	--

A fourth gender is assigned to the nouns which name non-living things.

Neuter gender: representing inanimate/non-living things

Examples: table, chair, tree, hill, house, river, library, box, car, computer, etc.

Rules Governing the Gender of the Noun:

1. Collective nouns, even when they denote living beings, are considered to be of the **neuter gender**.

   Examples :

   (a) Mr. Smith had a herd of cows. He kept a herdsman to look after **her**.

   (b) Mr. Smith had a herd of cows. He kept a herdsman to look after **it**.

   Sentence (b) is correct. Though herd consists of cows (females), herd is not a feminine noun as it a collective noun.

2. Young children and the lower animals are also referred to as of the **neuter gender**.

   Examples :

   (a) The baby loves **his** toys. (Incorrect)

   (b) The baby loves **its** toys. (correct)

   (c) The mouse lost **his** tail when the cat pounced on him. (Incorrect)

   (d) The mouse lost its tail when the cat pounced on it. (correct)

   We are often uncertain regarding the gender of the animals. The mouse here may be a male or a female. So, English language prefers the easy way out: treat it as of the neuter gender.

3. When objects without life are personified they are considered to be of

   (i) The masculine gender if the object is remarkable for strength and violence. Ex. Sun, Summer, Winter, Time, Death etc.

   (ii) The feminine gender if the object is remarkable for beauty, gentleness and gracefulness. Ex: Earth, Moon, Spring, Nature, Mercy etc.

   Examples:

   (a) The Sun came from behind the clouds and with **her** brilliance tore the veil of darkness. (Incorrect)

   The Sun came from behind the clouds and with **his** brilliance tore the veil of darkness. (Correct)

   (b) Nature offers **his** lap to him that seeks it. (Incorrect)

   Nature offers her lap to him that seeks it. (Correct)

   Tell which sentence is correct.

   (a) The earth goes round the sun in 365 days. Can you calculate **her** speed?

   (b) The earth goes round the sun in 365 days. Can you calculate **its** speed?

   Sentence b is correct. The error being made here is that personification is being brought where it does not exist. In the above statement the earth is being treated as a celestial body (a thing), not a person. So, neuter gender should be applied.

Rules Governing the Usage of Apostrophe With Nouns :

(a) Singular noun: 's is added after the word.

(b) Singular noun: Only an apostrophe is added when there are too many hissing sounds. For ***example***: Moses' laws, for goodness' sake, For justice' sake.

(c) Plural nouns ending in s like boys, cows: only (') is added after the word

(d) Plural nouns not ending in s like men, children: ('s) is added after the word.

(e) 's is added primarily after living things and personified objects. For ***example***: Governor's bodyguard, horse's head, Nature's law, Fortune's favourite.

(f) 's is not used with inanimate or non-living things. For ***example***: leg of the table, cover of the book.

(g) But in nouns that denote time, distance or weight,'s is used. For ***example***: a stone's throw, in a year's time, the earth's surface.

(h) Some other common phrases where' s is used are to his heart's content, at his wit's end, out of harm's way.

(i) When a noun consists of several words, the possessive sign is attached only to the last word.

   Examples:

   (a) The **Queen's of England** reaction is important in the Diana episode. (Incorrect)

   (b) The **Queen of England's** reaction is important in the Diana episode. (Correct)

   Do not be mistaken that since it is the Queen's reaction, the ('s) should come after queen. It is a mistake to think that putting it after England would make the reaction England's and not the Queen's. Do not see Queen and England in isolation, Queen of England is one whole unit and the apostrophe should come at its end.

(j) When two nouns are in apposition, the possessive sign is put to the latter only.

   Examples :

   (a) I am going to Stephen **Hawking's the scientist's country**. (Incorrect)

   (b) I am going to Stephen **Hawking the scientist's country**. (Correct)

(k) When two or more nouns show joint possession, the possessive sign is put to the latter only.

   Examples:

   (a) Bachchanji **is Amitabh's and Ajitabh's father**. (Incorrect)

   (b) Bachchanji **is Amitabh and Ajitabh's father**. (Correct)

(I) When two or more nouns show separate possession, the possessive sign is put with both.

Examples:

(a) The audience listened to **Javed and Vajpayee's** poems. (Incorrect)

(b) The audience listened to **Javed's and Vajpayee's** poems. (Correct)

PRONOUNS

PRONOUNS are words that replace nouns to avoid the monotonous repetition of the same noun in a sentence or paragraph.

KINDS OF PRONOUNS

1. Personal pronouns

[that show distinction of the person]:

		Singular	Plural
I.	Person: the person speaking	I, me	*we, us*
II.	Person: the person spoken to	you	*you*
III.	Person: the person spoken of	he, him she, her, it	*they, them*

Example. *I* instructed *him* to inform *them*.

2. Possessive Pronouns

[forms of personal pronouns that show possession): mine, ours, yours, his, hers, theirs

[Note, that **my, our, your, his, her** and **their** are not possessive pronouns but possessive adjectives by function as they appear just before nouns to qualify them]

Example. That car is *his* not *mine*.

3. Demonstrative Pronouns

[that identify or point out]: this, that, these, those

Example. *Those* were the days when we led a carefree life.

He says *this* only to annoy them.

There is no question of *that*.

[Remember, that the position (case) of a pronoun is before/after a verb or after a preposition as shown in the ***example***s above. So, **this**, **that**, **these**, **those** become demonstrative adjectives if they appear just before nouns; e.g. this pen, those girls, etc.]

4. Distributive Pronouns

[that refer to all members of a group individually, one at a time]: each, any, either, neither, none.

Example. *Each* of the farmers in the country is in favour of agricultural reforms.

5. Reciprocal Pronouns

[that refer to mutual interaction among all members of a group]: each other, one another.

Example. The people present wished *one another* a happy new year.

6. Reflexive pronouns

[the objective forms that reflect the subject of the sentence]: myself, ourselves, yourself, yourselves, himself, herself, itself, themselves, oneself.]

Examples:

> as a direct object of the verb: I have taught *myself* to remain calm in every situation.

They used to call *themselves* 'Young Turks'.

> with verbs such as *help, busied, behave, applied,* etc., to make special phrases:

Please *help yourself* to some snacks. She *busied herself* in work to overcome her grief.

Behave yourself; you are standing amidst eminent men. I *applied myself* to my studies.

> for emphasis; for someone important/famous: I did it *myself.* The King *himself* was present.

> to show being 'alone' or 'without help': I walked **by** *myself.* He worked all **by** *himself.*

> as an object of preposition **for**: He fried some eggs **for** *himself.* I feel sorry **for** *myself.*

> prepositions **with**, **beside**, etc., take personal pronouns in objective case, not reflexives:

I took him with **me**. I kept my bag beside **me**.

7. Emphatic/Emphasizing Pronouns

[Reflexive pronouns (listed above) that adjoin the subject (noun/pronoun) to lay emphasis on it]

Example. The Secretary *himself* is supervising all the arrangement.

8. Indefinite Pronouns:

everybody, somebody, nobody, anybody, everyone, someone, no one, anyone, everything, something, nothing, anything, all, some, any, both, another, much, few, little.

Example. *Nobody* knows where he is.

9. Relative Pronouns

[that connect a clause to a noun or pronoun]: who, whoever, whom, whomever, that, which, when, where, and whose

Example. This is the girl *who* has defied all odds to attain the top position in the examination.

10. Interrogative Pronouns

[that make a query]: what, who, whom, which, whose.

Example. *Whose* is this bag with an HP laptop inside?

[Remember, that the words **what**, **which**, **whose** function as interrogative adjectives, not interrogative pronouns, when they appear just before nouns. e.g. What fruit is this? Which boy won? Whose creation was accepted?]

CASE OF PERSONAL PRONOUNS

1. Used as the subject (***Nominative case***): I, we, you, he, she, it, they
2. Used as the object (***Objective case***): me, us, you, him, her, it, them
3. Used to show possession (***Possessive case):*** mine, ours, yours, his, hers, its, theirs

RULES GOVERNING THE CASE OF PERSONAL PRONOUNS :

1. Pronouns change form in different cases:
   Examples :
   (a) This is a boy. He works hard. (He subjective case)
   (b) This is a boy. His exercise is done well. (His is possessive case)
   (c) This is a boy. All praise him. (Him is objective case)
2. Which sentence is correct?
   (a) The presents are for you and me.
   (b) The presents are for you and I.
   Sentence a is correct. Pronoun has to agree with the case. Here it is the objective case. So, 'me' should be used instead of 'I'.
   Example : My uncle asked my brother and me to dinner.
3. Which sentence is correct ?
   (a) He loves you more than I.
   (b) He loves you more than me.
   Sentence (a) is correct. 'Than' is a conjunction joining clauses. And the case of the pronoun to be used may be found by writing the clauses in full. So, in sentence (a) the two clauses joined by 'than' are 'He loves you more' and 'I love you'. The pronoun being in a subjective case, 'I' should be used.
   Examples: He is taller than I (am).
   Sentence (ii) is also correct if the clauses are 'He loves you more' and 'He loves me'.
   Example:
   He trusts you more than (he trusts) me.
4. An apostrophe is never used in the possessive cases 'its', 'yours' and 'theirs'.
5. The complement of the verb be, when it is expressed by a pronoun, should be in the nominative form.
   Examples.
   (a) It was he (not him),
   (b) It is I (not me) that gave the prizes away.
   (c) It might have been he (not him).
6. The case of a pronoun following than or as is determined by mentally supplying the verb.
   Examples :
   (a) He is taller than I (am).
   (b) I like you better than he (likes you).
   (c) They gave him as much as (they gave) me.
7. When 'one' is used as pronoun, its possessive form 'one's' should follow instead of his, her, etc.
   Example : One must put one's best efforts if one wishes to succeed.
8. The pronoun one should be used throughout, if used at all.
   Examples:
   (a) One must use one's best efforts if one wishes to succeed.
   (b) One should be careful about what one says.
9. With let objective case of the pronoun is used.
   Example : Let you and me do it.

SEQUENCE OF PERSONA PRONOUNS

1. When pronouns of all persons are used in the subjective case, their normal sequence is 231.
   Example. You (2), she (3) and I (1) shall go to the party together.
2. However, with an expression of something unpleasant, they appear in the sequence of 132.
   Example. I (1), he (3) and you (2) shall gracefully take responsibility for this debacle.
3. When the pronouns are in plural, the order is 123.
   Example. We (1), you (2) and they (3) shall join hands to accomplish this difficult task.
4. When a pronoun refers to more than one noun or pronoun of different persons, it must be of the first person plural in preference to the second and of the second person plural in preference to the third.
   Examples :
   (a) You and I, husband and wife, have to look after your home. (Incorrect)
   You and I, husband and wife, have to look after our home. (Correct)
   (b) You and Hari have done their duty. (Incorrect)
   You and Hari have done your duty. (Correct)
   (c) You, he and I have not forgotten your roots. (Incorrect)
   You, he and I have not forgotten our roots. (Correct)

RULES GOVERNING RELATIVE PRONOUNS :

1. That is used after adjectives in the superlative degree.
   Examples:
   (a) This is the best that we can do.
   (b) He is the best speaker that we ever heard.
2. That is used after the words all, same, any, none, nothing, only.
   Examples:
   (a) Man is the only animal that can talk.
   (b) He is the same man that he has been.
   (c) After two antecedents, one denoting a person and the other denoting an animal or a thing.
   Example: The man and his pet that met with an accident yesterday died today.
3. Relative pronouns change form in different cases:
   Examples:
   (a) This is the boy who works hard (Who in place of He)
   (b) This is the boy whose exercise is done well. (whose in place of His)
   (c) This is the boy whom all praise. (Whom in place of Him)
   The above sentences show that Who is the subjective case, Whose the possessive case and Whom the objective case.
4. Who is used in the nominative case and whom in the objective case.

Examples :

(a) There is Mr. Dutt, who (not whom) they say is the best painter in the town.

(b) The student, whom (not who) you thought so highly of, has failed to win the first prize.

5. Who is used for persons only. It may refer to a singular or plural noun.

Examples:

(a) He who hesitates is lost.

(b) Blessed is he who has found his work.

6. Whose can be used for persons as well as things without life also.

Examples :

(a) This is the hotel whose owner is a criminal.

(b) This is the person whose will power is extraordinary.

7. Which is used for inanimate things and animals, both singular and plural.

Examples :

(a) I have found the book which I had lost last week.

(b) The horse, which won the race yesterday, is my favourite.

8. When 'which' is used for selection, it may refer to a person or a thing.

Examples :

(a) Which of these packets is yours?

(b) Which of the boys has not done his homework?

9. Who, Which, Whom, That, Whose should be placed as near to the antecedent as possible.

Examples :

(a) I with my family reside in Delhi, which consists of my wife and parents.

This sentence is incorrect as which relates to 'my' family'. So 'which' should be placed as near to family as possible. So, the correct sentence is :

I with my family, which, consists of my wife and parents, reside in Delhi.

10. When the subject of a verb is a relative pronoun, the verb should agree in number and person with its antecedent.

Examples :

(a) This is one of the most interesting novels that have (not has) appeared this year. (Here, antecedent of relative pronoun that is novels and not one)

(b) This is the only one of his poems that is (not are) worth reading. (Here, the antecedent of that is one and not poems. Note the difference between sentences a and b)

11. If a relative pronoun has two antecedents, it should agree with the nearer one.

Examples :

(a) I hold in high esteem everything and everybody who reminds me of my failures.

(b) I hold in high esteem everybody and everything, which reminds me of my failures.

RULES GOVERNING INDEFINITE PRONOUNS

1. In referring to anybody, everybody, anyone, each, etc., the pronoun of the masculine or the feminine gender is used according to the context.

***Example*s.**

(a) I shall be glad to help everyone of my boys in his studies.

(b) I shall be glad to help everyone of my girls in her studies.

(c) I shall be glad to help everyone of my students in their studies.

When gender is not determined, the pronoun of the common gender is used as in sentence c.

2. **Either** should be used when **two** persons or things are spoken of .

Example : They can use **either** of these props.

3. Anyone should be used when more than two persons or things are spoken of.

Example : She was taller than anyone of her five sisters.

PRONOUN-ANTECEDENT AGREEMENT

The literal meaning of 'antecedent' is something or someone from which something descends. (For ***example***: you are your grandparents' descendant and your grandparents are your **antecedents)**

Each and every definite pronoun takes the place of or replaces a noun in the sentence, which is called its 'antecedent'.

Rule 1: The pronoun and its antecedent must agree in number and kind (personal or impersonal).

Examples:

(a) *Chinu was the one that stood out in the crowd.*

In the above sentence, the pronoun **that** doesn't agree with its antecedent **Chinu** in kind. Chinu is a person, but 'that' is an impersonal pronoun. The correct form would be:

(b) *Chinu was the one* **who** *stood out in the crowd.*

Rule 2: Antecedent of a pronoun should be clear and not ambiguous.

Examples:

(a) *Mita went shopping with Renu and she bought a football kit.* (Incorrect)

In the above statement, does the pronoun refer to Mita or Renu? It is not clear. Hence, the above statement is grammatically incorrect.

(b) *Mita bought a football kit when she went shopping with Renu.* (Correct)

Rule 3: The same pronoun should be used consistently while referring to a same thing, place, person or idea.

Examples:

(a) *'One' should be careful about 'themselves' while visiting places which are under some regional conflict.* (Incorrect)

In the above statement, two different pronouns are used to refer to the same noun.

(b) *'One' should be careful about 'oneself' while visiting places which are under some regional conflict.* (Correct)

NOUN

The basic unit of any language is **words** which group/arrange together as phrases, clauses and sentences to create meaning.

Words can function as different parts of speech, namely noun, pronoun, adjective, verb, adverb, preposition, conjunction, interjection in a sentence. Of these, verb is the most important; for, every clause/sentence essentially has a **verb** (as the main part of the predicate) saying something about a **noun/pronoun** (the subject)**.**

A VERB, forming the main part of the predicate of a sentence, describes an *action* (eat, go, sing, etc.), state **(be, know, have, etc.), or *occurrence* (happen, snow, rain, die, etc.).**

CLASSIFICATION OF VERBS BY FUNCTION

Verbs, by function, are classified as follows:-

Verbs → Main verbs
→ Auxiliary verbs
→ Causative verbs

(a) Main/Principal Verbs

These are the stand alone verbs, that describe the main action, state or event. They exist in various forms.

Examples:

- Harry **eats** an apple every day. Harry **ate** the whole apple in a minute. Harry has already **eaten** the apple.
- She **knows** the problem. She **knew** the problem. She has **known** the problem all along.
- It normally **rains** at this time of the year. It **rained** a little yesterday. It has **rained** incessantly today.

Linking verbs: In cases where main verbs simply express a subject's state of being, they are called linking verbs, for they link the subject to a predicate adjective or noun/pronoun (referred to as the **subject complement**) that supplies information on its state of being.

The verbs *be* (is, am, are, was, were, has been), *seem, appear, feel, grow, look, prove, remain, smell, sound, taste,* and turn are linking verbs.

Examples:

- He very much **looks** a sculptor.
- He **has been** the lead actor in many productions.
- My mother **appeared** distraught on hearing the news.

Some Verbs Confused with Other Verbs

	V_1	V_2	V_3
(i)	wind (tie, finish)	wound	wound
	wound (injure)	wounded	wounded
(ii)	find (search)	found	found
	found (start/build)	founded	founded
(iii)	grind (crush)	ground	ground
	ground (restrict ship/plane on land)	grounded	grounded
(iv)	bind (tie)	bound	bound
	bound (leap/bounce)	bounded	bounded
(v)	bear (tolerate, conceive)	bore	borne
(**Note:** 'born' is the passive form of bear (conceive); e.g., A son is/was/had been born to him.			
(vi)	fall (go down)	fell	fallen
	fell (cut down)	felled	felled
(vii)	hang (suspend)	hung	hung
	hang (to death)	hanged	hanged
(viii)	lie (speak untruth)	lied	lied
	lie (be horizontal/supine)	lay	lain
	lay (keep horizontal)	laid	laid
(ix)	rise (ascend, move up)	rose	risen
	raise (move something up)	raised	raised
	raze (bring down)	razed	razed
(x)	fly	flew	flown
	flow	flowed	flowed
(xi)	see	saw	seen
	saw	sawed	sawed/sawn
(xii)	rend (tear)	rent	rent
	rent (use/allow use on payment)	rented	rented

(B) AUXILIARY VERBS:

These are helping verbs that help the main verbs to express tense, voice, mood, negatives and interrogatives. Helping verbs are of two kinds, as shown below.

Auxiliary verbs
→ **Primary auxiliaries**— all forms of *be, do, have*
→ **Modal auxiliaries (Modals)**—*can, will, shall, should, may, etc.*

Primary auxiliary verbs are derived from the verbs BE, DO and HAVE, which otherwise also act as main verbs.

- **BE** exists in seven different forms—is, am, are, was, were, been, being—and helps in forming tenses and passive voice.

  Progressive tenses: Aspirants are burning midnight oil. I am writing a biography. Are you doing the work? Was he listening to music at that time?

  Passive voice: They were scolded for their mistake. The task is being completed at a steady pace.

  [Refer to the chapters 'Tense' and 'Voice' for a detailed study]

  BE as a **main (linking) verb**: I am happy. They are aware. She has been there. People are unforgiving.
- **DO** exists in five different forms— do, does, did, done, doing — and helps in making negative and interrogative sentences.

  Interrogatives: Does he know it? Do you read the newspaper daily? Did I tell you something?

  Negatives: Rajan does not like apples. I do not like oranges. Don't you like grapes?

  [Refer to the chapter 'Subject-verb agreement' for more ***example****s*]

  DO as a main verb: They do what they are told. He does this better. I have done it. You did it. Anish is doing well.
- **HAVE** exists in four different forms— has, have, had, having—and helps in forming tenses and passive voice.

  Perfect tenses: I have been practising grammar for a while. They have succeeded in their mission. He has organized a reunion for his old classmates. You had promised to help.

  Passive voice: He was seen off by his mates. I was given a warm welcome. The accused have been arrested. The task has been accomplished. Candidates have been asked to wait outside.

  [Refer to the chapters 'Tense' and 'Voice' for a detailed study]

  HAVE as a main verb: I have a dream. They have what they need. He had a dog named Bruno.

  Where is the car you had? She is having her lunch now. Let's have a break. Have a shower, you'll feel better.

Modal auxiliary verbs or **Modals** help main verbs to express the mood and/or attitude of the speaker of a sentence.

The modals that help main verbs are **can**, **could**, **shall**, **should**, **will**, **would**, **may**, **might**, **must**, **ought to**, **used to**, **need**, and **dare.**

(c) Causative Verbs

Show that someone or something caused something to happen. The verbs **get**, **have**, **make**, **let** and **help** function as causative verbs.

1. Have/Get Something Done

This use is to express that a person caused another to do something by exercising authority, or paying for it. It is the work that is given emphasis and mention of the person who does the work is not required.

Examples:

- He had/got his hair cut on Sunday.
- They had/got their washing machine repaired by him.
- Did you have/get the documents couriered?

2. Have Someone do Something

This use is to express that a person caused a particular mentioned noun/pronoun to do something by exercising authority, or paying for it. The emphasis is on the doer of the work.

Examples: The invigilator had the candidates sign on the attendance sheet.

- shall have the letter mailed to me.
- would you have the meeting fixed on some other day?

3. Get Someone to do Something

This use is to express that someone caused a particular mentioned noun/pronoun to do something by some persuasion, promise, etc.

Examples:

- I got the agitating students calm down with the promise of an inquiry into the matter.
- They can never get him to accept their conditions.
- She got her parents allow her to go on the college trip.

4. Make Someone to do Something

This use is to express that a subject (noun/pronoun) forced some noun/pronoun to do something.

Examples:

- Their constant bullying made him cry.
- The institution made them work hard.
- You shouldn't make them anxious about your well-being.

5. Let Someone/Something do Something

This use is to express that someone permits someone to do something or allows something to happen.

Examples:

- Let him stay out a little longer.
- How could they let that happen?
- She let the cake turn a rich golden brown.

6. Help Someone (to) do Something

This use is to express that someone/something helps/assists/aids someone/something.

Examples:

- Exercise helps you burn excess body weight.
- How can this help them survive the onslaught?
- They must do something to help us beat the heat.

CLASSIFICATION OF VERBS IN TERMS OF OBJECTS

Verbs
→ **Transitive (with object/s)**
→ **Intransitive (without object)**

Action verbs often have a noun/pronoun as the object to which the action conveyed by them gets **transited** (or 'passed over'). Observe the following sentences with action verbs to understand this.

(1) The boy **shot** the bird with a catapult.
(2) The bird **flew** away flapping its wings.

Now, put the 'what' question to the verb in each case:

(1) **Shot** what? Shot the bird. We see, that the action conveyed by the verb 'shot' passes over to the bird for the action to be meaningful. The noun bird is the object without which the action 'shot' is incomplete.
(2) **Flew** what? It is clear, that this question has no answer; it means, there is no object to which the action conveyed by 'flew' passes over. The verb 'flew' expresses the action completely by itself.

Transitive Verbs

Are those action verbs that need **an OBJECT (a noun/pronoun) for the completion of the action.**

Observe the transitive verbs and their respective objects in each of the following ***example***s.

Examples:

- A vast percentage of graduate students in the country **take** $\dfrac{\text{the Civil Services Examination}}{\text{object}}$.
- Several students came forward to **lend** $\dfrac{\text{support}}{\text{object}}$ to the campaign.
- Improper use of office for private purposes is a scourge that **afflicts** $\dfrac{\text{most public servants}}{\text{object}}$.

Direct and Indirect Objects

Transitive verbs can have not one but two objects—direct and indirect.

The **direct object** is the direct receiver of the action as shown in the following sentences.

- Medical practitioners treat **patients** under the Hippocratic oath of upholding ethical standards.
- Mountaineers equip **themselves** with oxygen cylinder to supplement decreased levels at high altitudes.
- Harsh has won **the coveted prize** by dint of his dedication. [Note that the **object** of a transitive verb is a noun or a pronoun that can have an adjective before it. Here, prize is a noun qualified by the adjective coveted]

The **indirect object** is usually a person or thing that is affected by the action of the intransitive verb, or for whom/what the action of the verb is performed.

- His friends presented **him** a psycho-drive game. (verb-presented; indirect object – him; direct object – game (qualified by adjective psycho-drive)
- Devout Hindus believe that the holy Ganges gives **them** life. (verb- gives; indirect object – them; direct object – life)
- No apology will save **him** a jail term. (verb- will save; indirect object – him; direct object – jail term)

Note that the indirect object always appears before the direct object.

Distinguishing between a direct object and an object complement

Often, a word that describes the object is mistaken for a direct object only because it immediately follows the indirect object. It is advisable to verify whether the word receives the action of the verb. If it does so, only then, it acts as the direct object. Otherwise, it qualifies as an object complement. An object complement is a noun, a pronoun, or an adjective which follows a direct object to rename it or state what it has become.

Observe The Following Sentences

- They named their daughter Kali.
  [verb –named; direct object 'their daughter'; **Kali** is not the indirect object, rather, the object complement.]
- They elected me the non-playing captain.
  [verb-elected; direct object- me; **the non-playing captain** is not the indirect object, rather, the object complement.
- The performance left them spellbound.
  [verb –left; direct object—them; **spellbound** is not the indirect object, rather the object complement.
- Some more transitive verbs with no direct object are call, make, *believe, consider, declare, find, judge, keep, know, label, appoint, presume, pronounce, prove, rate, regard, think, create, paint, etc.*

INTRANSITIVE VERBS

Are those action verbs which convey complete meaning by themselves and require NO OBJECT.

Intransitive verbs are followed by a prepositional phrase or an adverb to add to the thought being expressed, but they can never be followed by a noun functioning as the object of the verb.

Examples:

- The assembly **converged** $\underbrace{\text{on the table laid out with refreshments}}_{\text{Prepositional phrase}}$.
- All the kings' horses **galloped** $\underbrace{\text{towards Humpty Dumpty}}_{\text{Prepositional phrase}}$.
- The Gir forest in Gujarat **roars** $\underbrace{\text{fiercely}}_{\text{Adverb}}$ with its formidable lion population.

Some action verbs such as arrive, go, lie, sneeze, sit, die, etc., are always intransitive.

It is important to note that the same verb may be transitive or intransitive in different contexts/ sentences. To understand this, compare the following sentences:

- The batsman *hit* **the ball** outside the boundary. [The verb *hit* has an object **the ball**]
- The batsman *hit* outside the boundary. [The verb *hit* has no object. It is followed by a prepositional phrase starting with preposition *outside*. Hence, *hit* here is not transitive]

CLASSIFICATION OF VERBS IN TERMS OF LIMITATION/CHANGEABILITY

Verbs → **Finite verbs (limited by number/person/tense)**
Verbs → **Non-finite verbs or verbals (not limited)**

Finite verbs

Have a subject. Therefore, they show inflections limited by the person and number of the subject. As this subject uses different tenses of its verb to show time of action or state of being, the verb is limited by tense, too. Observe the following ***example***s to know how this happens.

Number: He (singular) walks a mile daily. They (plural) walk a mile daily.

Person: We (1st Person) like fruits. You (2nd Person) like fruits. She (3rd Person) likes fruits.

Tense: Remo *is writing* (present continuous) his autobiography. Remo *wrote* (simple past) his autobiography last year. Remo *has written* (past perfect) his autobiography.

Non-finite Verbs

On the other hand, do not have a subject; so, they are free from any inflection or change in form governed by a particular subject or tense. They remain in the same form across all changes in the sentence with respect to Number, Person or Tense. Observe how.

Number: He (singular) learns *singing* daily. They (plural) learn *singing* daily. [*learn*-finite verb; *singing*- non-finite]

Person: We (1st Person) found the men severely *wounded.* You (2nd Person) found the men severely *wounded.* She (3rd Person) found the men severely *wounded.* [*found*- finite verb; *wounded*-non-finite]

Tense: Remo is writing *(*present continuous*)* this to *publish* in a *refereed* journal. Remo wrote (simple past) this to *publish* in a *refereed* journal. Remo has written this to *publish* in a *refereed* journal. [*write*-finite verb; *publish* and *refereed*-non-finite]

The three non-finite verbs or *verbals* in the English language are **Infinitive, Gerund and Participle**. Remember, that a **Verbal is a form of a verb that functions as some other part of speech in a sentence.**

The **Infinitive** is a '*to* + V_1' verbal functioning usually as a noun, but sometimes as an adjective/adverb.

The **Gerund** is a 'V_1*–ing*' verbal functioning as a noun.

The **Participle** is a verbal existing in present (V_1-ing), past (V_3), and perfect (having + V_3) forms, and functioning as an adjective. [See the table of FORMS OF VERBS in the Supplementary eBook to understand V_1, V_2, V_3]

ADVERBS

An adverb is a word that modifies or describes a verb (she sings **beautifully**), an adjective (**very** beautiful), or another adverb (treat **so** badly), or even a whole sentence (**Luckily**, no one was injured). Adverbs often end in -ly, but some appear to be like adjectives.

Observe the use of adverbs in the following sentences:

- *Rajesh played* **badly**.
- *The show ended* **too** *quickly.*
- **Unfortunately**, *we missed the train.*
- *She will* **seriously** *consider his proposal.*
- *Raj sings* **loudly** *in the bathroom.*
- *The beggar* **impatiently** *waited for his food.*
- *Turn* **left**.
- *She arrived* **early**.

KINDS OF ADVERBS

There are various kinds of adverbs in the English language. Here is a brief explanation of each kind, along with ***example***s.

1. Adverbs of Time

An adverb of time gives information about *when* an action/evnt takes place. They are placed usually at the beginning or end of a sentence. Sometimes, we put it at the beginning of a sentence to emphasise the time of the action/event described in the sentence. ***Example***s of adverbs of time are: **never, lately, just, always, recently, during, yet, soon, sometimes, usually, so far**, etc.

Examples:

- *So far*, we have not found any discrepancy in the document.
- She hasn't been going for a walk *lately*
- They *recently* bought a new house.

2. Adverbs of Place

An Adverb of place shows *where* the verb is happening. It's usually placed after the main verb or object, or at the end of the sentence. ***Example***s of adverbs of place are: **here, there, nowhere, everywhere, out, in, above, below, inside, outside, into**, etc.

Examples:

- We went to the zoo, and there were animals *everywhere*!
- He lost the way and didn't know *where* he was going.
- We can't get this movie at this store, let's look *elsewhere*.

3. Adverbs of Manner

Adverbs of manner are used to express the way or manner of some action/event. An adverb can be added to the verb 'play' to modify its meaning in the sentence "He plays cricket"—He plays cricket **superbly**. He plays cricket **beautifully**. He plays cricket **badly**.

Most of adverbs of manner end in –ly. ***Example***s of these are: **neatly, slowly, quickly, sadly, calmly, politely, loudly, kindly, lazily**, etc.

Examples:

- Raju folded his school uniform *neatly*.
- She greeted us *politely* as we entered her home.
- Their pet cat rested *lazily* on the sofa.

4. Adverbs of Degree

Adverbs of degree express the level or intensity of a verb, adjective, or even another adverb. ***Example***s of adverbs of degree include: **almost, quite, nearly, too, enough, just, hardly, simply, so**, and so on.

Examples:

- Can I accompany you to the picnic, *too*?
  (modifying the verb 'accompany')
- You are *too* good for any competition.
  (modifying the adjective 'good')
- He *promptly* answered the instructor's question.
  (modifying the verb 'answered')
- She's *so* very excited to go to the university!
  (modifying the adverb 'very')

5. Adverbs of Frequency

Adverbs of frequency are used to show routine or repeated activities; hence they are often used with the present simple tense. If a sentence has only one verb, the adverb of frequency is positioned after the subject, or before the verb. ***Example***s of adverbs of frequency are: **never, always, rarely, sometimes, normally, seldom, usually, again,** etc.

Examples:

- Raj *usually* goes for a walk after dinner.
- He is *always* ready to lend a helping hand.
- One must *never* shy away from helping a person in need.
- *Rarely* does a phenomenon occur that has such a far reaching effect.
- I had *barely* taken off my shoes on reaching home, when the doorbell rang.
- They have four sedans of which three are *seldom* used.

6. Interrogative Adverb

Interrogative adverbs are used to make different types of queries, e.g., **when** makes time-related question, **where** makes place-related questions; **why** asks the reasons; while **how** may make questions pertaining to time, place, manner, quantity, amount, degree, or reason.

Examples:

- *When* will you return from your foreign trip? *(Time)*
- *Where* do your grandparents live? *(Place)*
- *Why* did you not seek help when you needed it? *(Reason)*
- *How long* will you take to finish the job? *(Time)*
- *How often* do you go out? (*Frequency*)
- *How fast* can you swim? *(Manner)*
- *How much* do you earn from this occupation? *(Amount)*
- *How many* matchsticks are left in the box? *(Quantity)*
- *How good a doctor is he?* *(Degree)*

7. Relative Adverb

An adverb which introduces a relative clause is called a relative adverb. An interrogative adverb used as a subordinating conjunction becomes a relative adverb. ***Example***s of relative adverbs are: **when, where, why, how, wherever**, etc. Study the following sentences.

Examples:

- You can come to me *when* I am not working.
- Nobody knows *where* he is.
- I am not going to explain again *how* it needs to be done.
- The poor orphans happily went wherever they were ordered to go.

8. Adverbs of Affirmation & Negation

The adverbs that are used to affirm/confirm/validate/ support a statement are called adverbs of affirmation; while those that are used to negate/deny/nullify/reject are called adverbs of negation. Adverbs of affirmation commonly used are **absolutely, affirmatively, assuredly, avowedly, clearly, truly, definitely, doubtlessly, exactly, alright, obviously, positively, really, sure, surely, undoubtedly, yes, certainly, by all means, verily**, etc.

Examples:

- *Yes*, I do.
- I shall *certainly* support your candidature.
- Whether anybody else reaches or not, I will *definitely* be there in time.
- The event turned out to be *exactly* as we had imagined.
- With the kind of dedication he has, he will *surely* be rewarded at work.

Adverbs of negation commonly used are **no, not, nothing, contrarily, contradictorily, oppositely, conversely, contrariwise, on the contrary, no**, **not** (including words like **haven't**, **couldn't), not at all**, etc.

Examples:

- There is *no* clarity on the matter.
- Once the verdict had been passed, they had *nothing* to say.
- Did I offend you? *Not at all*, rest assured.
- Are you against the proposal? *On the contrary,* I offer full support to it.

Rules of Adverbs

The following rules for using adverb can be very useful for finding errors in a sentence.

Rule 1

Adverbs of manner are often formed by adding *-ly* to an adjective. However, some adverbs do not take -ly, and care must be taken to use them correctly.

Examples:

- She sings *sweetly*.
- They performed *badly*.
- He runs *fast*.

Adverbs answer 'How' with respect to an action. Fast also answers the question 'How', so it is an adverb. But fast never has -ly attached to it.

Rule 2

No -ly is attached with linking verbs such as taste, smell, look, feel, which pertain to the senses. Adverbs are often misplaced in such sentences, which require adjectives instead.

***Example*s:**

- Mangoes smell *sweet.* ['Smell' is a linking verb.]
- She felt *bad* about the incident. ['Felt' is a linking verb]
- The teacher looked angry. ['Looked' is a linking verb.]
- The teacher looked angrily at Raj.
  ['Looked' is an action verb directed at the object Raj]

Rule 3

- 'Good' is an adjective, whose adverb equivalent is 'well'.
- She's done a good job. (*Good* describes the job, it is an adjective)
- She's done the job well. (*Well* answers **how** the job is done; it is an adverb)

Rule 4

- 'Good' and 'well' while referring to health.
- Sujata looks good today.
  (Sujata's appearance is impressive today.)
- Sujata looks well today.
  (Sujata may have been ill, but now she is fit again.)
- Grandma does not look well today. Grandpa doesn't feel well, either.

Rule 5

- Adverbs with *-ly* do not drop the -ly in the comparative or superlative degrees.
- She went out of the room quickly.
- She went out of the room quicker than he did. (incorrect)
- She went out of the room more quickly than he did. (correct)
- Work more quietly, please!
- She dresses most decently of all the girls here.

Rule 6

- Adverb 'too much' is used with nouns and adverb 'much too' with adjective:
- His injured finger gives him too much pain. (Here 'pain' is a noun)
- She is much too vindictive. (Here 'vindictive' is adjective)

Rule 7

- Adverb 'fairly' is usually used with positive sense while 'rather' with negative or unfavourable sense:
- Sujata is fairly tall.
- This is a rather tedious novel.

Rule 8

- Adverb 'enough' should be preceded by an adjective.
- Raj is now enough strong to lift this box. (incorrect)
- Raj is now strong enough to lift this box. (correct)
- Ratan is enough intelligent to qualify this interview. (incorrect)
- Ratan is intelligent enough to qualify this interview. (correct)

Rule 9

- Adverb 'very' is used to modify a positive degree of adjective, while 'much', comparative degree.
- Raj is very intelligent.
- Trains are much faster than cars.

Rule 10

- 'Late' refers to period of time and 'lately' shows recently.
- They always come lately. (incorrect)
- They always come late. (correct)
- Karan late had a minor accident. (incorrect)
- Karan lately had a minor accident. (correct)

Rule 11

If the sentence begins with **hardly, never, seldom, scarcely, rarely, no sooner,** etc., the verb is in inverted form.

- No sooner they had reached the station than the train started. (incorrect)
- No sooner *had they* reached the station than the train started. (correct)
- Hardly she goes for a walk. (incorrect)
- Hardly *does she* go for a walk. (correct)

ADJECTIVES

Adjectives are words that describe or modify nouns by giving some information about their quality, colour, size, shape, age, origin, position, material, etc. For ***example***, if we say it's a round table; we describe the shape of that table as round.

Observe how the underlined adjectives add information on their nouns.

- *The old woman is very kind and thoughtful.*
- *Their house was destroyed in the cyclone.*
- *He studies in that school.*
- *He is the most honest man I have ever met.*
- *He impressed the interviewers with his straightforward and intelligent answer.*

KINDS OF ADJECTIVES

I. Descriptive Adjectives

Descriptive adjectives describe nouns and pronouns. They add information and qualities to the nouns they modify. Words like fat, beautiful, slim, silly, tall, annoying, loud and nice are all descriptive adjectives.

Example: She is fat but her friend is very slim.

Position of Descriptive Adjectives

Descriptive adjectives appear attributively (right before a noun as its attribute) or predictively (in the predicate of the sentence, i.e., after the verb)

Examples:

- She is a *beautiful* girl. They are *accomplished* actors. (attributive)
- The girl is *beautiful*. The actors are *accomplished.* (predicative)

II. Determiner Adjectives

Determiner adjectives only determine or identify which nouns are being referred to. They do not describe any quality of the nouns.

1. **Quantitative Adjectives:** They give the quantity of uncountable nouns — much, no, some, few, etc.
2. **Numeral Adjectives:** They indicate the number of countable nouns — one, two ...several, many,... first, next,etc.

3. **Demonstrative Adjectives:** They point out near or far nouns — this, that, these, those, etc.
4. **Possessive Adjectives:** They show possession or indicate to whom a noun belongs — my, his, her, their, your, our.
5. **Interrogative Adjectives:** They ask a question related to a noun — which, what, whose, etc.
6. **Distributive Adjectives:** They refer to one or more specific members of a group in different ways of distribution — each, every, either, neither, any, both, none, etc.
7. **Article Adjectives:** Articles are used to determine whether the noun being referred to is general or specific — a, an and the are the three articles used in the English language.
8. **Emphatic Adjectives:** They lay emphasis on the noun being referred to — own, such, same, very, etc.
   [Determiners have been discussed in detail in the next chapter.]

Position of Determiner Adjectives

Determiner adjectives appear only attributively (preceding nouns) as they perform the function of determining or identifying the nouns being referred to.

III. Proper Adjectives

They are derived from Proper nouns. When words such as Polar, Asiatic, Arabian, Indian, etc., derived from Proper nouns of place (Pole, Asia, Arabia, India,..respectively) precede other nouns to indicate their place of origin, they function as Proper adjectives.

Examples:

- He is *Irish* by birth, but is an *American* citizen now.
- *Chinese* products have overtaken every domain of consumer goods today.

IV. Exclamatory Adjective

The word 'what' when used to express strong emotion functions as an exclamatory adjective.

Examples:

- *What* a captivating scene it is!
- *What* a stellar performance!

V. Participial Adjectives

They are derived from present participle (-ing) or past participle (-ed) verb forms. When participles such as struggling, captivating, injured, retired, etc., precede nouns, they function as adjectives by describing or adding information on them.

Examples:

- He jumped off a *moving* bus.
- The boys were playing with *hammering* tongs.

RULES FOR THE USAGE OF ADJECTIVES

Rule 1: When we make comparisons between two things, the comparative degree is used and not the superlative degree.

Example: She is the tallest of the two sisters. (Incorrect)
She is *the taller of the two* sisters. (Correct)

Rule 2: We use the comparative degree when we make a choice between two persons or things. Article 'the' is used before the comparative degree and 'of the' is used after the comparative degree. The structure will be: the + Comparative + of the…

Example: Kanpur is *the better of the* two cities.

Rule 3: If the choice is to be made between more than two things or persons, the superlative degree will be used.
The structure will be: the + Superlative degree + of all the…

Example: He is *the best of all the* batsmen in the Indian cricket team.

Rule 4: When we use an adjective between "as………as" and "not so……….as", the adjective will be in positive degree.

Example: Jaipur is *as hot as* Bhopal in summers.
Gwalior is *not so developed as* Delhi.

Rule 5: In comparative degree, we use (adjective + er) + than. 'Than' is used in case of comparison between two persons or things and an adjective of comparative degree is used with it.

Example: Rajesh is *taller than* his brother.

Rule 6: Article 'the' is used before superlative degree as it becomes definite and unique.

Example: Gurugram is *the* most polluted city of India.

Rule 7: When we wish to state that someone or something is better or worse than the rest compared one at a time, 'any other' is used.

Example: Ramesh is taller than any boy in the class. (Incorrect)
Ramesh is *taller than any other* boy in the class. (Correct)

Rule 8: Certain adjectives can't be used in comparative or superlative degree. They are perfect, supreme, impossible, absolute, ideal, everlasting, eternal, triangular, square, round, major, minor, complete, entire, chief, extreme, etc.

Rule 9: In comparative degree, we use 'than'. However, for adjectives ending in '-ior' 'to' is used. ***Example**s*: superior, inferior, junior, senior, prior, anterior, posterior, exterior, interior, etc.

Rule 10: The same word can be an adjective in a sentence and a noun in another sentence.

Example: He teaches Science (noun). He is a *Science* (adjective) teacher.

Rule 11: If a word, mostly used as a noun, is used as an adjective in a sentence, it is not used in the plural form.

Example: He will be hospitalised tomorrow for his eyes surgery. (Incorrect)
He will be hospitalised tomorrow for his *eye* surgery. (Correct)

Rule 12: 'As' is used in the positive degree to denote equality while 'than' is used in the comparative degree. However, when a sentence contains adjectives in positive and comparative forms, both 'as' and 'than' are required.

Example: She is as pretty, if not prettier than any other girl in the class. (Incorrect)
She is *as pretty as*, if not prettier than any other girl in the class. (Correct)

Rule 13: Some adjectives like 'afraid, asleep, alike, aware, alone, due, ready, unable, glad, sorry, well, ill, sure', etc., are not used before nouns. For ***example*** afraid boy, asleep woman, aware shopkeeper, alone lady are all wrong expressions.

Example: I talked to the alone old woman. (Incorrect)
I talked to the old woman who was all alone. (Correct)

Rule 14: No comparison in weight, quantity and number and positive degree is used; however, when the statement is without 'times', comparative degree is used.

Example: His house is three times as cheap as yours.

Rule 15: The adjective is used predictively (after verb), when the noun is followed by a preposition.

Example: She is a suitable woman for this post. (Incorrect)
The woman is *suitable* for this post. (Correct)

ORDER OF ADJECTIVES

Generally, the order of adjectives is as under:

1. quantity/ number – *eleven* players
2. opinion – *good* boy
3. size – *huge* tree
4. shape – *round* table
5. condition – *frail* woman
6. age – *old* man
7. colour – *blue* sky
8. pattern – *striped* shirt
9. origin – *Indian* boy
10. material – *wooden* cupboard
11. purpose – *sleeping* bag

Examples:

I love that big, old, red, antique car that is parked in front of Mr. Sharma's house.

Tom took along three large ripe apples for his playmates.

CONJUNCTION

A conjunction is a word that joins two or more words, phrases or clauses in a single sentence. Conjunctions help us to share ideas and make connections more easily. Without them, we would have to make lots of short, blunt little statements. The most common conjunctions are 'and', 'or', 'but' and 'because'.

USAGE OF CONJUNCTIONS

Let's see how conjunctions act in a sentence with some ***examples***:

- She's going to visit her grandparents *and* she will go to her friend's house afterwards.
- She dropped the idea of going to her friend's house *because* she got caught in a traffic jam.
- You can have *either* rice pudding *or* Ras Malai for dessert, but you can't have both.

In the first ***example***, the conjunction used is 'and'. Without it, the sentence would read:

She's going to visit her grandparents. She will go to her friend's house afterwards.

Though, in the above sentences, the information conveyed is still the same, the use of the conjunction *and* helps to create a better flow with the sentence. Without it, the same information seems rather dull and a little curt!

In the second ***example***, the conjunction used is 'because'. Without it, the sentence reads as follows: She dropped the idea of going to her friend's house. She got caught in a traffic jam.

In this case, the conjunction is very important – without it, the meaning of the sentence becomes totally different. The use of 'because' shows that there is a connection between the two – an action has happened as a result of something else. Without the conjunction, the connection between the two events is not clear at once.

In the third ***example***, the conjunction 'either...or' shows a choice between two items in one clause and the conjunction 'but' contrasts it with the alternative provided in the other.

Which conjunction to use?

There are many conjunctions in the English language and each one has a specific usage. Some of the most common conjunctions we use in our day-to-day conversation are:

For: She bought medicines *for* grandmother. (shows the reason or purpose for doing something)

And: He is going to Shimla *and* Mussoorie in summer. (adds one item to another)

But: He loves playing cricket, *but* hasn't ever played football. (shows contrast or difference between ideas)

Because: He came first in the class *because* he studied hard. (shows that something happens as a result of something else taking place)

So: He had to take a taxi so he could reach the office in time. (shows that some action or event follows from another)

TYPES OF CONJUNCTIONS

There are four types of conjunctions:

1. Coordinating Conjunctions

These conjunctions link equal parts of a sentence including clauses and phrases. A comma is used when a coordinating conjunction is used to join two independent clauses. The most commonly used coordinating conjunctions are easily remembered by the mnemonic FANBOYS: **for, and, nor, but, or, yet, so.**

For - refers to reason or purpose of an action/event
And - adds one clause or phrase to another similar one
Nor - adds another negative idea to an already existing one
But - shows a contrast
Or - adds another positive idea to an already existing one
Yet - provides a contrasting idea to an existing logical idea or point
So - shows the result or consequence of an event

In addition to the above, other conjunctions include also, as well as, yet, still, too, only, however, nevertheless, no less than, else, otherwise, etc.

Examples:

- She couldn't reach the station in time, *so* she missed the train.
- We went out to play cricket *but* we couldn't as it began raining.
- Would you like rice *or* chapatti in dinner?
- She doesn't like mangoes *nor* does she like bananas.
- His brother *and* he look alike.
- We must hurry up *or* we will be late for the movie.
- He is very intelligent; *also*, he works very hard.
- Tagore won a Nobel for his writing. He was an extraordinary painter, *too*.
- We must water the plants; *otherwise*, they will die.
- His intentions are not wrong; *only*, he is a little thoughtless.
- They have not left any instructions; *yet*, every employee has been working responsibly.
- These mangoes are delicious; still, they leave a tangy taste later.
- The girls *no less than* the boys are participating in full numbers.
- The militants opened fire at the forces conducting a search operation; *however*, the forces retaliated valiantly despite being caught unawares.

2. Subordinating Conjunctions

They help to link or connect a dependent clause to an independent one. The most common subordinating conjunctions are **that, which, where, who, after, because, when, where, whatever, whoever, while, before, though, although, if, that, till, until, unless, than, as, since, as if, so that**, etc.

Examples:

- He is finding it difficult to make both ends meet *while* his brother is living a luxurious life.
- You can sit *wherever* you like.
- She couldn't come *because* she was ill.
- You ought to respect fellow humans *so that/ in order that* you get respect in return.
- *Although* he is poor, he is involved in many charitable activities.
- The rehabilitation work was stalled *because/as/since* dangerous landslides began occurring.
- He acted as *if* he was familiar with the CEO of the company.
- He is as good as Rajan at playing football.
- Although they put their heart and soul into the project, it did not turn out so well.
- You will not be able to salvage the situation *unless* you devote all your resources to it.
- Don't expect them to believe *whatever* you say.
- This is the person who has been invited preside over the function.
- The Conference of the Parties, *which/that* meets every year, deliberates over environmental issues under the United Nations Framework Convention on Climate Change.
- One should not *go where* one is not welcome.

3. Correlative Conjunctions

These are paired conjunctions that are generally used at two places in a sentence to connect two equal grammatical entities. The most common correlative conjunctions are **neither...nor, either...or, not only...but also, whether...or**, etc.

Examples:

- *Either* he *or* she broke the window glass.
- They have *neither* a car nor a bike.
- He is not *only* foolish, *but* also argumentative.
- Would you *rather* go to movies or sleep at home?
- *Either* he or she cooks the dinner.
- He will *neither* come over *nor* give a call.

4. Compound Conjunctions

The phrases which are used as conjunctions are called compound conjunctions. They are: **so that, provided that, as well as, as soon as, as long as, such that, in order that,** etc.

Examples:

- They have got a car as well as a *bike*. (connects nouns)
- I love swimming as well as *driving*. (connects gerunds)
- She has been hired *to wash* clothes as well as to cook meals for the family. (connects To- infinitives)
- He talks as *if* he is the owner of this company. (Perhaps he is the owner.)
- He talks as *if* he were the owner of this company. (He isn't the owner, only assumes so.)
  [**Note:** Remember that a past tense after as *if/though* indicates that the comparison is unreal.]
- The dog jumped in *as soon as* I opened the door.
- She will lose weight *provided that* she works out hard.
- He is working hard *so that* he will qualify the exams.
- You can borrow my car *as long as* you pay for fuel.
  [**Note:** After *as long as,* we use a present tense to refer to the future]
- They organise the show on Sundays *in order that* everybody would be able to attend.
  [**Note:** *So that* and *in order that* have similar meanings. *So that* is more common in an informal style]

RULES OF CONJUNCTIONS

Rule 1

We use **and, as well as, both...and, not only...but also** to emphasise the link between two things.

Examples:

- Both the US and North Korea agree on the treaty.
- He played *both hockey and* cricket when he was young.
- He is *not only* foolish *but also* arrogant.

Rule 2

The conjunction **so....as, as....as** is used to make comparison between two persons, things, ideas.

Examples:

- He is not so intelligent as you.
- He is as intelligent as you.
  [**Note:** *So... as* is used in negative sentences; *as...as* is used in affirmative sentences.]

Rule 3

Although, though are followed by *yet* or a comma (,)

Examples:

- *Though* he did not work hard, he passed the exams.
- *Although* these questions are easy to solve, *yet* he took the help from his sister.

Rule 4

Pairs such as **no sooner...than, hardly... when, scarcely... when, barely...when** should be used in correct form.

Examples:

- *No sooner* had he walked onto the stage *than* he was applauded.
- *Hardly* had I stepped out of the room *when* I saw an intruder scurrying away.
- *Scarcely* had he entered the hall *when* the audience fell silent.
- *Barely* had he driven the car a mile *when* it broke down.
  Remember that *hardly*, *scarcely*, and *barely* are negative words. So, do not use *not, no, never* with the clause containing these words. If a sentence begins with a negative word, the helping verb gets positioned before the subject ('Had he' rather than 'He had').

Rule 5

Lest is followed by **should** or first from of the verb. *Lest* is a negative word. So, do not use *not, never, no* with *lest.*

Examples:

- Walk carefully *lest* you *should* fall.
- Walk carefully *lest* you *fall.*

Rule 6

Until is time oriented and **unless** is action oriented. *Until* and *unless* are negative words which don't require *not, never, no* with the clause containing these words.

Examples:

- Wait here *until* you get my call.
- *Unless* you work hard, you will not qualify this test.

Rule 7

In affirmative sentences, the phrases *doubt* and *doubtful* are followed by if or *whether*. In negative or interrogative sentences, the phrases *doubt* and *doubtful* are followed by *that*.

Examples:

- I am *doubtful if* he will pass the exam.
- I *do not doubt that* he will pass the exam.

Rule 8

The connectors **not only....but also** must be placed before the parts joined.

Examples:

- He not only lied to his wife but also to his children. (Incorrect)
  He lied not only to his wife but also to his children. (Correct)
- He lied not only to them but also cheated me. (Incorrect)
  He not only lied to them but also cheated them. (Correct)

Rule 9

Between is followed by **and; from** is followed by **to**

Examples:

- You will have to choose *between* black *and* golden.
- The doctor attends to his patients *from* morning *to* evening.

Rule 10

Neither of means none of the two; **none of** is used for more than two; **either of** means one of the two; when more than two are concerned, **one of** is used.

Examples:

- *Neither of* the children was hurt.
- *None of* my friends got admission in medical.
- *Either of* the parties has enough support to form a government.
- *One of the students* of your class is responsible for this tragic incident.

Rule 11

After **rather/other,** the subordinating conjunction **than** should be used.

Examples:

- He has no *other* objective *than* to get a lucrative job abroad.
- She would *rather* buy a car *than* a moped.

TENSE

Tense is the form taken by a verb to indicate time and continuance or completeness of an action or event.

Tenses are of three main types, viz. Present Tense, Past Tense and Future Tense. Further, each of these is sub-divided into four categories, i.e., Simple Tense, Continuous Tense, Perfect Tense and Perfect Continuous Tense.

(I) PRESENT TENSE

It expresses an action or event that takes place in the present time; or, a habit or state that currently or generally exists.

(1) Simple Present Tense

It is used to describe universal truths, habits, unchanging situations and scheduled activities.

***Example*s for repeated or regular actions in the present time period:**

- I ***take*** the tram to the office.
- Prakash ***works*** eight hours every day.
- The train to Mumbai ***leaves*** at 10 P.M.
- He ***goes*** to dance classes in the weekends.
- I ***get up*** every day at four o'clock in the morning.

***Example*s for facts:**

- We ***belong*** to India.
- Sun ***sets*** in the west.
- The president of the USA ***lives*** in the White House.

***Example*s for habits:**

- They ***travel*** to their farmhouse every weekend.
- She ***brushes*** her teeth twice a day.
- I ***get*** up early every day.

Formation of Simple Present Tense

- The first person (I) takes the first form of verb like- I ***go*** and we ***work*** there, etc.
- The second person (You) takes the first form of verb like- You ***come*** and You ***run,*** etc.
- In the third person singular number, the verb always ends with 's' like- He ***wants***, She ***gives***, Nina ***thinks***, Ravi ***runs,*** etc. In case the verb is ending with 'y', it changes to 'ies' like- She ***flies*** and He ***cries,*** etc.
- In the third person plural number, the first form of verb is used like- They ***come***, Children ***play,*** etc.

(2) Present Continuous Tense

It is used for those actions which are happening now or are unfinished. This tense is also used when the action is temporary and it is also known as Present Progressive Tense.

Examples:

- He is ***weeping***.
- She is ***talking*** with the guests.
- The baby is ***sleeping*** in the crib.

Present Continuous Tense is also used to express something not happening right now or will not happen in the near future.

Examples:

- You are not ***watching*** the game.
- She is not ***sitting*** over there.
- I am not ***going*** to the meeting after work.

The Present Continuous Tense is also used in questions.

Examples:

- Is he ***laughing***? Are you ***coming***?
- Are they ***listening*** to the teacher?

(3) Present Perfect Tense

It is used to indicate the completion of an activity or an action that occurred at some point in the past. Though, the time of the action is not exactly known, this tense is mostly used to refer to actions completed in the immediate past (not a very long time ago).

Examples:

- I ***have eaten*** my meal.
- I ***have finished*** cooking.
- He ***has bought*** a car.

In the present perfect sentences, the past participle of 3rd form of verb is used with the auxiliary verbs 'has' or 'have 'depending upon the subject of the sentence. For ***example***, if the subject of the sentence is 'She, He, It or a singular noun' then the auxiliary verb 'has' is used and when the subject of the sentence is 'They, You or a plural noun' then the auxiliary verb 'have' is used.

Examples:

- She ***has qualified*** the exam.
- They ***have helped*** us.
- You ***have done*** a good job.
- He ***has not started*** a business.
- It ***has come***.

(4) Present Perfect Continuous Tense

It is used for an action which started in the past and is continuing at the present time. A time reference is also used in the sentence to show the time of action. The specific words 'since' and 'for' are used to show the time of action.

'Since' is used to refer to a point of time - since Sunday, since 6 A.M., etc.,

'For' is used to express the duration of time - for 10 days, for six months, etc.

The auxiliary verbs 'have been' or 'has been' is used depending upon the subject of the sentence. If the subject of the sentence is 'She, He, It or a singular noun' then the auxiliary verb 'has been' is used and if the subject of the sentence is 'They, You or a plural noun' then the auxiliary verb 'have been' is used.

Sentence Structure: Subject + Have been / Has been + Present Participle (verb + ing) + (Object) + Time-reference

Examples:

- He ***has been living*** in the USA ***since*** 1990.
- She ***has been working*** in this company ***since*** 2002.
- He ***has been studying*** this book ***for*** three months.
- They ***have been waiting*** for me ***for*** three hours.
- Ravi ***has been writing*** for this newspaper ***since*** 25th May, 2007.
- I ***have been watching*** the movie ***for*** two hours.

***Example*s of interrogative sentences :**

- Has ***she been working*** as a professor ***for*** five years?
- Have ***they been making*** a noise ***for*** two hours?
- Has ***she been writing*** the report ***since*** 1st March, 2016?
- Has ***your mother been teaching*** you ***since*** 2001?

(II) PAST TENSE

It expresses an action, event or state in the past.

(1) Simple Past Tense

It is used to talk about a completed action in a time before now. The time of the action can be in the recent past or the distant past.

Examples :

- He ***went*** home yesterday.
- The work ***was finished*** on 4th June.
- She ***worked*** in a sugar factory.
- My father ***believed*** in superstitions.
- The steamer ***sailed*** yesterday.
- He ***went*** home some time back.
- She ***used to*** carry an umbrella.

(2) Past Continuous Tense

It is used to mention an ongoing action of the past or an action that continued for sometime in the past. It is also known as Past Progressive Tense. In these sentences, 1st form of the verb + ing and auxiliary verbs 'was' or 'were' is used depending upon the subject of the sentence. If the subject of the sentence is 'I, She, He or a singular noun then the auxiliary verb 'was' is used and if the subject of the sentence is 'You, we, They or a plural noun then the auxiliary verb 'were' is used.

Examples:

- He ***was waiting*** for his mother.
- She ***was riding*** a bike.
- The dog ***was barking*** at them.
- I ***was planning*** for the holidays.
- They ***were eating*** their meal.
- You ***were not preparing*** for the exam.
- We ***were not going*** with them.

(3) Past Perfect Tense

It is used to show that something happened before another action in the past or simply, to express two actions that happened in the past. In this case, it is important to use the connecting words like **when, before, because,** etc., correctly to show which action/event happened earlier than the other.

Examples:

- I ***had done*** my homework when Hari ***came*** to see me.
- They ***lost*** many games because ***they had*** not practiced enough.
- You ***had studied*** French before you ***moved*** to Italy.
- When I ***reached*** the station, the train ***had departed***.
- I ***had just gone*** out when it ***started*** raining.

(4) Past Perfect Continuous Tense

It is used to show an action/event that began before a certain point of time in the past and was continuing at the given point of time in the sentence. The sentence includes a 'time-reference' with 'since' and 'for' to show when the action started in past or for how long the action continued in the past.

Sentence structure: Subject + Had been + Present Participle + (Object) + Time-reference

Examples:

- She ***had been watching*** the game ***for*** two hours.
- He ***had been working*** for a newspaper ***for*** seven years.
- I ***had been applying*** for jobs ***since*** May 2013.
- She ***had been teaching since*** October, 2010
- Had ***she been waiting*** for her husband ***for*** three years?
- Had ***they been asking*** for me?

(III) FUTURE TENSE

It expresses an action/event that has not yet happened or a state that does not yet exist.

(1) Simple Future Tense

It is used to express an action that will occur or happen in the future.

Examples:

- I ***will*** buy a laptop at the end of this month.
- We ***will*** shift to a new apartment the next week.
- My father ***will*** buy me a bicycle on my birthday.
- He ***will*** leave for Canada day after tomorrow.
- She ***will*** get admission in a new school.

(2) Future Continuous Tense

It is used to express an on-going or continued action which will occur at some time in the future. In these sentences, the first form of the verb + ing is used along with the auxiliary verbs 'will be or 'shall be'.

Examples:

- He ***will be singing*** a song for the audience.
- I ***shall be reading*** the paper then.
- He ***will be meeting*** us next week.
- I ***will be writing*** a report.

(3) Future Perfect Tense

It is used to indicate the completion of an action/event in the future. In these sentences, the third form of the verb is used with the auxiliary verbs 'will have' or 'shall have'.

Examples:

- I ***shall have written*** my exercise by that time.
- He ***will have completed*** his project by Sunday.
- I ***will have taken*** my lunch.
- He ***would have finished*** his task.

(4) Future Perfect Continuous Tense

It is used to indicate an action represented as being in progress over a period of time that will end in the future. Time period is generally mentioned along with it. 'Since' or 'for' is used in the sentence for time-reference.

Sentence Structure : Subject + Will/Shall have been + Present Participle + (Object) + Time reference.

Examples:

- By next July, we ***shall have been living*** here for four years.
- The child ***will have been sleeping*** since 10 P.M.
- The doctor ***will have been treating*** patients for three years.
- You ***will have been using*** my bike for six months.
- The company ***will not have been advertising*** posts for two years.
- ***Will he have been studying*** for so long?
- ***Shall I have been waiting*** since morning?

Additional notes

- Events occurring at the same time must be given in the same tense.

  Examples : When he ***fainted***, his brother ***was*** with him; When he was writing his report, his mother was preparing meal for him, etc.
- Will or Shall can't be used twice in the same sentence even if both the actions refer to future tense.

  Examples :

  I shall come if he will call me. **(Incorrect)**

  I shall come if he calls me. **(Correct)**
- With the phrase 'as if 'or 'as though', the past tense and plural form of the verb should be used.

  Examples :

  He behaves ***as if*** he ***were*** the owner.

  It looks ***as if*** they ***have had*** a shock.

  It looks ***as though you've*** not ***met*** him before.
- With the word 'wish', four verbs are used namely, ***were, had, could and would***.

  '***Were***' is used when the wish seems to be unrealizable like, I wish I were a king.

  '***Had***' is used when our wish is lament over the past happening like, I wish I had accepted that offer.

  '***Would***' is used when we refer to the future like I wish I would get a ticket.

  '***Could***' is used when we wish that something which has already happened should have happened otherwise like, He did not go because he was busy yesterday, I wish he could go with you.

(SUBJECT)-VERB AGREEMENT

PRONOUN (SUBJECT)-VERB AGREEMENT

1. Since a pronoun is used **instead of a Noun**, it must be of the same number, gender and person as the noun for which it stands. ***Example:*** Those **beggars** are idle. **They** refuse to work for their living.
2. Consider the following two sentences.
   - (a) After a few hearings the jury gave **its** verdict. (Pronoun 'its is used in place of noun 'jury').
   - (b) The **jury** were divided in **their** opinions. (Pronoun 'their' is used in place of noun 'jury'

   You must be wondering why different pronoun 'its' and 'their' is used in place of the same noun 'jury' The reason is when a pronoun stands for a **collective noun** it must be in the singular number and neutral gender. (Sentence a). But when collective noun conveys the idea of separate individuals comprising the whole, the pronoun standing for it must be of the plural number. In sentence b, it is clear that members of the jury are not behaving as whole.

   Example :
   - (a) The **committee** is reconsidering its decision.
   - (b) The **committee** decided the matter without leaving their seats.
3. When two or more singular nouns are joined by '**and**', the pronoun used for them must be **plural**.

   Example : Rama and Hari work hard. **Their** teachers praise **them**.
4. But when two Singular nouns joined by '**and**' refer to the same person or thing, the pronoun should be singular.

   Example : The Secretary and Treasurer is negligent of **his** duty.

   Here the same person is acting as Secretary and Treasurer. That's why singular pronoun is used.
5. When two singular nouns joined by '**and**' are preceded by 'each' or 'every', then the pronoun must be singular

   Example : Every soldier and every sailor was in **his** place.
6. When two or more singular nouns are joined by **'or', 'either...or', 'neither...nor'**, the pronoun is generally singular.

   Example :
   - (a) Neither Abdul nor Rehman has done his lessons.
   - (b) Either Rama or Hari must help **his** friend.
7. When a plural and a singular noun are joined by '**or**' **or** '**nor**', the pronoun must be in the plural

   Example : Either the manager or his assistants failed in **their** duty.
8. When two things which have been **already mentioned** are referred to, 'this' refers to the thing last mentioned and 'that to the thing first mentioned.

   Example : Alcohol and Tobacco are both injurious: **this** perhaps less than **that**.
9. **Each, either and neither** are always singular and are followed by the verb in the singular

Example :

(a) Neither of the accusations is true.
(b) Each boy took **his** turn.
(c) Each of the ladies performs **her** duty well.

10. A pronoun must agree with its antecedent in **person, number and gender**.

Example:

(a) All passengers must show **their** (**not his**) tickets.
(b) I am not one of those who believe everything **they** (**not I**) hear

11. None is used in the singular or plural as the sense may require.

Example:

(a) Each boy was accompanied by an adult but there were none, with the orphan (Incorrect)
(b) Each boy was accompanied by an adult but there **was** none with the orphan. (Correct)
(c) I am used to many guests everyday but there **was** none today. (Incorrect)
(d) I am used to many guests everyday but there **were** none today. (Correct)

12. **Plural** is commonly used with **none**.

Example.

(a) **None** of his poems are well known.
(b) **None** of these words are now current.

NOUN (SUBJECT)-VERB AGREEMENT

1. A verb must agree with its subject in number and person. Often due to "Error of Proximity" the verb is made to agree in number with a noun near it instead of with its proper subject.

Examples:

(a) The quality of the mangoes were not good. (Incorrect since subject is **quality**, a singular noun, and not **mangoes**.)
(b) The quality of the mangoes **was** not good (Correct).
(c) His knowledge of Indian vernaculars are far beyond the common. (Incorrect)
(d) His knowledge of Indian vernaculars **is** far beyond the common. (Correct)

2. Two or more singular subjects connected by 'and' usually take a verb in the plural.

Example: Hari and Rama **are** there.

3. If two singular nouns refer to the same person or thing, the verb must be singular.

Example: My friend and benefactor **has** come.

4. If two subjects together express one idea, the verb may be in the singular.

Examples:

(a) The horse and carriage **is** at the door.
(b) Bread and Butter are essential for one's life. (Incorrect)
(c) Bread and Butter is essential for one's life. (Correct)

5. Two or more singular subjects connected by 'or', 'nor', either... or, neither...nor take a verb in the singular.

Examples:

(a) Neither he nor I **was** there.
(b) No nook or corner **was** left unexplored.
(c) Our happiness or our sorrow **is** largely due to our own actions.

6. But when subjects joined by 'and', 'or', 'nor' are of different **numbers**, the verb must be plural, and the plural subject must be placed next to the verb.

Examples:

(a) Rama and his brothers **have** done this.
(b) Neither Rekha nor her friends was present at the party. (Incorrect)

Neither Rekha nor her friends **were** present at the party. (Correct)

7. When the subjects joined by 'or', 'nor' are of different **persons**, the verb agrees in person with the nearest one.

Examples:

(a) Either he or I **am** mistaken.
(b) Neither you nor he **is** to blame.

8. When words are joined to a singular subject by 'with', 'together with', 'along with', 'accompanied by', 'in addition to', 'as well as', 'but', 'nothing but', 'besides', 'except', 'rather than', 'like', 'unlike', 'no less than', then also number of the verb remains singular.

Examples :

(a) The Chief with all his men, **was** massacred.
(b) The chairman, with the directors, **is** to be present.
(c) Silver, as well as cotton, **has** fallen in prices.

9. **Either, neither, each, everyone, many** a must be followed by a singular verb.

Examples :

(a) Neither of the two men **was** very strong.
(b) Every one of the prisons **is** full.
(c) Many a man **has** done so.
(d) He asked whether either of the applicants **was** suitable.

10. When a plural noun denotes some specific quantity or amount considered as a whole, the verb is generally singular.

Examples :

(a) Five hours are too short a time to judge one's character. (Incorrect)
Five hours is too short a time to judge one's character. (Correct)
This is so because five hours is considered as one duration of time.
(b) One hundred paise is equal to one rupee.
(c) Six miles is a long distance.
(d) Fifty thousand rupees is a large sum.

11. **Two nouns** qualified by each or every, even though connected by 'and' require a singular verb.

Example : **Every boy and every** girl **was given a packet of sweets.**

12. 'None' though singular commonly takes a plural verb.

Example : None are so deaf as those who will not hear. However, singular verb also is correct. None is so deaf as one who will not hear.

SOME COMMON MISTAKES COMMITTED

Examples :

(a) His diet was abstemious, his prayers long and fervent. (Incorrect as subjects are not in the same number.)
His diet was abstemious, his prayers were long and fervent. (Correct)

(b) He never has and never will, take such strong measures. (Incorrect)
He never has taken, ad never will take, such strong measures. (Correct)

(c) Ten new members have been enrolled and seven resigned. (Incorrect)
Ten new members have been enrolled and seven have resigned. (Correct)

(d) Being a very hot day, I remained in my tent. (Incorrect as participle being is referring to none)
It being a very hot day, I remained in my tent. (Correct)

(e) Sitting on the gate, a scorpion stung him. (Incorrect participle sitting is not referring to any word)
While is was sitting on the gate, a scorpion stung stung him (Correct)

(f) Put in to bat first, a huge total was expected from India.
Put in to bat first, India was expected to pile up a huge total.
Who has been put in to bat first? A huge total of India? Common sense tells us it must be India. But the sentence a, as it stands, appears otherwise. So, sentence b is correct.

(g) Being a rainy day, I decided to take my umbrella.
It being a rainy day, I decided to take my umbrella.
The first sentence, as it stands, gives us the impression that being a rainy day qualifies I. This is simply not true. I am not a rainy day. So the second sentence is correct.

(i) The verb lay (lay, laid, laid) is transitive and is always followed by an object. The verb lie (lie, lay, lain) is intransitive and cannot have an object.
Examples:
Lay the child to sleep.
Let me lie here.
I laid the book on the table.

ARTICLES, QUANTIFIERS AND OTHER DETERMINERS

Determiners are words that precede nouns to introduce or identify them, thereby making their reference more specific. Determiners include articles (the teacher, a college), quantifiers (some honey, few birds, any person), demonstratives (those people), possessives (your choice), interrogatives (whatever purpose), distributives (either way), etc.

ARTICLES

An article is a word used before a noun that defines a noun as specific or unspecific. Articles are adjectives by function as they add information about nouns.

There are three articles in all: **a**, **an** and **the**.

A and **an** are the *indefinite articles*. They are used to refer to a single and unspecified entity. **A** is used with nouns that start with a consonant sound, e.g., a soap, a bicycle, a pen, a book, etc. **An** is used with words that start with a vowel sound, e.g., an apple, an egg, an umbrella, an insect, etc.

The is the *definite article*. It refers to a specific entity or entities. We use the definite article when a definite noun is being referred to. ***Examples***: The sun is very hot today. The Pope is visiting the Vatican. This is the oldest monument in the city.

How to use indefinite articles 'A' and 'An'

Rules:

(i) The choice of 'a' and 'an' is determined by the sound rather than the letter at the beginning of the word. We use **an** if the word begins with a vowel sound and use **a** if it begins with a consonant sound: **a** book, **a** horse, **a** cheeseburger, **an** orange, **an** umbrella, **an** igloo, etc.

(ii) We use **an** when the word begins with the consonant 'h', but a vowel sound.
An hour: the word 'hour' begins with the consonant 'h', but the 'h' is silent, so the word starts with a vowel sound.

(iii) We use **a** when the word begins with a vowel letter but a consonant sound.
a university, **a** union: these words begin with the vowel 'u' but the 'u' is pronounced as the consonant y.
Another vowel with a consonant sound is 'o'. In some words, the letter 'o' at the start is pronounced as the consonant 'w'. So, we use 'a':
Examples: a one-eyed man, a once-in-a-lifetime experience.

(iv) We use **an** before **acronyms** in which the first letter is pronounced with a vowel sound.
When we pronounce a single consonant letter and it begins with a vowel sound, we precede it with 'an'. The consonants pronounced with vowel sounds include f, h, l, m, n, r, s, and x. ***Examples***: **an** HIV patient, **an** MRI test, **an** MLA, **an** MP, **an** FM station, etc.

(v) We use indefinite article a/an when we talk about a singular/ countable noun (person or a thing) that is indefinite or mentioned for the first time

Examples:

- She has finally got *a* good job.
- He immediately needs *a* doctor.
- He is training to be *an* engineer.

(vi) We use indefinite article a/an when a person/ thing is singled out as a representative of a class of things, animals and persons:

***Examples*:**

- *A* lion is *a* ferocious carnivore.
- *A* river becomes the lifeline for settlers.

(vii) We use indefinite article a/an when we use it before a verb functioning as a noun:

***Examples*:**

- He has planned for an outing today.
- She took the children for a long drive.
- They stayed up late for a talk.

(viii) We use indefinite article a/an when we use a proper noun as a common noun to express a particular trait/quality:

***Examples*:**

He is a Shylock in the city. 'Shylock' (a character from Shakespeare's *Merchant of Venice*) stands for 'a cruel moneylender'.

(ix) To replace 'per' in measurement of time:

***Examples*:**

- She earns forty thousand rupees a year.
- This pick-up van comes twice a day.

(x) In exclamation with 'what' or 'how' before singular countable nouns:

Examples:

- What a good idea!
- What a lovely day!
- How I love the winter holidays!

(xi) When we don't know the person we refer to:

Examples:

A Mr. William = Some Mr. William; A Mr. Wilson = Some Mr. Wilson

(xii) To make certain phrases with nouns:

Examples:

- It's '*a*' pity he hasn't passed his exams even in his second attempt.
- She didn't say 'hello' as she was in '*a*' hurry.
- The culprit was just telling '*a*' lie.

(xiii) Before the adjectives 'few' and 'little' in the positive sense of 'a small quantity':

Examples:

- *A* few oranges are left in the refrigerator.
- There's *a* little milk in the kitchen.

Examples:

- *Observe how the indefinite article is positioned with adverbs like* **rather, very, much, quite, as, too, such***:*
- It has become rather *a* burden.
- It's quite *an* art, I must say.
- He's too clumsy *a* technician to fix it.
- They are *a* much hated lot.
- You are such *an* angel that you don't perceive any falsehood.

How to use Definite Article 'The'

Rules

(i) Before a particular person or thing that's already mentioned or known:

***Example*s:**

- *The* maid has gone to *the* market.
- *The* bus has picked up *the* children for school.
- Look at *the* man standing over there.
- What I saw was unusual. *The* scrooge was feeding *the* beggars.

(ii) Before proper nouns while referring to historical buildings, geographical names

Examples:

The Eiffel Tower, The Himalayas, The Ganges, The Ramayana, The Bible, The Sahara, The Arabian sea, The US, The Earth, The Moon, The best movie, etc.

(iii) To express a class of animals or things:

Examples:

- *The* cow is very useful animal for farmers.
- *The* dog has an intense sense of smell.
- *The* pineapple is a tropical fruit.

ZERO ARTICLE OR OMISSION OF ARTICLE

Sometimes, we omit the use of article before a noun. Such a case wherein neither definite (the) nor indefinite (a, an) article appears before a noun is often referred to as zero article.

Rules

(i) Before the proper names of places and institutions:
***Example*s:** Jawaharlal Nehru University, Rajiv Chowk, Indira Gandhi International Airport, Victoria Terminus, George Washington Bridge

(ii) Before specific mealtime:
***Examples*:**

- Have you had breakfast this morning?
- Grandma will have fruit for lunch.
- They have gone out for dinner tonight.

(iii) With names of days, months, seasons, holidays and specific time of the day:
***Example*s:** On Tuesday, in April, in summer, at Diwali, at Christmas, at noon, at night, at midnight, before dusk, after sunset, at sunrise, etc. (but *the* is very much required with parts of the day: in the morning, in the afternoon, in the evening)

(iv) With names of pubs, restaurants ending in 's:

Examples:

- We went to Sakley's last night.
- Let's meet at Domino's.

(v) With names of sports, games and activities:

Examples:

- I love snooker.
- Rummy is a lot more difficult than solitaire.
- They play Squash at the Club.

(vi) With geographical names:

Examples:

- Continents: Africa, Antarctica, Asia, Australia, Europe, etc. (**but** the Americas (North and South America), the Antarctic, the Arctic)
- Countries: Chile, France, New Zealand, Kazakhstan, Namibia, etc. (**but** the Czech Republic, the Netherlands, the Philippines, the United Kingdom (UK), the United States of America (USA)
- Lakes: Lake Geneva, Lake Lopnor, Lake Michigan, Lake Victoria, etc.)
- Mountain peaks: Mawson Peak, Mont Blanc, (Mount) Everest, Mount Kenya, Mount Washington
- Cities: Beijing, New York, Reykjavík, Rio de Janeiro (**but** the Hague, the Vatican, etc.)
- Streets and roads: Downing Street, Michigan Avenue, 7, Lok Kalyan Marg, 10 Janpath, etc.

(vii) With certain places in their institutional sense:

***Examples*:**

- The children are going to school. (*for studying*) (**but** I've not seen him in *the* school today)
- What time do you go to bed? (*to sleep*) (**but** He went to *the* bed to check if the children were asleep)
- The accused has been sentenced to 2 years in prison. (*as a punishment*) (**but.** He is a cook at *the* prison)

QUANTIFIERS AND NUMERAL DETERMINERS

Quantifiers express the quantity of a noun, and can be used with both countable and non-countable nouns. The quantifiers tell how many or how much of the noun. Selecting the correct quantifier depends on correctly distinguishing between Countable and Uncountable Nouns.

Quantifiers include the words some, any, enough, all, no, both, none, half, double, several, few, much, many, more, most, little, less, least, etc.

***Examples*:**

- *Many* of the eggs he had bought were stale.
- *Each* competition had the same rules for participants.

Quantifiers With Countable Nouns:

Many eggs, a few eggs, few eggs, several eggs, a couple of eggs, none of the eggs

Quantifiers With Uncountable Nouns:

Not much milk, a little milk, little milk, a bit of milk, no milk.

Quantifiers With Both Countable And Uncountable Nouns:

Some eggs/milk, enough eggs/milk, a lot of eggs/milk, plenty of eggs/milk, a lack of eggs/milk, etc.

Use Of Most And Most Of The

The quantifier 'most' must include the definite article 'the' with 'of' when it modifies a specific noun— whether countable or uncountable.

***Examples*:**

Most of the teachers at this university are from England. *Most of the* snow has melted.

With a general plural noun, however, only 'most' is used and 'of the' is omitted:

***Examples*:**

Most colleges have their own rules and regulations. *Most* students in this college come from migrants' families.

Use Of Little, A Little, The Little And Few, A Few, The Few

Note, that there is an important difference between 'little', 'a little' and 'the little'(used with uncountable nouns): 'a little' shows a small quantity or amount of something in a *positive* sense; 'little', emphasizes in a *negative* sense that there is only a very small quantity or amount of something; and 'the little' refers to 'all of the small quantity that was there'. The same goes with 'few', 'a few' and 'the few' (used with countable nouns).

Examples:

- He is visiting France, but he knows *little* French. (marks negative implication of knowing little French)
- She is not educated but does understand the political gimmicks *a little*. (marks positive implication of understanding a little)
- Some pigeons pecked on *the little* rice that was leftover in the earthen pot. (marks 'all of the little quantity present')

Numeral determiners

When numerals appear in front of a countable noun, they are determiners. Numeral determiners are of two kinds: cardinal (one, two, three, etc.) and ordinal (first, second, third, next, last, etc.)

Examples:

- He has *two* cats and *a* dog as pets.
- The bananas looked ripe so, I bought a *dozen*.
- The *next* bus departs at 2.30.
- He was the *first* President of Independent India.

OTHER DETERMINERS

Possessive determiners: my, your, his, her, its, our, their (indicating possession)

***Examples*:**

- *My* father has gone to see *his* ailing grandmother.
- *Her* sister studies in a boarding school. I am forgetting *its* name.
- It is not *my* notebook that is on top of the pile.
- *Their* idea is not feasible.

Demonstrative determiners: this, that, these, those (pointing out a noun)

***Examples*:**

- *These* oranges are sour.
- *This* plan won't work as our requirement is different.
- *These* eggs too are stale, and are no better than *those* you bought yesterday.

Interrogative determiners: whose, what, which (asking question to identify a noun)

***Example*s:**

- *Whose* father is seated there?
- *What* plan-B do you suggest?
- *Which* school are you joining this year?

[Note, that **who** or **how** are not adjectives/determiners as they don't precede nouns.]

Distributive Determiners: each, every, half, both, either, neither (referring to individual members of a group in different ways of distribution)

***Example*s:**

- *Either* brother (either of the two brothers) could make it to the final team.
- *Both* the candidates have been expelled for indulging in unfair practices.
- *Every* student has to fill this form.

Emphatic determiners: own, such, same, very (emphasise the noun being referred to)

***Example*s:**

- The defender kicked the ball straight into his *own* goalpost.
- The *very* person who created the mess will now clear it.
- The *same* man who stood screaming a while ago, was seen dancing wildly.

General determiners: A, an, any, another, other, what, etc. (refer to things in general)

Any with a singular noun or an uncountable noun when we talk about one of all people or things:

***Example*s:**

- With this licence, you are allowed to drive *any* car.
- I like going Nainital, Shimla, Darjeeling – *any* hill station.

Another to talk about an additional person or thing:

***Example*s:**

- Would you like *another* cup of tea?
- There's *another* side to the story.

Other as the plural form of 'another':

***Example*s:**

- I invited Raman, Sarin and a few *other* friends.
- If you fail in one, try *other* ways to succeed.

Zero determiner: Sometimes, no determiner is used before a noun.

***Example*s:**

- *Milk* is good for your health. (an uncountable noun with zero determiner)

- The government must focus on *health* and *education*. (2 uncountable nouns with no determiner)
- Girls chat more in class than *boys* do. (plural nouns with no determiner)

PREPOSITION

A preposition is a word which is usually placed before a noun or pronoun and it shows the relationship between the noun or pronoun and other words in a sentence. In other words, prepositions are the words that help glue a sentence together. They do this by expressing position and movement, possession, time and manner of an action.

Observe the following examples where the prepositions have been italicized in boldface.

- He prefers to travel ***by*** train.
- Take your sister ***with*** you.
- She signed her name on the dotted line.
- He pushed his way ***onto*** the crowded subway station.

Object of preposition

We have learnt that prepositions precede nouns/pronouns. The noun or pronoun which follows a particular preposition in a sentence is called its object. Therefore, train, you, the dotted line and the crowded subway station are the respective objects of the prepositions ***by, with, on*** and ***onto***.

TYPES OF PREPOSITIONS

I. Prepositions of Time

Prepositions of time are at, on, in, before, after, during, until, to, etc. Time prepositions are used to show when something happened, happens or will happen.

Examples:

- We had the meeting at 11am.
- The watchman attends here until dawn.
- She arrived home before dinnertime.
- Here in London, it often snows in December.
- There should be a lot of progress after they finish this project next month.
- Doesn't he work on Sundays?

Rules for Using Prepositions of Time

In: for years, months, seasons, centuries and times of day

- He first met him in 2010.
- It's always hot in June.
- Easter falls in spring each year.
- India's freedom struggle started in the 19th century.
- We eat dinner in the evening.

On: for days, dates and specific holidays

- The housemaid comes on Mondays, but not on Sundays.
- Diwali is on October 27th this year .
- Will you buy him a watch on his birthday?

At: for times, indicators of exception and festivals

- Families often whitewash their houses at Diwali time.
- He works faster at night.
- He called it a day at 6 pm.

Before and **after**: when something happened, happens or will happen in relation to another thing

- *Before* we discovered this park, we used to play on the pavement.
- The train will not leave *before* 2 am.
- Rajesh came to school *before* Raman, but *after* Sarin.

Around and **about:** to convey uncertainty/inexactness of time

- The maid usually arrives *around* 8 am.
- It is *about* time we left for the airport.

During and **throughout:** to show time period

- The elections will be held in seven phases *throughout* the month of April and May.
- I learned how to drive a car *during* the holidays.

On time, in time, in good time:

- Our train pulled into New Delhi Railway Station *on time*. (according to schedule; punctual or punctually)
- I got home just *in time* - it's beginning to rain. (before a time limit expires)
- She arrived at the airport *in good time*. (in a reasonable length of time; when or before due)

Since and **for**: *since* refers to a 'point of time'; *for* denotes 'duration of time'

- He has been working here *since* the end of the last century.
- It has been raining *since* Monday.
- It rained *for* two days.
- He ruled the marquee *for* many decades.
- This is all I have *for* today.

Till and **Until**: *till* and *until* are generally interchangeable though 'till' now has become obsolete. Both mean 'up to the time of'.

- They haven't completed the project till today.
- I didn't remember it until they reminded me.
- This pedestrian bridge is open till/until midnight.

To: *to* indicates a time limit or a period:

- We work nine to five, Monday to Saturday.
- It is a quarter to two. (i.e., 01:45 p.m.)

II. Prepositions of Place

Prepositions of place describe the position of a person or thing in relation to another person or thing. The most common prepositions of time – *on, at, in* – are also the most common prepositions to indicate position, but they are used in a different way, as understandable. Other prepositions of place are under, over, inside, outside, behind, in front of, above, below, etc.

Examples:

- There is a flower vase *on* the table.
- The aeroplane hovered *above* the runway.
- He stood *in front of* the judge and pleaded not guilty.
- The doctor placed a sheet *over* the dead body.
- She sat *beside* her ailing dog and stroked it fondly.
- A small stream runs *below* that bridge.
- She put the papers *beneath* the bed sheet.
- He put his hand *behind* his back.

Rules for Using Prepositions of Place

On: used to relate to something with a surface.

- The painting hangs on the wall.
- There are four images on the page.
- The menu is on the table.

In: used to relate to something that is inside or within confined boundaries

- Sarin is *in* India, visiting his uncle *in* the hospital.
- The honey is *in* the jar on top of the rack.
- The children are playing *in* the park.

At: used to relate to something at a specific point

- She was *at* the entrance of the mall.
- We met the actor *at* the airport.

Observe the following sentences for the usage of **at** and **in**:

- She stood *at* the parking lot *in* the fifth avenue.
- I live at Shanti Nagar *in* Cochin.
- They will stay at the Maurya Sheraton in Delhi.

Other prepositions of place are **under, over, inside, outside, above** and **below.**

- The secret tunnel ran *under* the International border.
- The mouse hid *under* the table.
- Put the butter *over* there.
- The child got accidentally locked *inside* the car.
- She stepped *outside* the house to attend to the stranger at her door.
- The child is waving at his mother from *below* the stairs.

Abov*e and over: referring to ‘at o*r to a place higher than someone or something’

- A light bulb hangs *over/above* the table.
- She raised her arms *over/above* her head.
- She lives in an apartment *over/above* a grocery shop.
- This picture is suitable for children *over/above* 15 years old.

Be careful! Only one of these two is appropriate in certain contexts:

- They’ve been waiting at the station for *above* an hour. (incorrect)
  They’ve been waiting at the station for *over* an hour. (correct)
- *Above* 40 people died in the accident. (incorrect)
  Over 40 people died in the accident. (correct)
- Grandma’s picture hung *over* the mantelpiece. (incorrect)
  Grandma’s picture hung *above* the mantelpiece. (correct)
- They are quarrelling *above* a trifle. (incorrect)
  They are quarrelling *over* a trifle. (correct)

III. Prepositions of Direction

Prepositions of direction show where or in which direction something moves. These prepositions are generally used with verbs of motion and are found after the verb. Some examples of prepositions of direction are to, from, on, onto, in, into, towards, through, up, down, around, etc.

Examples:

- The teacher has gone *to* the Principal’s office.
- He warned them to keep away *from* his dog.
- A fly fell *into* his tea while he was sipping it.
- The strong wind blew the roof *off* his house. (*off* shows separation or detachment)
- The nursery maid must have put the baby *into* someone else’s cradle.
- He hopped *onto* the carriage as it slowed down.
- Three monkeys have managed to escape *from* the zoo.
- She sent a message *to* her employer.
- She lives *in* Bangalore but she’s *from* Chennai.
- The hikers walked *up* the hill.
- The ball rolled *down* the hill.
- The child fell *into* the pond.
- She walked *round/around* the other side of the park.

Rules for Using Prepositions of Direction

To: The basic preposition of direction is “to.”

- She is going *to* school.

To/towards: The preposition ‘*to*’ indicates movement aimed at a specific destination, which can be a place or an event; *towards* denotes ‘in the direction of’.

- He went *to* Mumbai last week.
- He was carrying a suitcase and walking *towards* the train.
- The stock market index rose *to* 40000 before crashing. (destination in the sense of limit)
- The thief ran away when he felt that the police were coming *towards* him.

Onto/ into/out of: ‘onto’ denotes movement to land at a surface; ‘into’ denotes movement to the interior of a capacity or change to another form; ‘out of’ denotes movement from a confined place to the open.

- The policeman climbed up the ladder to get *onto* the roof.
- He put the money *into* the drawer.
- The egg hatched *into* a chick.
- He took her purse *out of* her bag.
- They got *out of* the car and walked *to* the house.

Through and **into**: The preposition *through* refers to movement within a space, from one end to the other; *into* expresses movement or action with the result that someone or something becomes enclosed or surrounded by something else.

- He drove *through* the tunnel.
- He jumped *into* the river. He walked *into* the room.

Across, over and **along**: *Across* and *over* convey movement from one side of a place to another; along is used for movement in a constant direction.

- Raj is swimming *across* the lake.
- The policeman climbed *over* the fence.
- The plane flew *over* Delhi.
- She followed him *along* the corridor.

At and **To**: Be careful! Prepositions of direction, “at” and “to” are not interchangeable. “At” is not always used as a preposition of direction, and is only common with the meaning of “towards” or “in the direction of” and that too only in some contexts.

Compare these sentences:

He threw the ball *to* Santosh. (enabling Santosh to catch it)
He threw the ball *at* Santosh. (trying to hit him)
Don’t put *on* gloves in summers.

IV. Prepositions of Agency/Instrumentality

Prepositions of agency/ instrumentality are used to indicate a causal relationship between an action and the doer (noun) of the action, e.g. by, with, of, etc.

Examples:

- ‘Freedom in Exile’ was written *by* the Dalai Lama.
- A number of universities are accredited *by* the UGC.
- The dog was hit *by* a car while it was crossing the road.
- Amartya graduated *with* a Master’s degree in Economics.

- The child is playing *with* his toys.
- I tried to open the car door *with* the key, but it was jammed.
- She scrubbed the surface clean *with* hot water.

V. Prepositions of Purpose /Relation/Connection/ Belonging/ Reference:

Prepositions that indicate purpose, relation, connection, belonging and reference are of, for, about, to, between, among, etc.

Examples:

- This is the climax *of* the film.
- The beauty *of* this game is that no one loses.
- The first chapter *of* any book usually sets the tone *for* the reader.
- He interned in the summer *of* 2017.
- He pleaded guilty *of* kidnapping and extortion.
- The farmer saved three bags *of* grain that year.
- Democracy is a government *of* the people.
- I can never compromise on at least eight hours *of* sleep daily.
- This article is *about* the various new gadgets in the market.
- Everybody is working hard *for* the exam
- My friends baked a cake *for* my birthday.
- I sincerely apologise *for* my behaviour.
- Your consent is important *to* me.
- What is your answer *to* this question?
- He is junior/younger *to* them.
- Nothing will change his decision *to* quit his job.

Between and among: 'Between' is used for referring to two persons or things; 'Among' is used for more than two persons or things.

Examples:

- Mother divided the pancake equally *between* the two sisters.
- The birthday girl distributed sweets *among* her classmates.

PREPOSITION DISPLACED FROM USUAL PLACE BEFORE THE OBJECT

(i) When the object is an interrogative pronoun:
Who (whom) were you talking to?
What are you referring to?
What are you waiting for?

(ii) When the object of the preposition is a relative pronoun:
This is the man that my uncle is working for.
This is the novel that she always talks of.

(iii) When the object is stated as a definite noun with 'the':
He is the man you can rely on.
This is the thing you can open the jar with.
This is the safe place you can live in.

(iv) With verbs such as rob, fine, inform, explain, recommend, compensate, suggest, propose, etc.
They robbed the woman of her gold chain.
(NOT robbed the gold chain of the woman)
The teacher explained the root formula to us.
(NOT explained to us the root formula)

PREPOSITION OMITTED

(i) No preposition is used after the following verbs:
Enter, discuss, marry, lack, resemble, approach, stress, emphasise, board, describe, investigate, comprise, demand, resemble, sign, resign, attack, invade, pervade, resist, befall, stress, etc.
She entered the compartment.
(NOT She entered into the compartment.)
They discussed the plan at great length.
(NOT they discussed about the plan.)
She resembles her sister.
(NOT She resembles with her sister).

(ii) The preposition 'to' must be omitted before indirect objects of verbs, such as advise, ask, beg, encourage, request, inform, order, etc.
He advised her to join that company.
(NOT advised to her)
They informed the police about the theft.
(NOT informed to the police)

Chapter 2

Reading Comprehension

A lot of questions in almost all competitive examinations are based on Reading Comprehension and thus, it is very important to successfully attempt the questions of this section. Reading comprehension is the most favoured section in English because it doesn't require prior knowledge. High accuracy in it acts as a game changer in clearing the cut off in English section with ease.

IMPORTANT TIPS & TECHNIQUES

- Most of the exams these days are conducted online; so, you need to have ample RCs practice on computer to pass this section with flying colours. While attempting RCs online, you can't underline important points or mark different areas in the passage and therefore, you need to hone your skills by practising regularly.
- Quickly skim through the passage before you read the passage thoroughly or attempt the questions.
- Before you start reading the passage, go through the questions that need to be answered. This will give you a fair idea about what the passage talks about. Once you start reading the passage, you can start locating the answers to questions.
- It is very important to make inferences while reading the passage because most of the questions are not asked directly. Your understanding of the passage and its theme is of utmost importance as it helps you eliminate the wrong options and pick the right one.
- Before reading the entire passage, first, read the first and last paragraph of the RC to have an idea what the author is saying in the paragraph. This will help you in having an overview of the whole passage.
- When you are attempting a question based on phrase, just read the two-three lines above and below that phrase to have an idea what is implicit from that phrase.
- If there are questions on vocabulary then you should attempt them first as it is quite easy to pick the antonyms and synonyms. You don't have to answer the questions in the order they appear to you because in the exams, you can skip the questions and move to the next one and again come back to the previous ones as per your choice.
- In most of the cases, elimination of choices works better than selection of choices. You should try to eliminate those options which are broad, narrow, odd and irrelevant to the question asked. This strategy will help you reach the correct choice easily along with high accuracy.
- Mark the answers only if you are sure of it and make sure you don't go for wild guess.
- Never use your past knowledge about the topic to answer any question.
- Read articles in newspapers on regular basis to improve your reading speed and vocabulary.

EXERCISE

DIRECTIONS (Qs. 1-5): *Read the passage carefully and answer the given questions.*

Passage 1

If an opinion contrary to your own makes you angry, that is a sign that you are subconsciously aware of having no good reason for thinking, as you do. If someone maintains that two and two are five, or that Iceland is on the Equator, you feel pity rather than anger, unless you know so little of arithmetic or geography that his opinion shakes your own contrary conviction.

1. If someone else's opinion makes us angry, it means that
(a) we are subconsciously aware of having no good reason for becoming angry
(b) there may be good reasons for his opinion but we are not consciously aware of them
(c) our own opinion is not based on good reason and we know this subconsciously
(d) we are not consciously aware of any reason for our own opinion

2. "Your own contrary conviction" refers to
(a) the fact that you feel pity rather than anger
(b) the opinion that two and two are four and that Iceland is a long way from the Equator
(c) the opinion that two and two are five and that Iceland is on the Equator
(d) the fact that you know so little about arithmetic or geography

3. Conviction means
(a) persuasion (b) disbelief
(c) strong belief (d) ignorance

4. The writer says if someone maintains that two and two are five you feel pity because you
(a) have sympathy
(b) don't agree with him
(c) want to help the person
(d) feel sorry for his ignorance

5. The second sentence in the passage
(a) builds up the argument of the first sentence by restating it from the opposite point of view
(b) makes the main point which has only been introduced by the first sentence
(c) simply adds, a further point to the argument already stated in the first sentence
(d) illustrates the point made in the first sentence

DIRECTIONS (Qs. 6-10) : *Read the passage carefully and answer the given questions.*

Passage 1

The problem of water pollution by pesticides can be understood only in context, as part of the whole to which it belongs - the pollution of the total environment of mankind. The pollution entering our waterways comes from many sources, radioactive wastes from reactors, laboratories and hospitals; fallout from nuclear explosions; domestic wastes from cities and towns; chemical wastes from factories. To these is an added a new kid of fallout - the chemical sprays applied to crop lands and gardens, forests and fields. Many of the chemical agents in this alarming melange initiate and augment the harmful effects of radiation, and within the groups of chemicals themselves there are sinister and little - understood interactions, transformations and summations of effect.

Ever since the chemists began to manufacture substances that nature never invented, the problem of water purification have become complex and the danger to users of water has increased. As we have seen, the production of these synthetic chemicals in large volume began in the 1940's. It has now reached such proportion that an appalling deluge of chemical pollution is daily poured into the nation's waterways. When inextricably mixed with domestic and other wastes discharged into the same water, these chemicals sometimes defy detection by the methods in ordinary use by purification plants. Most of them are so complex that they cannot be identified. In rivers, a really incredible variety of pollutants combine to produce deposits that sanitary engineers can only despairingly refer to as "gunk".

6. All the following words mean 'chemicals' except:
(a) sands (b) substances
(c) pesticides (d) deposits

7. The main argument of paragraph 1 is:
(a) that there are sinister interaction in the use of chemicals
(b) that there are numerous reasons for contamination of water supplies
(c) that there are many dangers from nuclear fallout
(d) that pesticides are dangerous

8. The word 'gunk' in the last line refers:
(a) to the waste products deposited by sanitary engineers
(b) to the debris found in rivers
(c) to unidentifiable chemicals found in water
(d) to the domestic water supplies

9. Water pollution can only be understood:
(a) in relation to world contamination
(b) by the whole human race
(c) in context
(d) in relation to the number of pesticides that exist

10. Water contamination has become serious:
(a) since water pollution was difficult to assess
(b) since nature has taken a hand in pollution
(c) since chemists began to use new substances
(d) since businessmen authorised the use of chemicals.

DIRECTIONS (Qs. 11-15) : *Read the passages carefully and choose the best answer to each question out of the four alternatives.*

Passage 1

Pidgins are languages that are not, acquired as mother tongues and that are used for a restricted set of communicative functions. They are formed from a mixture of languages and have a limited vocabulary and a simplified grammar. Pidgins serve as a means of communication between speakers of mutually unintelligible languages and may become essential, in multilingual areas. A creole develops from a pidgin when the pidgin becomes the mother tongue of the community. To cope with the consequent expansion of communicative functions, the vocabulary is increased and the grammar becomes more complex. Where a creole and the standard variety of English coexist, as in the Carribbean, there is a continuum from the most extreme form of creole to the form that is closest to the standard language. Linguists mark off the relative positions on the creole continuum as the 'basilect' (the furthest from the standard language), the 'mesolect' and the 'acrolet'. In such situations, most creole speakers can vary their speech along the continuum and many are also competent in the standard English of their country.

11. A pidgin develops in a situation when
(a) Different and mutually unintelligible languages exist side by side
(b) A creole becomes the mother tongue of a linguistic community
(c) A language with restricted vocabulary undergoes an expansion in grammar and vocabulary
(d) Two similar languages are mixed to create a new language.

12. According to the given passage, a pidgin becomes a creole when
(a) It ceases to be a means of communication
(b) It becomes the mother tongue for a new generation of speakers
(c) Its vocabulary undergoes some kind of change
(d) Two or more languages are mixed with an existing pidgin

13. According to the passage, a creole continuum is

(a) A linguistic term for the mixture of more than two languages

(b) A scale which measures the linguistic competence of the speaker.

(c) A scale in which the proximity of the creole to the standard language is measured

(d) A record of the continuous history of a creole

14. According to the passage 'basilect' means

(a) An impure form of a creole

(b) A form of creole which is furthest from the standard language

(c) A form of creole which has an extended vocabulary

(d) A form of creole which is very close to the standard language

15. Find out a word in the passage which is opposite in meaning to the word - 'Simplified'

(a) Complex (b) Expansion

(c) Restricted (d) Consequent

DIRECTIONS (Qs. 16-20) : *In questions below, you have a passage with 5 questions. Read the passage carefully and choose the best answer to each question out of the four alternatives.*

Passage 4

Research is a detailed study of a subject undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications. It is used to establish or confirm facts, reaffirm the results of previous work, solve new or existing problems or develop new theories. To test the validity of instruments, procedures or experiments, research may replicate elements of prior projects, or the project as a whole. The primary purposes of basic research are documentation, discovery, interpretation or the research and development of methods and systems for the advancement of human knowledge. There are several forms of research : scientific, humanities, artistic, economic, social, business, marketing, etc.

Academic publishing describes a system that is necessary in order for academic scholars to review the work and make it available for a wider audience. Most academic work is published in book form. There is also a large body of research that exists in either a thesis or dissertation form. Many researchers spend their time applying for grants for research funds. These grants are necessary not only for researchers to carry out their research, but also as a source of merit.

16. How many kinds of research are there ?

(a) There are seven different kinds of research.

(b) There are different kinds of research.

(c) There is only one kind of research.

(d) There are two different kinds of research.

17. Select the answer which best reflects the view expressed in the passage.

(a) Grants are not based on merit.

(b) Researchers never apply for grants.

(c) Research can thrive without grants.

(d) Documentation is important in research.

18. Why is research conducted ?

(a) Research is conducted in order to minimise the result of previous works.

(b) Research is conducted in order to destroy facts.

(c) Research is conducted in order to develop new problems.

(d) Research is conducted in order to verify information.

19. What is research ?

(a) Research is the destruction of previous works.

(b) Research is the creation of new forms of knowledge.

(c) Research is a process having no practical use.

(d) Research is the attempt to limit the growth of knowledge.

20. Choose the most appropriate answer from this passage.

(a) Academic publishing is meant only for academicians.

(b) Academic publishing is meant only for professionals.

(c) Academic publishing is meant to benefit the general public.

(d) Academic publishing is meant only for experts.

DIRECTIONS (Qs. 21-25) : *Read the passage carefully and answer the given questions.*

Passage 5

Self directed learning, in its broadest meaning, describes a process in which individuals take the initiative with or without the help of others, in diagnosing their learning needs formulating learning goals, identifying resources for learning, choosing and implementing learning strategies and evaluating learning outcomes. Thus, it is important to attain new knowledge easily and skillfully for the rest of his or her life.

What is the need for self directed learning? One reason is that there is convincing evidence that people, who take the initiative in learning, learn more things and learn better than people who sit at the feet of teachers passively waiting to be taught. The second reason is that self-directed learning is more in tune with our natural processes of psychological development; an essential aspect of maturing is developing the ability to take increasing responsibility of our own lives to become increasingly self-directed. The third reason is that many of the new developments in education put a heavy responsibility on the learners to take a good deal of initiative in their own learning. To meet the challenges in today's instructive environment, self-directed learning is most essential.

21. In self-directed learning, an individual

(a) Takes initiative with or without the help of others

(b) Is passive and waits for directions

(c) Is helpless and dependent

(d) Takes initiative, without an objective

22. There is need for self-directed learning because

(a) it is less challenging

(b) it helps people to learn more things and learn better

(c) it is a more cost-effective method

(d) it is a modern method of learning

23. Which word best describes self-directed learning ?
(a) Active learning (b) Passive learning
(c) Compulsory learning (d) Repulsive learning

24. The modern environment according to the author is
(a) Restrictive (b) Instructive
(c) Less developed (d) Impracticable

25. The synonym of the word "diagnosing" is
(a) Searching (b) Examining
(c) Identifying (d) Complying

DIRECTIONS (Qs. 26–30): *Read the following passage carefully and choose the most appropriate answer to each question out of the four alternatives.*

Passage 1

Expedition mountaineering could be viewed as slow and heavy, where climbers may use porters, pack animals glacier airplanes, cooks, multiple carries between camps, usage of fixed lines, etc. Expedition mountaineers still employ the skill sets of the Alpine mountaineer, except they have to deal with even higher altitudes, expanded time scale, longer routes, foreign logistics, more severe weather, and additional skills unique to expeditionary climbing. The prevalence of expedition-style climbing in the Himalaya is largely a function of the nature of the mountains in the region. Because Himalayan base camps can take days or weeks to trek to, and Himalayan mountains can take weeks or perhaps even months to climb, a large number of personal and amount of supplies are necessary. This is why expedition-style climbing is frequently used on large an isolated peaks in the Himalaya in, Europe and North America there is less of a need for expedition-style climbing on most medium-sized mountains. These mountains can often be easily accessed by car or air, are at a lower altitude and can be climbed in a shorter time scale.

26. Which of the following is true?
(a) Expeditionary climbing is popular in the Americans,
(b) Most medium-sized peaks in Europe are accessed by car or air.
(c) Himalayan base camp treks can be completed in a day or two.
(d) European and North American mountains require expanded time scale for climbing

27. What necessitates the huge amount of supplies and large number of personnel in Himalayan expeditions?
(a) foreign logistics (b) low altitudes
(c) expanded time scale (d) severe weather condition

28. Which of the following style of mountaineering is considered to be slow and heavy?
(a) sports mountaineering
(b) expedition mountaineering
(c) alpine mountaineering
(d) Himalayan mountaineering

29. What accounts for the greater prevalence of expedition mountaineering in the Himalayas?
(a) glacier airplanes
(b) the severe weather condition
(c) the specific nature of mountains
(d) multiple carries between camps

30. Which of the following is best undertaken as expedition mountaineering?
(a) medium-sized mountains
(b) short time scale mountaineering
(c) peaks in Europe and North America
(d) large and isolated peaks

DIRECTIONS (Qs. 31-39): *Read the given four passages carefully and answer the questions given below them.*

Passage 1

A new analysis has determined that the threat of global warming can still be greatly diminished if nations cut emissions of heat-trapping green-house gases by 70% this century. The analysis was done by scientists at the National Centre for Atmospheric Research (NCAR). While global temperatures would rise, the most dangerous potential aspects of climate change, including massive losses of Arctic sea ice and permafrost and significant sea-level rise could be partially avoided.

"This research indicates that we can no longer avoid significant warming during this century," said NCAR scientist Warren Washington, the study paper's lead author. "But, if the world were to implement this level of emission cuts, we could stabilise the threat of climate change", he added.

Average global temperatures have warmed by close to 1°C since the pre-industrial era. Much of the warming is due to human-produced emissions of greenhouse gases, predominantly carbon dioxide. This heat-trapping gas has increased from a pre-industrial level of about 284 parts per million (ppm) in the atmosphere to more than 380 ppm today. With research showing that additional warming of about 1°C may be the threshold for dangerous climate change, the European Union has called for dramatic cuts in emissions of carbon dioxide and other greenhouse gases.

To examine the impact of such cuts on the world's climate, Washington and his colleagues ran a series of global studies with the NCAR-based Community Climate System Model (CCSM). They assumed that carbon dioxide levels could be held to 450 ppm, at the end of this century. In contrast, emissions are now on track to reach about 750 ppm by 2100 if unchecked. The team's results showed that if carbon dioxide were held to 450 ppm. global temperatures would increase by 0.6°C above current readings by the end of the century. In contrast, the study showed that temperatures would rise by almost four times that amount, to 2.2°C above current readings, if emissions were allowed to continue on their present course. Holding carbon dioxide levels to 450 ppm would have other impacts, according to the climate modeling study.

Sea-level rise due to thermal expansion as water temperatures warmed would be 14 cm (about 5.5 inches) instead of 22 cm (8.7 inches). Also, Arctic ice in the summertime would shrink by about a quarter in volume and stabilise by 2100, as opposed to shrinking at least three-quarters and continuing to melt, and Arctic warming would be reduced by almost half.

31. What would be the impact of unchecked green-house gas and carbon dioxide emissions?
(a) The temperature would rise from the current temperature by 2.2°C
(b) The sea-level would rise by about 5.5 inches
(c) The Arctic ice would stabilise by 2100
(d) The Arctic ice would reduce by one-fourth

32. What can be the most appropriate title of the above passage?
(a) A study of the rise in water level
(b) A study of rise in temperatures
(c) A study of the effects of green-house gas emissions
(d) A study of the Arctic region

33. What does scientist Warren Washington mean when he says "we could stabilise the threat of climate change"?
(a) Climate change can be stopped completely
(b) Climate change can be regularised
(c) Climate change and its effects can be studied extensively
(d) The ill-effects of the change in climate can be minimised

34. Why did Washington and his colleagues conduct a series of studies?
(a) Because they realised that the temperature increase was almost about 1°C
(b) So that they could stabilise the climate change
(c) So toot they could help the European Union in cutting the carbon dioxide emissions
(d) None of the above

35. What would be the impact of holding the carbon dioxide level at 450 ppm at the end of this century?
1. Global temperatures would increase by 0.6 degrees Celcius.
2. Arctic warming would be reduced by half.
3. Thermal expansion will stop completely.
(a) 1 only (b) 1 and 2
(c) 2 and 3 (d) All 1, 2 and 3

Passage 7

It is often forgotten that globalization is not only about policies on international economic relationships and transactions, but has ally to do with domestic policies of a nation. Policy changes necessitated by meeting the internationally set conditions (by WTO etc.) of free trade and investment flows obviously affect domestic producers and investors. But the basic philosophy underlying globalization emphasizes absolute freedom to markets to determine prices and production and distribution patterns, and view government interventions as processes that create distortions and bring in inefficiency. Thus, public enterprises have to be privatized through disinvestments and sales; sectors and activities hitherto reserved for the public sector have to be opened to the private sector. This logic extends to the social services like education and health. Any restrictions on the adjustments in workforce by way of retrenchment of workers should also be removed and exit should be made easier by removing any restrictions on closures. Employment and wages should be governed by free play of market forces, as any measure to regulate them can discourage investment and also create inefficiency in production. Above all, in line with the overall philosophy of reduction in the role of the State, fiscal reforms should be undertaken to have generally low levels of taxation and government expenditure should be kept to the minimum to abide by the principle of fiscal prudence. All these are policy actions on the domestic front and are not directly related to the core items of the globalization agenda, namely free international flow of goods and finance.

36. According to the passage, under the globalization, government interventions are viewed as processes leading to
(a) distortions and inefficiency in the economy.
(b) optimum use of resources.
(c) more profitability to industries.
(d) free play of market forces with regard to industries.

37. According to the passage, the basic philosophy of globalization is to
(a) give absolute freedom to producers to determine prices and production.
(b) give freedom to producers to evolve distribution patterns.
(c) give absolute freedom to markets to determine prices, production and employment.
(d) give freedom to producers to import and export.

38. According to the passage, which of the following is/are necessary for ensuring globalization ?
1. Privatization of public enterprises
2. Expansionary policy of public expenditure
3. Free play of market forces to determine wages and employment
4. Privatization of social services like education and health
Select the correct answer using the code given below :
(a) 1only (b) 2 and 3 only
(c) 1, 3 and 4 (d) 2, 3 and 4

39. According to the passage, in the process of globalization the State should have
(a) expanding role. (b) reducing role.
(c) statutory role. (d) None of the above roles.

DIRECTIONS (Qs. 40-49): *Read the following passage carefully and answer the questions given below it.*

Over a couple of days in February, hundreds of thousands of point-of-sale printers in restaurants around the world began behaving strangely. Some churned out bizarre pictures of computers and giant robots signed, "with love from the hacker God himself". Some informed their owners that, "YOUR PRINTER HAS BEEN PWND'D". Some told them, "For the love of God, please close this port". When the hacker God gave an interview to Motherboard, a technology website, he claimed to be a British secondary-school pupil by the name of "Stack over flow in". Annoyed by the **parlous** state of computer security, he had, he claimed, decided to perform a public service by demonstrating just how easy it was to seize control.

Not all hackers are so public-spirited, and 2016 was a bonanza for those who are not. In February of that year cyber-crooks stole $81m directly from the central bank of Bangladesh—and would have got away with more were it not for a crucial **typo**. In August America's National Security Agency (NSA) saw its own hacking tools leaked all over the internet by a group calling themselves the Shadow Brokers. (The CIA suffered a similar indignity this March.) In October a piece of software called Mirai was used to flood Dyn, an internet infrastructure company, with so much meaningless traffic that websites such as Twitter and Reddit were made inaccessible to many users. And the hacking of the Democratic National Committee's e-mail servers and the **subsequent** leaking of embarrassing communications seems to have been part of an attempt to influence the outcome of the American elections.

Away from matters of great scale and grand strategy, most hacking is either show-off vandalism or simply criminal. It is also increasingly easy. Obscure forums oil the trade in stolen credit-card details, sold in batches of thousands at a time. Data-dealers hawk "exploits": flaws in code that allow malicious attackers to **subvert** systems. You can also buy "ransomware", with which to encrypt photos and documents on victims' computers before charging them for the key that will unscramble the data. So sophisticated are these facilitating markets that coding skills are now entirely optional. Botnets—flocks of compromised computers created by software like Mirai, which can then be used to flood websites with traffic, knocking them offline until a ransom is paid—can be rented by the hour. Just like a legitimate business, the bot-herders will, for a few dollars extra, provide technical support if anything goes wrong. The total cost of all this hacking is anyone's guess (most small attacks, and many big ones, go unreported). But all agree it is likely to rise, because the scope for **malice** is about to expand remarkably. "We are building a world-sized robot," says Bruce Schneier, a security analyst, in the shape of the "Internet of Things". The IOT is a buzz-phrase used to describe the computerisation of everything from cars and electricity meters to children's toys, medical devices and light bulbs. In 2015 a group of computer-security researchers demonstrated that it was possible to take remote control of certain Jeep cars. When the Mirai malware is used to build a botnet it seeks out devices such as video recorders and webcams; the botnet for fridges is just around the corner.

40. Which is the most appropriate title?
(a) Public spirited hackers.
(b) Broken Computer security.
(c) Hacking: The criminal offence
(d) The Internet of Things
(e) The Growing Artificial Intelligence

41. According to the paragraph, why did 'the hacker god' decide to perform a public service?
(a) To hack the NSA server
(b) To show to the people that hacking was very easy
(c) To influence the outcome of the American elections
(d) To aware the people about the computer security threats
(e) None of these

42. Which of the following is false in context of the passage?
(a) The IoT is a buzz-phrase used to describe the computerisation of everything from cars and electricity meters to children's toys, medical devices and light bulbs.
(b) The hacking of the Democratic National Committee's e-mail servers was performed with the help of a malware named "Mirai".
(c) A group called "the Shadow Brokers" leaked hacking tools of America's National Security Agency all over the internet
(d) Obscure forums oil the trade in stolen credit-card details, sold in batches of thousands at a time.
(e) All of them are true

43. According to the paragraph, what caused the websites like 'twitter and reddit' inaccessible to the users?
(a) It was caused due to hacking the security contents of the website.
(b) Due to unscramble of the encrypted Data on the websites.
(c) Due to Dyn, an internet infrastructure company.
(d) Due to surge in the worthless traffic which was forced by the hackers.
(e) All are correct.

44. Which of the following statement(s) is/are correct about 'Internet of Things' according to passage?
(i) To take remote control of all digital devices.
(ii) A world sized Robot.
(iii) It means computerization of everything.
(a) Only (i) is correct
(b) Only (ii) is correct
(c) Both (i) and (iii) are correct
(d) Both (ii) and (iii) are correct
(e) All are correct

DIRECTIONS (Qs. 45-46): *Choose the word/group of words which is most opposite in meaning to the word/group of words printed in bold as used in the passage.*

45. Malice
(a) Antipathy (b) Malevolence
(c) Benignity (d) Audacity
(e) Valour

46. Parlous
(a) Adventurous (b) fatal
(c) terrible (d) innocuous
(e) risky

DIRECTIONS (Qs. 47-49): *Choose the word/group of words which is most similar in meaning to the word/group of words printed in bold as used in the passage.*

47. Subsequent
(a) consequent (b) direct
(c) anterior (d) foregoing
(e) prior

48. Subvert
(a) vitiate (b) comply
(c) undermine (d) betray
(e) overwhelm

49. Typo
(a) advantage (b) defeat
(c) strength (d) bug
(e) stain

DIRECTIONS (Qs. 50-54) : *Read the passage carefully and choose the best answer to each question out of the four alternatives and mark it by blackening the appropriate circle (·).*

Like watering a plant, we grow our friendships (and all our relationships) by running them. Friendships need the same attention as other relationships. If they are to continue. These relationships can be delightfully non-judgemental, supportive, understanding and fun.

Sometimes a friendship can bring out the positive side that you never show in any other relationship. This may be because the pressure of playing a 'role' (daughter, partner or child) is removed. With a friend, you are to be yourself and free to change. Of course, you are free to do this in all other relationships as well, but in friendships you get to have lots of rehearsals and discussion about changes as you experience them. It is an unconditional experience where you receive as much as you give. You can explain yourself to a friend openly without the fear of hurting a family member. How do friendships grow ? The answer is simple. By revealing yourself; being attentive: remembering what is most showing empathy; seeing the world through the eyes of your friend, you will understand the value of friendship. All this means learning to accept a person from a completely different family to your own or perhaps someone from a completely different cultural background. This is the way we learn tolerance. In turn, we gain tolerance and acceptance for our own differences.

50. In good friendships, we
(a) give and receive (b) neither give nor receive
(c) only give (d) only receive

51. Empathy means
(a) someone else's misfortunes.
(b) the ability to share and understand another feelings.
(c) skill and efficiency.
(d) ability to do something.

52. Through strong friendships, we gain
(a) only acceptance
(b) only attention
(c) acceptance and tolerance
(d) only tolerance

53. Friendships and relationships grow when they are
(a) compared (b) divided
(c) favoured (d) nurtured

54. When we are with a good friend, we tend
(a) to be ourselves. (b) not to be ourselves.
(c) to shut ourselves. (d) to be someone else.

DIRECTIONS (Qs. 55-59) : *Read the passage carefully and choose the best answer to each question out of the four alternatives and mark it by blackening the appropriate circle (·).*

Chameleons can make their skin colour change, but not because they decide to. The colour changes to help the chameleon avoid its enemies. It is a forth of camouflage, a disguise that lets it blend in with its surroundings. The determined by environmental factors, such as light and change is actually temperature.

Bright sunlight causes the skin to darken. On cool nights, the colour fades to a creamy changes chameleons are excited, angry or afraid. The colour, the colour change is rapid and increases when the chameleon is handled, injured, or approached by another chameleon. There are many types of chameleons. Almost half of them are found on the African island of Madagascar. The others mostly occur in the Sahara Desert, with few in Western Asia and Southern Europe. Chameleons live in trees, where they usually eat insects. Very large chameleons may even use their sticky tongues to catch birds.

55. Chameleons change colour when they are
(a) angry, excited or happy.
(b) afraid, angry or hungry.
(c) afraid, excited or angry.
(d) excited, angry or hungry.

56. Half of the worlds, Chameleons are found
(a) on the African island of Madagascar.
(b) on the Asian island of Madagascar.
(c) in the continent of Asia.
(d) in the Sahara Desert.

57. The colour changing ability of a chameleon is a form of camouflage which is a
(a) dance done by chameleons.
(b) colour that fades.
(c) disease which affects chameleons.
(d) disguise that lets it blend in with its surroundings.

58. A chameleon' s colour changes to help it
(a) avoid its enemies. (b) fly away.
(c) look beautiful. (d) attract prey.

59. The colour change is determined by
(a) pressure and temperature.
(b) light and temperature.
(c) light and wind.
(d) light and pressure.

Answers & Explanations

1. (c) The very first line of the passage reveals that we can become angry on someone's opinion contrary to ours only when our own opinion is not based on good reason and we are aware of this subconsciously.

2. (a) 'Your own contrary conviction' refers to the fact that you feel pity rather than anger.

3. (c) Conviction means a firmly held belief or opinion.

4. (d) If someone maintains that two and two are five, you feel pity because you feel sorry for his ignorance of the subject i.e. Arithmetic.

5. (d) The second sentence in the passage elaborates the hidden i.e. the main point in the first sentence.

6.	**(a)**	**7.**	**(b)**	**8.**	**(c)**	**9.**	**(a)**	**10.**	**(c)**
11.	**(a)**	**12.**	**(b)**	**13.**	**(c)**	**14.**	**(b)**	**15.**	**(a)**
16.	**(b)**	**17.**	**(d)**	**18.**	**(d)**	**19.**	**(b)**	**20.**	**(c)**

21. **(a)** In self directed learning, an individual takes initiative with or without the help of others to learn new things.

22. **(b)** There is need for self-directed learning because it helps people to learn more things in a better way.

23. **(a)** Self-directed learning is active learning as one does not sit passively and waits for someone to teach. The learner actively initiates its own learning process.

24. **(b)** The modern environment is instructive in nature.

25. **(c)** Diagnosing means identifying.

26. **(b)** Most medium sized peaks in the Europe are accessed by car or air. Expeditionary climbing is popular in Himalayas. Himalayan base camp treks takes days or even weeks to trek to. European and North American mountains can be climbed in short time scale.

27. **(c)** Since, Himalayan mountains takes weeks or months to climb, large amount of personnel and food supplies is necessary.

28. **(b)** Expedition mountaineering can be considered as slow (Because it takes few weeks to months to climb the mountain) and heavy (because of the additional food supplies required to be carried while climbing).

29. **(c)** The specific nature of Himalayan mountains accounts for greater expedition mountaineering there.

30. **(d)** Large and isolated peaks are best for expedition mountaineering.

31. **(a)** It is mentioned in the fourth paragraph.

32. **(c)** Since the entire passage is based on the effect of green house gas emissions thus, option (c) would be the appropriate title.

33. **(d)**

34. **(d)** None of these

35. **(b)** Statements 1 and 2 are clearly mentioned in the passage but not statement 3.

36. **(a)** According to the passage, government interference leads to distortions and inefficiency in the economy in the sense that there is room for corruption as well as a lack of interest in investment on the part of the entrepreneurs.

37. **(c)** The first paragraph states that the basic philosophy of globalization is to ensure absolute freedom for the markets, to set their prices, produce their goods, and distribute them as per their own criterion.

38. **(c)** The passage clearly states that in accordance with the conditions set by the WTO etc., for globalization, public sectors should be privatized. So statement (1) is correct. Employment and wages should be conditioned by the free play of the market forces involved, otherwise it might discourage investment as stated in statement (3). Even social services like health and education should welcome private players as is correctly expressed in statement (4).

39. **(b)** The entire passage focuses on the fact that the state should play a reducing role in the process of globalization. This is elaborated in the last few lines of the passage with particular reference to India.

40. **(b)** The paragraph revolves around the theme of computer security that is being broken by Hackers.

41. **(d)** Refer to the last few lines of first paragraph, "Annoyed by the **parlous** state of computer security, he had, he claimed, decided to perform a public service by demonstrating just how easy it was to seize control".

42. **(b)** The information in this option is not mentioned in the passage.

43. **(d)** Refer to the fifth sentence of second paragraph. "In October, a piece of software called Mirai was used to flood Dyn, an internet infrastructure company, with so much meaningless traffic that websites such as Twitter and Reddit were made inaccessible to many users".

44. **(d)** In the last paragraph, IOT is defined and only option, (ii) and (iii) are mentioned while there is obscurity in option (i).

45. **(c)** Malice means "wrongful intention". Hence it has opposite meaning as Benignity. Antipathy and malevolence has same meaning as Malice. Audacity means disrespectful behavior. Valour means courage.

46. **(d)** Parlous means "full of danger or uncertainity". Hence it has opposite meaning as innocuous.

47. **(a)** Subsequent means "coming after something in time; following". Hence it is similar in meaning to the word "consequent".

48. **(c)** Subvert means "corrupt". Hence it is similar in meaning to the word "undermine". Vitiate means destroy.

49. **(d)** Typo means "error". Hence is similar in meaning to the word "Bug".

50. **(a)** In good friendships, we receive as much as we give.

51. **(b)** Empathy means the ability to show and understand the feelings of others.

52. **(c)** A strong friendship helps us gain acceptance and tolerance.

53. **(d)** The very first line of the passage states that friendships and relationships grow when they are nurtured just like nurturing a plant.

54. **(a)** When we are with a good friend, we tend to be ourselves.

55. **(c)** Chameleons change colour when they are afraid, excited or angry.

56. **(a)** It is clearly mentioned in the paragraph that almost half of the world's Chameleons are found on the African island of Madagascar.

57. **(d)** The colour changing ability of a Chameleon is a form of camouflage which is a disguise that lets it blend in with its surroundings.

58. **(a)** A Chameleon's colour changes to help it avoid its enemies.

59. **(b)** The colour change is determined by light and temperature.

Chapter 3 Spotting Errors

Despite possessing a good command over the English language and considering ourselves well-versed in it, we many times end up making the silliest of errors in grammar. Every English exam/ test contains question on 'spotting errors' to test the grammatical knowledge of the candidate. Thus, in order to enhance your grammatical knowledge and make you aware of common errors that we usually commit while speaking and writing, below are given some important points.

IMPORTANT TIPS & TECHNIQUES

- Some nouns are singular in form, but they are used as plural nouns and always take a plural verb. Examples of such nouns are – Police, People, Company, Cattle and Peasantry, etc.

  Sentence examples:

  Police has reached the crime spot. (**INCORRECT**)

  Police have reached the crime spot, (**CORRECT**)

  The ***cattle is*** grazing in the ground. (**INCORRECT**)

  The ***cattle are*** grazing in the ground. (**CORRECT**)

- Some nouns are always used in plural form and always take a plural verb. Examples of such nouns are – Spectacles, Scissors, Trousers, Premises and Alms, etc.

  Sentence examples:

  Where ***is*** my trousers? (**INCORRECT**)

  Where ***are*** my trousers? (**CORRECT**)

  The scissors ***is*** on the rack. (**INCORRECT**)

  The scissors ***are*** on the rack. (**CORRECT**)

- There are nouns that indicate length, measure, money, weight or number and when they are preceded by a numeral, they remain unchanged in form so long as they are followed by another noun or pronoun. Examples of such nouns are – Year, Pair Foot Meter and Million, etc.

  Sentence examples:

  This is a ***ten-meters*** cloth. (**INCORRECT**)

  This is a ***ten-meter*** cloth. (**CORRECT**)

  He has completed a ***three-years*** degree course. (**INCORRECT**)

  He has completed a ***three-year*** degree course. (**CORRECT**)

- When a number is followed by a noun denoting measure, length, money, weight or number, but these are not followed by another noun or pronoun then they take the plural form.

  Sentence examples:

  This mat is ***five yard*** long. (**INCORRECT**)

  This mat is ***five yards*** long. (**CORRECT**)

  The weight of the machinery was eleven ***kilogram.*** (**INCORRECT**)

  The weight of the machinery was eleven ***kilograms.*** (**CORRECT**)

- Collective nouns such as public, team, jury, committee, audience and company etc. are used both as singular as well as plural depending on the meaning. When these words indicate a unit, the verb is singular; otherwise the verb will be plural.

  Sentence examples:

  The ***jury was*** divided in this case. (**INCORRECT**)

  The ***jury were*** divided in this case. (**CORRECT**)

- A pronoun must agree with its antecedent in person, number and gender.

  Examples:

  Every student must bring ***his*** identity-card.

  All employees must do ***their*** work in the given time.

  Each of the girls should carry ***her*** water-bottle.

- The pronoun 'one' must be followed by 'one's'.

  Sentence examples:

  One must complete ***his*** task in time. (**INCORRECT**)

  One must complete ***one's*** task in time. (**CORRECT**)

  One should respect ***his*** elders. (**INCORRECT**)

  One should respect ***one's*** elders. (**CORRECT**)

- 'One of' always takes a plural noun after it.

  Sentence examples:

  This is ***one of*** the best ***moment*** of my life. (**INCORRECT**)

  This is ***one of*** the best ***moments*** of my life. (**CORRECT**)

  One of my ***friend*** is an engineer. (**INCORRECT**)

  One of my ***friends*** is an engineer. (**CORRECT**)

- Question tags are always the opposite of the sentence which means if the sentence is positive, the question tag will be negative and vice-versa.

  Sentence examples:

  You were quarreling, ***were you?*** (**INCORRECT**)

  You were quarreling, ***weren't you?*** (**CORRECT**)

  She did this, ***did she?*** (**INCORRECT**)

  She did this, ***didn't she?*** (**CORRECT**)

EXERCISE

DIRECTIONS (Qs. 1-10) : *In the following questions, some of the sentences have errors and some have none. Find out which part of a sentence has an error. The number letter of that part is your answer. If there is no error, your answer is (d)/(4) i.e., No error.0*

1. He is a university professor (a)/ but of his three sons (b)/ neither has any merit. (c)/ No error (d)
2. After knowing truth, (a)/ they took the right decision (b)/ in the matter. (c)/ No error (d)
3. It is time for you (a)/ decide on your next (b)/ course of action. (c)/ No error (d)
4. He who has suffered most (a)/ for the cause, (b)/ let him speak. (c)/ No error (d)
5. A cup of coffee (a)/ is an excellent complement (b)/ to smoked salmon. (c)/ No error (d)
6. Judge in him (a)/ prevailed upon the father (b)/ and he sentenced his son to death. (c)/ No error (d).
7. Nine tenths (a)/ of the pillar (b)/ have rotted away. (c)/ No error (d).
8. One major reason (a)/ for the popularity of television is (b)/ that most people like to stay at home. (c)/ No error (d).
9. Our efforts are (a)/ aimed to bring about (b)/ a reconciliation. (c)/ No error (d).
10. Three conditions (a)/ critical for growing (b)/ plants are soil, temperature, chemical balance or amount of moisture (c)/ No error (d).

DIRECTIONS (Qs. 11-20) : *In the following questions, some of the sentences have errors and some have none. Find out which part of a sentence has an error. The number letter of that part is your answer. If there is no error, your answer is (d)/(4) i.e., No error.0*

11. It was he who (a) / came running in the house (b) / with the news about the earthquake. (c) / No Error. (d)
12. Her mother does not approve of (a) / her to go to the party (b) / without dressing formally. (c) / No Error. (d)
13. Riding across the battle field (a) / the famous Bhishm (b) / saw a large number of dead warriors. (c) / No Error. (d)
14. My Aunt (a) / was first (b) / to get a degree (c) / No Error. (d)
15. Padmini had not rarely missed (a) / a dance performance or festival since (b) / she was eight years old. (c) / No Error. (d)
16. Krupa and Kavya studied (a) / in the Delhi Public School (b) / and so does Kamya. (c) / No Error. (d)
17. You can eat (a) / as much as you like/ (b) at the newly lunch bar (c) / No Error (d)
18. The teacher, as well as the students (a) / have gone on an excursion (b) / to Ooty during their summer vacation (c) / No Error. (d)
19. The US (a) / don't want (b) / Indian in the Security Council (c) / No Error (d)
20. The cruel lady made (a) / her step – daughter to do (b) / all the household chores. (c) / No Error (d)

DIRECTIONS (Qs. 21-30) : *In each of these questions, a sentence has been divided into four parts and marked a. b, c and d. One of these parts contains a mistake in grammar Idiom or syntax. Identify that part and mark it as the answer.*

21. (a) They appointed him (b) as a manager
    (c) as he (d) is efficient
22. (a) Owing to illness (b) he was unable
    (c) to go (d) for his holiday
23. (a) Pickpocketers are (b) sometimes spotted
    (c) by policemen (d) at bus stops

24. (a) His both hands (b) have been injured
(c) so he (d) cannot work

25. (a) Several guests noticed Mr. Peter
(b) fall back
(c) in his chair
(d) and gasping for breath

26. (a) The short story (b) should not exceed
(c) more than (d) two hundred words.

27. (a) If one reads the newspaper regularly
(b) you will be surprised at the improvement
(c) in your overall reading skills
(d) day by day

28. (a) Preetam asked her sister
(b) why had she not gone to the school
(c) the previous day
(d) or applied for leave

29. (a) In tropical climate, it is necessary
(b) that a person drink
(c) several cups of water daily
(d) if he wishes to remain healthy

30. (a) Pollution effects more people
(b) today than it ever did in the past
(c) because more people live near industrial units
(d) and inhale noxious gases from the atmosphere

DIRECTIONS (Qs. 31-45) : *In each of these questions, a sentence has been divided into four parts and marked a. b, c and d. One of these parts contains a mistake in Grammar, Idiom or Syntax. Identify that part and mark it as the answer.*

31. (a) The only persons in the theatre
(b) on that stormy night
(c) were the staff of the theatre
(d) and me

32. (a) Sunita is more talkative than
(b) any boy in the class because
(c) she is not afraid of the teacher
(d) who is his own brother

33. (a) There is only the banana
(b) and one apple in the refrigerator
(c) so let us go to the market
(d) and buy some more fruits

34. (a) Like his brother who did not wear his helmet
(b) and was injured in the accident
(c) Rajan was always careful
(d) and wore his helmet without fail

35. (a) We were not worried about being late
(b) since we knew that our other friends
(c) would have been caught in a worse traffic jam
(d) than us

36. (a) The part of Madras that interested us the most
(b) were the beach and the museum
(c) which we recommend to all friends
(d) who plan to visit that city

37. (a) Although Greek and Latin were
(b) of extreme important during their day
(c) they had become dead languages
(d) by the beginning of the fifteenth century

38. (a) Amphibians are creatures which
(b) live equally effortlessly
(c) in water and land are found
(d) in all the continents of the world

39. (a) Near the pond was standing
(b) a dog, a donkey and a cow
(c) but when I threw a stone at them
(d) it was only the dog that ran away

40. (a) Psychiatrists claim that the dream process
(b) can offer insights into
(c) how the brain has worked, though
(d) it cannot be taken as the final evidence

41. (a) Collecting money for the new school
(b) may not be very easy
(c) but if everyone does their best
(d) we can still reach the target

42. (a) The chairman reviewed the many details
(b) connecting with the profitability
(c) of the Company and then decided that
(d) further expansion was not desirable

43. (a) On entering the meeting hall
(b) loud cheers greeted the Prime Minister
(c) who acknowledged them with a smile
(d) and waved back happily at the gathering

44. (a) I am sure that if you were me
(b) and had been talked to in a similar manner
(c) you would also have lost your temper
(d) and talked back as I did

45. (a) He would not listen to us at all
(b) and it was quite apparent that
(c) he had other different sources of information
(d) than what we were relying on

Answers & Explanations

1. (c) 'Neither' is used for two things. For more than two things, 'none' should be used.

2. (a) **After knowing the truth** will be correct usage.

3. (b) **It is time/It is high time** is followed by the clause in simple past that shows present time. Hence, **to decide on your next** should be used.

4. (c) Replace **let him speak** by **should be allowed to speak.**

5. (d) No error

6. (a) Sometimes, Common Nouns are used as Abstract Nouns as they express qualities. In this situation, we use 'the' before them. Hence. **The Judge in him** should be used.

7. (c) The structure of some sentences is :

Indefinite number + of + Noun

Indefinite quantity + of + Noun

In these sentences, the subject is one that comes after 'of'. Here, the word pillar is singular, hence, **has rotted away** should be used.

8. **(c)** Here, replace **that most people like to stay at home by most of the people** like to stay at home.
9. **(b)** The word aim takes preposition 'at'.
   Hence, at bringing about should be used.
10. **(c)** Chemical balance and amount of moisture.
11. **(b)** Running 'towards' should be used instead of 'in' because the preposition 'in' is wrong in the context of the sentence.
12. **(b)** Going to the party, not to go to the party.
13. **(d)** No error
14. **(b)** 'the' should be added before 'first' because the sentence is expressing a quality and some times, common nouns are used as abstract nouns to express qualities.
15. **(a)** Padmini had rarely missed makes the correct sense of the sentence.
16. **(c)** 'so also kamya' should be used.
17. **(c)** Here, 'newly launched ..., should be used.
18. **(b)** When we use as well as, along with and with etc. the verb agrees according to the first subject. Hence, has gone ...... should be used.
19. **(b)** 'doesn't' should be used because 'doesn't' is used with Singular Noun and US which is a country is a Singular Noun. 'Don't' is used with plural noun as second person.
20. **(b)** Remove 'to' before 'do'.
21. **(b)** They appointed **him as a manager** should be replaced with they appointed him a manager.
22. **(a)** There is an incorrect use of 'owing to'.
23. **(a)** 'Pickpocketers' is not the correct word. The correct one is 'Pickpockets' and hence option (a) is right.
24. **(a)** Option (a) is our answer, because 'his' is a possessive pronoun and it should come next to the noun it is referring to, i.e. his would come just before hands.
25. **(b)** As the given sentence is describing a continuous action in the past, 'fall' should be replaced with 'falling' back. Hence, option (b) is correct.
26. **(c)** Option (c) is correct, because it is redundant and there is no use of it. The word 'exceed' is enough to convey that the short story should not have more than 200 words.
27. **(a)** If you read .....
   The indefinite pronoun 'one' or the personal pronoun 'you' should be used throughout the sentence.
28. **(b)** why she had not gone...
   As per the rules of syntax, the subject comes before the verb and not after.
29. **(a)** In a tropical climate....
   The article 'a' used as "tropical climate" here is being used generically. One should either say "a tropical climate" or "tropical climates".
30. **(a)** Pollution affects
   The verb affects is to be used here which means "to produce an effect on'
31. **(d)** 'and I'.
   When a noun (or pronoun) is used as the Subject of a verb, it is said to be in the Nominative Case and when it is used as the Object of a verb, it is said to be in the Objective (or Accusative) case. In the sentence given, the staff and the person speaking form the subject of the verb 'were' and hence the Nominative Case of the First Person-Singular i.e. 'I' should be used instead of the Accusative Case i.e. 'me'.
   Note- To find the Nominative Case put Who? or What? before the verb.
   To find the Accusative Case put whom? or What? Before the verb and its subject. For e.g.. Hari broke the window. (Object). The window was broken. (Subject)
   The Nominative generally comes before the verb and the Accusative after the verb. Hence they are distinguished by the order of words, or by the sense.
32. **(b)** than any other boy in the class.
   When a comparison is instituted by means of a Comparative followed by 'than', the thing compared must be always excluded from the class of things with which it is compared, by using 'other' or some such words.
33. **(a)** a banana
   The reference here is to one banana and not a particular one.
34. **(a)** Unlike his brother
   The adverb unlike is to be used here as logical reasoning suggests.
35. **(d)** than we had been
   The past perfect tense 'had been' is used here to denote an action completed before a certain moment in the past.
36. **(a)** The parts of Madras…
   A verb must agree with its subject in number and person. The plural 'parts' fits in with the verb 'were'. Thus, if the subject is of the Singular Number, First Person, the verb must be of the Singular Number, First Person; as, I am here. I was there. I have a bat. I play cricket.
37. **(b)** 'of extreme importance'...
   'Importance' is a noun; 'important' is an adjective.
38. **(c)** 'and land and are found'
   The cumulative conjunction 'and' is needed here to add one statement to another.
39. **(a)** 'were standing'
40. **(c)** 'how the brain works'. The simple present tense is needed as part (b) indicates.
41. **(c)** 'everyone does his best'
42. **(b)** 'connected with'
   The past tense is to be used as part (a) indicates.
43. **(a)** On his entering the meeting hall
44. **(a)** 'that if you were I'
45. **(c)** other sources of information \ different sources of information.
   The tautology is to be removed.

Chapter 4

Cloze Test

A cloze test is a test wherein aspirants are asked to supply the correct words (from the set of given options for each) that have been systematically removed from a passage as a test of their ability to comprehend text. A cloze test passage has a definite structure, logical pattern and chronological order which helps in maintaining a unified tone throughout.

IMPORTANT TIPS & TECHNIQUES

- You should read the entire passage slowly and thoroughly without filling up the blanks. This will help you to understand the idea or the theme of the passage.
- Look at each missing blank and try to imagine what word would fit.
- Decide which part of speech (noun, adjective, etc.) is functionally required in a particular blank.
- It is very important to understand the tone of the passage as this will help you eliminate the irrelevant options.
- You must emphasize on linking the sentences together because in the passage, all the sentences are connected to each other. Do not make the mistake of treating each sentence as an individual or independent sentence. Try to come up with logical connections that link up the sentences because this will be very helpful in picking up the correct options.
- You will often come across a blank that has more than one correct option. List out all these options and try them one by one. Use the one that seems most fitting. Instead of getting confused, think of words that are appropriate not only to the given sentence but also fit the context of the entire passage.
- Sometimes, you may not be able to decide between two words. In this case, if you see a word in the options that is frequently used with the words around the blank, then pick that option.
- The knowledge of how prepositions are used will surely come handy. There are times when looking at preposition alone can help you pick the correct option.
- It is always advised to look at the sentences that come before and after the sentence that has (a) blank/s in it. By doing so, quite often, you will get a confirmation or some sort of clue regarding the most appropriate word to fill the blank.
- Cultivate the habit of reading newspapers, magazines and novels, etc., to improve your language. Gradually, you build your vocabulary and learn the usage of words and expressions in different contexts. You also get familiar with a lot of idioms and phrases that prove to be very helpful while picking up the correct choices.

Given below are some solved examples.

EXERCISE

DIRECTIONS (Qs. 1-70): *In the following passages, some of the words have been left out. First, read the passages over and try to understand what it is about. Then fill in the blanks with the help of the alternatives given.*

Passage - 1

The Solar System has been a complicated wonder for the astronomers. This is a (1) to which we may never have the exact answer. Man has wondered (2) the age of the Earth (3) ancient times. There were all kinds of (4) that seemed to have the (5). But man could not begin to (6) about the question scientifically until about 400 years (7). When it was proved that the (8) revolved round the Sun and the Earth was a (9) of our Solar System, then scientists knew where to (10).

1. (a) problem (b) question
(c) matter (d) query

2. (a) around (b) out
(c) about (d) on

3. (a) since (b) during
(c) around (d) from

4. (a) ideas (b) opinions
(c) stories (d) matters

5. (a) solution (b) novel
(c) book (d) answer

6. (a) read (b) think
(c) open (d) guess

7. (a) now (b) time
(c) then (d) ago

8. (a) Moon (b) time
(c) Earth (d) Mars

9. (a) part (b) division
(c) opening (d) centre

10. (a) end (b) begin
(c) think (d) work

Passage - 1

Auctions are public (11) of goods, conducted by an. (12) auctioneer. He encourages buyers to (13) higher prices and finally names the (14) bidder as the buyer of the goods. This is called 'knocking down' the goods, for when the bidding ends the auctioneer (15) a small hammer on a table in front of him.

11. (a) sale (b) marketing
(c) promotion (d) viewing

12. (a) authoritative (b) allowed
(c) authentic (d) approved

13. (a) bid (b) buy
(c) get (d) bargain

14. (a) smartest (b) highest
(c) biggest (d) strongest

15. (a) bangs (b) thrashes
(c) smashes (d) hits

Passage - 1

One fine morning, a (16) man knocked at the doors of the home for the aged run by nuns. He told the nun in charge that as he was (17) to Delhi, he wanted to leave his servant-maid to the (18) of the nuns. He assured the nun of sending some money every month (19) she was an orphan. The nun (20) her saying that she had got an excellent master.

16. (a) gentle (b) bad
(c) nice (d) good

17. (a) moved (b) shifted
(c) changed (d) transferred

18. (a) care (b) home
(c) custody (d) protection

19. (a) because (b) and
(c) though (d) if

20. (a) loved (b) praised
(c) consoled (d) condoled

Passage - 1

A civilised life is a rule (21) violence, against taking (22) into our hands. It is a rule which (23) of us observe so often, indeed, that a great (24) of people go through life (25) orderliness and non-violence as part of the scheme of nature. But when (26) comes into their midst (27) refuses to observe the current rules, and (28) the simple rule that might is right, the law abiding members (29) society do not know what to do, and look on in (30) bewildered confusion.

21. (a) after (b) at
(c) against (d) upon

22. (a) police (b) people
(c) rule (d) law

23. (a) most (b) none
(c) many (d) every

24. (a) amount (b) number
(c) capacity (d) sum

25. (a) not expecting (b) expecting
(c) not accepting (d) accepting

26. (a) no one (b) any one
(c) none (d) everyone

27. (a) who (b) how
(c) where (d) whom

28. (a) following (b) followed
(c) follows (d) follow

29. (a) of (b) at
(c) in (d) on

30. (a) helping (b) helped
(c) helpless (d) helpful

Passage - 1

Although we can (31) the (32) bodies of our solar system (33) a telescope, it is only (34) who can (35) the depth of outer space. It is reported that they have seen (36) galaxies, stars taking (37) (38) 'black holes'. They say that the deeper they look (39) the universe, the more they know (40) the universe originated.

31. (a) reach (b) observe
(c) look (d) find

32. (a) heavlier (b) heavy
(c) heavier (d) heavenly

33. (a) by (b) through
(c) with (d) at

34. (a) astronomers (b) astronomy
(c) stunned (d) astrologers

35. (a) viewed (b) views
(c) overview (d) view

36. (a) shine (b) stunning
(c) stunned (d) stun

37. (a) born (b) borne
(c) birth (d) berth

38. (a) die (b) died
(c) dyeing (d) dying

39. (a) into (b) at
(c) through (d) on

40. (a) why (b) where
(c) how (d) what

Passage - 6

The Bhagavad Gita is a poem of 700 verses which is a part of the Mahabharata. It is the only philosophical song existing in all languages. Its popularity and influence have never waned. It (41) light and guidance to the troubled mind in times of crisis. It is in the (42) of a dialogue between Arjuna and Krishna on the battlefield. Arjuna's mind is troubled at the thought of the killings of his friends and relatives. He cannot conceive of any gain. Arjuna is the (43) of the tortured spirit of man torn by conflicting obligations and moralities.

The dialogue proceeds and takes upto the higher level of individual duty and social behaviour, application of ethics to practical life and social outlook that should govern all. An attempt is (44) to reconcile the three paths of human advancement - the path of knowledge, the path of action and the path of faith. But more (45) is laid on faith. There is a call of action to meet the obligations of life, keeping in view the spiritual background and the large purpose of the universe.

41. (a) provides (b) shines
(c) enforces (d) secures
(e) seeks

42. (a) programme (b) constitution
(c) part (d) formation
(e) form

43. (a) conceived (b) dream
(c) source (d) figures
(e) symbol

44. (a) generated (b) made
(c) established (d) coined
(e) given

45. (a) important (b) significant
(c) declaration (d) emphasis
(e) blessings

Passage - 1

Day dreaming is often overlooked as a proper dream and (46) instead as wandering thoughts. However, the meanings to your nightly dream symbols are also (47) to your day dreams. The content in your day dreams are helpful in understanding your true feelings and will help you in (48) your goals. Day dreaming is the spontaneous imagining or recalling of various images or experiences in the past or the future. When you daydream, you are accessing your right brain, which is the creative and feminine side of your personality. Worrying about something creates visual images in your brain of the worst outcome that you are imagining and is a form of daydreaming. By repeating these negative images in your mind, you are more likely to make them happen. So the next time you start worrying, try to think of a positive outcome. Positive daydreaming is very healthy and acts as a temporary (49) from the demands of reality. It is also a good way to (50) built up frustrations without physically acting them out.

46. (a) composed (b) determined
(c) thought (d) felt
(e) regarded

47. (a) duplicated (b) present
(c) established (d) applicable
(e) depictive

48. (a) thinking (b) holding
(c) achieving (d) realise
(e) capturing

49. (a) solitude (b) healing
(c) gateway (d) passage
(e) escape

50. (a) adjust (b) confirm (c) capture (d) release
(e) demonstrate

Passage - 6

Today experts all over the world are of the opinion that agriculture will affect the future of the world.

The world has a serious food (51) and the only way to solve (52) is if more people take up (53). Moreover since the 1980s, technology and finance jobs (54) been the basis of America's economy. (55), in recent times, farmers' incomes have risen (56). It has also been a long time (57) farming was a major source of employment, but data (58) that unemployment in America is (59) in states where farming is the (60) occupation.

As the demand for food is rising – what the world needs today is more farmers.

51. (a) trouble (b) problem
(c) doubt (d) discussion
(e) production

52. (a) how (b) usually (c) it (d) these
(e) which

53. (a) farming (b) time (c) matter (d) offer
(e) job

54. (a) also (b) has (c) not (d) have
(e) were

55. (a) However (b) Instead (c) Despite (d) Again
(e) Still

56. (a) much (b) up (c) above (d) sharply
(e) highly

57. (a) when (b) since (c) while (d) as
(e) after

58. (a) collected (b) informs (c) calculate (d) analysed
(e) show

59. (a) lowest (b) smaller
(c) decreased (d) important
(e) not

60. (a) mostly (b) best
(c) suitable (d) superior
(e) main

Passage - 6

Mobile phones are changing the world we live in.

Kenya was regarded as a poor (61) lacking hospitals, running water, electricity, education, (62) etc. Mobile phone technology has (63) all this. Today, 92 per cent of Kenyans (64) the Internet using their mobile phones. Farmers can (65) only check the prices of crops but also (66) with customers directly. Banking services are (67) available through mobile phones. A (68) by the World Bank shows that (69) countries where more people use mobile phones (70) by 0.6 per cent to 1.2 per cent every year.

This technology has also helped the world come closer? Together as it allows people from different countries to interact with each other.

61. (a) neighbour (b) performance
(c) country (d) development
(e) choice

62. (a) tend (b) roads (c) poverty (d) people
(e) leader

63. (a) changed (b) discovered
(c) created (d) transform
(e) made

64. (a) go (b) access (c) connect (d) used
(e) online

65. (a) decide (b) allow (c) simply (d) not
(e) still

66. (a) handle (b) supply
(c) deal (d) argument (e) sell

67. (a) cheap (b) easy (c) income (d) also
(e) though

68. (a) report (b) fund (c) researcher (d) wish
(e) move

69. (a) more (b) any (c) because (d) in
(e) those

70. (a) increase (b) work (c) value (d) rise
(e) grow

DIRECTIONS (Qs. 71-80): *In the following passages, some of the words have been left out. First, read the passages over and try to understand what it is about. Then fill in the blanks with the help of the alternatives given.*

Passage - 10

Parents tend to spoil their own children either by overindulgence or by deprivation. Childhood should be the time for (71) from primary selfishness to sharing, for learning to (72) with deprivation and disappointment and learning to (73) failure, since breaking a toy and forgetting a homework assignment are (74) serious than breaking a marriage or forgetting to prepare for career advancement. But (75) deprivation, as is common in (76) families, leaves many children (77) the stage of personal gratification. They lack resources for developing a sense of (78) towards others and a wish to care for them. And children (79) be poor to be underprivileged. The (80) are also deprived, cheated out of learning how to face life.

71. (a) changing (b) turning
(c) shifting (d) removing

72. (a) cope up (b) adjust
(c) fight (d) cope

73. (a) overcome (b) eliminate
(c) remove (d) forget

74. (a) far better (b) far less
(c) far worse (d) far more

75. (a) much (b) exhaustive
(c) excessive (d) every

76. (a) undernourished (b) uncoordinated
(c) uncooperative (d) underprivileged

77. (a) stuck in (b) stuck on
(c) stuck about (d) stick in

78. (a) gratitude (b) responsibility
(c) concern (d) friends hip

79. (a) would not (b) should not
(c) need not (d) had not

80. (a) over confident (d) over cautious
(c) over enthusiastic (d) over indulged

Answers & Explanations

Sol. (1 - 10) :

The passage states that initially, man was not able to find the answers to basic astronomical questions, but later on, it was proved that earth which is a part of our solar system revolves around the sun.

1. (b) The complicated wonder is a 'question' to which we may never have the exact answer.

2. (c) Man has wondered 'about' the age of earth.

3. (a) Man has wondered about the age of earth 'since' ancient times.

4. (c) There were many 'stories'.

5. (d) The stories seem to have the 'answer'.

6. (b) Man could not begin to 'think' about the question.........

7. (d) But man could….......until about 400 years 'ago'.

8. (c) The 'Earth' revolves around the sun.

9. (a) Earth was a 'part' of our Solar System

10. (b) The scientists knew where to 'begin'.

Sol. (11 - 15) :

The passage states that Auctions are conducted by an approved auctioneer who declares the highest bidder as the buyer by banging a small hammer on the table.

11. (a) Auctions are public 'sale' of goods.

12. (d) Auctions are done by an 'approved' auctioneer.

13. (a) The auctioneer encourages the buyers to 'bid' higher prices.

14. (b) The 'highest' bidder is declared by the auctioneer.

15. (a) At the end of the bidding, the auctioneer 'bangs' a small hammer on the bidding table.

Sol. (16 - 20) :

The passage states that a gentleman goes to an old age home to leave his maid servant in the custody of the nuns and promises that he would be sending money every month to her as she was an orphan.

16. (a) A 'gentle' man knocked at the doors.

17. (d) The man was 'transferred' to Delhi.

18. (c) He wanted to leave his maid servant to the 'custody' of the nuns.

19. (a) The man wanted to take care of the maid 'because' she was an orphan.

20. (c) The nun 'consoled' the maid by saying that she has got an excellent master.

Sol. (21-30) :

The passage states that a civilized life is about following rules and laws which a lot of people go through expecting orderliness and non-violence as part of their scheme of nature but in later part of their life, they are left with confusion.

21. (c) A civilized life is a rule 'against' violence.

22. (d) Against taking 'law' into our hands.

23. (c) Rule which 'many' of us observe.

24. (b) A great 'number' of people go through life.

25. (b) 'Expecting' orderliness and non-violence….

26. (b) When 'anyone' comes.

27. (a) 'Who' refuse to observe the current rules.

28. (c) 'Follows' the simple rule that……

29. (a) Law abiding members 'of' society.

30. (c) Look on in 'helpless' bewildered confusion.

Sol. (31-40) :

The passage states that unlike us, Astronomers can view the depth of the outer space with a telescope and have their say on the formation of the universe as they see stunning events there.

31. (b) We can 'observe'….

32. (d) The 'heavenly' bodies of the solar system.

33. (c) ….solar system 'with' a telescope.

34. (a) It is only 'Astronomers' who can…..

35. (d) Astronomers can 'view' the depth of outer space.

36. (b) They have seen 'stunning' galaxies.

37. (c) Stars taking 'birth'.

38. (d) Starts 'dying'.

39. (a) They look 'into' the universe.

40. (c) The more they know 'how' the universe originated.

Sol. (41-45) :

The passage states that the Bhagavad Gita, a poem of 700 verses contains dialogues between Arjuna and Krishna which reconciles the three paths of human advancement i.e. the path of knowledge, the path of action and the path of faith.

41. (a) It 'provides' light and guidance to the troubled mind in time of crisis.

42. (e) It is in the 'form' of dialogue.

43. (e) Arjuna is the 'symbol' of the tortured spirit of man.

44. (b) An attempt is 'made' to reconcile the three paths.

45. (d) But more 'emphasis' is laid on faith.

Sol. (46-50) :

The passage states that day dreaming helps in understanding our true feelings and achieving our goals. Positive daydreaming is considered healthy and a good way to release built up frustrations without physically acting them out.

46. (e) Day dreaming………and 'regarded' instead as wandering thoughts.

47. (d) Nightly dream symbols are also 'applicable' to your day dreams.

48. (c) The content in your day dream will help in 'achieving' your goals.

49. (e) Positive daydreaming acts as a temporary 'escape' from the demands of reality.

50. (d) It is also a good way to 'release' built up frustration.

Sol. (51-60) :

The passage states that the world has a serious food problem and it only be solved when people take up farming. America where majority of people profess technological and financial jobs is also seeing a rise in its farming sector.

51. (b) The world has a serious food 'problem'.

52. (c) …the only way to solve 'it' is…..

53. (a) More people take up 'farming'.

54. (d) Technology and finance jobs 'have' been the basis……

55. (a) 'However', in recent times…….

56. (b) Incomes have risen 'up'.

57. (b) It has……. 'since' farming…….

58. (e) But data 'show' that …….

59. (d) …..employment is America is 'important' in states

60. (e) …..farming is the 'main' occupation.

Sol. (61-70) :

The passage states that Kenya can be considered a good example to show how mobile phones are changing the world. Mobile technology has also helped the world come closer.

61. (c) Kenya was regarded as a poor 'country'.

62. (b) ….. electricity, education, 'roads' etc.

63. (a) Mobile phone technology has 'changed' all this.

64. (b) Kenyans 'access' the internet.

65. (d) Farmers can 'not' only check the prices…..

66. (c) But also 'deal' with customers.

67. (d) Banking services are 'also' available..…….

68. (a) A 'report' by the World Bank shows……..

69. (e) The report shows that 'those' countries……….

70. (e) Countries 'grow' by 0.6% ……..

Sol. (71-80) :

The passage states that childhood should be the time to learn new and positive things but many times, children get spoiled by their own parents by deprivation or overindulgence.

71. (c) The time for 'shifting' from primary……

72. (d) …..learning to 'cope'…………

73. (a) …..learning to 'overcome' failure, ………

74. (b) …..homework assignment are 'far less'.

75. (c) But 'excessive' deprivation …….

76. (d) …….as is common in 'underprivileged'……

77. (a) ……. many children 'stuck in' the stage.

78. (b) A sense of 'responsibility'……

79. (c) And children 'need not' be poor ………

80. (d) The 'over indulged'………..

Chapter 5

Sentence Improvement

As the name suggests, these questions ask you to correct a sentence. They are asked on a number of tests because they not only check your ability to spot an error, but also to correct it. Hence, your grammar abilities are put to some real test in these questions.

Let us first see how these questions are framed. Sentence(s) will be given to you, and a part of a sentence or the entire sentence will be underlined. Now, from the options given, you have to select the one which you think should replace the underlined/ bold part. These questions can end up eating up your time, so make sure that you do not give yourself more than a minute or two to solve a sentence correction question. Anything beyond that is considered too much for such questions.

IMPORTANT TIPS & TECHNIQUES

- Understand the given sentence, including the part that is not underlined/bold. This way, you would be able to grasp the context and verb tense of the event or information talked about.
- Reread the underlined/bold part; if you are sure that there is no error, then just select the option which mentions the underlined/ bold part as the correct option.
- If you get to know the error (s) in the underlined/bold part, then correct it without looking at the options; if you have spotted the errors and bold/corrected them appropriately, your answer would be there in the options.
- If you have not been able to identify the error, but still think that the underlined/bold part is not right, then start checking on the 'grammar mistakes'.
- After selecting the option you think is correct, it is always advisable to reread the statement(s) given in the question with the corrected part to see if you have followed the right tense and everything is in line with the context of the sentences before or after the underlined/bold portion.

EXERCISE

DIRECTIONS (Qs. 1-30): *In the following questions, a part of the sentence or the whole sentence is bold or underlined. Below are given alternatives to the bold or underlined part at (a), (b) and (c) which may improve the sentence. Choose the correct alternative. In case no improvement is needed, your answer is 'No improvement'.*

1. Obviously he isn't **cut up** to be a good teacher.
(a) cut out (b) cut in
(c) cut for (d) No improvement

2. Power got with money is the most **craved for** today.
(a) sought after
(b) wished for
(c) welcomed for
(d) No improvement

3. The brown shirt **wants washing.**
(a) has to wash (b) is in need of a wash
(c) requires a wash (d) No improvement

4. You are asked to copy this letter **word by word.**
(a) word for word (b) word with word
(c) word to word (d) No improvement

5. The weak man is a slave to his **sensuous** pleasures.
(a) sensory (b) sensual
(c) secondary (d) No improvement

6. To get into the building, I'll **disguise** as a reporter.
(a) disguise to be (b) disguise as one
(c) disguise myself (d) No improvement

7. He denied that he **had not forged** my signature
(a) would not forge
(b) had forged
(c) did not forge
(d) No improvement

8. If **I had played well**, I would have won the match.
(a) I played well
(b) I play well
(c) I am playing well
(d) No improvement

9. Since the records are missing, the possibility of paying more than one compensation for the same piece of land cannot be ruled **aside**.
(a) out (b) off
(c) away (d) No improvement

10. A callous system **generates** nothing but a misanthrope.
(a) develops (b) induces
(c) produces (d) No improvement

11. **He has for good left India.**
(a) He has left for good India.
(b) He has left India for good.
(c) Good he has left India.
(d) No improvement

12. **We are credibly informed that the murderer has given himself up.**
(a) We are informed that the murderer has credibly given himself up.
(b) We are informed that the murderer has given credibly himself up.
(c) We are informed that credibly the murderer has given up himself,
(d) No improvement

13. We generally select **one of the most intelligent student of the school** for this award.
(a) one of the most intelligent students of the school
(b) one of the intelligent most students of the school
(c) one of the intelligent most student of the school
(d) No improvement

14. My friend lives in a nearby street **whose name** I have forgotten.
(a) the name of which
(b) which name
(c) of which name
(d) No improvement

15. **He both won a medal and a scholarship.**
(a) He won a medal and a scholarship both.
(b) Both he won a medal and a scholarship.
(c) He won both a medal and a scholarship.
(d) No improvement

16. **What do you for go to school?**
(a) For what do you go to school?
(b) What do you go for to school?
(c) What do you go to school for?
(d) No improvement

17. **He pleased the directors and this completed his report in good time.**
(a) He pleased the directors in good time and this completed his report.
(b) He completed his report in good time and this pleased the directors.
(c) He pleased the directors and completed his report and this in good time.
(d) No improvement

18. **The courtiers used to tell the King how efficient an administrator he was all day long.**
(a) The courtiers all day long used to tell the King how efficient an administrator he was.
(b) The courtiers used all day long to tell the King how efficient an administrator he was.
(c) The courtiers used to tell the King all day long how efficient an administrator he was.
(d) No improvement

19. Every Saturday I go out **for shopping.**
(a) for shops (b) to shopping
(c) for shop (d) No improvement

20. **We had a grand party and we enjoyed very much.**
(a) We had a grand party and enjoyed very much.
(b) We had a grand party to enjoy very much.
(c) We had a grand party and we enjoyed ourselves very much.
(d) No improvement.

21. Sordid and sensational books tend to vitiate the public taste.
(a) divide (b) distract
(c) distort (d) No improvement

22. By studying AIDS has engaged many researchers in the last decade.
(a) Important study (b) Now that the study
(c) The study of (d) No improvement

23. His Master's thesis was highly estimated and is now being prepared for publication.
(a) was highly discussed
(b) was highly commended
(c) is highly appraised
(d) No improvement

24. No sooner had she realized her blunder than she began to take corrective measures.
(a) then she began to take
(b) than she began taking
(c) when she began to take
(d) No improvement

25. A good scholar must be precise and possess originality.
(a) must be precise and original
(b) must be possess precision and original
(c) must be precision and possess originality
(d) No improvement

26. It took her a long time to get past her failure in the medical examination.
(a) through (b) over
(c) by (d) No improvement

27. The boy wanted to ask his father for money, but waited for a propitious occasion.
(a) protective (b) prophetic
(c) prospective (d) No improvement

28. I did not agree with him, he appeared to be so bigoted for me to concur.
(a) much (b) very
(c) too (d) No improvement

29. As soon as she noticed the workmen, she asked them what they have been doing.
(a) have done (b) had been
(d) are doing (d) No improvement

30. He was asleep before the mother tucked him off.
(a) through (b) away
(c) in (d) No improvement

DIRECTIONS (Qs. 31-80): *In the following questions, a part of the sentence is underlined. Below are given alternatives to the underlined part which may improve the sentence. Choose the correct alternative.*

---

31. The government has given subsidies to the Navratnas but there is no telling whether the subsequent one will do.
(a) whether the subsequent government will do so.
(b) if the government to follow will accept the policy.
(c) if the government to follow will adhere to the policy.
(d) no telling whether the subsequent one will do so.

32. Rahul Bajaj has done a great job of taking the company to its present status, but it is time that he let go of the reins.
(a) let go of the reins (b) stepped down
(c) let go off the reins (d) delegated responsibility

33. With the pick-up in the standard of education, expensive private schools have started blooming up in every corner of the country.
(a) started blooming in every corner of the country.
(b) have started mushrooming all over the country.
(c) have mushroomed all over the country.
(d) have blossomed all over the country.

34. It is important that whatever else happens, these two factors should not be messed around with.
(a) It is important that
(b) It is a fact that
(c) It should be urgently understood that
(d) It should be understood that

35. It must be note that under no circumstance should the company go in for diversification.
(a) It must be noticed that
(b) It must be noted that
(c) It must be pointed out that
(d) It should be noticed that

36. British Airspace has been focusing on building European links.
(a) concentrating on creating European links.
(b) pursuing ways of building European connectivity.
(c) stressing on building European links.
(d) focusing on forging European links.

37. The appetite of banks for funds was lost under the onslaught of the slowdown, corporate refused to borrow-even as bank deposit flourished.
(a) bank deposits flourished
(b) bank deposits swelled
(c) bank deposits were enhanced
(d) bank deposits flummoxed

38. He did many mischiefs.
(a) made many a mischiefs
(b) made much mischief
(c) committed many mischiefs
(d) No correction required

39. The main point of his speech was well understood.
(a) that he spoke (b) in the speech of his
(c) made when he spoke (d) No correction required

40. The indecisive man was readily persuaded to change his mind again.
(a) was persuaded ready (b) was ready to persuade
(c) was ready persuaded (d) No improvement

41. The teacher asked the intruder who was he and why was he occupying his chair.
(a) who he was and why he was
(b) who he was and why was he
(c) who he had been and why he had been
(d) No correction required

42. The custom of many centuries ago origin is slowly disappearing.
(a) which was originated ago many centuries
(b) originating for many centuries
(c) which orginated many centuries ago
(d) with many centuries of origin

43. He stayed back so that it can look as if he was unaware of the entire incident.
(a) may look (b) would look
(c) will look (d) No correction required

44. The local library has recommended that the books put up for the used book sale should be in good condition and should have no writing in them or be underlined.
(a) and should have no writing in them or be underlined
(b) and should not have writing in them or not be underlined
(c) and contain no writing or underlining
(d) without containing writing or underlining

45. The news of her employment soon circulated around the small town.
(a) circulated round the small town
(b) circulated in the small town
(c) was circulating across the small town
(d) was circulating within the small town

46. It is the craziness for speeding that is maddening that is responsible for many motor accidents.
(a) the craziness for speeding that is mad
(b) the mad craze for speed
(c) the mad craze for speeding
(d) the craze for speeding that is maddening

47. If they cooperate together by dividing up the work, they shall be over with the work faster.
(a) if they cooperate together by dividing the work
(b) if they cooperate by dividing up the work
(c) if they cooperate by dividing the work
(d) if they cooperate together by division of work

48. <u>Knowing the area was prone to earthquakes</u>, all the buildings were reinforced with additional steel and concrete.
(a) Having known that the area was prone to earthquakes
(b) Since they knew the area was prone to earthquakes
(c) Since the area was known to be prone to earthquakes
(d) Being prone earthquakes

49. He sailed for New York on Monday, arriving there on <u>Saturday for the much-awaited inauguration of the new hospital</u>.
(a) and arrived there on Saturday for the much-awaited inauguration of the new hospital.
(b) arriving there on Saturday for the inauguration of the much-awaited new hospital.
(c) arriving there for the inauguration of the much awaited new hospital on Saturday.
(d) and arrived here on Saturday for the long awaited inauguration of the new hospital.

50. After trying to convince him for a long time, I realized that <u>he was one of those people who never listens to reason.</u>
(a) he was one of those people who never listen to reason.
(b) he was one of those people who never listen to reasoning
(c) he is one of those people who never listen to reason.
(d) he is one of those people who never listens to reason.

Answers & Explanations

1. (a) Phrase 'cut out' means : to have the qualities and abilities needed for something.
2. (d) No improvement
3. (c) 'Requires a wash' should be used
4. (a) **'Word for word' means :** in exactly the same words or when translated exactly equivalent words.
5. (b) The word 'Sensual' (adjective) means: connected with your physical feelings; giving pleasure to your physical senses; especially to sexual pleasures.
6. (c) 'Disguise myself' should be used
7. (b) 'Not' should be removed because the word 'denied' itself means no or not. Use of 'not' again in the later part of the sentence will change the meaning of the sentence.
8. (d) No improvement
9. (a) 'Ruled out' is the correct phrase
10. (c) 'Generates' and 'produces' are same in meaning; however, here, 'produces' should be used as it is the most appropriate word in the context of the sentence.
11. (b) 'He has left India for good' is the correct structure.
12. (d) 'Give yourself up to somebody' means : to offer yourself to be captured.
13. (a) It implies only one from many
14. (a) 'the name of which I have' is the correct structure
15. (c) 'both a medal and a scolarship' is the correct structure.
16. (c) 'What do you go to school for?' Is the correct structure of an interrogative sentence.
17. (b) 'He completed his report in good time and this pleased the directors' is the correct sentence.
18. (c) The courtiers used to tell the King all day long how efficient an administrator he was.
19. (d) No improvement
20. (c) 'We had a grand party and we enjoyed ourselves very much' is the correct structure.
21. (b) 'Vitiate' means to spoil; 'distort' means to pull or twist' and 'distract' means to prevent someone from concentrating on something. 'Distract' fulfils the meaning of the sentence.
22. (c) 'The study of AIDS' is the correct structure to start the sentence.
23. (b) A thesis can't be estimated i.e. calculated. 'Commend' means to praise formally or officially. 'Commend' suits the best as only after a formed appraisal, the thesis can be forwarded for publication.
24. (d) No improvement
25. (a) 'Precise and original' is the correct usage.
26. (b) 'Get over' something means to accept an unpleasant factor situation after dealing with it for a while.
27. (d) Propitious means likely to result in success.
28. (c) 'Too bigoted' is the correct usage.
29. (b) 'Had been' should be used because the tense should be in past perfect continuous.
30. (c) 'Tuck somebody in/up' means : to make somebody fell comfortable in bed by pulling the covers up around them.
31. (a) This is an easy one because the other choices don't fit in properly even when we read them along with the sentence.
32. (a) The given statement means that Rahul Bajaj, who did a nice job of making the company what it is now, should now go away or leave it. 'Let go' refers to stop holding onto something, and in this context it means to stop holding onto this job in the company or the responsibilities. Rein as a noun could refer to anything which is a means of control. So, the given statement is correct: option (a) is the answer. Option (b) is not more appropriate than (a) because 'stepping down' can also mean reducing the level/scope, so then it would mean that Rahul Bajaj should not leave the company completely, which is different to what is stated in the statement. Option (c) is wrong, because the word 'off' is different from 'of'. Option (d) is wrong, because delegating responsibility means giving the responsibility to someone else, but that would slightly change the statement, as it does not say that Rahul Bajaj should leave and give his responsibility to someone; this would be like adding information from our side, which is not allowed.
33. (c) The given statement is trying to mean that as the standard of education has improved or picked up, expensive private school has grown and spread all over the country (all over the country, and every corner of the country, have the same meaning). 'Blooming up' is wrong because it means growing up and is used to

express a positive connotation. Here, it is clear that the author wants to state things in a negative shade.

Now, 'have started blooming or have started growing or have started mushrooming' are all redundant sentences as by just stating 'have grown/spread/ mushroomed' it can still mean that the action started sometime in the past and is still going on i.e. present perfect simple. So, options (a) and (b) can be ruled out. Option (a) is wrong too, because then, the tense would be simple past, which would mean that these private school grew or spread in the past, but this is not the case in present. Option (d) is wrong, because 'to blossom' is to develop and reach a promising state, but the sentence has not defined how much these schools have grown and what this stage of growth can be classified as. (an example of the use of blossomed: their friendship blossomed into romance).

34. (a) The given statement is correct. Option (b) cannot be true, because saying something is 'important' and something is a 'fact' have two different meanings. A fact refers to something that can be argued upon, and there is a certain proof to affirm its validity, whereas 'important' means something that is crucial or vital or necessary, and that is completely correct in the context as the speaker is stressing that the 'two factors' are vital. Options (c) and (d) are wrong, because understanding something is different from considering it important; understanding something means you 'get it', but 'understanding the importance' is a different thing. Option (c) is also incorrect, because there is nothing in the statement to suggest that the matter is 'urgent'.

35. (b) Let us understand the statement first: the speaker is expressing that it is very important to ensure that the company does not go for diversification (increasing the number of products/services that a company produces) i.e. the company should not go in different directions or set different goals. When we say 'it must be noted' we are suggesting that the people consider or understand the importance, whereas 'notice' refers to observing. It is clear from the context explained above that 'noted' is the appropriate word. Hence, option (b) is correct and (a) is incorrect. Option (c) is wrong too, because 'it must be pointed out' refers to showing or talking about something so that others will notice it, hence it will be clearly out of the context. Option (d) is similar to (b), the only difference being of 'should' instead of the presence of 'must'. The difference between must and should is only of the degree. When saying 'you must', you are saying that it is required and necessary, whereas in saying 'you should', you are merely suggesting something. Looking at the context, 'must' is the more appropriate word.

36. (a) The given statement means that the British Airspace is 'focusing' on spreading its network, but probably having their flights in more European countries. Let's first look at the words: concentrating, pursuing, stressing, and focusing. Focusing and concentrating are synonymous to each other and they refer to directing attention on someone or something. 'To pursue' is 'to chase, follow or seek to attain or accomplish a goal over a long period of time'. 'Stressing' means 'emphasizing something'. Hence, the appropriate word for the sentence would be concentrating or focusing. We have to pick between the options (a) and (d) now: forging can refer to creating something strong or enduring. We cannot say if the company is looking to form links for the long term, or the ones that would hopefully last, or it is just something they are trying out for sometimes. So, option (a) is correct.

37. (b) We have to basically pick the most appropriate word among: flourished, swelled, enhanced, and flummoxed. Let's look at the meanings of these words: Flourish refers 'to grow or develop rapidly or vigorously'; swell means 'grow or expand'; enhanced can refer to 'something has been made better or increased'; flummoxed means 'bewildered or perplexed'. The given statement means that the appetite of banks was lost and corporate were not taking funds, or not borrowing money from banks, hence the amount of funds with the banks increased. Option (b) is right because swell means increase in magnitude or number and that fits into the context. Option (a) is wrong because flourished means to grow quickly or rapidly, but there is nothing to indicate in the statement to show that there was this 'rapid pace'. Option (c) can be rejected, because enhanced can also mean increase in quality too, so if we had to pick between swell or enhance, then swell is more appropriate for this statement. Option (d) is wrong because flummoxed is a very different word, as explained already.

38. (c) **39. (d)** **40. (d)** **41. (a)** **42. (c)**

43. (b)

44. (c) The modal 'should' need not be repeated since the conjunction 'and' is being used. The first 'should' in the sentence will be used for both the parts.

45. (b) 'in' is the correct preposition to be used with the verb circulated.

46. (c) 'craziness' is no word, the right noun is craze. If that is maddening is chosen, it will be followed by 'that is responsible' which will not be appropriate 'mad craze' is the correct use, and this craze is not for the noun 'speed' but the verb 'speeding', i.e., driving vehicles at high speed.

47. (c) Co-operate has an implicit meaning of together. It means 'work together', so together must be eliminated. Similarly, 'dividing' means 'breaking up' so 'up' from 'dividing' must also be eliminated.

48. (c) The second part of the sentence is an action taken as a result of an incident, so the first part of the sentence must give the incident and use the word 'since'. (b) is not the right option because it will make the first part active voice and second passive voice which must not happen. Similarlity of voice should be maintained in the sentence.

49. (a) "arriving" is not in agreement with "sailed" in option (d) "here" is incorrect.

50. (b) "reason" is not the correct word for this context. There is no need to put an 's' in verb in case of third person plural number.

Chapter 6 Fill in The Blanks

Questions based on Word Fillers or Fill in the Blanks are those questions wherein a sentence is given with one, two or three blank(s) and the aspirants are asked to pick the correct word(s) from the given options to make the sentence meaningful.

IMPORTANT TIPS & TECHNIQUES

- You should be open to learning new words because a rich vocabulary always gives you an edge while picking up the correct word(s) for the blank(s).
- Always try to eliminate/rule out the odd/irrelevant words.
- Make reading a habit so that your familiarity with words and expressions will many a time get you the correct answer without even looking at the options.
- Knowing the use of specific prepositions following certain words is also very important as this also helps in eliminating the irrelevant options e.g. afraid of (something), act upon etc.
- Knowing a good number of Idioms & Phrases also proves to be handy.

Different types of Word Filler questions are asked in the exams which are illustrated below.

EXERCISE

DIRECTIONS (Qs. 1- 35): *In the following questions, sentences are given with blanks to be filled in with an appropriate word(s). Four/five alternatives are suggested for each question. Choose the correct alternative as your answer.*

1. The Union Budget is likely to be presented on February 26, two days ahead of the ___________ date.
(a) critical (b) conventional
(c) suitable (d) convenient

2. I am sorry ___________ the mistake.
(a) from (b) with (c) for (d) at

3. He ___________ her that she would pass.
(a) insured (b) ensured
(c) assumed (d) assured

4. Your father ___________ worry. I'm a very careful driver.
(a) needn't (b) none
(c) can't (d) doesn't

5. The ___________ chosen for construction of the building is in the heart of the city.
(a) cite (b) slight
(c) sight (d) site

6. Mr. Murugan has been in this college ________ 2010.
(a) for (b) since
(c) after (d) before

7. We attended a ________ discourse.
(a) spiritual (b) spirituous
(c) spirituality (d) spiritually

8. The valley is known for its ________ growth of vegetation.
(a) luxurious (b) luxury
(c) luxuriant (d) luxuriously

9. Satyajitray's films ________ all barriers of caste, creed and religion. They are universal.
(a) transcend (b) transcends
(c) trancend (d) transend

10. I could hardly recognize him ________ I saw him.
(a) after (b) but
(c) and (d) when

11. The new government took _______ last year.
(a) out (b) after (c) over (d) upon

12. Mohan's career has taken some __________ twists and turns.
(a) incentive (b) interesting
(c) interactive (d) intuitive

13. It is raining __________ . Do not go out.
(a) heavily (b) fast
(c) soundly (d) strongly

14. She tries to adjust _________ her relations.
(a) for (b) at (c) so (d) with

15. She was remarkably _________ in singing and dancing.
(a) accomplished (b) conducive
(c) fluctuating (d) cooperative

16. Sheila gained an advantage _________ me.
(a) upon (b) from
(c) on (d) over

17. Take this medicine regularly and you will get rid ________ this disease.
(a) at (b) from
(c) of (d) over

18. Statistics __________ always my worst subject.
(a) are (b) were (c) is (d) have

19. When she retired, she handed __________ the charge to the Vice-President.
(a) over (b) out
(c) across (d) off

20. The student was punished for his ________.
(a) impudence (b) prudence
(c) modesty (d) elemency

21. My father was too _______ to push the heavy door.
(a) faint (b) feeble
(c) fragile (d) faltering

22. The flood damaged the books so much that it was impossible to _______ them.
(a) retrieve (b) retrace
(c) retract (d) retreat

23. His bungalow went through a make ________.
(a) up (b) out (c) over (d) for

24. This auspicious beginning ________ well for a successful completion of our project.
(a) attunes (b) argues
(c) augurs (d) answers

25. I am quite satisfied that I have not been _________ in doing whatever was needful for building up their character.
(a) negligent (b) devoted
(c) caring (d) affectionate

26. Today, _______ society is literally poisoning the earth with acid rain.
(a) cosmopolitan (b) developing
(c) growing (d) industrialised

27. On the ________ occasion of Laxmi Puja, the Mathurs bought a new car.
(a) officious (b) auspicious
(c) fortuitous (d) prosperous

28. Precautions are to be taken with any one who seems ______.
(a) contagious (b) infectious
(c) diseased (d) defiled

29. The treasure was hidden ______ a big shore.
(a) on (b) underneath
(c) towards (d) off

30. The director congratulated Mr. Varma _____ his success.
(a) on (b) for (c) at (d) about

31. The boys were ________ to hear that we were going to build a bridge.
(a) delight (b) delights
(c) delighted (d) delighting

32. The revolting players and the game's administrators held _____ discussions to resolve the payment dispute.
(a) unnecessary (b) obligatory
(c) preliminary (d) silent

33. The higher you climb, the more difficult it _________ to breathe.
(a) became (b) becomes
(c) has become (d) is becoming

34. Neha has been crying _______ morning.
(a) from (b) of
(c) since (d) till

35. Fourteen kilometres _______ not a short distance, to reach to my office daily.
(a) are (b) has
(c) have (d) is

DIRECTIONS (Qs. 36-40): *Fill in the blanks with the most appropriate option.*

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36. A speaker must _____ to intellectual level of the audience.
(1) adhere (2) speak
(3) adapt (4) quality
(5) organize (6) adjust
(a) 1&4 (b) 2&3 (c) 3&6 (d) 1&5
(e) 4&6

37. Life is as _____ to a mute creature as it is to a man.
(1) worse (2) dubious
(3) dear (4) trusty
(5) important (6) clear
(a) 2&4 (b) 1&5 (c) 3&4 (d) 3&5
(e) 2&6

38. According to a recent _____, 61% of India's unemployed within the next decade could be its educated youth.
(1) idea (2) data
(3) survey (4) philosophy
(5) explanation (6) surge
(a) 2&3 (b) 1&5 (c) 4&1 (d) 3&6
(e) 1&6

39. The art of effective presentation is the _____ of persistent efforts and practice.
(1) norm (2) fruit
(3) onus (4) viability
(5) result (6) outcome
(a) 1&2 (b) 4&5 (c) 3&4 (d) 1&5
(e) 5&6

40. Human needs are more _____ than those of their pets but they still have their basis in instinct.
(1) desirable (2) complicated
(3) easy (4) complex
(5) costly (6) demanding
(a) 2&3 (b) 2&4 (c) 1&5 (d) 5&6
(e) 3&6

DIRECTIONS (Qs. 41-50): *In question given below, there are two statements or one, each containing some blanks. You have to choose the option which provides the correct set of words that fits the blanks in the statement(s) appropriately and in the same order making them meaningful and grammatically correct.*

41. (1) With a firm _____, the government should be able to focus more on the strategy to further _____ growth and demand.

(2) They can't accept the attack on their electoral ______ which has the chances to negatively ______ their voters.

(a) edict, deter (b) mandate, stimulate
(c) directives, appease (d) denial, prompt
(e) authority, dissuade

42. (1) It is a great misfortune that an internal ______ has moved ______ towards a full-blow crisis.

(2) While ______ still exists between the status of men and women in the world, the tide of history is flowing ______ in favour of women.

(a) controversy, wrongly (b) unity, adamantly
(c) cleft, impeccably (d) concordance, doggedly
(e) rift, inexorably

43. (1) He appeared to be the ______ as everyone in the party was ______ about him.

(2) Being the ______ of the meeting, he was busy ______ about the new project laid by his company.

(a) cynosure, talking (b) nonentity, discussing
(c) hotshot, sceptical (d) linchpin, aporetic
(e) boss, incredulous

44. (1) In the _____ issued last week, the state government has _____ all the civil servants to take up the matter of child labour seriously.

(2) Adhering to the _____ issued by the court, the censor board has temporarily banned all the movies _____ by such directors who are accused in any crime.

(a) order, asked (b) circular, directed
(c) direction, composed (d) paper , dwindled
(e) norms, progressed

45. (1) The soldier refused to accept a ______ for his bravery because he felt he was ______ performing his duty.

(2) The inexperienced singer was surprised to receive a ______ for ______ singing in the chorus.

(a) compliment, ambiguously
(b) reward, effortlessly (c) plaudit, simply
(d) bestowal, normally (e) citation, callously

46. (1) In order to ______ himself from the beating of his father, the student ______ a way to cheat in the examination.

(2) To ______ their businesses, the black marketers had ______ with the police in a shoddy business.

(a) protect, cogitated (b) secure, confederated
(c) save, connived (d) bulwark, plotted
(e) defend, scheme

47. (1) His _____ towards his brother led him to ______ his car.

(2) Since I bear no ______ towards you, I don't understand what provoked you to ______ the boundary of my campus.

(a) animosity, eradicate (b) grudge, repair
(c) antipathy, devastate (d) malice, vandalize
(e) benevolence, build

48. (1) The dollar has been gradually ______ against major currencies ______ the beginning of the last year.

(2) The increasing difference between the rich and poor has resulted in ______ of people's faith in our democracy ______ independence.

(a) depreciating, since (b) growing, from
(c) undermining, from (d) crippling, since
(e) weakening, since

49. (1) Monika used to walk ______ foot for five kilometers to look after her father who was ______ in the city hospital.

(2) The chief minister in the party meeting stressed _____ the view shared by one of his ministers, as two days ago, he in a press conference ______ that the state government was not doing its work up to the mark.

(a) on, accepted (b) over, abstained
(c) on, admitted (d) over, put
(e) at, repudiated

50. (1) The increasing burden of loans on the company has forced it to ______ from ______ to CSR.

(2) As rising oil prices put pressure on domestic consumers, the government will have to ______ from ______ to subsidies.

(a) desist, resorting (b) cease, addressing
(c) relinquish, dodging (d) endure, procuring
(e) recover, providing

Answers & Explanations

1. **(b)** 'Two days ahead of conventional date' is correct use as the fixed date february 26 is given.
2. **(c)** 'Sorry for' is the correct prepositional use
3. **(d)** 'He assured' means 'He made sure' thus, he assured is the correct use.
4. **(a)** 'Needn't worry' is the correct usage.
5. **(d)** Site which means location is the correct use.
6. **(b)** 'Since' is usually followed by a time expression (last year, this morning, 4 o'clock etc.) or by a clause in the simple past tense.
7. **(a)** 'discourse' which is a noun requires an adjective before it. The words 'spirituality' and 'spiritually' being noun and adverb respectively get ruled out. 'Spirituous' is derived from the word 'spirit' as in alcohol; so, it being irrelevant gets ruled out. 'Spiritual' is derived from the word 'spirit' as in relating to or affecting the human spirit or soul correctly fits the blank.
8. **(c)** The adjective 'luxuriant' which means '(of vegetation) rich and profuse in growth; lush' correctly fits the blank thereby, making the sentence meaningful.
9. **(a)** Options (c) and (d) get ruled out because no words as such exist. Option (b) also gets ruled out because according to subject-verb agreement rule, 'transcends' doesn't go correctly with 'films'. Option (a) i.e. 'transcend' is the correct alternative.
10. **(d)** 'When' is the most appropriate word to be used in the sentence.
11. **(c)** 'Took over' here, means came into force or effect
12. **(b)** 'Interesting', is the correct usage
13. **(a)** 'Heavily' is the correct usage
14. **(d)** 'With' is the right preposition
15. **(a)** 'Accomplished' is the correct usage
16. **(d)** Over; 'Advantage over' means to have an edge.
17. **(c)** 'Of' here means 'cured of, get rid of or to be free'
18. **(c)** 'Is' as 'statistics' is a singular word
19. **(a)** 'Hand over' or give the responsibility to other person
20. **(a)** The correct word that will fit the blank is 'impudence'. 'Impudence' means 'not to show the proper respect'.
21. **(b)** The correct word that will fit the blank is 'feeble'. 'Feeble' means 'weak'.
22. **(a)** The correct word that will fit the blank is 'retrieve'. 'Retrieve' means to 'get or bring back'.
23. **(c)** The correct word that will fit the blank is 'over'. As it is given in the sentence, 'makeover' means to 'renew or renovate something'. Hence, the preposition 'over' will suit the meaning of the sentence.
24. **(c)** The correct word that will fit the blank is 'augurs'. 'Augurs' means 'something that will proceed well'.
25. **(a)** 'Negligent' means failing to take proper care of something.
26. **(d)** The most appropriate word is the adjective 'industrialised' which means 'developed industries in a country or a region on a wide scale'.
27. **(b)** On the auspicious occasion of Laxmi Puja, the Mathurs bought a new car.
28. **(b)** Precautions are to be taken with anyone who seems infectious. [infectious means likely to transmit or spread in a rapid manner. 'Contagious and diseased' can't be used in this context because they refer to already having infection].
29. **(d)** The treasure was hidden off the shore. When something is hidden "off the shore," it just means that it's hidden somewhere near it.
30. **(a)** 'On' is the correct prepositional use
31. **(c)** 'Delighted' is the correct use of tense
32. **(c)** 'Preliminary discussions' means 'initial discussions'
33. **(b)** 'Becomes' makes the sentence grammatically correct.
34. **(c)** 'Since' is usually followed by a time expression (last year, this morning, 4 o'clock etc.) or by a clause in the simple past tense.
35. **(d)** There are nouns that indicate length, measure, money, weight or number and when they are preceded by a numeral, they remain unchanged in form so long as they are followed by another noun or pronoun. Therefore, 'is' should be used in the sentence.
36. **(c)** The people in the audience are the listeners; therefore, the speaker must speak in a way wherein his audience understands what he speaks .i.e., he should adjust himself according to the intellectual level of the audience. Thus, both 'adapt' and 'adjust' meaningfully fill the blank. Rests of the options are irrelevant.
37. **(d)** The words 'worse' and 'dubious' have negative connotations which don't suit the context of the sentence. Hence, they get ruled out. 'trusty' and 'clear' are irrelevant in the context of the sentence; therefore, they too get ruled out. The use of 'dear' and 'important' make the sentence meaningful thereby, making option (d) the answer.
38. **(a)** 'Idea' is ruled out as it is not preceded by 'an'. 'philosophy', 'explanation' and 'surge' are irrelevant in the context of the sentence; hence, they get ruled out too. The words 'data' and 'survey' make the sentence meaningful and contextually correct.
39. **(e)** The words 'norm', 'onus' and 'viability' are irrelevant in the context of the sentence; hence, get ruled out. Though 'fruit' appears to be an appropriate alternative but its combination with 'norm' as given in option (a)

eliminates it. 'result' and 'outcome' fit correctly in the blank thereby making the sentence meaningful.

40. (b) The words 'desirable' and 'easy' are irrelevant in the context of the sentence; hence, get ruled out. The use of the words 'costly' and 'demanding' with 'human needs' doesn't make sense; so, these two are eliminated too. The leftover options .i.e. 'complicated' and 'complex' can be used as the fillers as they make the sentence meaningful. Therefore, the correct answer is option (b).

41. (b) The word 'edict' which means 'an official order or proclamation issued by a person in authority' is irrelevant in the context of both the sentences; so, option (a) gets ruled out. Option (c) gets ruled out because 'appease' which means 'to satisfy or pacify' doesn't go correctly with the meaning of the sentence. The use of 'prompt' is inappropriate in context of both the sentences; so, option (d) gets ruled out. The use of 'dissuade' will be incorrect in the first sentence; thus, option (e) too gets ruled out. The leftover option .i.e. option (b) is the correct answer as 'mandate' and 'stimulate' make both the sentences meaningful.

42. (e) The word 'unity' is inappropriate in the context of the sentence because the sentence requires a word which means 'dispute or disagreement'. So, option (b) gets ruled out. The words 'cleft' and 'concordance' which mean 'split, divided' and 'agreement or consistency' are irrelevant in the context of both the sentences; therefore, option (c) and (d) get ruled out. Both 'controversy' and 'rift' fit correctly in the first blank so, we will move to the second filler to deduce the correct answer. The most relevant filler to fit the blanks is 'inexorably' which means 'impossible to stop or prevent'; hence, the correct answer is option (e).

43. (a) All the first fillers of each of the options except for option (b) fit correctly in the first blank; 'nonentity' which means 'an unimportant person' doesn't go correctly in context to the meanings of both the sentences. All options (c), (d) and (e) get eliminated because the words 'sceptical', 'aporetic' and 'incredulous' which mean 'doubtful', 'expressing doubt' and 'unwilling or unable to believe something' respectively do not make the sentence meaningful. The words 'cynosure' which means 'center of attraction' and 'talking' make both the sentences contextually correct. So, the correct answer is option (a).

44. (b) The words 'asked', 'composed', 'dwindled' and 'progressed' do not fit meaningfully in the second blank. So, options (a), (c), (d) and (e) are ruled out. However, 'circular' and 'directed' when filled in the blanks, make both the sentences meaningful.

45. (c) All the first fillers of each of the options correctly fill the first blanks of both the sentences; so, we will move on to the second fillers to find out the correct answer. The words 'ambiguously', 'effortlessly', 'normally' and 'callously' are irrelevant in the contexts of both the sentences. Hence, option (a), (b), (d) and (e) get ruled out. The words 'plaudit' which means 'praise or acclamation' and 'simply' make both the sentences contextually correct. Therefore, the correct answer is option (c).

46. (c) Both 'bulwark' and 'defend' which mean 'a defensive wall' and 'resist an attack made on (something or someone)' are irrelevant in the contexts of both the sentences. So, options (d) and (e) get ruled out. All the first fillers of options (a), (b) and (c) correctly fill the first blank; so, we will move on to the second blanks to ascertain the correct answer. The words 'cogitated' and 'confederated' which mean 'thought deeply about something' and 'joined by an agreement or treaty' respectively when used as the fillers do not make any sense; thus, options (a) and (b) are eliminated. The words of option (c) i.e., 'save' and 'connived' make both the sentences meaningful.

47. (d) The word 'benevolence' which mean 'kindness' is eliminated because it does not make the sentences correct rather, it is the antonym of the word that should have been used. All the first fillers of each of the options (a), (b), (c) and (d) fit in correctly in the first blank of both the sentences; so, we will move on to the second filler in order to find out the correct answer. The words 'eradicate' and 'repair' are contextually irrelevant; thus, option (a) and (b) get ruled out. Though 'devastate' and 'vandalize' both, appear to be very close in meaning to each other, we will pick the word 'vandalize' here because it means 'deliberately destroy or damage (public or private property)' which suits most appropriately in both the sentences in comparison to 'devastate' which means 'destroy or ruin'.

48. (e) The use of 'from' in the second blank of both the sentences in inappropriate. So, option (b) and (c) get ruled out. Among the leftover options, only 'weakening' and 'since' i.e., option (e) make the sentence contextually correct.

49. (c) We always use 'on' with 'foot' in the context of 'walking'. So, by elimination method, all the options except for options (a) and (c) are ruled out. The use of the word 'admitted' in the context of both the sentences is appropriate whereas 'accepted' is irrelevant in the first sentence. Therefore, option (c) is the correct answer.

50. (a) All the second fillers of each of the options (b), (c), (d) and (e) are irrelevant in the context of the sentence; hence they get ruled out. The words given in option (a) i.e., 'desist and 'resorting' which mean 'stop doing something' and 'turning to and adopting (a course of action, especially an extreme or undesirable one) so as to resolve a difficult situation' respectively correctly fit in the blanks thereby, making the sentence meaningful.

Chapter 7

Para Jumbles

Parajumble is the lexical term used for the kind of questions wherein the sentences of a paragraph are jumbled and the examinee is required to figure out the logical sequence of the sentences that would render the paragraph meaningful and grammatically correct.

Such questions, basically, pertaining to rearrangement of a given set of sentences. At times, instead of sentences of a paragraph, phrases of a complex sentence may be jumbled for the candidate to arrange logically.

(I) Let us first discuss the single sentence with its parts jumbled.

IMPORTANT TIPS & TECHNIQUES

- Every sentence has a subject and a predicate. So, locating the **subject** will give headway in arranging the parts of the sentence sequentially. The subject of a sentence is a noun or a pronoun.
- **Nouns** are always mentioned first and later get replaced by **pronouns**.

  e.g. Raman told Mona that he trusted her.
  (noun) (noun) (pronoun) (pronoun)
  Heena promised herself that she would not lie again.
  (noun) (pronoun) (pronoun)
- The predicate contains the verb of the subject. So, locate the verb.
- A sentence may be either in **active** or in **passive** voice. In the active voice, the sentence follows the structure, subject+verb+object+preposition...

  e.g. Aditi helped them in their work.
  (subject) (verb) (object)

  In the passive voice, the 'by phrase' containing the doer of the action occurs towards the end of the sentence,

  e.g. They were helped in their work by Aditi.
  or at the end of a clause with correlative conjunction.
  e.g. She was *so* spoilt by her parents *that* she threw tantrums every now and then.
- **Connectors** occur generally in the middle or alternatively, in the beginning of the sentence.

  e.g. **If** you are happy, you will be healthy.
  You will be healthy **if** you are happy.
  That he is ill is no news.
  It is no news **that** he is ill.
- Definite article **the** comes later to refer to the noun already mentioned. As an opener, it can come only with singularly known nouns like sun, moon, monuments, newspapers, trains, etc.

(II) Now, we shall discuss the jumbled paragraph, wherein the sentences of the paragraph are given in a random order and need to be sequenced logically.

IMPORTANT TIPS & TECHNIQUES

- Every passage will have a central theme. It helps to identify it and sequence the sentences logically in accordance with the structure of:

  Premise
  Support
  Example
  Progression
  Conclusion
  Often, the opening sentence starts with 'It is...'
- The opening sentence will have a noun rather than a pronoun. That is, it will introduce a person, place, body, group or any other entity.
- Sentences bearing personal pronouns, that is, you, he, she, it, him, her, they or demonstrative pronouns this, that, these, those will always come later. They establish pairs with other noun-bearing sentence of the paragraph.
- Adjectives showing a degree of comparison, for example better, more, worse etc., establish link with other sentences.
- Some links or pairs of sentences of the given paragraph can be identified from the options. These may be based on the subject, time sequence (then, later, next, before, after etc.), noun-pronoun sequence, etc.
- Sometimes, a sentence stands as an example of another. It will always come later than the sentence for which it is working as an example.
- Signal words of support, for example - and, also, as well, beside, to, in fact, moreover, likewise, similarly, additionally, furthermore, etc.; and of contrast, for example–although, yet, despite, in spite of, instead of, while, whereas, on the other hand, on the contrary, nevertheless, none the less, however, still, ironically, surprisingly, paradoxically etc. are never the opening sentence. They follow the sentence that they support or contrast.
- Words such as therefore, because, consequently, hence, thus, given that, in order to, when/if...then, so/such... that, accordingly etc., Also show pairs of cause and effect sentences, where one causes or determines another which follows it logically.

EXERCISE

DIRECTIONS (Qs. 1-20) : *In the following items, some parts of the sentence have been jumbled up. You are required to re-arrange these parts which are labelled P, Q, R, and S to produce the correct sentence. Choose the proper sequence and mark accordingly.*

1. Many
P : way to fuel growth
Q : economists argue that
R : and alleviate poverty
S : free trade is a magic bullet - the quickest
Which one of the following is the correct sequence ?
(a) Q - P - S - R (b) R - S - P - Q
(c) Q - S - P - R (d) R - P - S - Q

2. As a
P : maestro appeared to be enjoying every bit of it
Q : and followed every composition the
R : thunderous applause from
S : an appreciative audience preceded
Which one of the following is the correct sequence ?
(a) P - Q - S - R (b) R - S - Q - P
(c) P - S - Q - R (d) R - Q - S - P

3. Keeping
P : farmers to smoke their fields during
Q : in view the prevailing weather conditions
R : agricultural experts have advised
S : the night to protect vegetables from cold
Which one of the following is the correct sequence ?
(a) S - R - P - Q (b) Q - P - R - S
(c) S - P - R - Q (d) Q - R - P - S

4. It is
P : stressful or joyful
Q : with the belief in the evanescence of life itself
R : necessary to rise above the situations
S : and in the philosophical of the purpose of life
Which one of the following is the correct sequence?
(a) R - P - Q - S (b) Q - S - R - P
(c) R - S - Q - P (d) Q - P - R - S

5. The difference
P : and development on the other affects
Q : in the relationship between death and birth rates on the one hand
R : but the age structure of the population
S : not just the rate of population growth
Which one of the following is the correct sequence ?
(a) S - R - Q - P (b) Q - P - S - R
(c) S - P - Q - R (d) Q - R - S - P

6. Here
P : another supposed discovery of 29-inch footprints
Q : claim to have found in Kerala
R : we go again with yet
S : which a group of amateur anthropologists
Which one of the following is the correct sequence ?
(a) R - Q - S - P (b) S - P - R - Q
(c) R - P - S - Q (d) S - Q - R - P

7. Creative
P : world of reality
Q : writers and artists, through their imagination
R : transform the details of the
S : into the world of art
Which one of the following is the correct sequence?
(a) S - P - R - Q (b) Q - R - P - S
(c) S - R - P - Q (d) Q - P - R - S

8. Thus
P : against the state through the courts
Q : of one's privacy against arbitrary intrusion by the police
R : the court emphasized that the security
S : is basic to a free society and enforceable
Which one of the following is the correct sequence ?
(a) P - Q - S - R (b) R - S - Q - P
(c) P - S - Q - R (d) R - Q - S - P

9. The preference
P : responsibilities of looking after parents in their old age
Q : despite the fact that in a growing number of families
R : at least in urban India, daughters are taking on the
S : for the male child continues
Which one of the following is the correct sequence?
(a) S - Q - R - P (b) R - P - S - Q
(c) S - P - R - Q (d) R - Q - S - P

10. The producer must
P : give enough information so that the consumer
Q : will understand how the product differs the competition
R : about the product but to buy it, the producer must
S : inform the consumer of his product and if he wants the consumer not only know
Which one of the following is the correct sequence?
(a) P - R - S - Q (b) S - Q - P - R
(c) P - Q - S - R (d) S - R - P - Q

11. The bigoted
P : reality that additional hands also mean additional mouths to feed, clothe and house
Q : in order to augment their incomes, plead for more children, ignoring the resultant
R : not only to the national interests but also to those families which
S : belief – the more, the merrier – has done immense harm

Which one of the following is the correct sequence ?
(a) S - Q - R - P (b) P - R - Q - S
(c) S - R - Q - P (d) P - Q - R - S

12. Critics
P : cover up the essentially inequalitarian
Q : and unjust nature of a Third World State
R : has been basically a sugar-coated concept that tries to
S : also point out that development administration
Which one of the following is the correct sequence?
(a) P - Q - S - R (b) S - R - P - Q
(c) P - R - S - Q (d) S - Q - P - R

13. For
P : are determined by nature and which not by nature
Q : about two decades now
R : aspects of cognition and behaviour in the human brain
S : scientists have been trying to figure out which
Which one of the following is the correct sequence ?
(a) S - Q - R - P (b) Q - S - P - R
(c) S - Q - P - R (d) Q - S - R - P

14. A school of psychology argues that
P : is one of the manifestations of impulse control disorder, a condition in which
Q : an act harmful for oneself or others
R : motorcycling — like gambling or skydiving –
S : an individual cannot resist the impulse or temptation to perform
Which one of the following is the correct sequence ?
(a) R - P - S - Q (b) Q - S - P - R
(c) R - S - P - Q (d) Q - P - S - R

15. With six of its neighbours
P : there is a renewed warning for India
Q : and safeguard its own strategic interests
R : ranking high on global roster of failed states
S : to reassess its policy towards them
Which one of the following is the correct sequence ?
(a) P - R - S - Q (b) R - P - Q - S
(c) P - R - Q - S (d) R - P - S - Q

16. Faced with the
P : traditional culture in the pre-independence India
Q : challenge of the intrusion of colonial culture and ideology
R : developed during the nineteenth century
S : at attempt to reinvigorate traditional institutions and realize the potential of
Which one of the following is the correct sequence ?
(a) P - R - Q - S (b) Q - S - P - R
(c) P - S - Q - R (d) Q - R - P - S

17. Looking back,
P : two wars I had been through
Q : life in the Army had all along been truly joyous
R : and the innumerable postings and below par accommodation at many stations
S : despite the vicissitudes and hardships of the
Which one of the following is the correct sequence ?
(a) S - R - P - Q (b) Q - P - R - S
(c) S - P - R - Q (d) Q - R - P - S

18. A diversified use
P : as a heating or power generation fuel by converting gas into
Q : adding a new dimension to the traditional use of gas
R : of natural gas is emerging
S : amongst other products, high quality diesel transportation fuel virtually free of sulphur
Which one of the following is the correct sequence?
(a) R - P - Q - S (b) S - Q - P - R
(c) R - Q - P - S (d) S - P - Q - R

19. As things stand,
P : but a majority still does not have access to English
Q : linguistic edge they are equipped with
R : after globally because of the
S : Indian professionals are much sought
Which one of the following is the correct sequence?
(a) R - S - P - Q (b) S - R - Q - P
(c) R - S - Q - P (d) S - R - P - Q

20. While advocates
P : of its provisions with the
Q : there is some misguided concern about a possible clash of some
R : of social reform have generally hailed the new legislation
S : religious and customary practices in vogue in the country
Which one of the following is the correct sequence ?
(a) R - Q - P - S (b) Q - R - S - P
(c) R - Q - S - P (d) Q - R - P - S

DIRECTIONS (Qs. 21 - 25) : *The questions below consist of a set of labelled sentences. Out of the four options given, select the most logical order of the sentences to form a coherent paragraph.*

21. P : It had been umpteen years since we had seen each other.
Q : One dull dark in autumn, I was travelling on horseback through a dreary stretch of countryside.
R : This was the house of Roderick Usher, who had been my childhood pal.
S : At night fall, I came in sight of the house of Usher.
(a) PQSR (b) PSQR
(c) QSRP (d) QRSP

22. P : According to various estimates between 1942 and 1944 there were approximately 400 victims of this practice daily in Warsaw alone, with numbers on some days reaching several thousands.
Q : A common German practice in occupied Poland was to roundup random civilians on the streets of Polish cities.
R : For example, on 19th September 1942 close to 3000 men and women were transported by train to Germany - they had been caught in the massive round - ups all over Warsaw the previous two days.

S : The term, "lapanka" (Polish for 'roundup') carried a sardonic connotation from the word's earlier use for the children's game known in English as "tag".

(a) SQRP (b) SRPQ
(c) QSPR (d) QPRS

23. P : But he did not know how to find one at that hour.
Q : It was his first visit to the city and he didn't know where to go.
R : Mohanlal's train was late and it reached Kolkata a little after midnight.
S : He thought he would go to a choultry where he would not have to pay rent.

(a) PSQR (b) QRSP
(c) RQSP (d) RSQP

24. P : And slowly, you reach the pinnacle of self - awareness, experiencing a unity with all life.
Q : If you transform your energy positively, it naturally becomes compassion and love.
R : Once you experientially are a part of everything then nobody needs to teach you morality.
S : Then you can do something to improve the situation, but without anger.

(a) PQRS (b) QPRS
(c) RQPS (d) RSPQ

25. P : The aim must be to ensure that our country does not experience either paucity or a-surfeit of trained manpower in any specific segment of our economy.
Q : When we set about the task of higher education, we should be absolutely clear in our perception of the goals of education in the specific context of our nation's development.
R : No doubt, one of the important aims of education would be to create the required range and nature of trained manpower assessed to be needed by different sectors of national growth.
S : The entire educational apparatus must be geared progressively to fulfill the requirements of different phases of our growth in every sector primary, secondary and tertiary.

(a) SQPR (b) QRSP
(c) SRQP (d) PSQR

DIRECTIONS (Qs.26-28) : *Four or more sentences are given below, they need to be arranged in a logical order to form a coherent paragraph/passage. From the given options, choose the most appropriate option.*

---

26. A. Classical music, by contrast, encodes maturity and, by extension, the demands of responsibility to family and to society.
B. The meaning of the commercial emerges out of this odd juxtaposition of the music you see and the music you hear.
C. What the commercial is saying (though not in so many words, of course) is that you can begin responsible financial planning without selling out on your youth, freedom, and spontaneity.
D. Rock stands for youth, freedom, being true to yourself; in a word, authenticity.
E. Through music, the commercial accomplishes a kind of conjuring trick, combining both sets of values and in this way selling the advertiser's message (you need to start planning for your old age now) to a segment of society that might be expected to be resistant to it.

(a) BDAEC (b) EDABC
(c) ECBDA (d) BECDA

27. A. The good news is that a major deficiency in rainfall, as had happened last year, is an extremely remote possibility.
B. Two crucial indicators, the El Nino, caused by difference in sea surface temperatures in the Indian Ocean, and the Indian Ocean Dipole, are both moving in a direction that is positive for a good monsoon.
C. The first long-range forecast for the rainfall during the four-month period of July- September indicates rain around the end of this month.
D. It is still very early days for a monsoon forecast for this season but at least the available signs as of now are all pointing in the right direction.
E. Even the persistent & sustained heat is the past few days over most of central and Northern India is likely to help in good rainfall.

(a) ADBCE (b) DABCE
(c) BCDEA (d) DCBEA

28. A. It is against this background and in this context that we must begin our understanding of political theory.
B. Students of anthropology and of animal behavior are making it increasingly clear that in man, most of the other primates, and in many other animal species as well, social life and organization are primary biological survival devices.
C. What we call political and social organization— the customs, practices, and procedures that with varying degrees of firmness hold men together in interrelated groups— is perhaps the most important form of human adaptation to environment, both external and internal.
D. Man has no leathery armor like a turtle or spines like a porcupine, but he does have social life and the capacity to organize it effectively for survival purposes.

(a) BCAD (b) CBDA
(c) BCDA (d) DCBA

Answers & Explanations

1. **(c)** Many economists argue that free trade is a magic bullet – the quickest way to full growth and alleviate poverty.
2. **(b)** As a thunderous applause from an appreciative audience preceded and followed every composition the maestro appeared to be enjoying every bit of it.
3. **(d)** Keeping in view the prevailing weather conditions agricultural experts have advised farmers to smoke their fields during the night to protect vegetables from cold.
4. **(a)** It is necessary to rise above the situations stressful or joyful with the belief in the evanescence of life itself and in the philosophical purpose of life.
5. **(b)** The difference in the relationship between death and birth rates on the one hand and development on the other affects not just the rate of population growth but the age structure of the population .
6. **(c)** Here we go again with yet another supposed discovery of 29-inch footprints which a group of amateur anthropologists claim to have found in Kerala.
7. **(b)** Creative writers and artists, through their imagination transform the details of the world of reality into the world of art.
8. **(d)** Thus the court emphasized that the security of one's privacy against arbitrary intrusion by the police is basic to a free society and enforceable against the state through the courts.
9. **(a)** The preference for the male child continues despite the fact that in a growing number of families at least in urban India, daughters are taking on the responsibilities of looking after parents in their old age.
10. **(d)** The producer must inform the consumer of his product and if he wants the consumer not only know about the producer but to buy it, the producer must give enough information so that the consumer will understand how the product differs the competition.
11. **(c)** The bigoted belief – the more, the merrier – has done immense harm not only to the national interests but also to those families which in order to augment their incomes, plead for more children, ignoring the resultant reality that additional hands also mean additional mouths to feed, clothe and house.
12. **(b)** Critics also point out that development administration has been basically a sugar-coated concept that tries to cover up the essentially inequalitarian and unjust nature of a Third World State.
13. **(d)** For about two decades now scientists have been trying to figure out which aspects of cognition and behavior in the human brain are determined by nature and which not by nature.
14. **(a)** A school of psychology argues that motorcycling – like gambling or skydiving – is one of the manifestations of impulse control disorder, a condition in which an individual cannot resist the impulse or temptation to perform an act harmful for oneself or others.
15. **(d)** With six of its neighbours ranking high on global roster of failed states there is a renewed warning for India to reassess its policy towards them and safeguard its own strategic interests.
16. **(b)** Faced with the challenge of the intrusion of colonial culture and ideology at attempt to reinvigorate traditional institutions and realize the potential of traditional culture in the pre-independence India developed during the nineteenth century.
17. **(c)** Looking back, despite the vicissitudes and hardships of the two wars I had been through and the innumerable postings and below par accommodation at many stations life in the army had all along been truly joyous.
18. **(c)** A diversified use of natural gas is emerging adding a new dimension to the traditional use of gas as a heating or power generation fuel by converting gas into amongst other products, high quality diesel transportation fuel virtually free of sulphur.
19. **(b)** As things stand, Indian professionals are much sought after globally because of the linguistic edge they are equipped with but a majority still does not have access to English.
20. **(a)** While advocates of social reform have generally hailed the new legislation there is some misguided concern about a possible clash of some of its provisions with the religious and customary practices in vogue in the country.
21. **(c)** All the options start either with P or Q. So, we will try to find out which of these sentences will be the starting sentence. P can't be the first sentence of the paragraph as the presence of 'we' in it indicates that something about the writer and someone else has already been discussed in the paragraph. So, option (a) and (b) get eliminated. Q which starts with the narrative of the author will be the first sentence. S will follow Q as it correctly continues with the narrative;

further, followed by R and P respectively thereby, making option (c) the answer.

22. (c) All the options start either with S or Q; so, we will try to find out which if these two sentences will be the starting sentence. S can't be the first sentence of the paragraph because it is a linking sentence i.e., it talks about something that has already been said in the paragraph. So, option (a) and (b) get eliminated. Q will be the first sentence as it starts the paragraph by introducing a common German practice. S will come next and it makes a direct link with Q (use of the word 'roundup' in both the sentences). P will follow S as R will be the last sentence which gives an example of what has been said in P. Therefore, the correct answer is option (c).

23. (c) R can easily be picked as the first sentence of the paragraph because it starts with a subject i.e., 'Mohanlal'. Rest of the options start either with a pronoun or conjunction. So, we will consider only options (c) and (d) for the answer. Q will come next as the presence of 'city' in it indicates a link with 'Kolkata' as mentioned in R. S will come next to maintain the continuation correctly and further, P will end the paragraph. So, the correct answer is option (c).

24. (b) It is very clear that Q is starting the paragraph; so, option (b) i.e., QPRS is the correct answer; no other option apart from option (b) begins with 'Q'.

25. (b) Only Q appears to be an independent and introductory sentence of the paragraph; thus, it will be the first sentence of the paragraph. Only option (b) starts with Q; so, it will be the answer.

26. (a) B is the opening sentence as it introduces the topic. The word this' in B is a demonstrative adjective and describes the juxtaposition. D and A continue this idea and explain by giving examples of rock and classical music. DA forms a mandatory pair as A talks about the condensed and elaborate meanings of classical music. E should come immediately after DA as it talks about both sets of values C summaries the whole concept and should come in the end. EC forms a mandatory pair as both the sentences talk about commercials depicting an idea through music.

27. (b) The paragraph follows the pattern of assertions, which are then followed by data to support them. D is clearly the opening statement. A should follow as it again adds to the idea. Although 'it is still early to forecast' in D followed by 'The good news is that a major deficiency is unlikely' in A. Statements B, C and E follow in that order as they demonstrate why these assertions were made.

28. (b) (B-D) is a mandatory pair as it discusses the idea of social life as a survival device. This pair is only present in option (b).

Chapter 8

Idioms and Proverbs

An **idiom** is an expression with a figurative meaning that is generally well-established and known. This meaning is different from the literal meaning of the idiom's individual elements. In other words, idioms don't mean exactly what their component words say. They have a peculiar hidden meaning.

A **phrase** is a small group of words that function like a unit. These units form a part of a bigger sentence or a clause. Phrases, unlike idioms, are actually direct and to the point. They do not have figurative meanings; the expression conveys what the words literally mean or indicate.

Some examples of phrases are:

- **The bewildered tourist** was lost.
- He was **waiting for** the rain to stop.
- **Singing for his supper** was how he earned his keep.

EXERCISE

DIRECTIONS (Qs. 1-20): *Choose the correct meaning of an idom/ phrase.*

1. To turn over a new leaf :
(a) To change completely one's course of action
(b) To shift attention to new problems
(c) To cover up one's faults by wearing new marks
(d) To change the old habits and adopt new ones

2. To wrangle over an ass's shadow :
(a) To act in a foolish way
(b) To quarrel over trifles
(c) To waste time on petty things
(d) To do something funny

3. All agog :
(a) Everybody (b) All ready
(c) Full of vigour (d) Almighty

4. To take with a grain of salt :
(a) To take with some reservation
(b) To take with total disbelief
(c) To take whole heartedly
(d) To take seriously

5. Hobson's choice :
(a) Feeling of insecurity
(b) Accept or leave the other
(c) Feeling of strength
(d) Excellent choice

6. To talk through one's hat :
(a) To speak fluently (b) To talk nonsense
(c) To talk wisdom (d) To speak at random

7. To snap one's fingers :
(a) To speak abruptly
(b) To accept immediately
(c) To grasp eagerly
(d) To become contemptuous of

8. To take the bull by the horns :
(a) To punish a person severely for his arrogance
(b) To grapple courageously with difficulty that lies in our way
(c) To handle it by fierce attack
(d) To bypass the legal process and take action according to one's own whims

9. To be in abeyance :
(a) To be in trouble (b) Dual minded
(c) In a fighting mood (d) In a state of suspension

10. To cast pearls before a swine :
(a) To spend recklessly
(b) To spend a lot of money on the unkeep of domestic hogs
(c) To waste monkey over trifles
(d) To offer to a person a thing which he cannot appreciate

11. To take people by storm :
(a) To put people in utter surprise
(b) To captivate people unexpectedly
(c) To exploit people's agitation
(d) To surprise people

12. Harp on :
(a) To comment (b) To criticise
(c) To keeep on talking (d) To keep on insulting

13. To bring one's eggs to a bad market :
(a) To face on humiliating situation
(b) To bring one's commodities to a market where there is no demand for them
(c) To show one's talents before audience which is incapable of appreciating them
(d) To fail in one's plans because one goes to the wrong people for help

14. To give/get the bird :
(a) To get the awaited (b) To have good luck
(c) To send away (d) To get the impossible

15. To save one's face :
(a) To hide oneself
(b) To oppose
(c) To avade disgrace
(d) To say plainly

16. To split hours :
(a) To sidetrack the issue
(b) To quarrel over trifles
(c) To indulge in over-refined arguments
(d) To find faults with other

17. Will o' the wisp :
(a) Anything that is unachievable
(b) To act in a childish way
(c) To act in a foolish way
(d) To have desires unbacked by efforts

18. To read between the lines :
(a) To concentrate
(b) To read carefully
(c) To suspect
(d) To grasp the hidden meaning

19. To flog a dead horse :
(a) To act in a foolish way
(b) To waste one's efforts
(c) To revive interest in an old subject
(d) To revive old memories

20. A tall order :
(a) A task difficult to perform
(b) A bid problem
(c) A royal summon
(d) A big demand

DIRECTIONS (Qs. 21-40) : *In the following questions, four alternatives are given for the idiom / phrase underlined in the sentence. Choose the alternative which best expresses the meaning of the idiom / phrase.*

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21. Once the case reached the court, the police washed their hands off it.
(a) waited for a response to
(b) claimed credit for
(c) disassociated themselves from
(d) seemed eager to continue

22. She wanted to go hitch-hiking but her mother put her foot down and now she's going by bus.
(a) took a firm stand
(b) expressed her displeasure
(c) scolded her badly
(d) got irritated

23. Adolescence is a period of halcyon days.
(a) hard days (b) of mental pressure
(c) happy days (d) days of preparation

24. My sincere advice to my maidservant fell on stony ground.
(a) was counter productive
(b) had a strong impact
(c) made on stubborn
(d) had little success

25. He has all his ducks in a row; he is complacent.
(a) has everything ready
(b) is well organised
(c) always scores a zero
(d) never gets confused

26. With great difficulty, he was able to carve out a niche for himself.
(a) became a sculptor
(b) did the best he could do
(c) destroyed his career
(d) developed a specific position for himself

27. You will succeed if you follow my advice to the letter.
(a) about writing letters
(b) written in the letter
(c) in every detail
(d) very thoughtfully

28. A critic's work is to read between the lines.
(a) to comprehend the meaning
(b) to appreciate the inner beauty
(c) to understand the inner meaning
(d) to read carefully

29. Her grandmother had a hell of a time trying to connect to the internet.
(a) a very enjoyable time
(b) a difficult experience
(c) a fearful experience
(d) finish something before the deadline

30. The convict claimed innocence and stood his ground in spite of the repeated accusations.
(a) knelt (b) surrendered
(c) kept standing (d) refused to yield

31. Ram is very calculative and always has an axe to grind.
(a) has no result
(b) works for both sides
(c) has a private agenda
(d) fails to arouse interest

32. The police looked all over for him but drew a blank.
(a) did not find him
(b) put him in prison
(c) arrested him
(d) took him to court

33. Those new shoes are all the rage these days.
(a) popular (b) very expensive
(c) clumsy (d) fashionable

34. His investments helped him make a killing in the stock market.
(a) lose money quickly
(b) plan a murder quickly
(c) murder someone quickly
(d) make money quickly

35. There is no gain saying the fact that the country is in difficulties.
(a) ignoring
(b) hiding
(c) forgetting
(d) denying

36. His speech has taken the wind out of my sails.
(a) made my words or actions ineffective
(b) made me depressed
(c) made me think for the future
(d) made me remember my past

37. There is no point in discussing the new project with him as he always pours cold water on any ideas.
(a) puts off (b) dislikes
(c) disapproves of (d) postpones

38. Regardless of what her parents said, she wanted to let her hair down that night.
(a) really enjoy (b) wash her hair
(c) comb her hair (d) work till late

39. I jumped out of my skin when the explosion happened.
(a) was in panic (b) was excited
(c) was nervous (d) was angry

40. She didn't realize that the clever salesman was taking her for a ride.
(a) trying to trick her (b) taking her in a car
(c) pulling her a long (d) forcing her to go with him

Answers & Explanations

1.	**(d)**	**2.**	**(b)**	**3.**	**(c).**	**4.**	**(a)**	**5.**	**(b).**
6.	**(b)**	**7.**	**(d)**	**8.**	**(b)**	**9.**	**(d)**	**10.**	**(d)**
11.	**(b)**	**12.**	**(c)**	**13.**	**(d)**	**14.**	**(c)**	**15.**	**(c)**
16.	**(c)**	**17.**	**(a)**	**18.**	**(d)**	**19.**	**(b)**	**20.**	**(a)**
21.	**(c)**	**22.**	**(a)**	**23.**	**(c)**	**24.**	**(d)**	**25.**	**(b)**
26.	**(d)**	**27.**	**(c)**	**28.**	**(c)**				

29. (b) A hell of a time means a difficult experience; hence, option (b) is the correct answer.

30. (d)

31. (c) Idiom have an axe to grind means : to have private reasons for being involved in something or for arguing for a particular cause.

32. (a) Idiom draw a blank means : to get no response or result.

33. (a) The idiom all the rage means popular. Hence, option (a) is the correct answer.

34. (d) Idiom make a killing means : to make a lot of money quickly.

35. (d) Idiom Gainsay (verb) means : to disagree; to deny.

36. (a) Idiom take the wind out of somebody's sails means : to make somebody suddenly less confident or angry when you say or do something that they do not expect.

37. (c) Idiom pour/throw cold water on something means : to give reasons for not being in favour of something; to criticize something

38. (a) Idiom let your hair down means : to relax and enjoy yourself especially in a lively way.

39. (a) Idiom jump out of your skin means : to move violently because of a sudden shock.

40. (a) Idiom take somebody for a ride means : to cheat or trick somebody.

Chapter 9

Synonyms & Antonyms

SYNONYMS (SIMILAR WORDS)

A synonym is a word, or in some cases, a phrase that has the same meaning as another words in the same language. For example, ‘unsafe’ and ‘risky’ are synonyms of ‘dangerous’. When two words are synonyms of one another, we call them synonymous words. For example, ‘enormous’, ‘gigantic’, ‘grand’, and ‘big’ are all synonymous words. Words are usually synonymous in one particular sense, for example, ‘heavy’ and ‘bulky’ in the context of ‘heavy load’ or ‘bulky load’ are synonymous; but ‘bulky’ cannot be used in the phrase ‘a heavy discussion’ which means not all synonymous words are used interchangeably.

ANTONYMS (OPPOSITE WORDS)

Antonyms are words or phrases that are opposite in meaning to a particular word or phrase. For example, agree-disagree, ancient-modern, for-against, benevolent-unkind are pairs of antonyms.

IMPORTANT TIPS & TECHNIQUES

- It is important to have a strong hold on vocabulary in order to solve the questions with high accuracy. Read newspapers, magazines, blogs, etc., to improve your vocabulary. When you read more, you develop an idea of using various words in different contexts.
- Every time you come across a new word, look for its meaning in dictionary so that the word is well-understood and well-memorised. Use that word in a sentence of your own as this will help you store the word well in your mind.
- Once you find a new word, find its synonyms and antonyms in the dictionary and look for different examples mentioned over there so that you may understand various contexts they are used in.
- Sometimes you may guess the meaning of the word by breaking down the word into its roots. For example, the word ‘malnutrition’ can be split into the root word ‘mal’ which means ‘bad’ or ‘lack of’ and ‘nutrition’ which means ‘food or nourishment’. Thus, the word ‘malnutrition’ refers to ‘lack or inadequate intake of certain nutrients’.
- During the examination, you must carefully examine each option before choosing the correct one. You can eliminate the least relevant answers (elimination method) by using each word in the sentence.
- In case, you are unable to choose between two given options, look for the option which does not change the context or meaning of the sentence as a whole.

The types of questions illustrated below are asked in the competitive exams.

EXERCISE

SYNONYMS

DIRECTIONS (Qs. 1 - 50): *In the following questions, out of the four alternatives, choose the one which best expresses the meaning of the given word.*

1. Luxuriant
(a) Luxury loving (b) Lovely
(c) Rich (d) Abundant

2. Cantankerous
(a) Cancerous (b) Ferocious
(c) Quarrelsome (d) Fissiparous

3. Onus
(a) Sadness (b) Happiness
(c) Responsibility (d) Criticism

4. Derision
(a) Humiliation
(b) Embarrassment
(c) Ridicule
(d) Condemnation

5. Trite
(a) Commonplace (b) Clever
(c) Brief (d) Impudent

6. Debacle
(a) Decline (b) Downfall
(c) Discomfiture (d) Degeneration

7. Ostracise
(a) Banish (b) Belittle
(c) Beguile (d) Besiege

8. Prophylactic
(a) Antagonistic (b) Toxic
(c) Preventive (d) Purgative

9. Coddle
(a) Huddle (b) Satisfy
(c) Protect (d) Cheat

10. Flimsy
(a) Funny (b) Irrational
(c) Weak (d) Partisan

11. Loquacious
(a) Talkative (b) Slow
(c) Content (d) Unclear

12. Vindictive
(a) Imaginative (b) Accusative
(c) Spiteful (d) Aggressive

13. Inclement
(a) Selfish (b) Active
(c) Unfavourable (d) Inactive

14. Genial
(a) Cordial (b) Unselfish
(c) Careful (d) Specific

15. Accrue
(a) Accumulate (b) Accommodate
(c) Grow (d) Suffice

16. Barren
(a) Good (b) Wholesome
(c) Unproductive (d) Profitable

17. Infamy
(a) Notoriety (b) Glory
(c) Integrity (d) Familiarity

18. Intrepid
(a) Hesitant (b) Fearless
(c) Extrovert (d) Rash

19. Prodigal
(a) Exclusive (b) Productive
(c) Lavish (d) Carefree

20. Perspicuous
(a) Relevant (b) Precise
(c) Brief (d) Clear

21. Annexure
(a) Retirement (b) Commencement
(c) Attachment (d) Development

22. Errand
(a) Energy (b) Task
(c) Mistake (d) Blunder

23. Bequeath
(a) Give (b) Disclose
(c) Scold (d) Surround

24. Nonchalant
(a) Imaginary (b) Casual
(c) Neutral (d) Formal

25. Forbearance
(a) Deliverance (b) Patience
(c) Extravagance (d) Relevance

26. Gaol
(a) Destination (b) Garden
(c) Jail (d) Bird

27. Loathing
(a) Warmth (b) Affectation
(c) Hatred (d) Affection

28. Pragmatic
(a) Intelligent (b) Wise
(c) Religious (d) Practical

29. Notion
(a) Thought (b) Fact
(c) Truth (d) Hypothesis

30. Vivacious
(a) Poisonous (b) Energetic
(c) Tricky (d) Slow

31. Vociferous
(a) Violent (b) Loud
(c) Secret (d) True

32. Fictional
(a) Genuine (b) Authentic
(c) Fanciful (d) Real

33. Hostility
(a) Enmity (b) Sympathy
(c) Goodwill (d) Friendship

34. Impudent
(a) Vigilant (b) Astute
(c) Insolent (d) Arrogant

35. Pompous
(a) Pretentious (b) Supportive
(c) Demanding (d) Flashy

36. Abnormal
(a) Unnatural (b) Aggressive
(c) Unique (d) Informal

37. Venal
(a) Corrupt (b) Comprehensible
(c) Legible (d) Forgivable

38. Conjurer
(a) Magician (b) Jester
(c) Performer (d) Trickster

39. Invoice
(a) Word (b) Sound
(c) Statement (d) Language

40. Ameliorate
(a) Improve (b) Degrade
(c) Motivate (d) Agree

41. Garrulous
(a) Talkative (b) Sedative
(c) Cocative (d) Positive

42. Tinsel
(a) Tinkle (b) Decoration
(c) Tin (d) Colourful

43. Labyrinth
(a) Meandering (b) Rotating
(c) Pacing (d) Wriggling

44. Barbaric
(a) Thorny (b) Uncivilized
(c) Premeditated (d) Barber's

45. Hurdle
(a) Suspicion (b) Throw
(c) Opposition (d) Obstacle

46. Deter
(a) To hinder (b) To neglect
(c) To disapprove (d) To differ

47. Devout
(a) Solemn (b) Loyal
(c) Dedicated (d) Pious

48. Predilection
(a) Favour (b) Whim
(c) Prejudice (d) Preference

49. Effigy
(a) Dummy (b) Imagery
(c) Reflection (d) Organ

50. Annihilate
(a) Initiate (b) Destroy
(c) Solve (d) Deduce

ANTONYMS

DIRECTIONS (Qs. 51 - 100) : *In the following questions, choose the word opposite in meaning to the given word.*

51. Florid
(a) Weak (b) Pale
(c) Monotonous (d) Ugly

52. Verity
(a) Sanctity (b) Reverence
(c) Falsehood (d) Rarity

53. Perspicuity
(a) Vagueness (b) Dullness
(c) Unfairness (d) Unwillingness

54. Fervent
(a) Inexcitable (b) Enduring
(c) Dispassionate (d) Subdued

55. Meandering
(a) Sliding (b) Slopping
(c) Strained (d) Straight

56. Jettison
(a) Accept (b) Reward
(c) Preserve (d) Consent

57. Ameliorate
(a) Improve (b) Depend
(c) Soften (d) Worsen

58. Grotesque
(a) Natural (b) Odd
(c) Whimsical (d) Sinful

59. Devious
(a) Straight (b) Obvious
(c) Simple (d) Superficial

60. Evanescent
(a) Imminent (b) Permanent
(c) Pervasive (d) Immanent

61. Liberty
(a) Serenity (b) Slavery
(c) Serfdom (d) Subordination

62. Disorderly
(a) Chaotic (b) Organized
(c) Adjusted (d) Arranged

63. Elevation
(a) Reduction (b) Humiliation
(c) Depression (d) Debasement

64. Glossy
(a) Dull (b) Shining
(c) Weary (d) Tired

65. Appropriate
(a) Dissimilar (b) Incomparable
(c) Unsuitable (d) Disparate

66. Impeccable
(a) Faulty (b) Tedious
(c) Flashy (d) Boring

67. Amalgamate
(a) Separate (b) Combine
(c) Assimilate (d) Integrate

68. Zenith
(a) Climax (b) Crisis
(c) Acme (d) Nadir

69. Public
(a) Common (b) Ready
(c) Private (d) Restricted

70. Orderly
(a) Semitic (b) Colic
(c) Democratic (d) Chaotic

71. Amenable
(a) Acquiescent (b) Distrustful
(c) Inattentive (d) Unwilling

72. Conspicuous
(a) Blatant (b) Definite
(c) Obvious (d) Obscure

73. Reproof
(a) Approbation (b) Apposition
(c) Condemnation (d) Appropriation

74. Niggard
(a) Avaricious (b) Extravagant
(c) Generous (d) Miserly

75. Exotic
(a) Conventional (d) Poor
(c) Inexpensive (d) Indigenous

76. Cultivated
(a) Crude (b) Genteel
(c) Suave (d) Refined

77. Impertinent
(a) Insolent (b) Impudent
(c) Cheeky (d) Courteous

78. Divulge
(a) Disseminate (b) Dissemble
(c) Publicize (d) Transmit

79. Appreciation
(a) Aspersions (b) Admiration
(c) Commendation (d) Compliment

80. Supple
(a) Pliant (b) Pliable
(c) Rigid (d) Flexible

81. Fabricate
(a) Unearth (b) Construct
(c) Demolish (d) Renovate

82. Gregarious
(a) Sociable (b) Societal
(c) Unsociable (d) Solitary

83. Pragmatic
(a) Indefinite (b) Vague
(c) Optimistic (d) Idealistic

84. Debacle
(a) Success (b) Response
(c) Acceptance (d) Agreement

85. Abusive
(a) Laudatory (b) Profuse
(c) Effusive (d) Noble

86. Amorphous
(a) Amoral (b) Definite
(c) Perfect (d) Irregular

87. Unitary
(a) Single (b) Triple
(c) Multiple (d) Double

88. Adulteration
(a) Purification (b) Normalization
(c) Rejuvenation (d) Consternation

89. Safe
(a) Rash (b) Insecure
(c) Beneficial (d) Harsh

90. Redundant
(a) Repentant (b) Surplus
(c) Singular (d) Required

91. Fair
(a) Untrue (b) Unjust
(c) Coarse (d) Harsh

92. Boisterous
(a) Serenity (b) Calm
(c) Cheerful (d) Courageous

93. Substantial
(a) Flimsy (b) Hefty
(c) Actual (d) Excess

94. Equilibrium
(a) Work out (b) Disturb
(c) Imbalance (d) Unevenness

95. Immortal
(a) Eternal (b) Permanent
(c) Deathly (d) Temporary

96. Focus
(a) Disappear (b) Disperse
(c) Link (d) Layer

97. Veteran
(a) Activist (b) Enthusiast
(c) Novice (d) Master

98. Superfluous
(a) Essential (b) Excess
(c) Unwanted (d) Necessary

99. Vacillation
(a) Inoculation (b) Relief
(c) Steadfastness (d) Remorse

100. Placid
(a) Dull (b) Stormy
(c) Urgent (d) Moving

Answers & Explanations

1. (d) The word Luxuriant (Adjective) means: growing thickly and strongly; rich in something that is pleasant or beautiful; abundant.

2. (c) The word Cantankerous (Adjective) means: bad tempered and always complaining.
Hence, the words cantankerous and quarrelsome are synonymous.

3. (c) The word Onus (Noun) means: the responsibility for something.

4. (c) The word Derision (Noun) means: ridicule; mockery; a strong feeling that somebody/something is ridiculous and not worth considering seriously.

5. (a) The word Trite (Adjective) means: dull and boring because it has been expressed so many times before; not original; banal; very ordinary and containing nothing that is interesting or important.
Hence, the words trite and commonplace are synonymous.

6. (b) The word Debacle (Noun) means: an event or a situation that is a suden or complete failure.
Hence, the words debacle and downfall are synonymous.

7. (a) The word Ostracise (Verb) means: to refuse to let somebody; a member of a social group: refuse, shun.
Hence, the words banish and ostracise are synonymous.

8. (c) The word Prohylactic means: course of action used to prevent a disease.
Hence, the words prophylactic and preventive are synonymous.

9. (b) The word Coddle (Verb) means: to treat somebody with too much care and attention, pamper, cosset.
Hence, the words coddle and satisfy are synonymous.

10. (c) The word Flimsy (Ajective) means: badly made and not strong enough: thin and easily torn.
Hence, the words flimsy and weak are synonymous.

11. (a) The word Loquacious (Adjective) means: talking a lot; talkative. Option (a) is the right synonym while others have different meanings.

12. (c) The word Vindictive (Adjective) means: trying to harm or upset somebody or showing that you want to, because you think that they have harmed you; spiteful; revengeful. Option (c) spiteful is the correct synonym as it means-having or showing a desire to harm, anger or defeat someone.

13. (c) The word Inclement (Adjective) means: not pleasant; unfavourable; cold, wet, etc.

14. (a) The word Genial (Adjective) means: friendly and cheerful; affable; cordial.

15. (c) The word Accrue (Verb) means: to increase over a period of time; to allow a sum of money or debts to grow over a period of time. Therefore, grow is the correct nearest word.

16. (c) The word Barren (Adjective) means: not good enough for plants to grow on it; infertile unproductive.

17. (a) The word Infamy (Noun) means: the state of being well-known for something bad or an evil act notoriety.

18. (b) The word Intrepid (Adjective) means: very brave not afraid of danger or difficulties fearless.

19. (c) The word Prodigal (Adjective) means: too willing to spend money or waste time, energy or materials extravagant lavish.

20. (b) The word Perspicuous (Adjective) means precise clear and accurate.

21. (c) The word Annexure (Noun) means: attachment; appendix

22. (b) The word Errand (Noun) means: a job that you do for somebody; task

23. (a) The word Bequeath (Verb) means: pass something on to someone else; give

24. (b) The word Nonchalant (Adjective) means: careless; indifferent; behaving in a calm and relaxed way; casual.

25. (b) The word Forbearance (Noun) means: patience; the quality of being patient and sympathetic towards other people.

26. (c) The word Gaol (Noun) means: a place for the confinement of accused person; put someone in jail.

27. (c) The word Loathing (Noun) means: a strong feeling of hatred.

28. (d) The word Pragmatic (Adjective) means: practical, busy; realistic; solving problems in a practical and sensible way rather than by having fixed ideas or theories.

29. (a) The word Notion (Noun) means: belief; desire; intention; thought.

30. (b) The word Vivacious (Adjective) means: having a lively, attractive personality; energetic.

31. (b) The meaning of word Vociferous (Adjective) is:
outspoken, blunt. Its synonym should be: Loud.

32. (c) The meaning of word Fictional (Adjective) is: Imaginary, unreal, fabricated, mythical
Its synonym should be: fanciful

33. (a) The meaning of word Hostility (Noun) is: bitterness.
Its synonym should be: Enmity.

34. (c) The meaning of word Impudent (Adjective) is:
not showing due respect for another person.
Insolent the correct synonym means–to show a rude and arrogant attitude.

35. (a) The meaning of word pompous (Adjective) is: self important.
It's synonym should be: Pretentious.

36. (a) The word Abnormal (Adjective) means: unusual, irregular; unnatural ; different from what is usual.
For example:
They thought his behaviour was abnormal.

37. (a) The word Venal (Adjective) means: corrupt; prepared to do dishonest or immoral thing in return for money.
For example:
Venal leaders should be denied vote.

38. (a) The word Conjurer (Noun) means: a person who performs magic tricks ; magician.

39. (c) The word Invoice (Noun) means: list of goods that have been sold ; bill ; statement.

40. (a) The word Ameliorate (Verb) means: to make something better; improve.

41. (a) The word Garrulous (Adjective) means: talkative; talking a lot.

42. (b) The word Tinsel (Noun/Adjective) means: strips of shiny material like metal used as decorations.

43. (a) Labyrinth (Noun) means: a place that has many confusing path's or passage. The correct synonym is meandering that means to have a lot of curves on a path.

44. (b) Barbaric means uncivilized

45. (d) Hurdle means obstacle

46. (a) Deter means to hinder

47. (d) Devout means deeply religious or pious

48. (d) Predilection means a predisposition in favour of something; a strong liking; preference.

49. (a) Effigy means a representation of a person (especially in the form of sculpture); hence, dummy.

50. (b) Annihilate means to destroy utterly.

51. (b) The word Florid (Adjective) means: rosy; gaudy; ornated; red; having too much decoration or detail.
The word Pale (Adjective) means: light in colour; not strong or bright; having skin that is almost white because of illness.
Hence, the words florid and pale are antonymous.

52. (c) The word Verity (Noun) means: a belief or principle about life that is accepted as true; truth.
Hence, the words verity and falsehood are antonymous.

53. (a) The word Perspicuity (Noun) means: clarity.
The word Vagueness (Noun) means: no clarity in a person's mind.
Hence, the words perspicuity and vagueness are antonymous.

54. (c) The word Fervent (Adjective) means: having or showing very strong and sincere feelings about something; ardent.
The word Dispassionate (Adjective) means: not influenced by emotion; impartial.
Hence, the words fervent and dispassionate are antonymous.

55. (d) The word Meandering (Adjective) means: not straight; curved ; a course that does not follow a straight path.
Hence, the words meandering and straight are antonymous.

56. (a) The word Jettison (Verb) means: to throw something; abandon; to reject an idea.
Hence, the words jettison and accept are antonymous.

57. (d) The word Ameliorate (Verb) means: to make something better.
Hence, the words ameliorate and worsen are antonyms.

58. (a) The word Grotesque (Adjective) means: strange in a way that is unpleasant: extremely ugly, unusual
Hence, the words grotesque and natural are antonyms.

59. (a) The word Devious (Adjective) means: behaving in a dishonest way: a route that is not straight.
Hence, the words devious and straight are antonymous.

60. (b) The word Evanescent (Adjective) means: disappearing quickly from sight or memory.
Hence, the words evanescent and permanent are antonymous.

61. (b) The word Liberty (Noun) means: freedom to live as you choose without too many restrictions from government or authority.
The word slavery (Noun) means: state of being a slave: a system of legally owning another person and forcing to work for them.

62. (d) The word Disorderly (Adjective) means: showing lack of control untidy deranged. Its antonym should be arranged.

63. (c) The word Elevation (Noun) means to increase in the level of something.
The word Depression (Noun) means: the state of feeling very sad and without hope; part of a surface; that is lower than the parts around it.

64. (a) The word Glossy (Adjective) means shining, smooth and shiny.
Its antonym should be dull.

65. (c) The word Appropriate (Adjective) means: suitable acceptable or correct for the particular circumstances.
Its antonym should be unsuitable.

66. (a) The word Impeccable (Adjective) means: without mistakes or fault; perfect.
Hence, its antonym should be faulty.

67. (a) The word Amalgamate (Verb) means: merge; to put two or more things together so that they form one; assimilate.
Its antonym should be separate which means: to divide into different parts or groups; to move apart.

68. (d) The word Zenith (Noun) means: the highest point; peak; the time when something is strongest and most successful.
The word Nadir (Noun) means: the worst moment of a particular situation.

69. (c) The word Public (Adjective) means: of or concerning the people as a whole. Private will be its correct antonym.

70. (d) The word Orderly (Adjective) means: arranged or organised in a neat, careful and logical way; tidy; behaving well.
The word Chaotic (Adjective) means: in a state of complete confusion and lack of order.

71. (d) The word Amenable (Adjective) means: responsible; responsive; easy to control; willing. Its antonym should be unwilling.

72. (d) The word Conspicuous (Adjective) means: eminent, easy to see or notice; obvious.
The word Obscure (Adjective) means: difficult to understand; not well known; unknown.

73. (a) The word Reproof (Noun) means: condemnation; blame, rebuke; disapproval.
The word Approbation (Noun) means: approval or agreement.

74. (c) The word Niggard (Adjective) means: mean; miserly; unwilling to be generous with money.
The word Generous (Adjective) means: giving on willing to give freely; lavish.

75. (d) The word Exotic (Adjective) means: from or in another country.
The word Indigenous (Adjective) means: native; belonging to a particular place rather than coming to it from somewhere else.

76. (a) The word cultivated (Adjective) means: educated.
It's antonym should be: Crude.

77. (d) The meaning of word Impertinent (Adjective) is: Ill mannered, disrespectful.
It's antonym should be: courteous.

78. (b) The meaning of word Divulge (Verb) is: reveal, make known.
Its antonym should be Dissemble.

79. (a) The meaning of word Appreciation (Noun) is: Thankfullness.
It's antonym should be: Aspersions

80. (c) The meaning of word Supple (Adjective) is: Flexible.
It's Antonym should be: Rigid.

81. (c) Fabricate means construct something artificial or untrue while demolish means destroy completely which is just opposite to fabricate.

82. (c) Gregarious denotes tending to associate with others of the same species and unsociable is the opposite.

83. (d) Pragmatic means concerned with practical matters while idealistic means that very good things can be achieved, often when this does not seem likely to others.

84. (c) The word Debacle (Noun) means: a situation that is a complete failure and causes embarrassment.

85. (a) The word Abusive (Adjective) means: Using rude and offensive words.
The word Laudatory (Adjective) means: expressing praise or admiration.

86. (b) The word Amorphous (Adjective) means: shapeless; irregular, having no definite shape.

87. (c) The word Unitary (Adjective) means: single; forming one unit.
Multiple means: many in number

88. (a) The word Adulteration (Noun) means: making impure by mixing; contamination.
The word Purification (Noun) means: making something pure by removing substances that are dirty. harmful.

89. (b) Safe means free from harm. Its opposite is insecure.

90. (c) Redundant means excessive. Its opposite is singular.

91. (b) Fair means impartial. Its opposite is unjust.

92. (b) Boisterous means noisy and mischievous. Its opposite is calm.

93. (a) Flimsy means insubstantial and easily damaged.

94. (c) Equilibrium means balance. Its opposite is imbalance.

95. (d) Immortal means death-defying or endless. Its opposite is temporary.

96. (b) Focus means the main or central point. Its opposite is disperse that means spread across.

97. (c) Veteran means experienced. Whereas, novice means a person just learning something.

98. (d) Superfluous means unnecessary. Its opposite is necessary.

99. (c) Vacillation means indecision in speech or action while steadfastness means fixed or unchanging.

100. (b) Placid means calm and peaceful, with little movement or activity while stormy means characterized by violent emotions or behaviour.

Chapter 10

Spelling Test

A spelling test is an assessment of a student's ability to spell words correctly. In exams, such type of questions is asked to test the aspirant's vocabulary. Therefore, it is of utmost importance for the examinee to have a good vocabulary in order to solve the questions with high accuracy and score well.

EXERCISE

DIRECTIONS (Qs. 1 - 30): *Choose the correct spelling of the given words.*

1. (a) Efflorascence (b) Efflorescence
(c) Efllorescence (d) Eflorescence

2. (a) Aliennate (b) Allienate
(c) Alienate (d) Alienatte

3. (a) Forefiet (b) Forefeit
(c) Forfeit (d) Forfiet

4. (a) Comemorate (b) Commemmorate
(c) Momemmorate (d) Commemorate

5. (a) Exampli (b) Exampel
(c) Example (d) Exampal

6. (a) Psychology (b) Sycology
(c) Psykology (d) Sychology

7. (a) Acessible (b) Accesibel
(c) Accessible (d) Acessible

8. (a) Tresspass (b) Trespass
(c) Tresspas (d) Trespas

9. (a) Argumant (b) Arguemant
(c) Argument (d) Arguement

10. (a) Aproched (b) Aproached
(c) Appraoched (d) Approached

11. (a) Comentry (b) Commentry
(c) Commentery (d) Commentary

12. (a) Coimmision (b) Comision
(c) Comission (d) Commission

13. (a) Guerila (b) Gurilla
(c) Gorila (d) Gorilla

14. (a) Pasanger (b) Pessenger
(c) Pesanger (d) Passenger

15. (a) Tariff (b) Tarriff
(c) Tarif (d) Tarrif

16. (a) Jewelery (b) Jewellry
(c) Jwellry (d) Jewellery

17. (a) Grametic (b) Grammetic
(c) Grammatic (d) Gramatic

18. (a) Blisfull (b) Blissful
(c) Blisful (d) Blissfull

19. (a) Embarasment (b) Embarassment
(c) Embarrasment (d) Embarrassment

20. (a) Sattellite (b) Satellite
(c) Sattelite (d) Satelite

21. (a) Ocasion (b) Ocassion
(c) Occasion (d) Occassion

22. (a) Posesion (b) Possession
(c) Posession (d) Possesion

23. (a) Greivance (b) Greievance
(c) Griveance (d) Grievance

24. (a) Beligrent (b) Beligerent
(c) Belligrent (d) Belligerent

25. (a) Coruppt (b) Curropt
(c) Corrupt (d) Currupt

26. (a) Dielectic (b) Deallectic
(c) Dilectic (d) Dialectic

27. (a) Achievment (b) Acheivment
(c) Achievement (d) Achevement

28. (a) Coreander (b) Coriander
(c) Coriandar (d) Coreandor

29. (a) Bouquete (b) Bouquet
(c) Boquet (d) Bouquette

30. (a) Translucent (b) Translusent
(c) Transluscent (d) Tranclucent

DIRECTIONS (Qs. 31-60): *Choose the misspelt word out of the given options.*

31. (a) Designation (b) Amature
(c) Controversy (d) Burglar

32. (a) Deceive (b) Conneive
(c) Perceive (d) Acheive

33. (a) Penance (b) Menace
(c) Tendancy (d) Governance

34. (a) Prejudicial (b) Affectionate
(c) Indispensible (d) Assiduous

35. (a) Kitten (b) Cumulative
(c) Justified (d) Inediable

36. (a) Hillock (b) Vilify
(c) Mileage (d) Hillarious

37. (a) Predilection (b) Discipline
(c) Indigenous (d) Preferrable

38. (a) Suicide (b) Suiteable
(c) Summarize (d) Superficial

39. (a) Neice (b) Neither
(c) Neigh (d) Rein

40. (a) Light (b) Fight
(c) Hight (d) Might

41. (a) Control (b) Confusion
(c) Confrence (d) Committee

42. (a) Instantanious (b) Intermediate
(c) Intermittent (d) Interference

43. (a) Breakage (b) Brevity
(c) Breathless (d) Briliance

44. (a) Nuptial (b) Nickers
(c) Nephew (d) Nuisance

45. (a) Explaination (b) Extermination
(c) Exaggeration (d) Expectation

46. (a) Covetous (b) Coherent
(c) Consice (d) Consent

47. (a) Plateau (b) Plebian
(c) Pledge (d) Pollinate

48. (a) Cruelly (b) Truly
(c) Verbally (d) Rudely

49. (a) Oversear (b) Oscillate
(c) Ossicle (d) Obscure

50. (a) Cruise (b) Deduse
(c) Truce (d) Bruise

51. (a) Democracy (b) Aristocracy
(c) Advocacy (d) Courtecy

52. (a) Hyphen (b) Hygene
(c) Hurdle (d) Haphazard

53. (a) Believe (b) Relieve
(c) Drive (d) Decieve

54. (a) Juice (b) Jersy
(c) Jaggery (d) Japanese

55. (a) Envelope (b) Enthuse
(c) Eratic (d) Emigrant

56. (a) Freshner (b) Forlorn
(c) Foreign (d) Fruity

57. (a) Democracy (b) Beaureaucracy
(c) Prophecy (d) Aristocracy

58. (a) Spurious (b) Studious
(c) Subsidary (d) Sensible

59. (a) Charade (b) Studious
(c) Cartrige (d) Sensible

60. (a) Ballistic (b) Baloon
(c) Bulletin (d) Bullock

DIRECTIONS (Qs. 61-80): *Choose the correct spelling of the word given in bold.*

61. He was **assidous**, working at this task for weeks before he felt satisfied with his results.
(a) assidous (b) assedious
(c) assiduous (d) asidous

62. The city council removed the mayor from office because of his **malfesence.**
(a) malfeasence (b) melfeasence
(c) malfeasanse (d) malfeasance

63. Lago is a **melovalent** villain who takes pleasure in ruining Othello.
(a) maleovolent (b) malevolent
(c) menovolent (d) melavolent

64. Although the **ostensiable** purpose of the expedition is to discover new lands, we are really interested in finding new markets for our products.
(a) onstensible (b) ontessible
(c) ostensibal (d) ostensible

65. Let us not be too **sangiune** about the outcome; something could go wrong.
(a) senguine (b) sanguine
(c) sangouine (d) sangeene

66. Shakespeare is quite possibly the most well-known **playright** in the world.
(a) playwrite (b) playrite
(c) playwright (d) plaewrite

67. A memo will be sent to all **personel** asking them to stick to the dress code provided in the company handbook.
(a) perssonel (b) personnel
(c) personnal (d) personal

68. My aunt was a little more **emperious** and stern than usual, but I observed no other token of her preparing herself to receive the visitor so much dreaded by me.
(a) emperous (b) imparious
(c) imperious (d) emperious

69. In order to cut costs, the boss asked the HR personnel to eliminate all the positions that are not **indispensable** to day-to-day operations.
(a) indespensable (b) indispenseble
(c) indespensible (d) indispensable

70. The rich youth cynically declared that the **penacea** for all speeding tickets was a big enough bribe.
(a) panacea (b) penecea
(c) panacia (d) panacya

71. She was quick to fill the power **vaccum** that was left by the sudden death of the managing director.
(a) vaccuum (b) vacume (c) vacume (d) vacuum

72. The chameleon's ability to **cemoflague** itself allows it to adapt to new environments and hide from predators.
(a) camoflage (b) camoflague
(c) camouflage (d) camoflag

73. The president will **acknowlege** the soldiers' suspicious deaths during his address to the nation.
(a) aknowledge (b) acknowledge
(c) aknowlege (d) acknowlaige

74. He wrote both on **psychology** and on metaphysics, but is known especially as a historian of philosophy.
(a) phsycology (b) sichology
(c) pshychology (d) psychology

75. Education should not be considered to be a **previllage** in a modern society.
(a) privelege
(b) priviledge
(c) privilege
(d) preeveledge

76. Humbled by life's **viccisitude**, the last emperor of China worked as a lowly gardener in the palace over which he had once ruled.
(a) wecissitude (b) veascissitude
(c) viccissitude (d) vicissitude

77. The canoe was tossed about in the **malestrom**; it had to leave the dangerous water quickly.
(a) maelstrome (b) maelstrom
(c) mailstrom (d) mailstrome

78. The woodsman had not realized how **ingenious** Little Red Riding Hood was until he heard that she had gone off for a walk in the woods with the Big Bad Wolf.
(a) ingenius (b) ingeneous
(c) ingenuous (d) ingeneaous

79. The vigorous pursuit of policies is no **garanty** of success.
(a) Garantee (b) Garentee
(c) Garenty (d) Guarantee

80. The medieval, Renaissance and modern collections cover more than a **milaenium**, from the Dark Ages to the interwar period.
(a) millenium (b) milennium
(c) millennium (d) millennium

Answers & Explanations

1. **(b)** Efflorescence
2. **(c)** Alienate
3. **(c)** Forfeit
4. **(d)** Commemorate
5. **(c)** Example
6. **(a)** Psychology
7. **(c)** Accessible
8. **(b)** Trespass
9. **(c)** Argument
10. **(d)** Approached
11. **(d)** Commentary
12. **(d)** Commission
13. **(d)** Gorilla
14. **(d)** Passenger
15. **(a)** Tariff
16. **(d)** Jewellery
17. **(c)** Grammatic
18. **(b)** Blissful
19. **(d)** Embarrassment
20. **(b)** Satellite
21. **(c)** Occasion
22. **(b)** Possession
23. **(d)** Grievance
24. **(d)** Belligerent
25. **(c)** Corrupt
26. **(d)** Dialectic
27. **(c)** Achievement
28. **(b)** Coriander
29. **(b)** Bouquet
30. **(a)** Translucent
31. **(b)** Amature; correct spelling: Amateur
32. **(d)** Acheive; correct spelling: Achieve
33. **(c)** Tendancy; correct spelling: Tendency
34. **(c)** Indispensible; correct spelling: Indispensable
35. **(d)** Inediable; correct spelling: Inedible
36. **(d)** Hillarious; correct spelling: Hilarious
37. **(d)** Preferrable; correct spelling: Preferable
38. **(b)** Suiteable; correct spelling: Suitable
39. **(a)** Neice; correct spelling: Niece
40. **(c)** Hight; correct spelling: Height
41. **(c)** Confrence; correct spelling: Conference
42. **(a)** Instantanious; correct spelling: Instantaneous
43. **(d)** Briliance; correct spelling: Brilliance
44. **(b)** Nickers; correct spelling: Knickers
45. **(a)** Explaination; correct spelling: Explanation
46. **(c)** Consice; correct spelling: Concise
47. **(b)** Plebian; correct spelling: Plebeian
48. **(b)** Truly; correct spelling: Truely
49. **(a)** Oversear; correct spelling: Overseer
50. **(b)** Deduse; correct spelling: Deduce
51. **(d)** Courtecy; correct spelling: Courtesy
52. **(b)** Hygene; correct spelling: Hygiene
53. **(d)** Decieve; correct spelling: Deceive
54. **(b)** Jersy; correct spelling: Jeresy
55. **(c)** Eratic; correct spelling: Erratic
56. **(a)** Freshner; correct spelling: Freshener
57. **(b)** Beaureaucracy; correct spelling: Bureaucracy
58. **(c)** Subsidary; correct spelling: Subsidiary
59. **(c)** Cartrige; correct spelling: Cartridge
60. **(b)** Baloon; correct spelling: Balloon
61. **(c)** assiduous
62. **(d)** malfeasance
63. **(b)** malevolent
64. **(d)** ostensible
65. **(b)** sanguine
66. **(c)** playwright
67. **(c)** personnal
68. **(c)** imperious
69. **(d)** indispensable
70. **(a)** panacea
71. **(d)** vacuum
72. **(c)** camouflage
73. **(b)** acknowledge
74. **(d)** psychology
75. **(c)** privilege
76. **(d)** vicissitude
77. **(b)** maelstrom
78. **(c)** ingenuous
79. **(d)** guarantee
80. **(c)** millennium

Chapter 11

One Word Substitution

One Word Substitution is a process in which an aspirant is required to replace a certain group of words, or an entire sentence, with a single word that suits its meaning the best.

IMPORTANT TIPS & TECHNIQUES

- It is important to have a strong hold on vocabulary in order to solve such questions with high accuracy.
- Read newspapers, magazines, blogs, etc., to improve your language. When you read more, you develop an idea of using various words in different contexts. You also get to read a lot of idioms and phrases that prove to be very helpful while picking up the correct choices.
- While practising, sort words/phrases of a particular category together. This will not only help you memorize words/phrases by heart but also ease your preparation. For example,
  - *Words for various fields of study*
    1. Study of collection of coins, tokens, paper money, etc. – Numismatics
    2. Study of human development – Anthropology
    3. Study of birds – Ornithology
  - *Words used for experts and people with various qualities, habits and abilities.*
    1. The dentist who specializes in root canal and nerve treatment – Endodontist
    2. One who takes part in dialogue or conversation – Interlocutor
    3. A shrewish loud-mouthed female – Virago
  - *Words used for various systems of governance.*
    1. Government by departments of state – Bureaucracy
    2. Government by a few powerful people – Oligarchy
    3. Government by divine guidance – Theocracy
- Another easy method of doing one word substitution is by using the root method. Roots are nothing but the words from which the main word has been derived. For example,
  - the root word 'Omni' means 'all', so one can sort the words/phrases together which start with the root word 'Omni'.
    1. One who is all powerful – Omnipotent
    2. One who is present everywhere – Omnipresent
    3. One who knows everything – Omniscient
  - The root word 'cide' means 'killing'
    1. Killing/ Murder of a king – Regicide
    2. Killing of either or both parents – Parricide
    3. Killing of a human being - Homicide

EXERCISE

DIRECTIONS (Qs. 1-60): *In the questions given below, out of the four alternatives, choose the one which can be substituted for the given words/sentence.*

1. An underhand device resorted to in order to justify misconduct
(a) Subterfuge (b) Manoeuvre
(c) Stratagem (d) Complicity

2. Impossible to describe
(a) Miraculous (b) Ineffable
(c) Stupendous (d) Appalling

3. One who criticises popular beliefs which he thinks is mistaken or unwise
(a) Philistine (b) Iconoclast
(c) Imposter (d) Cannibal

4. Detaining and confining someone
(a) Interruption (b) Interrogation
(c) Internment (d) Liberation

5. Science of the races of mankind
(a) Genealogy (b) Epistemology
(c) Ethnology (d) Sociology

6. One who hides away on a ship to obtain a free passage
(a) Compositor (b) Stoker
(c) Stowaway (d) Shipwright

7. Clues available at a scene
(a) Circumstantial (b) Derivative
(c) Inferential (d) Suggestive

8. An unexpected piece of good fortune
(a) Windfall (b) Philanthropy
(c) Benevolence (d) Turnstile

9. An emolument over and above fixed income or salary
(a) Honorarium (b) Sinecure
(c) Perquisite (d) Prerogative

10. The animals of a particular region
(a) Flora (b) Museum
(c) Zoo (d) Fauna

11. A post with little work but high salary
(a) Director (b) Trustee
(c) Sinecure (d) Ombudsman

12. Something that causes death
(a) Dangerous (b) Fatal
(c) Brutal (d) Horrible

13. A person who writes decoratively
(a) Calligrapher (b) Collier
(c) Choreographer (d) Cartographer

14. Pertaining to cattle
(a) Canine (b) Feline
(c) Bovine (d) Verminous

15. To look at someone in an angry or threatening way
(a) Glower (b) Gnaw
(c) Gnash (d) Grind

16. An inscription on a tomb
(a) Espionage (b) Epilogue
(c) Epitaph (d) Elegy

17. Feeling inside you which tells you what is right and what is wrong :
(a) Cleaverness (b) Conscience
(c) Consciousness (d) Fear

18. Release of a prisoner from jail on certain terms and condition
(a) Parole (b) Parley
(c) Pardon (d) Acquittal

19. Loss of memory
(a) Ambrosia (b) Amnesia
(c) Insomnia (d) Forgetting

20. To struggle helplessly
(a) Flounder (b) Founder
(c) Fumble (d) Finger

21. One who loves books
(a) Bibliophile (b) Bibliophagist
(c) Bibliophoebe (d) Bibliographer

22. Speaking without preparation
(a) Deliberate (b) Fluent
(c) Loquacious (d) Extempore

23. Special trial of the Head of State by Parliament
(a) Impingement (b) Infringement
(c) Impeachment (d) Impediment

24. Someone able to use both hands with equal skill
(a) Ambivalent (b) Amphibious
(c) Ambiguous (d) Ambidextrous

25. Cure for all diseases
(a) Curable (b) Panacea
(c) Incurable (d) Curative

26. A raised place on which offerings to a God are made
(a) Rostrum (b) Church
(c) Altar (d) Mound

27. Something that cannot be explained
(a) Unthinkable (b) Impregnable
(c) Mysterious (d) Inexplicable

28. A written declaration made on oath in the presence of a magistrate
(a) Affidavit (b) Dossier
(c) Voucher (d) Document

29. A person who thinks only about himself’ and not about others’ needs:
(a) Egomaniacal (b) Egoistic
(c) Egotistic (d) Egocentric

30. A guide-post pointing out the way for a place
(a) Finger-post (b) Lamp-post
(c) Checkpost (d) Lastpost

31. A group of three books, films etc. that have the same subject or characters
(a) Trinity (b) Trilogy
(c) Trio (d) Tripod

32. A study of the human race
(a) Anthropology (b) Archaeology
(c) Ethnology (d) Etymology

33. An expert in an area of the fine or other arts
(a) Neophyte (b) Amateur
(c) Connoisseur (d) Enthusiast

34. The art of preserving skin of animals, birds, fishes
(a) Topology (b) Taxonomy
(c) Seismology (d) Taxidermy

35. Chanting of magic spells
(a) Narration (b) Recitation
(c) Incantation (d) Utterance

36. A round or cylindrical container used for storing things such as food, chemicals or rolls of film
(a) Tankard (b) Canister
(c) Vessel (d) Casket

37. A place of permanent residence
(a) Abode (b) Dormitory
(c) Domicile (d) Apartment

38. That cannot be altered or withdrawn
(a) Irrevocable (b) Irretrievable
(c) Irrefutable (d) Irresistible

39. Money paid to employees on retirement
(a) Gratuity (b) Gift
(c) Pension (d) Arrears

40. A place where clothes are kept
(a) Locker (b) Drawer
(c) Wardrobe (d) Cupboard

41. Detailed plan of a journey
(a) Travelogue (b) Tavel kit
(c) Schedule (d) Itinerary

42. One who cannot be corrected
(a) Incurable (b) Incorrigible
(c) Hardened (d) Invulnerable

43. A general pardon granted by the Government to political offenders
(a) Pardon (b) Excuse
(c) Honesty (d) Amnesty

44. One who hates women
(a) Misogynist (b) Misogamist
(c) Ambivert (d) Misanthrope

45. A person who consumes human flesh
(a) Cannibal (b) Javage
(c) Captor (d) Carnivore

46. A school boy who cuts classes frequently is a
(a) Defeatist (b) Sycophant
(c) Truant (d) Martlinet

47. Stealing of ideas or writings of someone else
(a) Autism (b) Scepticism
(c) Mesmerism (d) Plagiarism

48. One who is unaffected or indifferent to joy, pain, pleasure or grief
(a) Tolerant (b) Resigned
(c) Passive (d) Stoic

49. A person who is greatly respected because of wisdom
(a) Veracious (b) Vulnerable
(c) Venerable (d) Verger

50. One who is in the habit of drinking
(a) Domiale (b) Drunkard
(c) Altruist (d) Ambivert

51. Belief in many gods
(a) Pantheism (b) Monotheism
(c) Polytheism (d) Atheism

52. A cluster of flowers on a branch
(a) Bouquet (b) Inflorescence
(c) Wreath (d) Incandescence

53. A person who believes that only selfishness motivates human actions
(a) Agnostic (b) Cynic
(c) Sceptic (d) Misogynist

54. A highly skilled musician
(a) Artiste (b) Virtuoso
(c) Performer (d) Diva

55. A method of boiling briefly to cook food slightly
(a) Steam (b) Bake
(c) Saute (d) Parboil

56. The group, especially in the arts, regarded as being the most experimental
(a) Avant-garde (b) Iconoclast
(c) Revolutionary (d) Nerd

57. One who helps people by giving them money or other aid
(a) Benefactor (b) Beneficiary
(c) Tycoon (d) Patriot

58. A recurrent compulsive urge to steal
(a) Pneumonia (b) Insomnia
(c) Nymphomania (d) Kleptomania

59. Act of injuring another's reputation by any slanderous communication
(a) Orchestration (b) Aberration
(c) Misrepresentation (d) Defamation

60. A story in which animals or objects speak and give wholesome moral lesson
(a) Fable (b) Parable
(c) Allegory (d) Legend

Answers & Explanations

1. (b) Manoeuvre
2. (b) Ineffable
3. (b) Iconoclast
4. (c) Imposter
5. (c) Ethnology
6. (c) Stowaway
7. (a) Circumstantial
8. (a) Windfall
9. (a) Honorarium
10. (d) Fauna
11. (c) Sinecure
12. (b) Fatal
13. (a) Calligrapher
14. (c) Bovine
15. (a) Glower
16. (c) Epitaph
17. (b) Conscience
18. (a) Parole
19. (b) Amnesia
20. (a) Flounder
21. (a) Bibliophile
22. (d) Extempore
23. (c) Impeachment
24. (d) Ambidextrous
25. (b) Panacea
26. (c) Altar
27. (d) Inexplicable
28. (a) Affidavit
29. (d) Egocentric
30. (a) Finger-post
31. (b) Trilogy
32. (a) Anthropology
33. (c) Connoisseur
34. (d) Taxidermy
35. (c) Incantation
36. (b) Canister
37. (c) Domicile
38. (a) Irrevocable
39. (a) Gratuity
40. (c) Wardrobe
41. (d) Itinerary
42. (d) Incorrigible
43. (d) Amnesty
44. (a) Misogynist
45. (a) Cannibal
46. (c) Truant
47. (d) Plagiarism
48. (d) Stoic
49. (c) Venerable
50. (b) Drunkard
51. (c) Polytheism
52. (b) Inflorescence
53. (b) Cynic
54. (b) Virtuoso
55. (d) Parboil
56. (a) Avant-garde
57. (a) Benefactor
58. (d) Kleptomania
59. (d) Defamation
60. (a) Fable

Chapter 12

Active and Passive Voice

The Voice of a verb tells whether the subject of the sentence **performs** or **receives** the action.

Compare the following sentences.

Sentence I : Ram helps Hari.

Sentence II : Hari is helped by Ram.

While both sentences express the same meaning, there is a difference in their construction, the difference of voice.

In sentence I, the subject Ram is the doer of the action and thus the verb is in the **Active voice.**

In sentence II, the subject is Hari on whom the action is done and thus the verb is in the **Passive Voice.**

Observe the following examples of Active and passive voice sentences :

Active Voice	Passive Voice
The peon opened the gate.	The gate was opened by the peon.
Some boys were helping the old man.	The old man was being helped by some boys.
He will finish the work in a fortnight.	The work will be finished by him in a fortnight.
Why did your brother write such a letter?	Why was such a letter written by your brother ?
He handed her a chair.	A chair was handed to her by him.

TRANSFORMATION OF VOICE

Tense	Active voice	Passive Voice
Simple present	take/takes	is/am/are taken
Present continuous	is/am/are taking	is/am/are being taken
Present perfect	has/have taken	has/have been taken
Simple past	took	was/were taken
Past continuous	was/were taking	was/were being taken
Past perfect	had taken	had been taken
Simple future	will/shall take	will/shall be taken
Future perfect	will/shall have taken	will/shall have been taken

Steps to Change a Sentence from Active to Passive Voice :

1. Move the active sentence's direct object into the passive sentence's subject slot

Active Voice → **Passive Voice**
Marilyn mailed the letter → The letter . . .
↑ ↑
direct object **subject**

2. Place the active sentence's subject into a phrase beginning with the preposition **by**

Active Voice → **Passive Voice**
Marilyn mailed the letter. → The letter . . . by Marilyn.
↑
subject **prepositional phrase**

3. Add a form of the auxiliary verb **be** to the main verb and change the main verb's form to past participle (V3).

Active Voice → Passive Voice

Marilyn mailed the letter. → The letter **was mailed** by Marilyn.
↑ ↖↗
verb **verb + be axuiliary**

Examples :

Active Voice

1. At each concert the soprano sang at least one tune from a well-known opera.
↑ ↑ ↑
doer of action **action** **receiver of action**

Passive Voice

At each concert, at least one tune from a well-known opera was sung by the soprano.
↑ ↑ ↑
receiver of action **action** **doer of action**

Active Voice

2. Asbestos abatement teams will remove large chunks of asbestos-laden material from the hallways on the second and third floors.
↑ ↑ ↑
doer of action **action** **receiver of action**

Passive Voice

Large chunks of asbestos-laden material will be removed from the hallways on the second and third floors by asbestos abatement teams.
↑ ↑ ↑
receiver of action **action** **doer of action**

Reverse transformation

To change a Passive Voice sentence into an Active Voice sentence, simply reverse the steps shown above.

1. Move the passive sentence's subject into the active sentence's direct object slot
Passive Voice → **Active Voice**
The letter was mailed by Marilyn. → . . .(mailed) the letter.
↑ ↑
subject **direct object**

2. Remove the auxiliary verb **be** from the main verb and change main verb's form as per the table of transformation given above.
Passive Voice → **Active Voice**
The letter was mailed . . . → mailed the letter
↑
be auxiliary

3. Place the passive sentence's object of the preposition **by** into the subject slot.
Passive Voice → **Active Voice**
. . .by Marilyn. → * Marilyn mailed the letter
↑ ↑
object of preposition by **subject**

preference of voice

Because it is more direct, the active voice is preferred whenever possible. The passive voice may be a better choice, however, when

- the doer of the action is unknown, unwanted, or unneeded in the sentence
  Examples:
  - ♦ The ballots have been counted.
  - ♦ Sometimes our efforts are not fully appreciated.
- the writer wishes to emphasize the action of the sentence rather than the doer of the action
  Examples:
  - ♦ The high-jump record was finally broken last Saturday.
  - ♦ A suspect was questioned for sixteen hours by the police.
- The writer wishes to use passive voice for sentence variety.

EXERCISE

DIRECTIONS (Qs. 1-30) : *In the following questions, the sentences have been given in Active / Passive Voice. From the given alternatives, choose the one which best expresses the given sentence in Passive / Active Voice as your answer.*

1. They first sun-dried the garbage for one to three days to bring down the moisture level.
(a) The moisture level was brought down by sun-drying the garbage for one to three days
(b) One to three days of sun-drying brought down the moisture level of the garbage.
(c) The moisture level of the garbage came down when it was sun-dried for one to three days.
(d) The garbage was first sundried for one to three days to bring down the moisture level.

2. Women like men to flatter them.
(a) Men are liked by women to flatter them.
(b) Women like to be flattered by men.
(c) Women like that men should flatter them.
(d) Women are liked to be flattered by men.

3. What one must do, one must do properly.
(a) What must be done, must be done properly.
(b) It must be done properly what one must do.
(c) It must be done what one must do properly.
(d) One must do properly what has to be done.

4. Look at the poll results-do they inspire hope?
(a) Let the poll results be looked-is hope inspired by them?
(b) Let the poll results be looked at-has hope been inspired by them?
(c) Let the poll results be looked at-is hope being inspired by them?
(d) Let the poll results be looked at-is hope inspired by them?

5. It is your duty to make tea at eleven O'clock.
(a) You are asked to make tea at eleven O'clock.
(b) Your are required to make tea at eleven O'clock.
(c) You are supposed to make tea at eleven O'clock.
(d) Tea is to be made by you at eleven O'clock.

6. He was congratulated by his teacher on his brilliant success in the recent examination.
(a) His teacher congratulated him on his brilliant success in the recent examination.
(b) His teacher congratulated him for his success in the examination.
(c) His teacher congratulated him on his success.
(d) His teacher congratulated him.

7. People speak English all over the word.
(a) English is spoken all over the world.
(b) English was spoken all over the world.
(c) English was spoken by people.
(d) English is spoken by people.

8. Who gave you permission to enter?
(a) By whom were you given permission to enter?
(b) By whom was you given permission to enter?
(c) By whom you were given permission to enter?
(d) By whom given you permission to enter?

9. The Principal has granted him a scholarship.
(a) A scholarship has granted to him by the Principal.
(b) He has been granted a scholarship by the Principal.
(c) He has granted a scholarship by the Principal.
(d) A scholarship was granted to him by the Principal.

10. Before festivals the shops are thronged with men, women and children making various purchases.
(a) During festivals people throng the shops
(b) Men, women and children throng the shops before festivals making various purchases.
(c) Men, women and children make purchases during festivals.
(d) The shops are thronged by people making purchases.

11. We all know that there is only one God.
(a) We are all known that there is only one God.
(b) It is known to us all that there is only one God.
(c) We have all known that there is only one God.
(d) Only one God is known by us all.

12. The people elected him Mayor.
(a) Him was elected Mayor the people.
(b) He was elected Mayor by the people.
(c) Mayor is elected by the people.
(d) He is elected by the people Mayor.

13. Don't laugh at me.
(a) Let me be laughed at.
(b) Let me be not laughed at.
(c) I am laughed at.
(d) Let me be not laughed.

14. I saw him leaving the house.
(a) Leaving the house he was seen by me.
(b) He was seen leaving the house by me.
(c) He had been seen leaving the house.
(d) He was seen to be leaving the house.

15. Someone pulled the bull violently.
(a) The bull had been pulled violently by someone.
(b) The bull was to be pulled violently by someone.
(c) The bull had been pulled violently.
(d) The bull was pulled violently.

16. This shirt cannot be worn by me any longer.
- (a) I cannot wear this shirt any longer.
- (b) Wearing of this shirt any longer is not possible.
- (c) This shirt is too worn out to be worn any longer.
- (d) This worn out shirt cannot be worn any longer

17. A lion does not eat grass, however hungry he may be.
- (a) Grass is not eaten by a lion, however hungry he may be
- (b) Grass is not being eaten by a lion, however hungry he may be
- (c) Grass is eaten not by a lion, however hungry he may be
- (d) Grass is being not eaten by a lion, however hungry he may be

18. Someone saw him picking up a gun.
- (a) He was seen pick up a gun by someone
- (b) He was seen picking up a gun by someone
- (c) he was seen when he was picking up a gun
- (d) He was seen by someone pick a gun

19. He was obliged to resign.
- (a) He was made to resign
- (b) To resign was his obligation
- (c) Circumstances obliged him to resign
- (d) Resignation obliged him

20. Why did you not agree to my proposal?
- (a) Why was my proposal not agreed to?
- (b) Why was my proposal not agreed by you?
- (c) Why my proposal was not agreed to by you?
- (d) Why was my proposal not agreed to by you?

21. The boy has rung the bell
- (a) The bell has been rung by the boy.
- (b) The bell was being rung by the boy.
- (c) The bell was rung by the boy.
- (d) The bell has been being rung by the boy.

22. He likes people to call him Sir.
- (a) He likes to be called Sir by people.
- (b) He likes to be call Sir by people.
- (c) He likes people who call him Sir.
- (d) To call him Sir is liked by people.

23. We added up the money and found that it was correct.
- (a) The money was added up and found to be correct.
- (b) Correct it was found and the money was added up.
- (c) The money added up by us and it was correctly found.
- (d) The money added up by us found it was correct.

24. The telegraph wires have been cut.
- (a) Someone has been cut the telegraph wires
- (b) No one has cut he telegraph wires.
- (c) The telegraph wires have cut someone.
- (d) Someone has cut the telegraph wires.

25. Will she tell us the truth?
- (a) Is the truth told to us by her?
- (b) The truth will be told to us by her.
- (c) Will the truth be told to us by her?
- (d) Will the truth be told us by her?

26. Mr. Sen asked him a question.
- (a) He was asked a question Mr. Sen.
- (b) He was asked a question to Mr. Sen.
- (c) He was asked a question by Mr. Sen.
- (d) A question was being asked by Mr. Sen.

27. The teacher punished the boys who had not done their home work.
- (a) The boys who had not done their homework had been punished by their teacher.
- (b) The boys were punished by their teacher who had not done their homework.
- (c) The boys who had not done their homework were punished by the teacher.
- (d) The boys who had not done their homework were being punished by the teacher.

28. Somebody told me that there had been an explosion in the Town Hall.
- (a) I was told by somebody about the explosion in the Town Hall.
- (b) I was told about the explosion in the Town Hall.
- (c) I was informed that there was an explosion in the Town Hall.
- (d) I was told by somebody that there had been an explosion in the Town Hall.

29. The doctor advised the patient not to eat rice.
- (a) The patient was advised by the doctor not to eat rice.
- (b) The patient was advised by the doctor that he should not eat rice.
- (c) The patient was being advised by the doctor that he should not rice by the doctor.
- (d) The patient has been advised not to eat rice by the doctor.

30. I cannot accept your offer.
- (a) Your offer cannot be accepted by me.
- (b) I cannot be accepted by your offer.
- (c) The offer cannot be accepted by me.
- (d) Your offer cannot be accepted.

Answers & Explanations

1. **(d)** The garbage was first sundried for one to three days to bring down the moisture level.
2. **(b)** Women like to be flattered by men.
3. **(a)** What must be done, must be done properly.
4. **(d)** Letthepollresultsbelookedat-ishopeinspiredbythem?
5. **(c)** You are supposed to make tea at eleven o'clock.
6. **(a)** In Voice change, one can transform the sentence from Active to Passive or vice versa, but can't change the sense, i.e., is, one can't remove the information conveyed through the sentence or add any additional information. The transformation must be done keeping the information intact.
7. **(a)** "People speak English" can be transformed into Passive form thus-
   "English is spoken by the people"
   So, in Passive from, the sentence stands thus-
   "English is spoken by the people all over the world.
   In this type of sentence, we need not use "by the people".
   Another example:
   People call him Mahatma. (Active)
   He is called Mahatma. (Passive)
   So the answer is (a).
8. **(a)** The Auxiliary Verb that should be used with you is 'were' and not 'was'. Again, as the given sentence is an Interrogative sentence, in Passive form also, the sentence will be Interrogative, that is in 'Verb + Subject' form. Keeping these two conditions in mind, if we consider the given options, we find option (a) correct.
9. **(b)** The transformation follows the simple rules related to the transformation of an Assertive Sentence.
10. **(b)** The given sentence is in Passive form. Here subject is "the shops" and object is "Men, women and children". So, a sentence where "the shops" is used as the object and "men, women and children" is used as the Subject should be chosen as the answer. Here also, we should not miss any information supplied in the original sentence.
11. **(b)** It is known to us all that there is only one God.
12. **(b)** He was elected Mayor by the people.
13. **(b)** Let me be not laughed at.
14. **(b)** He was seen leaving the house by me.
15. **(d)** The bull was pulled violently.
16. **(a)** I cannot wear this shirt any longer.
17. **(a)** Grass is not eaten by a lion, however hungry he may be.
18. **(b)** He was seen picking up a gun by someone.
19. **(b)** To resign was his obligation.
20. **(d)** Why was my proposal not agreed to by you?
21. **(a)** The bell has been rung by the boy.
22. **(a)** He likes to be called Sir by people.
23. **(a)** The money was added up and found to be correct.
24. **(d)** Someone has cut the telegraph wires.
25. **(c)** Will the truth be told to us by her?
26. **(c)** **27. (c)** **28. (d)** **29. (a)** **30. (a)**

Chapter 13

Direct & Indirect Speech

The art of conveying the words of the speaker is called Narration. Narration is of two types viz. Direct Speech and Indirect Speech.

(1) **Direct Speech** – It is a kind of speech which is conveyed by some other person exactly in the words spoken by the speaker. In this form, the actual words of the speaker are put in inverted commas.

Examples :

The President said, "We will become a developed nation in the coming ten years." In this example, ***The President*** is the conveyer/reporter, ***said*** is the reporting verb and "***We will become a developed nation in the coming ten years***." is the reported speech. -

(2) **Indirect Speech** – It is a kind of speech in which some other person reports what the speaker said in his own words rather than quoting the exact words, i.e., the actual words of the speaker are transformed and said in a simple manner by using certain conjunctions in place of commas and making necessary changes in the verbs, pronouns etc., of the reported speech.

Examples :

Direct speech – Monika said, "I am suffering from fever".

Indirect speech – ***Monika said that she was suffering from fever.***

IMPORTANT RULES TO CONVERT DIRECT SPEECH INTO INDIRECT SPEECH

Rules of changing Direct into Indirect Speech

Rule 1: Changes in Tenses:

The past perfect and past perfect continuous tenses do not change.

	Direct Speech	**Indirect Speech**
Simple Present Changes To Simple Past	"I always drink tea", he said	He said that he always drank tea.
Present Continuous Changes To Past Continuous	"I am reading a book", she said.	She said that she was reading a book.
Present Perfect Changes To Past Perfect	She said, "He has finished his work"	She said that he had finished his work.
Present Perfect Continuous Changes To Past Perfect Continuous	"I have been to England", he told me.	He told me that he had been to England.
Simple Past Changes To Past Perfect	"Bill arrived on Saturday", he said.	He said that Bill had arrived on Saturday.
Past Perfect Changes To Past Perfect (No Change In Tense)	"I had just come back from work," he said.	He said that he had just come back from work.
Past Continuous Changes To Past Perfect Continuous	"We were living in Hong Kong", they told us.	They told us that they had been living in Hong Kong.
Future Changes To Present Conditional	"I will be in Italy on Saturday", she said	She said that she would be in Italy on Saturday.
Future Continuous Changes To Conditional Continuous	He said, "I'll be visiting mother next Monday."	He said that he would be visiting mother next Monday.

Exception to the above rule:

If the direct speech contains the Universal Truth, the tense of the direct speech remains unchanged even if the reporting verb is in the past.

- The teacher said, "The sun rises in the East". (Direct Speech)
- The teacher said that the sun rises in the East. (Indirect Speech)

Rule 2: Words Expressing Nearness In Time Or Places Are Generally Changed Into Words Expressing Distance.

Direct Speech	Indirect Speech
Here	There
Today	That day
This morning	That morning
Yesterday	The day before
Tomorrow	The next day
Next week	The following week
Next month	The following month
Now	Then
Ago	Before
Thus	So
Last Night	The night before
This	That
These	Those
Hither	Thither
Hence	Thence
Come	Go

Rule 3: Changes in Pronouns

The pronouns of the Direct Speech are changed where necessary, according to their relations with the reporter and his hearer, rather than with the original speaker. This is the SON rule -Subject, Object, No change- of the PERSON of the pronoun.

	Direct Speech	Indirect Speech
The **first person** of the reported speech changes according to the **subject** of reporting speech.	He says, "I am in fifth class."	He says that he is in fifth class.
The **second person** of reported speech changes according to the **object** of reporting speech.	He says to them, "You have completed your job."	He tells them that they have completed their job.
The **third person** of the reported speech has no **change**.	She says, "She is in ninth class."	She says that she is in ninth class.

Rule 4: Changes in Modals

	Direct Speech	Indirect Speech
CAN changes into COULD	He said, “I can touch the ceiling”.	He said that he could touch the ceiling.
MAY changes into MIGHT	He said, “I may buy a house”.	He said that he might buy a house.
MUST changes into HAD TO	He said, “I must resign from the job”.	He said that he had to resign from the job.
*These Modals Do Not Change: **would, could, might, should, ought to**.*		
Would	She said, “She would apply for a visa”.	She said that she would apply for a visa.
Could	He said, “I could climb the ladder”.	He said that he could climb the ladder.
Might	Tom said, “I might help him”.	Tom said that he might help him.
Should	She said, “I should go to the pub”.	She said that she should go to the pub.
Ought to	She said to me, “You ought to wait for her”.	She said to me that I ought to wait for her.

Rule 5: If the reported speech is an Assertive Sentence

- Remove the quotation marks in the statement
- Use the conjunction ‘that’ to connect the reporting clause with the reported speech.
- Change the reporting verb ‘say to’ into ‘tell’
- Change the reporting verb ‘said to’ into ‘told’

Note

- He said that (correct)
- He told me that (correct)
- He told that (Incorrect)

Examples:

1. “I will work hard to get first class”, said Amir. (Direct Speech)

   Amir said he would work hard to get first class. (Indirect Speech)
2. “You can do this work”, said Nelson to John. (Direct Speech)

Nelson told John that he could do that work. (Indirect Speech)

3. He says, “I am glad to be here this evening”. (Direct Speech.)

He says that he is glad to be there that evening. (Indirect Speech)

4. "I'm going to the library now" said Neeta. (Direct Speech)

Neeta said that she was going to the library then. (Indirect Speech)

Rule 6: If the reported speech is an Imperative Sentence (Order, Advice or Request)

- Remove the quotation mark.
- Don't use 'that'.
- Use 'to' if it is a positive sentence. (without **don't**)
- Use 'not to' if the sentence begins with **don't**.
- If the direct speech contains a request or a command, change the reporting verb (*said*) into *told*, *requested*, *ordered*, *commanded* etc., in its correct tense.

Examples:

1. "Don't talk in the class", said the teacher to the boys. (Direct Speech)

   The teacher advised the boys not to talk in the class. (Indirect Speech)
2. "Please give me something to eat. I am hungry", the old man said to them. (Direct Speech)

   The old man requested them to give him something to eat and said that he was hungry. (Indirect Speech)
3. "Be careful", said he to her. (Direct Speech)

   He ordered her to be careful. (Indirect Speech)
4. "Bring me a cup of tea", said Nelson to Andriya. (Direct Speech)

Nelson asked Andriya to bring him a cup of tea. (Indirect Speech)

Rule 7: If the reported speech is an Interrogative Sentence (Questions)

- Remove the quotation marks and question mark.
- Don't use 'that'.
- Use 'if' or 'whether' if the reported speech begins with a helping verb (Auxiliary verb).
- Use the given interrogative word (what, when, where, why, who, whom, whose, which, how etc.) as the connector if it does not begin with a helping verb.
- Changing the reporting verb (said) into 'asked' or 'enquired'.
- Omit helping verbs 'do, does, did' that started the interrogative speech. But don't omit them when they are with 'not' (Example 4).

1. "Won't you help me to carry this box?" said I to my friend. (Direct Speech)

   I asked my friend if he would not help me to carry that box. (Indirect Speech)
2. Mohan said to Stalin, "Why didn't you attend the meeting yesterday"? (Direct Speech)

   Mohan asked Stalin why he had not attended the meeting the day before. (Indirect Speech)
3. "How often do you go to the theatre?" said David to John. (Direct Speech)

   David asked John how often he went to the theatre. (Indirect Speech)
4. Mohamed said to Sultan, "Do you like mangoes?" (Direct Speech)

Mohamed asked Sultan if he liked mangoes. (Indirect Speech)

Rule 8: If the reported speech is an Exclamatory Sentence

- Change the exclamatory sentence into Assertive statement.
- Remove the quotation marks and exclamatory mark.
- Use the conjunction 'that'.
- Omit the interjections such as Oh, O, Alas, How, What, Hurrah.
- Add the word 'very' to the adjective or adverb if necessary.
- If the verb is not given, use 'Be' the verb (is, was, are, were, am) in its correct tense according to the subject.
- Change the reporting verb (said) to 'exclaimed' with modifiers like joyfully, sorrowfully, etc., as the case may be.

1. "O, what a beautiful flower that is!" said she. (Direct Speech)

   She exclaimed joyfully that that was a very beautiful flower. (Indirect Speech)
2. "What a horrible sight!" we all cried. (Direct Speech)

   We all exclaimed that it was a very horrible sight. (Indirect Speech)
3. "Alas! I have broken my brother's watch", said he. (Direct Speech)

   He exclaimed sorrowfully that he had broken his brother's watch. (Indirect Speech)
4. "How beautiful she is!" said Boon. (Direct Speech)

   Boon exclaimed joyfully that she was very beautiful. (Indirect Speech)

EXERCISE

DIRECTIONS (Qs. 1-30): *In the following questions, a sentence has been given in Direct/Indirect Speech. Out of the four alternatives suggested, select the one which best expresses the same sentence in Indirect/Direct Speech.*

1. He said to her, "Are you coming to the party"?
(a) He asked her whether she was coming to the party.
(b) He told her if she was coming to the party.
(c) He asked her if she will be coming to the party.
(d) He asked her if she will be coming to the party.

2. The sage said, "God helps those who help themselves."
(a) The sage said that God helps those who help themselves.
(b) The sage said that God helped those whose helped themselves.
(c) The sage said that God helps those who helped themselves.
(d) The rage said God will help those who will help themselves.

3. "Please don't go away", she said.
(a) She said to please her and not go away.
(b) She told me not to go away.
(c) She begged that I not go away.
(d) She begged me not to go away.

4. He said, "I clean my teeth twice a day."
(a) He said that he cleaned his teeth twice a day.
(b) He said that he cleans his teeth twice a day.
(c) He said that he used to clean his teeth twice a day.
(d) He said that he is used to cleaning his teeth twice a day.

5. He said to them, " Don't make a noise".
(a) He told them that don't make a noise.
(b) He told them not to make noise.
(c) He told them not to make a noise.
(d) He asked them not to make a noise.

6. The teacher said, 'Be quiet, boys."
(a) The teacher said that the boys should be quiet.
(b) The teacher called the boys and ordered them to the quiet.
(c) The teacher urged the boys to be quiet.
(d) The teacher commanded the boys that they be quiet.

7. My friend said to me, "Has your father returned from Calcutta?"
(a) My friend said to me that my father has returned form Calcutta.
(b) My friend asked me if my father had returned from Calcutta.
(c) My friend told me that his father has returned from Calcutta.
(d) My friend enquired me if his father has returned from Calcutta.

8. He said, "Where shall I be this time next year?"
(a) He asked that where should he be that time next year.
(b) He wondered where he should be that time the following year.
(c) He contemplated where shall he be that time the following year.
(d) He wondered where he would be that time the following year.

9. Rajesh said, "I bought a car yesterday."
(a) Rajesh said that I have bought a car the previous day.
(b) Rajesh told that he had bought a car yesterday.
(c) Rajesh said that he had bought a car the previous day.
(d) Rajesh said that he bought a car the previous day.

10. The employer said to the workman, "I cannot pay you higher wages."
(a) The employer told the workman that he could not be paid higher wages.
(b) The employer forbade the workman that he could not pay him higher wages.
(c) The employer forbade the workman to pay higher wages.
(d) The employer warned the workman that he cannot pay him higher wages.

11. My cousin said, "My roommate snored throughout the night."
(a) My cousin said that her roommate had snored throughout the night.
(b) My cousin told me that her roommate snored throughout the right.
(c) My cousin complained to me that her roommate is snoring throughout the night.
(d) My cousin felt that her roommate may be snoring throughout the night.

12. He asked his teacher, "Need I read this chapter?"
(a) He asked his teacher whether there was a need to read that chapter.
(b) He asked his teacher whether he needed to read this chapter.
(c) He asked his teacher if it was necessary to read this chapter.
(d) He asked his teacher if he had to read that chapter.

13. He said, "What a beautiful scene!"
(a) He said that what a beautiful scene it was.
(b) He wondered that it was a beautiful scene.
(c) He exclaimed what a beautiful scene it was.
(d) He exclaimed that it was a very beautiful scene.

14. He said, "I saw a book here."
(a) He said that he saw a book here.
(b) He said that he saw a book there.
(c) He said that he had seen a book here.
(d) He said that he had seen a book there.

15. He said to me, "What time do the offices close?"
(a) He wanted to know what time the offices close.
(b) He asked me what time did the offices close.
(c) He asked me what time the offices close .
(d) He asked me what time the offices did close.

16. Pinki said to Gaurav, "Will you help me in my work just now."
(a) Pinki asked Gaurav if he would help her in her work just then.
(b) Pinki questioned to Gaurav that will you help me in my work just now.
(c) Pinki told Gaurav whether he will help her in her work just now.
(d) Pinki asked to Gaurav that will he help her in her work just now.

17. Sarita said to me, “I will do it now or never.”
(a) Sarita told me that I would do it then or never.
(b) Sarita told me that she would do it now or never.
(c) Sarita told me tht she will do that now or never.
(d) Sarita told me that she would do it then or never.

18. She said to him, “Why don’t you go today?”
(a) She said to him that why he don’t go today.
(b) She asked him if he was going that day.
(c) She asked him why he did not go today.
(d) She asked him why he did not go that day.

19. Gavaskar said, “Bravo! Azhar, you have done well.”
(a) Gavaskar exclaimed with joy that Azhar had done well.
(b) Gavaskar called Azhar and exclaimed that he had done well.
(c) Gavaskar congratulated Azhar, saying that he had done well.
(d) Gavaskar praised Azhar for his having done well.

20. He said to me, “Where is the post office?”
(a) He wanted to know where the post office was.
(b) He asked me that where the post office was.
(c) He asked me where the post office was.
(d) He asked me where was the post office.

21. He said, “The mice will play, when the cat is away.”
(a) He said that the mice will play when the cat is away.
(b) He said that the mice would play when the cat was away.
(c) He said that the mice would play when the cat would be away.
(d) He said that the mice shall play, when the cat is away.

22. He said to his servant, “Why are you so lazy today?”
(a) He asked his servant why he was so lazy that day.
(b) He asked his servant why he had been so lazy that day.
(c) He asked his servant why he was being so lazy that day.
(d) He asked his servant why was he so lazy that day.

23. He said, “Can you sing?” And I said, “No”.
(a) He asked me that could I sing and I refused.
(b) He asked me if I could sing and I said that I couldn’t.
(c) I denied, when he asked me if I could sing.
(d) He asked me if I could sing and I said no.

24. He said to her, “May you succeed!”
(a) He told her that she might succeed.
(b) He prayed to God that she may succeed.
(c) He wished her success.
(d) He said to her that she might succeed.

25. He said, “May God grant peace to the departed soul.”
(a) He wished by God to grant peace to the departed soul.
(b) He wished that God may grant peace to the departed soul.
(c) He prayed that might God grant peace to the departed soul.
(d) He prayed that God would grant peace to the departed soul.

26. “Are you alone, my son?” asked a soft voice close behind me.
(a) A soft voice from my back asked if I was alone.
(b) A soft voice said to me are you alone son.
(c) A soft voice asked that what I was doing there alone.
(d) A soft voice behind me asked if I was alone.

27. He said, “I must go next week”.
(a) He said that he must go next week.
(b) He said that he must go the following week.
(c) He said that he would have to go the following week.
(d) He said that he was to go the following week.

28. He said to her, “Don’t read so fast.”
(a) He told her not to read so fast.
(b) He advised her don’t read so fast.
(c) He requested her not to read so fast.
(d) He ordered her not to read so fast.

29. “I don’t know the way. Do you?” he asked.
(a) He said that he didn’t know the way and did I know it.
(b) He told that he was not knowing the way, but wondered if I knew.
(c) He said that he didn’t know the way and asked me if I did.
(d) He asked me if I knew the way which he didn’t.

30. He said, “Will you listen to such a man?”
(a) He asked them will you listen to such a man.
(b) He asked them are you listening to such a man.
(c) He asked them whether they would listen to such a man.
(d) He asked them whether they will listen to such a man.

Answers and Explanations

1.	**(a)**	**2.**	**(a)**	**3.**	**(d)**	**4.**	**(b)**	**5.**	**(d)**	**6.**	**(c)**	**7.**	**(b)**	**8.**	**(d)**	**9.**	**(d)**
10.	**(b)**	**11.**	**(a)**	**12.**	**(d)**	**13.**	**(d)**	**14.**	**(d)**	**15.**	**(c)**	**16.**	**(a)**	**17.**	**(d)**	**18.**	**(d)**
19.	**(c)**	**20.**	**(c)**	**21.**	**(a)**	**22.**	**(a)**	**23.**	**(b)**	**24.**	**(c)**	**25.**	**(d)**	**26.**	**(d)**	**27.**	**(c)**
28.	**(a)**	**29.**	**(c)**	**30.**	**(c)**												

SECTION-D : General Awareness

Chapter 1

History

ANCIENT HISTORY

SOURCES OF ANCIENT INDIAN HISTORY

- **Pliocene deposits** in Siwaliks. It came to be known as Ramapitheus, a type of early **hominid**.
- **Inscriptions** either on stone or on metal plates are old records of Ancient India. The study of inscriptions is called **epigraphy.**
- **Coins:** The study of coins is called **numismatics**.
  – The **Punch Mark Coins** (silver & copper) are the earliest coins of India.
- **Monuments:** Monuments reflect the material prosperity and development of culture e.g. Taxshila monuments about Kushans and Stupas, Chaityas and Vihars about Maurya.
- **Vedas:** Vedas point out features and development of different dynasties, e.g. **Rigveda** deals about Archery and known as "**The first testament of mankind**."
  – **Samveda** says about the art of music (i.e. melodies)
  – **Yajurveda:** It is known as ritual Veda.
  – **Atharvaveda:** It is the latest of the four. It is about beliefs and superstitions.
- **Upanishad:** It is anti-ritualistic in nature. It deals about the theories of creation of the universe and doctrine of action.
- **Sutras:** Sutras deal about rituals, Sanskaras, social life, Medical science etc.
- **Puranas:** Puranas describe the genealogies of various royal dynasties, i.e. Maurya, Andhra, Shishunag, Gupta, etc.
- **Jatak Kathas:** These are the parts of art and literature of 3rd century B.C.
- **Arthashastra:** It is the analysis of political and economic conditions of the Mauryas, composed by Kautilya (Chanakya).
- **Mudrarakshasa:** It tells about the establishment of the Maurya dynasty, the fall of Nanda, Ramgupta, etc.
- **Rajtarangini:** It was written by Kalhana in 12th century A.D. It is about the rulers of Kashmir. It is considered the, "*first historical book of India*."
- **Foreign travellers:** wrote about the information of India. For examples –
  Megasthenes: He wrote book, "INDICA" about the dynasty of Maurya.
  Fahien: He wrote about the Gupta Emperor.
  Hieun-Tsang: He wrote about the Buddhist record of the western world during period of Harshavardhan.
  Albiruni: He wrote 'Tarikh-ul-Hind.'
  Ibna-Batuta: He wrote about India under the rule of Muhammad Tughlaq.

PRE-HISTORIC PERIOD

- **Pre - historic period** is divided into three sections- **Stone age, Bronze age** and **Iron age**.
- **Stone age** is divided into three periods, i.e. Palaeolithic Age, Mesolithic Age and Neolithic Age.
- **Lower Palaeolithic Age** covers the greater part of the Ice Age.
- Its people used to eat fruits, birds and raw animal flesh, etc.
- The tools were usually made of hard rock.
- In **Middle Palaeolithic age** a bit change occurred in the shape of tools made of stones or bones.
- In **Upper Palaeolithic age**, human lived as nomadic hunter gatherers.
- **Mesolithic Age** was an intermediate stage in the stone age. It ended with the introduction of **agriculture**.
- **Neolithic age** was an age of polished tool culture.
- Tool making became an important profession and a variety of polished tools were manufactured.
- They learnt the art of pottery and their pots were well made and decorated with paintings.
- They discovered the art of producing fire by the friction of stones and the wheel was also an important discovery of this age.
- **Chalcolithic Age** is marked by the use of copper as **copper age**. The economy was based on subsistence agriculture, stock-raising, hunting and fishing.
- The Chalcolithic people slaughtered animals for food. Neither they milked animals for dairy products nor did they practise cultivation.
- It was the transitional stage when both bronze, copper and stone tools were used and humans started living settled life.
- The **Iron age** is usually associated with the **Painted Grey Wares (P.G.W.)**.
- The adoption of Iron brought various changes in society including agricultural practices, religious beliefs and attractive artistic styles.

INDUS VALLEY CIVILIZATION

- The **Indus Valley Civilization (IVC)** was a unique Bronze Age civilization (2500–1700 B.C.) based on Carbon–14 dating.
- The Civilization flourished around the Indus river basin and its tributaries, consisting of modern Pakistan and northwestern India.

Town planning

- The **main streets** ran from north to south varied from 9 to 34 feet in width. **Roads**, especially in Mohenjo-Daro had a width of 10.5 meter. The Harappa had wide roads of width of 30 feet.
- There was an impressive building which was used as a **public bath**. The overall dimension of the Bath is 180 feet by 108 feet used for religious both.
- **Houses**, often two-storey and spacious, lined up on the streets; there was well drainage system resulting in the brick-lined sewers.
- In town planning, grid system, underground drainage and granaries were found.

Culture

- Lothal, Balakot, Suktagendor and Allahdin (Pakistan) in the cities of the Harappan civilization were the major ports.
- **Domesticated animals** included dogs and cats, humped and sea cattle, poultry, and possibly pigs, camels and Buffalo. Elephant, probably, too, was domesticated, and his bones and tusks were freely used.
- **Women** were given high honour in society. Family was regulated in the name of mother.
- The Indus Civilization had four different classes in which the society was divided, i.e. Scholars, warriors, businessmen and labourers.
- In the valley of the Indus people used irrigation-based agriculture.
- Harappan people had features of Hinduism, such as worship of the mother Goddess, Pashupati Shiva, Sacred animals, trees, etc.

Sites their Location

Mohenjodaro- Sindh, Pakistan
Harappa- Punjab Province, Pakistan
Dholavira- Rann of Kutch in Gujarat
Lothal- Gulf of Khambat in Gujarat
Rakhigarhi- Haryana
Ganweriwala- Punjab, Pakistan
Banawali- Haryana
Chanhudaro- Kutch in Gujarat
Kalibangan- Rajasthan
Kot Diji- Sind, Pakistan
Ropar- Punjab (India)
Surkotada- Kutch, Gujarat
Suktagendor – Bank of Dast, Balochistan

Some Important names/facts of I.V. Civilisation

- **The Sumerian texts** refer to two intermediate station - Dilmun (Bahrain) and Makan. It also refers to trade relation with 'Meluha' - the name given to the Indus region.
- **Harappan cotton** was called '*Sindon*' by the Greeks.
- A community who worshiped rivers was called '*Dariyapanthi*' in Indus civilization.
- '*Boustrophendon*' is name of Indus script. It is written from right to left and then left to right.
- **English Bound System:** The way of fitting the bricks in making walls. In this system one large of bricks is placed in length and the other layer is made by placing the bricks widthwise.
- **Ziggurat:** The temples of Sumeria.
- The traces of **Sati system** is found in Lothal (Joint burial).
- **Lipistic** was discovered from Chahundaro and Black eastern bangles from Kalibangan. **Pastry** rollar and board and bowls have been discovered from Alamgirpur Meerut.
- The evidence of coins is not found. **Barter** is assumed to have been the method of exchange of goods.
- Merchants were the ruling class of Indus Civilization.
- The Harappan did not worship their gods in temple. They did not worship the cow as we do today. They worshipped Matridev Shakti, Yoni, Pashupati, Lingam, Naga (Serpent), trees (Peepal and acacia), humped bull, the sun, water, etc. They believed in paganism and sacrificed animals in religious ceremonies.
- **Steatite** was used in seals manufacturing.
- The origin of '**swastika**' is discovered from the Indus Civilization.
- **Indra**, the commander of Aryan, is accused of causing the decline of their civilization.
- The battle of '**Hariyumpia**' (in Rigveda) has been identified with Harappa. (M. Wheeler)
- '**Susa**' are Mesopotamian places where Harappa seals were found.

THE VEDIC PERIOD

- The **Vedic Period** or the Vedic Age refers to the period when the Vedic Sanskrit texts were composed in India.
- Literally '**Aryans**' means - the 'best' or 'eminent'.
- The Aryans are supposed to have migrated from Central Asia into the Indian Subcontinent in Several stages during 2000 to 1500 B.C.
- In order to prove their supremacy the Aryans called themselves '**The Aryas**' and they called their opponents '**Anarya**', '**Dasyu**' or '**Das**'.
- **The Rigveda** (1500–1000 BC) consists of 1028 hymns. These hymns were sung in honour of various gods and were recited by Hotri.

- The **Gaytri Mantra** had been discovered from the Rig Veda.
- The Sindhu and its tributaries are called **Sapta Sindhu.**
- The **Yajur Veda** is a book of sacrificial prayers. It is written in both verse and prose.
- The **Sama Veda** consists of **1549** hymns.
- It is a book of **chants** for singing during sacrifices.
- The **Atharva Veda** is a book of magical formulae which reflects the popular conventions and rituals of that period.
- **The Brahmans** were composed after the Vedas to explain the hymns of the Vedas. They are written in prose and ritualistic in nature.

Veda and their Brahmans

Rigveda	–	Aitareya and Kaushitiki or Shankhyan.
Samveda	–	Panchvisa (Tandya Mahabrahman), Shadvinsh Brahman, Jaiminiya Brahman.
Yajurveda	–	Shatapath (the oldest and the largest Brahman) and Taittariya.
Atharva Veda	–	Gopath (A treatise on **medical science**, charms and magic).

- The **Aranyakas** were written mainly for the **hermits** and the jungle living students.
- The **Upanishadas** are **anti ritualistic** discussing about the relations between Brahma (God) and Jiva (Creature).
- Upanishadas are philosophical texts and are called **Vedanta** as they came towards the end of the Veda.
- **Vrihadaranyaka** is the oldest Upani-shadas among all the 108 Upanishadas.
- According to **Rigveda**, the famous Dasrajan Yuddha or the **battle of ten kings** was fought between **Sudas,** a Bharat King of the Tritsu family, and the confederacy of ten well-known tribes - Puru, Yadu, Turvasa, Anu, Druhyu, Alina, Paktha, Bhalnas, Siva and Vishanin.
- In the bloody and decisive battle on the banks of river Parushni, the Bharatas emerged victorious.
- **Sabha** and **Samiti** (Popular Assemblies) controlled the affairs of Vedic states. These two assemblies were called the two daughters of Prajapati.

Important Terminologies

The Kula -the family
The Gram -the village
The Visha- the clan
The Jana- the people
The Rashtra -the nation

- The **Vedic Aryans** worshipped the forces of nature such as Earth, Fire, Wind, Rain and Thunder; their main occupation was cattle rearing.
- The King was responsible for the protection of the tribe.
- **Vedang** were composed during post-vedic period. Shiksha, Kalpa, Vyakaran, Nirukta, Chhanda and Jyotish are the six vedangas.

Vedang	**Dealt in**
Shiksha	Phonetics
Kalpa	Rituals
Vyakarana	Grammar
Nirukta	Etymology
Chanda	Metrics
Jyotish	

- **Upvedas** were composed after Vedangas.

Four Upvedas are : Ayurveda (medicine); Gandharvaveda (Music); Dhanurveda (Archery) and Shilpaveda (Craft and Wealth).

- **Puranas** means 'the old' and they are 18 in number.
- **Ashtadhyayi** is the first grammar of the world written by **Panini**.
- The **Ramayana** and the **Mahabharata** are the two Indian epics.
- **Darshans** are the auxiliary treatise of the Vedas. The six schools of Indian philosophy are called **Shad Darshan**.

Nyaya Darshana	–Akshpad Gautam
Vaisheshik Darshana	–Maharshi Kanad
Shankhay Darshana	–Kapil Muni
Yoga Darshana	–Patanjali
Purva Mimamsa	–Jamini
Uttar Mimansha	–Badrayan Rishi

- Literally '**Smriti**' means 'remembrance'. All the Smritis were composed during Gupta's period

Rivers and Their Ancient Names

Ancient	Modern
Vitasta	Jhelum
Askini	Chenab
Parushini	Ravi
Vipasa	Beas
Sutudri	Sutlej
Gomati	Gomal
Kubha	Kabul
Sadanira	Gandak
Saraswati	Ghaggar

LATER VEDIC PERIOD (1000-500 BC)

- The **later Vedic** society came to be divided into four varnas called the Brahmanas, rajanyas or kshatriyas, vaisyas and shudras, each varna was assigned with its duty.
- All the three higher varnas shared one common feature, they were known as **Dvijas** (twice born).
- The fourth varna was deprived of the sacred thread ceremony, and with it began the imposition of disabilities on the shudras.
- The worst position is reserved for the shudra. He is called the servant of another.

- Women were generally given a lower position.
- Ashramas or the four stages of life were created in the post-Vedic time.
- The four ashramas were: **Brahmachari** or a student, **grihastha** or householder, **vanaprastha** or partial retirement and **sanyasa** or full withdrawal from the world.

Kingdoms of the Later Vedic Period

Kingdom	Location
1. Panchal	Bareilly, Badayun & Farrukhabad in U.P.
2. Kushinagar	Northern region of Uttar Pradesh
3. Kashi	Modern Varanasi
4. Koshal	Faizabad in Uttar Pradesh
5. Southern Madra	Near Amritsar
6. Uttara Madra	Kashmir
7. Eastern Madra	Near Kangra
8. Kekaya	On the bank of Beas river east of Gandhar kingdom
9. Gandhar	Rawalpindi & Peshawar

Different types of Marriages

Asura: Marriage by purchase.
Gandharva: Marriage by the consent of two parties, often clandestine. A special form of it was syamvara or self choice.
Brahma: Marriage of a duly dowered girl to a man of the same varna with Vedic rites and rituals.
Daiva: Father gives the daughter to the sacrificial priests as part of fee or **dakshina**.
Arsa: A token bride-price of a cow and a bull is given.
Prajapati: Marriage without dowry and bride-price.

Paisacha: It is seduction of a girl while asleep, mentally deranged or drunk, hence it can hardly be called a marriage.

Rakshasa: Marriage by Capture.

- **Prajapati**, the Creator, came to occupy a Supreme position in the later Vedic Period.

Mahajanapadas	Capitals	Current location
Gandhara	Taxila	A part of Afghanistan
Kamboja	Rajpur	Part of Kashmir and Afghanistan
Asmaka	Potana	Godavari Valley
Vatsa	Kaushambi	Allahabad
Avanti	Ujjain	Malwa and a part of M.P.
Surasena	Mathura	Mathura in U.P.
Chedi	Shuktimati	Bundelkhand in M.P.
Malla	Kushinara, Pawa	Eastern U.P.
Kurus	Hastinapur/Indraprashta	Delhi and Meerut
Matasya	Virat Nagari	Jaipur and Alwar
Vajjis	Vaishali	North Bihar
Anga	Champa	Bhagalpur and Monghyr in Bihar
Kashi	Banaras	Banaras
Kosala	Shravasti	Faizabad in U.P.
Magadha	Girivraja/ Rajgriha	Patna and Gaya in Bihar
Panchala	Ahichhatra/ Kampilya	Rohilkhand in U.P.

- During the sixth and fourth centuries BC, Magadha (now Bihar), became the most powerful Mahajanapada.
- The earliest capital of Magadha was at Rajgir, which was called Girivraja at that time.

Chronology of Foreign Invasion

- 518–486 B.C.: King Darius or Darus invaded India.
- 326 B.C. : Alexander invaded India.
- 190 B.C. : India-Greeks or Bactrians invaded India.
- 90 B.C. : Sakas invaded India.
- A.D. 1st Century : Pahlavas invaded India.
- A.D. 45 : Kushanas or Yue-chis invaded India.

Summary of Alexander's Invasion

- Alexander marched to India through the **Khyber Pass in 326 B.C**.
- **Ambi**, the ruler of Taxila, submitted to Alexander.
- He was bravely checked by the local chieftains despite the fact that they had no chance of success.
- He was resisted first strongest by **Porus** at **Jhelum**.
- His advance was checked on the bank of the Beas because of the mutiny of his soldiers.
- In **325 B.C.**, he began his homeward journey.
- In **324 B.C.**, he reached Susa in Persia and died the next year, i.e. 323 B.C.
- The Greek invasion of India opened the trade route between north-west India and Western Asia.

RELIGIOUS MOVEMENTS

- Came into existence around 600 B.C.
- The main cause being reaction against domination of Brahmins and spread of agricultural economy in North-East.

Jainism

- Founder – **Rishabhadeva** (First Tirthankara).
- **Mahavira** was the last of the 24 tirthankaras.
- Jainism was divided into two sects: **Shwetambaras** and **Digambaras**.
- The **First Council** was held at **Pataliputra** by **Sthulabahu**.
- The Second Council was held at **Valabhi** under the leadership of **Devaradhi Kshamasramana**.

Teachings

- Jainism was based on 5 doctrines :
  (i) Ahinsa, i.e. non-violence; (ii) do not speak a lie, (iii) do not steal. (iv) do not acquire property, and (v) observe **continence** (**Brahmacharya**).

- Only the fifth (v) doctrine was added by **Mahavir**.
- Jainism recognizes the existence of the Gods but regarded them lower than the **jina**.
- Jainism did not condemn the Varna system.

Three Gems of Jainism (Ratnatrya) these are :

(i) Right faith (Samyak Vishwas)
(ii) Right knowledge (Samyak Gyan)
(iii) Right conduct/action (Samyak Karma)

Five Categories of Siddhas

(i) **Tirthankara** - who has attained salvation.
(ii) **Arhat** - who is about to attain Nirvana.
(iii) **Acharya** - The head of the ascetic group.
(iv) **Upadhyaya** - teacher or saint, and
(v) **Sadhu** - an ordinary ascetic.

Buddhism

- Gautam Buddha was the founder of Buddhism.
- His real name was **Siddhartha**.
- His father was a king named **Suddodana Tharu** and Mother was **Mahamaya**.
- He was born at **Lumbini**.
- He discovered enlightenment under the peepal tree (**Bodhi Vriksha**) in Gaya, Bihar at the age of 35.
- He gave his first sermon at the **Deer Park in Sarnath**.
- It was divided into three main sects: Hinayana, Mahayana and Vajrayana.
- There are three tripitak : **Vinay Pitak** (rules and regulations, which the Buddha promulgated), **Sutta Pitak** (discourses delivered by Buddha himself) and **Abhidhamma Pitak** (religions discourses of Buddha).
- Milindapanhs (dialogues between Menander and Buddhist saint Nagsen).
- Jatakas are the pre-birth stories of Buddha.
- He died at **Kushinagara** in U.P. the capital of mallas.
- **Buddha** means enlightened or the awakened or the wise one.
- **Nirvana** means to blow out or extinguish fires of greed, hatred and delusion.
- The followers of Hinayana believed in the original teaching of Buddha.
- Hinayanas did not believe in idol-worship.
- Hinayanas believed in the heavenliness of Buddha.
- Mahayanas sought solution through the grace of Buddha.
- Mahayanas believes in idol-worship.
- **Vajrayana** believes that salvation can be attained by magical power (i.e. Vajra)
- **Vajrayana** became popular in Bihar, Bengal, Tibet.

Buddhist Councils

- **First Council** at Rajgir where Vinaya Pitaka & Sutra Pitaka were compiled.
- **Second council** at Vaishali in 383 B.C.
- **Third Council** at Patliputra in 250 B.C. during Ashoka's reign.
- **Fourth Council** in Kashmir during Kanishka's reign.

IMPORTANT DYNASTIES IN ANCIENT INDIA

The Haryanaka dynasty (544 – 412 B.C.)

- **Bimbisara** was the first ruler and founder of Haryanka dynasty. The capital of the kingdom was **Rajagriha**.
- He strengthened his position by matrimonial alliances. He took three wives: daughter of the king Kosala, Chellana (Lichhavi Princess) and daughter of the chief of the Madra clan of Punjab.
- Bimbisara Sent Jivaka to Ujjain for the treatment of King Pradyota, the king of Avanti.
- Bimbisara was succeeded by his son **Ajatasatru** who killed his father and seized the throne for himself.
- He was contemporary to Lord Mahavira and Lord Buddha and a follower of Buddhism.
- Ajatasatru was succeeded by **Udayin**.
- He built the fort upon the confluence of the Ganga and Son at Patna.
- He shifted the capital from the Rajagriha to Pataliputra.
- Ajatasatru was killed by his son **Udayin**.

Shishunaga dynasty (412 - 344 B.C.)

- The last Haryanka ruler, Nagadasaka, was killed by his courtier Shishunaga in 430 B.C, who became the king and founded the Shishunaga dynasty.
- Shishunaga was succeeded by his son Kalashoka. The Second Buddhist Council was organised at Vaishali under the sponsorship of Kalashoka in 383 B.C.
- The last ruler of Shishunaga dynasty was Nandivardhan.

Nanda dynasty (344-321 B.C.)

- Mahapadmananda established the Nanda dynasty into a powerful empire.
- The Nanda dynasty had a huge army consisting 2,00,000 infantry, 20,000 cavalry, 2,000 war chariots and 3,000 war elephants.
- Last ruler of Nanda dynasty was Dhanananda. He was contemporary of Alexander.
- **Alexander** invasion of India took place in 326 B.C. during the reign of Dhanananda.

The Mauryan empire (322 – 185 B.C.)

- Founder— **Chandragupta Maurya**
- He defeated the king Dhanananda with the help of Chanakya.
- Its capital was **Pataliputra**.
- Greek and Latin name of Chandragupta was **Sandracottos**" or "**Andracottus**.
- Megasthene (Greek Ambassador) came to his court.
- **Chandragupta Maurya** embraced **Jainism**.
- He died at **Sravanbelagola** of Chandragiri hill.
- Chandragupta Maurya was succeeded by his son Bindusara.
- Greek sources refer to him as Amitrochates or in Sanskrit amitraghata ("destroyer of foes").
- The palace of Chandragupta was made of wood.

- Bindusara was followed by his son, **Ashoka** (273-232 B.C.).
- The war of Kalinga (BC 261) was the turning point of Ashoka's life. The mass death of the war changed his mind and he became a follower of **Buddhism**.
- **Ashok Stambh** of **Sarnath** was adopted as national emblem of India.
- **Sanchi Stupa** was built by Ashoka.
- Constructions carried out by Ashoka: Dhamek Stupa (Sarnath, Uttar Pradesh), Bharhut stupa (Madhya Pradesh), Mahabodhi Temple (Bihar).
- **Ashoka's Dhamma** was a code of conduct (a set of principles like respect to elders) mercy to slaves & emphasis on truth, non-violence & tolerance.
- Last Mauryan King: Brihadratha (Killed by his general Pushyamitra).
- Pushyamitra founded Sunga Dynasty.
- Important Sources of History of Mauryan Empire: **Arthshastra** (Kautilya), **Indica** (Megasthenes), **Rajtarangini** (Kalhan), **Mahabhasya** (**Patanjali**)
- Other Sources: Puranas, Buddhist Texts, Asoka's Inscriptions, Rocks & Pillar Edicts of Mauryas.

Categories of Ashoka's Inscription

- **Bhabru** – Conversion of Buddhism
- **Barabar Hills** – Enjoins toleration
- **Tarai Pillars** – Respect to Buddhism
- **14 Rock Edicts** – Administration and ethics.
- **Minor Rock Edicts** – Personal history of Ashoka & summary of Dhamma.
- **7 Pillar Rock Edicts** – Appendix to Rock Edicts.

Sunga Dynasty (185 to 73 B.C.)

- Pushyamitra Sunga was the senapati of last king of Mauryan empire Brihadratha. He killed Brihadratha and founded the Sunga dynasty in 187 B.C.
- It was a Magadha dynasty and its capital was Pataliputra but later Vidhisha was the capital of Sunga rulers.

  Patanjali (grammarian of Sanskrit) was patronized by Pushyamitra Sunga.

Kanva Dynasty (73-28 B.C.)

- Founder- Vasudeva Kanva.
- **Vasudeva** was a Brahmin and follower of lord Vishnu.
- Other Sunga Rulers: Bhumimitra, Narayana, Susarman.
- Susarman was put to death by Satavahana ruler.

Satvahana Dynasty

- It ruled in the Deccan and Central India after Mauryans.
- Founder- Simuka
- **Andhra dynasty** was situated between the region of Krishna and Godavari River.
- Most powerful Satavahana king - Gautamiputra Satakarni (A.D. 106-130)
- He defeated the Sakas, Yavanas (Greeks) and Pahlavas (Parithans)

OTHER DYNASTIES

- **Kharavela** was the greatest king of Chedi Dynasty.
- Source of information: **Hatigumpha** Pillar inscription (Created by Kharavela)
- He opposed Demetrius of Bactria and defeated them.
- The **Indo-Greeks** were the first to issue gold coins in India, Which increased in number under the Kushans.
- The **Sakas** were a group of nomadic tribes of Iranian origin or Scythian tribes, who lived in Central Asia.
- The most famous Saka ruler in India was **Rudradaman-I** (A.D. 130-150).
- The Saka kingdom in north-western India was followed by that of the Parthians (Saka-Pahlavas in Sanskrit text).
- The most famous Parthian king was **Gondophernes**.
- They were defeated by the Kushans in the second half of the 1st century AD.
- **The Parthians** were succeeded by the Kushans who established a powerful empire in north India.
- The greatest of the **Kushana** rulers was **kanishka** and is known for his military prowess.
- Capital of Kushans: Purushpura (Peshawar).
- **Kanishka** is considered to have conflicted with the Pataliputra and had taken Asvaghosa, the Buddhist Monk to Purushpura.
- He was a patron of Buddhism and convened the 4th Buddhist Council in the Kundalvana of Kashmir (or may be in Jalandhar) in 78 AD.
- Scholars in the Court of Kanishka were Parsva, Vasumitra, Asvaghosa, Nagarjuna, Charaka and Mathara.
- Sushruta who wrote Sushruta Samhita has also been connected to Kanishka.
- Founder of **Pallava** Dynasty- **Simhavishnu**, Capital – **Kanchi**.
- Nrasimhavarman was the greatest king of Pallava Dynasty.

The Sangam Kingdom

The Tamil Sangam was an academy of poets and bards.

Sangam	Place of Organisation	Chairman	Kingdom
First	Thenmadurai	Agastya	Pandiya
Second	Kapatapuram	Earlier- Agastya Later- Tolkappiyar (a disciple of Agastaya)	Pandiya
Third	North Madurai	Nakkirar	Pandiya

- Founder of **Chera Dynasty**: Utiyan Cheralatan.
- Founder of **Chola Dynasty**: Vijayalaya Capital **Kaveripattanam**.
- Most powerful kings of Chola Dynasty - Rajaraja (985-1014) and his son, Rajendra I.
- Rajendra I founded a new capital called Gangai Kondacholapuram.
- Rajendra I defeated the kings of Sumatra in a naval campaign and annexing a part of Sumarata kingdom to his kingdom.

- Rajendra Chola III was the last king of the dynasty.
- Pandya Dynasty: Madurai(Capital).
- The Pandya kings were constantly at war with Pallavas, Cholas and Ceylon.
- The three Sangam epics were Silappadikaram, Minimekalai and Sivaga Sidamanai.

Temples & their location

The Kailash Temple	Ellora
The Hoysala temple	Belur and Halebid
The Chennakesava temple	Belur
The Hoysaleswara temple	Halebid
The Ratha and Shore temple	Mahabalipuram
The Brihadeshwara temple	Tanjavur
The Vithala temple	Harmpi
The Meenakshi Temple	Madurai

The Gupta Empire (AD 320-467)

- Founder - Sri Gupta
- **Nalanda University** was built by Kumargupt.
- The great Mathematician **Aryabhata lived** during this age. He discovered the number "**0**" and value of **Pi**. He wrote "**Aryabhatiya**" and "Suryasiddhanta".
- **Kalidas** the great poet also belonged to this period.
- The great Physician **Dhanvantari** was also born in this era.
- During this age Sanskrit language and literature were at its peak. Poets Kalidasa, Dandi, Visakhadatta, Shudraka, and Bharavi — all belonged to the Gupta Age.
- **Chandragupta (320-335 AD)** was the son of Ghatotkacha and grandson of Sri Gupta.
- He married to Kumaradevi, the Lichhavi princess of the rich ruling family in Magadha which helped the Gupta Empire to become a powerful empire.
- **Sumudragupta** (AD 335-375) Harisena described him as the "Hero of a Hundred Battles."
- He was the greatest ruler of Gupta dynasty. He is called "**Indian Napoleon**".
- **Prayag Prashasti** (Written by **Harisen**) is the main source of information on his reign.
- **Samundragupta** was succeeded by his son Chandragupta Vikramaditya (or II).
- **Chandragupta II** married his daughter Prabhavati with a Vakataka prince who belonged to the Brahmana caste and ruled in central India.
- His court had **Navaratna (Nine Jewels)**. Kalidasa was one of the jewels among this Navaratna.
- He conquered western Malwa and Gujarat, which had been under the rule of the Saka Kshatrapas for about four centuries by that time.

Nine Gems in the Court of Chandragupta-II

S.No.	Name	Field	Work
1.	Kshapanaka	Astrology	Jyothisyashastra
2.	Dhanvantri	Medicine	Ayurveda (Book of Medicine)
3.	Kalidasa	Drama & Poetry	Abhijnana Shakuntalam, Meghadutta
4.	Amarasimha	Lexicography	Amarakosha (Glossary)
5.	Varahamihira	Astrology	Brihadsamhita
6.	Vararuchi	Grammar	Vyakarna (Sanskrit)
7.	Sanku	Architecture	Shilpashastra
8.	Vetalabhatta	Magic	Mantrashastra
9.	Harisen	Poet	—

- **Kumaragupta (AD 415-455)** is the son of Chandragupta II.
- Kumaragupta's dominion suffered severely from the invasion of Huna Hordes, all over North India.
- Skandagupta is the son of Kumaragupta.
- He defeated the Pushyamitra who had become powerful during the period of Kumaragupta. He also defeated the White Hunas.
- Tamralipti, a port in Bengal was an important trade centre during Gupta period.
- The most important officers in the Gupta empire were the kumaramatyas.
- The empire was divided into divisions : bhuktis (under the charge of an uparika) and vishayas (Districts) under the charge of vishyapati.
- Gupta Period is also known as the **'Golden Age of Ancient India'.**

Important Literary works during the Gupta period

Epics		
Raghuwansa, Ritusamhara, Meghaduta	–	Kalidasa
Ravanabodha	–	Batsabhatti
Kavyadarshana and Dasakumarcharita	–	Dandin
Kiraarjuniyam	–	Bharavi
Nitishataka	–	Bhartahari
Dramas		
Vikramovarshiya, Malvikagnimitra and Abhijnana Shakuntalam	–	Kalidasa
Mrichchakatika	–	Sudaraka
Swapnavasavadatta, Charudatta and Pratignayaugandharayana	–	Bhasa
Mudrarakshasa and Devichandraguptam	–	Visakhadatta

Eulogy	
Pryag - Prasasti	– Harisena
Philosophy	
Sankhyakarika (base on Sankhya philosophy)	– Ishwar Krishna
Padartha Dharmasangraha (based on Vaisheshika Prashastipada Philosophy)	– Acharya
Vyasa Bhasya (based on Yoga philosophy)	– Acharya Vyasa
Nyaya Bhasya (on Nyaya philosophy)	– Vatsyayana
Religious Works	
The two great epics, the Ramayana and the Mahabharata, were given final shape during the period.	
Grammar	
Amarakosha	– Amarsimha
Chandravyakarana	– Chandragomin
Kavyadarsha	– Dandin
Narrative Story	
Panchatantra and Hitopadesha	– Vishnu Sharma
Smritis	
Vaynavalkyasmritit, Parasharsmriti, Brihspatismriti, Naradasmriti and Katyayanasmriti	
Mathematics and Astronomy	
Aryabhattiya, Dashjitikasutra and	– Aryabhatta
Aryashtashata	– Varahmihira
Brhatsamhita and Panchasidhantika	– Brahmagupta
Brahmasidhanata	
Miscellaneous Works	
Nitisastra	– Kamandaka
Kamsutra	– Vatsayana
Kavyalankara	– Bhamah

The Post Gupta Period (550 AD – 647 AD)

NORTHERN INDIA

Pushyabhuti dynasty: Pushyabhuti (Founder)

- The **Pushyabhuti dynasty** came in power in **Thaneswar** (Karnal in Haryana) in the beginning of the 6th century AD.
- The first important king of this dynasty was **Prabhakaravardhan** (580-605 AD).
- The Maukhari king Grahavarman assassinated Rajyavardhan's brother-in-law and imprisoned his sister Rajashree with the help of Devagupta of Malava and Shashanka of Gauda.
- Rajyavardhan inflicted a crushing defeat on Devagupta and was killed by Shashank of Gauda.
- **Harshavardhana** (AD 606–647) was the last Hindu king of North India.
- Harsha himself wrote the **Ratnavali**, Naganandam and Priyadarshika plays in Sanskrit.
- His court poet **Banabhatta** wrote his biography, the Harsha Charita.
- Harsha united the two kingdoms of Thaneswar and Kannauj and transferred his capital from Thaneswar to Kannauj.

SOUTHERN INDIA

- Capital of **Chalukyas** (AD 543-753)- **Badami** (Bagalkot district of North Karnataka)
- **Pulakeshin I** is generally attributed to be the first Chalukyan king.
- Pulakeshin II was the most prominent ruler of the dynasty who ruled from 608 A.D. and was a contemporary of Harshavardhan. He stopped Harshavardhan to march into the Deccan.
- The Pallavas initially conquered the region of Thondaimandalam.
- Narasimhavarman completed the beautiful temples of **Mahablipuram.**

Rashtrakutas (AD 753–973)

- Founded by **Dantidurg**; Krishna I built **Kailasha** temple at **Ellora**. Amoghavarsha, who is compared to Vikramaditya, wrote the first Kannada poetry Kaviraj Marg. Rashtrakutas credited for building cave shrine **Elephanta** dedicated to Shiva.

Gangas

Ruled Orissa; Narsimhadeva constructed **Sun Temple** at Konark; Anantvarman built the **Jagannath Temple** at Puri; and Kesaris who used to rule before Gangas built the **Lingaraja Temple** at Bhubaneshwar.

Pallavas (AD 600-757)

Founder-**Simhavishnu**; capital-**Kanchi**; greatest king **Narsimhavarman** who founded the town of Mamallapuram (**Mahabalipuram**) and built rock-cut raths or even pagodas.

- **Palas** dynasty was founded by Gopala I, who was elected as king of people.
- **Palas** with capital at **Monghyr** is known for Dharmapala, their second king, who founded **Vikramashila University** and revived Nalanda University.
- The greatest ruler of **Pratiharas** was Bhoja (also known as Mihir, Adivraha).
- Khajuraho temples were built during the reign of **Chandellas** of Bundelkhand.
- **Rajputs** divided into four clans:- **Pratiharas** (S Rajasthan), **Chauhans** (E Rajasthan), **Chalukyas**/Solankis (Kathiawar), **Parmaras** (Malwa).

The Cholas (AD 985-1279)

- Founder **Vijayalaya**, Capital **Tanjore**.
- **Aditya I** Chola wiped out Pallavas and weakened Pandayas.
- **Purantaka I** captured Madurai, but defeated by Rashtrakuta ruler Krishna III at the **Battle of Takkolam**.
- **Rajaraja I** (AD 985-1014) led a naval expedition against Shailendra empire (Malaya Peninsula) and conquered Northern **Sri Lanka;** constructed Rajarajeshwari (or Brihadeshvara) Shiva temple at **Tanjore**.
- **Rajendra I** (AD 1014-1044) annexed whole Sri Lanka; took the title of Gangaikonda and founded Gangaikonda Cholapuram.
- **Dancing Figure of Shiva** (Nataraja) belong to Chola period. Local self government existed.

MEDIEVAL HISTORY

EARLY MEDIEVAL PERIOD

North India (AD 800 – 1200)

- After the death of Harshavardhan three dynasties came into existence in the northern part of India and Deccan. Palas, Gurjara-Partiharas and Rashtrakutas.
- The **Palas** (750-1150 AD) ruled in **Bihar** and **Bengal** from the 8th to the 12th century.
- The Palas were supporters of Buddhism.
- The Gurjara-Pratiharas were Rajputs who ruled in Gujarat and Rajasthan and later Kanauj.
- **Nagabhata-I** was great ruler of the dynasty who defeated Muslim forces of Arab.
- **Bhoja-I** (836-885 AD) adopted the title of **Adivaraha**.
- The Rashtrakutas- Dantidurga (Founder); Capital - Manyakheta.
- The king **Amonghavarsha-I** himself authored a part of Kavirajamarga.
- The king **Krishna-I** built the famous temple of **Kailash** at Ellora.

Tripartite Struggle

- Tripartite conflict was fought among the Gurjara-Pratiharas, Rashtrkutas and Palas for the control over Kannauj.
- Kannauj was located on the Ganga trade route and was connected to the Silk route.
- The tripartite struggle continued from the end of eighth century to middle of tenth century.
- This struggle started during the reign of Vatsaraja-Pratihara.
- Both Dharmpala, the Pala king and Pratihara king, Vatsaraja clashed against each other for Kannauj.
- Nagabhata ll Pratihara finally defeated Chakrayudha and usurped the throne of Kannauj.

The Rajputs

- The period between 647 A.D. and 1192 A.D., i.e. 500 years is known as the Rajput period in the history of India.
- The most powerful Rajputs: **Gahadavalas** (Kanauj), the **Paramaras**(Malwa), and the **Chauhans** (Ajmer).
- Other smaller dynasties : Kalachuris-Jabalpur, the Chandellas in Bundelkhand), the Chalukyas (Gujarat), and the Tomars (Delhi), etc.

Dynasties	-	**Place**
Tomars	-	Delhi
Chalukyas	-	Gujarat
Chandellas	-	Bundelkhand
Kalachuris	-	Jabalpur
Pratihara	-	Southern Rajasthan
The Chauhans	-	Eastern Rajasthan
The Solankis	-	Kathiwara Gujarat
Parmars	-	Malwa

- **Prithviraj Chauhan‘s** (1178-92 AD) empire included Punjab, Haryana, Rajasthan and Uttar Pradesh.
- His court's poet **Chand Bardai** wrote Prithviraj Chauhan's biography "**Prithviraj Raso**".
- He defeated **Shahabuddin Muhammad Ghori** in the first battle of **Tarrain** in **1191**.
- In the **Second battle of Tarrain** (1192) Muhammad Ghori won and killed Prithviraj Chauhan.
- **Jayachandra** was the king of Kannauj. Muhammad Ghori defeated and killed Jayachandra in the Battle of Chadawar in 1194.
- Rana Kumbha was the ruler of Mewar, a state in western India.
- **Dilwara temples** at **Mount Abu**, the Vimala Vasahi and the Luna Vasahi were built by Solankis of Gujarat.

South India

- The founder of **Chola Kingdom**: **Vijayalaya**.
- **Rajaraja Chola** (985-1014 AD) was one of the imperialistic and greatest Chola rulers.
- He maintained diplomatic ties with countries as distant as Burma (Myanmar), China, and Malaysia across the Indian Ocean.
- He built Raja Rajeshwar Temple.
- Rajendra-I built up a new capital called Gangaikondacholapuram.
- It was divided into Mandalams (provinces), Valanadus (commissionary), Nadus (district) and Kurram (group of villages).
- The founder of Kadamba was Mayurajarmas.
- The founder of the **Hoysalas dynasty** was Sala.
- The **Gangas** were associated with the Kanva dynasty.
- The first ruler of the **Yadavs dynasty** was Bhillama V and, made **Devagiri** his capital.
- Kakatiyas were popular under the rule of Ganapati.

MEDIEVAL INDIA

The Delhi Sultanate (1206 – 1526 AD)

Dynasties of Delhi Sultanate

(i)	Slave Dynasty	:	1206-1290 AD
(ii)	Khilje ”	:	1290-1320 AD
(iii)	Tughlaq ”	:	1320-1414 AD
(iv)	Sayyid ”	:	1414-1451 AD
(v)	Lodhi ”	:	1451-1526 AD

- **Sources of Medieval Indian History**: Tarikh i Firoze Shahi (Ziauddin barani); Tuzuk-i-Mubarak Shahi (Yahaya bin Ahmed Sirhindi); Futuhat-i-Firoze Shahi (Firoze Shah Tughluq), etc.
- The invasions of Mahmud of Ghazni and Muhammad Ghori introduced a new political chapter in India.
- The campaigns of Muhammad Ghori paved the way for the rule of the Turks and the Afghans.

- **Mahmud of Ghazni** targeted the North Indian temple cities for wealth and iconoclastic fervour.
- **Muhammad Ghori** nominated his trusted and prominent **slave, Qutubuddin Aibak** as his representative to govern the newly conquered regions in India. It was the beginning of slave dynasty.
- Delhi became the centre of the Turkish and Afghan power.
- The Turkish rule from Delhi came to be known as the Delhi Sultanate.
- The phrase 'Delhi Sultanate' is applied to the history of Northern India extending from 1206 to 1526.

The Manluk dynasty or the Slove dynasty (1206-1290 AD)

- **Qutubuddin Aibak** was the founder of Slave Dynasty.
- He also began the construction of **Qutub Minar,** in the honour of famous Sufi Saint **Khwaja Qutubuddin Bakhityar Kaki**.
- He was given the title of **Lakh Bakhsh** (giver of Lakhs).
- He died in 1210 while playing Chaugan or Polo.
- **Shamsuddin Iltutmish** was a slave of Qutubuddin Aibak.
- He organised **lqta system**.
- He established the official nobility slaves known as Chahalgani/Chalisa (a group of forty).
- **Iltutmish** stopped the Mongol attack in 1221 A.D led by **Chenghiz Khan**.
- Iltutmish nominated **his daughter Razia** as the successor.
- She was the first and only Muslim lady that ever ruled in India.
- She married Altunia and they both headed towards Delhi.
- She further offended the nobles by her preference for an **Abyssian slave Yakut.**
- In 1240 A.D, **Razia** was the victim of a conspiracy and was killed near **Kaithal** (Haryana).
- After Razia, rulers were Bahram Shah, Masud Shah, Nasiruddin Mahamud.
- **Ghiyasuddin Balban** ascended the throne in 1266.
- He ended the influence of Chalisa.
- He introduced the practice of **sijda** and **paibos**.
- Kaiqubad, grandson of Balban killed by the Khilji family.
- **Jalaluddin Khilji** founded Khilji dynasty.
- Invaded the fort of Ranthambhor in 1290 and defeated Mongols in 1292.
- **Alauddin Khilji** was the nephew and son-in-law of Jalaluddin Khilji.
- He killed Jalaluddin Khilji and took over the throne in 1296.
- He was the first **Turkish Sultan of Delhi** who **separated religion from politics**.
- Alauddin took control of Gujarat (1298), Ranthambhor (1301), Mewar (1303), Malwa (1305), Jalor (1311). In Deccan, Alauddin's army led by Malik Kafur defeated Ram Chandra, Pratap Rudradeva, Vir ballal-III and Vir Pandya.
- He appointed **Diwan-i-Riyasat** and **Shahna-i-Mandi** to regulate the fixed price market.
- He abolished **Iqtas** of royal troopers and the payment of their salaries in cash.
- He constructed monuments like **Alai-Darwaza** and **Sirifort** in Delhi.
- **Ghazi Malik** with the name of Ghiyasuddin Tughluq became the Sultan of Delhi in 1320.
- His son Jauna (Ulugh Khan) succeeded him with the title "Mohammad-bin-Tughlaq".
- **Mohammad-bin-Tughlaq** organised better **postal system.**
- **Ghiyasuddin Tughlaq** ascended the throne in 1325.
- He tried to introduce many administrative reforms such as taxation in the Doab (1326), transfer of Capital to Daulatabad (1327), introduction of Token Currency (1329), etc.
- He established the city of Jahanpanah and created Diwan-i-Kohi.
- **Firoz Shah Tughlaq** established Diwan-i-Khairat (department for poor and needy people), and Diwan-l-Bundagan (department of slaves).
- He constructed some canals for irrigation.
- He repaired Qutub Minar in 1368 which had got damaged in an earthquake.
- **Khizr Khan** was the first Sultan of the **Sayyed Dynasty**.
- The other rulers of this dynasty were Mubarak Shah (1421-1434), Muhammad Shah (1434-1443), Alam Shah (1443-1451).
- **Bahlol Lodhi** (1451-88 A.D.) was an **Afghan Sardar** who founded the Lodhi dynasty.
- **Sikandar Lodhi** shifted his capital from Delhi to Agra and conquered Bihar and Western Bengal.
- He introduced the **Gaz-i-Sikandari** (Sikandar's yard) of 32 digits for measuring cultivated fields.
- **Ibrahim Lodhi** was the last king of Lodhi dynasty and the last Sultan of Delhi.
- At last **Daulat Khan Lodhi**, the governor of Punjab invited Babur to overthrow Ibrahim Lodhi, Babur accepted the offer and inflicted a crushing defeat on Ibrahim Lodhi in the **first battle of Panipat** in 1526.
- There were five types of taxes. (i) Ushra (ii) Kharaj (iii) Khams (iv) Jazia (v) Zakat.

Causes of the decline of Delhi Sultanate

(i) Weak system of government.
(ii) The invasion of Taimur.
(iii) Lack of clear cut succession policy.
(iv) Ibrahim Lodhi was a foolish emperor.
(v) Greed for wealth and luxury among nobles.

Vijaynagar Empire (1336-1565 AD)

- The **Vijayanagar Empire** was a South Indian dynasty based in the **Deccan** on the South bank of **Tungabhadra** River.
- There were four dynasties ruled over Vijaynagar — Sangama Dynasty, Saluva Dynasty, Tuluva Dynasty and Aravidu Dynasty.
- **Hariharan I** (Hakka) and Bukka (the sons of Sangama) established Vijaynagar kingdom.
- **Harihara I** was the founder of the **Sangama** dynasty.
- Harihara was controlling northern portion of Hoysala kingdom.

- **Bukka Raya** ruled the kingdom for about twenty one years.
- Bukka died in about 1380 and was succeeded by Harihara II.
- Other kings of Vijaynagar Kingdom are Harihara Raya II, Virupaksha Raya, Bukka Raya II, Deva Raya I, Deva Raya II, Mallikarjuna Raya, Virupaksha Raya II.
- Virupaksha's son, **Praudharaya** was a weak king and his general Saluva Narasimha took control of the empire in 1485.
- **Saluva Narasimha** was the founder of Saluva Dynasty.
- Thimma Bhupala was the elder son of Saluva Narasimha Deva Raya.
- **Narasimha Raya II** (Immadi Narasimha) was the second son of King Saluva Narasimha Deva Raya. The real power was in the hands of the empire's able commander Tuluva Narasa Nayaka till his death in 1503.
- **Sri Krishna Deva Raya** was the most famous king of Vijayanagara Empire. He belonged to the **tuluva bunt** community.
- Rama Raya was popularly known as **"Aliya"** Rama Raya, was the progenitor of the "Aravidu" dynasty of Vijayanagar Empire.
- Later Kings of Vijaynagar: Tirumala Deva Raya, Sriranga Deva Raya, Venkatapati Deva Raya, Sriranga III.

Bahmani Kingdom

- The Bahmani Kingdom of Deccan's capital was **Gulbarga**.
- It was founded by Hasan Gangu (original name–Ismail Mukh).
- He took the tittle of Alauddin Hasan, Bahaman Shah.
- He ruled from AD 1347 to 1358.
- His son, Mahmud Shah I ruled from AD 1358 to 75. He was succeeded by his son, Ala-ud-din Majahid Shah.
- Firoz Shah was the most important ruler who ruled from AD 1397 to 1422.
- Ahmed Shah succeeded his brother in AD 1422 and ruled upto AD 1436.
- He was succeeded by his son Alauddin-II (AD 1436-58).
- Kalim Ullah Shah (AD 1524-27) was the last ruler of Bahmani Kingdom.

RELIGIOUS MOVEMENTS

Bhakti Movement

- **Bhakti** means personal devotion to God. It stresses the Union of the individual with God.
- **Bhakti movement** originated in South India between the 7th and the 12th centuries AD.
- The **Nayanmars**, who worshipped Siva, and the Alwars, who worshipped Vishnu, preached the idea of Bhakti.
- Saints like Sankara, Ramanuja and Madhwa gave their concepts of God and the individual soul.
- Teachings of **Ramanuja** were based on the **Upanishads** and **Bhagwad** Gita.
- **Ramananda** was disciple of Ramunaja. He was the first reformer to preach in Hindi.
- **Kabir** was an ardent disciple of Ramananda. He wanted unity between the Hindus and the Muslims.
- He preached that both the Hindus and the Muslims are the children of a single God.
- The devotees of Kabir were known as **Kabir Panthis.**
- **Namdeva** was a waterman by birth. He composed beautiful hymns in Marathi.
- **Nanak** was the founder of the Sikh religion.
- Nanak's teachings were in the form of verses. They were collected in a book called the **Adi Granth**.
- Later Adi Grantham was written in a script called **Gurmukhi**.
- **Chaitaniya**, a great devotee of Lord Krishna, was a saint from Bengal.
- **Meerabai** was a Rajput princess. She married the Rana of Mewar. She was a pious devotee of Lord Krishna.
- **Chatrapati Shivaji**, the great Maratha ruler, was a follower of Ramdas.
- **Tukaram** was a saint who lived in Maharashtra. He composed a large number of verses called **Abhangas.**
- **Tulsidas** composed the famous **Ramcharitamanas** in Hindi, expounding the various aspects of Hindu dharma.
- **Surdas** was a devotee of Lord Krishna and Radha. His works include **Sursagar**, **Sahitya Ratna** and Sur Sarawali.
- **Dadu Dayal** was a disciple of Kabir. His followers were known as Dadu Panthis.
- **Eknath** was a devotee of Vithoba. He wrote commentary on verses of the Bhagavad Gita.

The Sufi Movement

- **Sufism** is basically a religion based on the truth of life. The **mystics of Islam** are called **Sufis**.
- It emerged in India in 11th & 12th century A.D.
- It established brotherhood between Hindus & Muslims.
- It is a socio-religious movement.
- The founders of the most important Sufi lineage Chisti, Suhrawardi, Qadiri, Naqshbandi originally came from central and west Asia.
- The prominent sufi saints were Khwaja Nizamuddin Aulia, Ganj-e-Shakar Fariduddin, Qutubuddin Bakhtiyar Kaki and Hamuddin Nagori .
- **Hazrat Nizam-ud-Din** was the disciple of Fariduddin Ganj-i-Shakkar.
- **Qutbuddin Bakhtiar Kaki** was the disciple and the spiritual successor of Moinuddin Chishti.

Khwaja Moinuddin Chishti (1142-1236 AD)

- The Chisti order of Sufism was founded in **village Khwaja** Chishti near **Herat** in Persia, i.e. Iran.
- In India, Chisti silsila was founded by Khwaja Moinuddin Chishti (born 1142 AD).
- He came to India around AD 1192.
- He made **Ajmer** the main centre for his teachings.
- He died in Ajmer in 1236.

The Mughals (1526-1540 and 1555-1857)

EMPERORS OF MUGHAL DYNASTY

- The **Mughul era** began with the Babur's victory over Ibrahim Lodi in the First Battle Of Panipat in 1526.'
- **Babur (AD 1526-30)** Babur was the first Mughal Emperor of India. He was from the princely **family of mixed Mongol and Turkish blood**.
- He defeated Mewar ruler Rana Sanga in the **Battle Of Khanwa** in 1527 and Medini Rai in the **Battle of Chanderi** (1528).
- He died in 1530.
- **Babur** wrote his biography **Baburnama** which is also known as **Tuzk-e Babri.**

Humayun (AD 1530-40 & 55-56)

- **Humayun** succeeded Babur at the young age of 23 in 1530.
- He was defeated in the Battle of Chausa (1539) and Battle of Kanauj (1540) by **Sher Shah Suri** who became the ruler of Agra and Delhi.
- The Humayun's Tomb was built by his widow Haji Begum in Delhi.
- Humayun's sister **Gulbadan Begum** wrote **Humayunnama**.
- He died in 1556.
- The real name of **Sher Shah** was **Farid**.
- During the siege of the fort of **Kalinjar** one of the cannons accidentally went off killing him on 26th of May 1535.
- He was buried in **Sasaram** (Bihar).
- He built **Purana Qila** in Delhi.
- He constructed important roads:
  - (i) Grand Trunk (G.T.) road from Sunargaon to Peshawar.
  - (ii) Agra to Multan Via Burhanpur and Delhi.
  - (iii) Multan to Lahore.
  - (iv) Mandu to Agra.
- **Bairam Khan** became the Wakil of the kingdom with the title of Khan-i-Khana.

Akbar (AD 1556-1605)

- **Akbar** was crowned at **Kalanaur** at the age of 13 years in 1556.
- Akbar reoccupied Delhi and Agra in the second battle of Panipat with Hemu, a general of Adil Shah in 1556.
- Akbar's armies had conquered Kashmir, Sindh, Orrisa, Central India and also conquered Gujarat (1572-1573) and Bengal (1574-1576).
- Akbar's last campaign was against Asirgarh, resulting in the annexation of Khandesh (1601).
- He built the Buland Darwaza at Fatehpur Sikri.
- **Bhagwan Das** and Maan Singh enjoyed a privileged position in the Mughal court.
- **Akbar** built many buildings like **Agra Fort** (1565), **Lahore Palace** (1572), Fatehpur Sikri, Buland Darwaza and Allahabad Fort (1583).
- He died in 1605.

Main Events During the reign of Akbar

Year	Major Events
1562	Abolition of Slavery
1563	Abolition of Pilgrimage Tax.
1564	Abolition of Jaziya.
1575	Ibadatkhana was built in Fatehpur Sikri
1578	Parliament of Religions in *Ibadatkhana*.
1579	Proclamation of "*Marhar*'
1582	Proclamation of *Tauhid-i-illahi*.
1575-76	Entire empire divided into 12 provinces (After victory of south it became 15)
1582	'*Dahsala system*' introduced by Todarmal.
1573-74	'*Mansabdari system*' introduced after victory over Gujarat.

Jahangir (AD 1605-1627)

- The real name of **Jahangir** was **Salim**.
- Jahangir married **Mehr-un-Nisa** who assumed the title of **'Nur Jahan'** (Light of the world)
- Jahangir's most irksome foe was the Rana of Mewar, Amar Singh who finally capitulated in 1613 AD to Khurram's forces.
- He conquered three Kingdoms - Mewar, Kangra and Ahmadnagar in South India.
- His wife Nur Jahan built Itimad-ud-Daula's (another name of Mirza Ghiyas Beg) Marble tomb at Agra.
- He built **Moti Mahal** in Lahore and his own Mausoleum at **Shahdara (Lahore)**.
- He crushed the rebellion of his own son Khusro and made him blind.
- His son **Khurram** (Shah Jahan) rebelled against him at the end of his reign.

Shah Jahan

- **Shah Jahan** became emperor in 1627 and exhibited modernization as a ruler.
- He faced revolts in the Deccan and Bundelkhand by Jujhar Singh, the son of Bir Singh Bundela.
- He was married to the daughter of **Asaf Khan** named **Arjumand Bano Begum,** also known as **Mumtaz Mahal**.
- He built the **Taj Mahal** in Agra and the Jama Masjid (sand stone) in Delhi.
- **Ustad Isa** was the master **architect** under whose guidance the Taj Mahal was designed and constructed in Agra.
- He built the Red Fort and **Taqt-i-Taus (Peacock Throne)** in Shahjahanabad.

Auranzeb (AD 1658-1707)

- **Aurangzeb** was also called as **Zinda Pir** (the living saint).
- He had to face many problems such as problems of the Marathas in the Deccan, the Jats, and Satnamis and Rajputs in north India, and that of Chip Khans and Sikh in the north-west.
- His direct attention was concentrated on the affairs of north India but during 1681, the affairs of the South Central around the rise of the Marathas power under Shivaji.

- The **Mughul** conquest reached a climax during his reign.
- The second coronation of Aurangzeb took place when he defeated Dara (1659).
- He **forbade inscription of Kalma on the coins** and banned music in the court.
- He ended Jarokha Darsha , celebration of Navroz but **Jaziya** (tax on non-Muslims) was reintroduced by him.
- Prince Azam Shah built **Bibi Ka Makbara**, which is the tomb of his mother Rabbia-ul-Daurani at **Aurangabad** (1651-1661 AD).
- He died in 1707 AD.

The Later Mughals

- **Muazzam** ascended the Mughal throne with the title of **Bahadur Shah**.
- He pursued pacifist policy and was called **Shah Bekhabar**.
- He also assumed the title of **Shah Alam** I.
- Other successors of the Mughal Empire: Jahandar Shah, Farrukhsiyar, Mohammad Shah, Ahmed Shah, Alamgir, Shah Alam II, Akbar Shah II, Bahadur Shah Zafar (1837-1862).
- **Farrukhsiyar** ascended the throne with help of Sayyid brothers, Abdullah Khan and Hussain Khan.
- **Nadir Shah** raided India in 1738-39 and took away the **peacock throne** and **Kohinoor diamond** during the reign of Mohammad Shah (1719-48).
- The **Battle of Buxar** (1764) was fought during the reign of Shah Alam II.
- **Bahadur Shah Zafar** was the last Mughal king.
- He was proclaimed the Emperor by the rebellions during the revolt of 1857 and was deported to **Rangoon** following the 1857 rebellion.
- Famous painters: Khwaja Abdul Samad, Mir Saiyyad Ali, Mansoor, etc.
- **Tansen** was the musician of Akbar's court.
- Principal articles of export to Europe and other countries were indigo, opium, pepper, etc.
- Articles of import were horses, Chinese porcelain and African slaves, etc.
- **Aurangzeb's** death in 1707 caused the rapid decline of Mughal empire.

Women of the Mughal Family

Gulbadan Begum : the sister of Humayun.
Noor Jahan (Meherunnisa): Wife of Jahangir, daughter of Ghiyas Beg (Idmatuddaula).
Mumtaz Mahal (Anjumand Banu Begum): Wife of Shah Jahan, mother of 14 children.
Jahan Ara: Daughter of Shah Jahan.
Rabiaul-Daurani (Dilras Banu Begum): The first wife of Aurangzeb.

Mughal Buildings & Builder

Humayun's Tomb (Delhi) : Bega Begum
Buland Darwaza (Fatehpur Sikri) : Akbar
Shalimar Bagh (Srinagar) : Jahangir
Akbar's Tomb (Sikandara, Agra) : Began by Akbar and finished by Jahangir.
Tomb of Itmaduddaula (Agra) : Nur Jahan
Tomb of Jahangir (Shahdara Bagh, Lahore) : Shah Jahan
Taj Mahal (Agra) : Shah Jahan
Red Fort (Delhi) : Shah Jahan
Shalimar Gardens (Lahore) : Shah Jahan
Bibi Ka Maqbara (Aurangabad) : Azam Shah
Salim Chisti's Tomb (Fatehpur Sikri) : Akbar

Name of the Book- Author

Tuzk-i-Babari : Babar
Humayun Namah : Gulbadan Begum
Akbarnama, Aini Akbari : Abul Fazl
TuzkiJahangiri : Jahangir
Shah Jahan Namah : Inayat Khan
Padshah Namah (about Shah Jahan): Abdul Hamid Lahori
Alamgirnama (about Aurangzeb) : Mirza Muhammad Kazim

Battles Fought Between

1st Battle of Panipat (1526) : Babur and Ibrahim Lodhi
Battle of Khanwa (1527) : Babur and Rana Sunga.
Battle of Chausa (1539) : Sher Shah Suri and Humayun
2nd Battle of Panipat (1556) : Akbar and Hemu
Battle of Haldighati (1576) : Raja Maan Singh (Mughal army) and Rana Pratap
Battle of Samugarh (1658) : Aurangzeb and Dara Shikoh
Battle of Khanwa (1659) : Aurangzeb and brother Shah Shuja
Battle of Karnal (1739) : Nadir Shah and Muhammad Shah(Mughal)

	Foreign Travellers	Reign
1.	**Marco Polo**	Pandya kingdom
2.	**Ibn Batuta**	Muhammad bin Tughlaq
3.	**Nicolo Conti**	Deva Raya I
4.	**Abdur Razaq**	Deva Raya II
5.	**Nikitin**	Bahmani kingdom
6.	**Nuniz**	Krishna Deva Raya
7.	**Ralph Fitch**	Akbar
8.	**William Hawkins**	Jehangir
9.	**Thomas Roe**	Jehangir
10.	**Peter Mundy**	Shah Jahan
11.	**Tavernier**	Aurangzeb
12.	**Bernier**	Aurangzeb
13.	**Nicolo Manucci**	Aurangzeb.

Maratha State (1674-1818)

- **Shivaji** was born at Shivner, Poona and died on April 3, 1680 in Rajgarh.
- He was founder of the Maratha kingdom of India.
- **Shahji Bhonsle** was the father and Jija Bai was the mother of Shivaji.
- Shivaji inherited the Jagir of Poona from his father in 1637.
- After the death of his guardian Dadaji Kondadev Shivaji took over full charge of his Jagir.
- In 1659, **Shivaji killed Afzal Khan** who was deputed by Adil Shah to suppress him.

- **Ashta Pradhan Mandal** was the Cabinet of Eight Ministers in the court of Shivaji.
- Ashta Pradhan- Peshwa (Prime Minister), Muzumdar (Finance Minister), Surnis (Minister for Land Revenue, Vaknis (Minister for Internal and External Intelligence), Dabir (Minster for External Affairs), Sarnaubat (Commander-in-Chief), Nyayadhish (Chief Justice).

Sikh Gurus

- **Nanak** (1469-1539) founded Sikh religion.
- **Angad** (1538-52) invented **Gurmukhi**.
- **Amardas** (1552-74) struggled against **sati system** and **purdah system** and established 22 Gadiyans to propagate religion.
- **Ramdas** (1574-81) founded Amritsar in 1577. Akbar granted the land.
- **Arjun** (1581-1606) founded **Swarn Mandir** (Golden Temple) and composed Adi Granth.
- **Hargobind Singh** (1606-45) established **Akal Takht** and fortified Amritsar.
- **Har Rai** (l 645-66)
- **Harkishan** (1661-64)
- **Tegh Bahadur** (1664-75)
- **Gobind Singh** (1675-1708) was the last Guru who founded the **Khalsa**. After him Sikh guruship ended.

MODERN HISTORY

ARRIVAL OF EUROPEANS IN INDIA

Portuguese

- On 17th May 1498, **Vasco da Gama**, a Portuguese navigator, came to **Calicut**.
- He found new trade route from Europe to Asia via **Cape of Good Hope**.
- He became the first European to re-establish trade relations with India.
- He was welcomed with honour by the Zamorin of Calicut.
- He returned back to Portugal in AD 1499.
- His second visit in 1502 established Portuguese Trading Centres at Calicut, Cannanore and Cochin.
- **Cochin** was the first capital of the Portuguese in India which was shifted to Goa later on.

Dutch

- Dutch arrived in India as a beginning of Portuguese decline in 1605.
- The Dutch East India company of Netherlands was formed in 1592 to trade with East Indies.
- **Cornelis Houtman** was the first Dutch who came to India.
- The Dutch established trading centres at **Nagapatnam** in Tamil Nadu; **Machlipatnam** in Andhra Pradesh, **Chinsora** in Bengal & at **Mahe** on the Malabar coast.
- Their **headquarter** in India was at Nagapatnam.
- They could not compete with Portuguese & English and so left India.

French

- In AD 1664 French came to India as a last European Community.
- The French East India Company was founded by **Jean Baptiste Colbert.**
- In 1667, the first French Factory was established at Surat.
- The second Factory was established at Masulipatnam in 1669.
- Franco Martin was the well-known French Viceroy in India.
- Joseph-Francois Duplex was the most powerful French Governor, appointed in 1742.
- The Anglo-French rivalry can be acknowledged by the three Carnatic wars fought between French & English during 1745 & 1763.

Danes

- In 1616 the Danes came to India.
- They established at **Tranquebar (Tamil Nadu)** in 1620 and Serampore (Bengal) in 1676.
- They made Serampore as their headquarters.
- In 1854 they were pressured to sell their establishment to the British.

EAST INDIA COMPANY

- **Company rule** in India effectively began in 1757 after the **Battle of Plassey**.
- In the Battle of Plassey, Nawab of Bengal surrendered his dominions to the Company.
- Company was granted the diwani, or the right to collect revenue, in Bengal and Bihar in 1765.
- When the Company established a capital in Calcutta, **Warren Hastings** was appointed the **first Governor General**.
- Company's rule lasted until 1858 after Indian rebellion of 1857.
- **Siraj-ud-Daula** was the last independent Nawab of Bengal who succeeded Alivardi Khan to the throne.
- The end of his reign marks the end of the independent rule in India and beginning of the company's rule that continued unabated over the next two hundred years.
- **Mir Jafar Ali Khan Bahadur**, commonly known as Mir Jafar, (c. 1691–February 5, 1765) was the **first Nawab of Bengal under Company rule** in India.
- After Siraj decline Mir Jafar was installed as the Nawab in 1757 by the British East India Company.
- **Mir Qasim** (May 8, 1777) was the Nawab of Bengal from 1760 to 1763.
- The **Battle of Buxar** was fought on 23 October **1764** between East India Company led by **Hector Munro** and the combined army of **Mir Qasim**, the Nawab of Bengal: the **Nawab of Awadh** and the **Mughal King Shah Alam II.**

Governors of Bengal and Governor Generals of India

Name and Tenure	Well Known For	War fought
Robert Clive (1758-60) and (1765-67)	• ***Diarchy*** *of Dual Government* of Bengal from 1765-72. • Considered as one of the creators of British power in India.	• *Battle of Plassey* (1757) • Battle of Condore (1758)
Henry Vansittart (1760-65)	• Deposed Mir Jafar, the Nawab of Bengal, and replaced him with his son-in-law Mir Qasim.	• Battle of Buxar
Harry Verelst 1767-69	• Increased tax revenue of the East India Company. • Exposed corruption within the company.	
John Cartier (1769-1772)	• The Great Famine of Bengal 1770 occured in his regime which claimed about two million lives	
Warren Hastings (1772-85)	• Founding *Asiatic Society of Bengal* • Auctioning the right to collect land revenue to its highest bid • Starting *Diwani* and *Fauzdari Adalats* in district level and *Nizam Adalats at Kolkata*	• *Rohilla war* (1774) • *1st Anglo-Maratha War* (1776-82) • *2nd Anglo-Mysore War* (1780-84)
Lord Cornwallis (1786-93)	• Codifying laws in 1793 so as to separate the administration for revenue and justice • *Abolition of all the superfluous posts.* • *Creating the post of District judge.* • *Establishment of lower grade court.* • *Father of Civil Services in India.*	• *3rd Anglo-Mysore War* against Tipu Sultan and signed the treaty of Srirangapatnam in 1792
Sir John Shore (1793-98)	• 1st Charter of Act in 1793	• *Battle of Kharda* between Nizam and Marathas in 1793
Lord Wellesley (1798-1805)	• Started subsidiary alliance to achieve British dominancy over India • *Forming Madras Presidency*	• *4th Anglo-Mysore war* in 1799 and with defeat and death of Tipu Sulatan • *Treaty of Bassein* in 1802 • *2nd Anglo-Maratha war* from 1803-1805 defeating Scindia, Bhonsle and Holkar
Sir George Barlow (1805-1807)	• *Vellore Mutiny* in 1806	
Lord Minto (1807-1813)	• Concluding *Treaty of Amritsar* with Raja Ranjit Singh • *Charter of Act 1813* was passed	
Lord Hastings (1813-1823)	• Adopting the Policies of intervention and wars • Forceful implementation humiliating treaties or Peshwas and Scindias.	• *Anglo-Nepalese war* (1813-23)
Lord Amherst (1823-28)	• Acquisition of Malayan Peninsular territories • *Capturing* Bharatpur	• *First Burmese War* (1824-26)
Lord William Bentinck (1828-35)	• *Abolition of Sati* and other cruel rites in 1829 • *Annexation of Mysore.* • Concluding a treaty of perpetual friendship with Ranjit Singh (1831) • He was also known as *Father of Modern Western Education in India.* • He was last Governor General of Bengal who later continued his service as the first Governor General of India from 1833 to 1835	• Occupied Coorg and Central Cachar in 1834 on the plea of mis governance
Sir Charles Metcalfe (1834-36)	• Passed the famous *Press Law* which liberated the press in India	
Lord Auckland (1836-42)	• Extended irrigation • Inaugurated famine relief	• 1st Anglo Afgan war (1836-42)

Lord Ellen borough (1842-44)	• Brought an end to Afgan war. • Annexed Sindh in 1843	• War with Gwalior (1843)
Lord Hardinge (1844-48)	• Gave preference to English education • Treaty of Lahore in 1846	• 1st Anglo Sikh war (1845-46)
Lord Dalhousie (1848-56)	• Abolished titles and pensions • Passed widow Re-marriage Act 1856. • Introduced "*Doctrine of Lapse*" • Annexed Punjab, lower Burma or Pegu and Awadh. • Started railway, post and telegraph service.	• 2nd Anglo Sikh war (1848-49) • 2nd Anglo Burmese war, 1852.

RULE OF THE BRITISH GOVERNORS AND GOVERNOR GENERALS

Lord Chive

- After the victory of the English in Buxar, Clive was appointed the governor and **commander-in-chief** of the English possessions in Bengal.
- He settled relations with Oudh by the **Treaty of Allahabad** in 1765.

Warren Hastings

He was appointed the Governor of Bengal in 1772.

- To bring forth a reform in the affairs of revenue Warren Hastings introduced a five year settlement of land revenue in 1772.
- In 1773 **the Regulating Act** was passed which provided for the setting up of a supreme court to try all British subjects.
- Warren Hasting faced an uphill task in dealing with the Indian rulers. He faced stiff resistance from the Marathas in the North and Hyder Ali in the South.

Lord Cornwalis

- The court of Directors sent Cornwallis in 1786 to carry out the policy of peace outlined in **Pitts in India Act** to reorganise the administrative set up of the country.
- This **Permanent Settlement** was introduced by **Cornwallis**.
- Other incidents: **Treaty of Seringapatam** (1792), third Anglo-Mysore War - defeat of Tipu Sultan (1790-92).

Sir John Shore

- **Sir John Shore** succeeded Cornwallis and followed a policy of non-intervention in the affairs of the native states.

Lord Wellesley

He is considered to be one of the most brilliant Governor Generals of Bengal.

- He **introduced the Subsidiary Alliance system** to undo with the French influence and bring the Indian states within the purview of the British power of Jurisdiction.
- On 3rd July 1805, **Lord Cornwallis** came back as the Governor General for the second time. He died on 5th Oct. 1805.
- **George Barlow (1805-1807)** was followed by Lord Minto who was the president of the Board of Control before he became the governor general of the Company.
  Lord Minto-I (1807-13) was followed by Lord Hastings who governed from 1813 to 1823.
- His rule is famous for a treaty with Shah of Persia and Treaty of Amritsar (1809) with Ranjit Singh.
- **Marquess of Hastings (1813-1823)**– He was the first to appoint Indians to the highest posts of responsibility. The **first vernacular newspaper Samachar Patrika** published during his time.
- **Lord Amherst (1823-1828)**– His reign is known for the first Anglo Burmese War (1824-26) and **mutiny of Barrackpur** (1824).
- **Lord William Bentinck (1828-35)**– English accepted as the medium of instruction after the famous Macaulay's recommendation; Medical colleges at Calcutta in 1835; Charter Act of 1833 was passed and he was made the first Governor General of India; Abolition of sati in 1829.
- **Sir Charles Metcalfe (1835-36)**– He removed the restriction on the vernacular press.
- **Lord Auckland (1836-42)**– Important events of his regime included the outbreak of first Afghan war and the signing of a Tripartite Treaty among the English, Ranjit Singh and Shah Shuja of Afghanistan.
- **Lord Ellenborough (1842-44)**– His period is known for the end of the first Afghan war, annexation of Sindh to the British Empire (1843).
- **Lord Hardinge (1844-48)**– The most important event of his tenure is the **First Sikh War** (1845-1846).
- **Lord Dalhousie (1848-56)**– **Doctrine of Lapse**, The Second Burmese war, The Second Anglo Sikh War, Shimla made the summer capital, **First railway line was laid from Bombay to Thane, in 1853.**
- **Lord Canning (1856-58)** - Annexation of Avadh, enactment of Hindu Widow Remarriage Bill, 1857, **establishment of universities at Calcutta, Madras and Bombay, revolt of 1857**.

➢ Following the Queen's recommendation in 1858, transferring the Government from the company to the British Crown, **Lord Canning** was made the **first Viceroy** of India.

- **Lord Elgin Ist (1862) -** Suppression of the Wahabi tribe.
- **Lord John Lawrence (1864-69)**– Two famines hit India; first in 1800 in Orisa and second in 1868-69 in Bundelkhand and Rajputana.

- ➢ A Famine Commission was set up under the chairmanship of Sir Henry Campbell.
- **Lord Mayo (1869-72)–** Organised **first census** which was held **in 1871** and started the process of financial decentralisation in India. Established the Department of Agriculture and commerce.
- **Lord Northbrook (1872-76)–** The Kuka movement; visit of Prince of Wales, famine in Bihar and Bengal in 1873-1874.
- **Lord Lytton (1876-80)–** The Delhi Durbar, January 1, 1877 and the Ver**nacular Press Act,** 1878.
- **Lord Ripon (1880-84)–** First factory Act of 1881. **Local Self - Government was introduced in 1882.** Repeal of Vernacular Press act.
- **Lord Dufferin (1884-88)–** Third Anglo Burmese war, **Establishment of Indian national congress in 1885.**
- **Lord Lansdowne (1888-94)–** Factory Act of 1891 granted weekly holiday and stipulated working hours for women and children.
- ➢ Civil services were divided into imperial, Provincial and Subordinate Services.
  Indian Councils Act of 1892.
- ➢ The **Durand Commission** defined the Durand Line between British India and Afghanistan (now between Pakistan and Afghanistan) in 1893.
- **Lord Elgin II (1894-99)–** Southern uprisings of 1899. Great famine of 1896-1897 and **Lyall Commission** on famine was established.
- **Lord Curzon (1899-1905) -** Famine Commission, Agriculture Research Institute at Pusa, **Partition of Bengal** in 1905.
- **Lord Minto II (1905-10)–** Minto-Morley Reforms in 1909. Swadeshi movement (1905-08), foundation of Muslim League (1906), Surat session and split in the congress (1907).
- **Lord Hardinge II (1910-16)–** In the honour of King George V and Queen Mary of England, Coronation Darbar was held at Delhi.
- ➢ **Capital of country was announced to be shifted from Calcutta to Delhi.**
- ➢ **The First World War broke out in 1914.**
- **Lord Chelmsford (1916-21)–** Government of India Act 1919 (Montague-Chelmsford Reforms), enactment of Rowlatt Act (1919), **Jallianwala Bagh Tragedy (1919),** beginning of the Non-co-operation Movement.
- **Lord Reading (1921-26) –** Repeal of Rowalatt Act, Chauri-Chaura incident; Moplah Rebellion (1921) took place Kakori Train Robbery; Communal Riots of 1923-25 in Multan, Amritsar, Delhi, etc.
- **Lord Irwin (1926-31)–** Appointment of **Simon Commission** in 1928. Gandhi-Irwin Pact in 1931; First Round Table Conference (1930).
- **Lord Willington (1931-36)–** The Second Round Table Conference 1931, The communal award, 1932, the Poona pact, Third Round Table Conference, 1932.
- **Lord Linlithgow (1936-43) -** Beginning of the Second World War. Arrival of the Cripps Mission. Beginning of the Quit India Movement.
- **Lord Wavell (1944-47)-** Wavell Plan and Shimla Conference, Cabinet Mission (Lawrence, Cripps and Alexander), Direct Action Day" on August 16, 1946, Attlee's Declaration,
- **Lord Mountbatten, (March 1947-June 1948) Last Viceroy of British India** and **first-Governor general of free India.** Partition of India in third week of June, 1947; Indian Independence Act, Partition of the country between two independent states of India and Pakistan. He was **succeeded by C. Rajagopalachari.**

Some Important rulers in India (1720-1949)

Ruler	Period	Place
1. Sadat Khan Burhan-ul-Mulk	1722-39	Awadh
2. Safdar Jung	1739-54	Awadh
3. Shuja-ud-daulah	1754-75	Awadh
4. Asaf-ud-daulah	1775-97	Awadh
5. Wazir Ali	1797-98	Awadh
6. Nizam-ul-Mulk Asaf Jah	1724-48	Hyderabad
7. Nasir Jung	1748-50	Hyderabad
8. Muzaffar Jung	1750-51	Hyderabad
9. Salabat Jung	1751-60	Hyderabad
10. Nizam Ali	1760-1803	Hyderabad
11. Sikandar Jah	1803-29	Hyderabad
12. Nasir-ud-daulah	1829-57	Hyderabad
13. Afjal-ud-daulah	1857-69	Hyderabad
14. Mahabat Ali Khan	1869-1911	Hyderabad
15. Osman Ali Khan	1911-49	Hyderabad
16. Hyder Ali	1761-82	Mysore
17. Tipu Sultan	1782-99	Mysore
18. Ranjit Singh	1792-1839	Punjab

Some important Nawabs of Bengal (1717-1772)

Nawabs	Period
1. Murshid Quli Khan	1717-27
2. Suf-ud-din	1727-39
3. Sarfraz Khan	1739-40
4. Alivardi Khan	1740-56
5. Siraj-ud-daulah	1756-57
6. Mir Jafar	1757-60
7. Mir Qasim	1760-63
8. Mir Jafar	1763-65
9. Najm-ud daulah	1765-72

THE REVOLT OF 1857

- **Political Causes:** The policy of Doctrine of Lapse.
- **Nana Sahib** was refused pension, as he was the adopted son of Peshwa Baji Rao I.

- Rani Laxmi Bai's adopted son was not recognized by the East India Company as the heir to Jhansi.
- Bahadur Shah's successor was denied the right to live at the Red Fort.
- **Economic Causes:** Heavy taxation, evictions, discriminatory tariff policy against Indian products, destruction of traditional handicrafts.
- **Military Discrimination:** Discrimination between the Indian and the British soldiers.
- **Religious Discrimination:** The introduction of Enfield rifle, the cartridge of which was greased with animal fat, provided the spark.
- On March 29, 1857, a soldier named **Mangal Pandey** attacked and fired at his senior at Barrackpur in Bengal (in 19th and 34th Native infantry).
- Mutiny spread throughout UP along with some other parts of the country.
- **Mughal emperor Bahadur Shah II** was proclaimed the Emperor of India.
- **Causes of Failure of the Revolt:** Lack of planning, organization and leadership.
- Some Indians supported the British in suppressing the revolt as **Scindia of Gwalior, the Holkar of Indore**, the **Nizam of Hyderabad, the Raja of Jodhpur, the Nawab of Bhopal, the rulers of Patiala, Sindh and Kashmir and the Rana of Nepal.**
- The revolt was mainly feudal in character carrying with it some nationalist elements.
- The control of Indian administration was passed on to the British crown by the Government of India Act, 1858.
- After the revolt, the British pursued the policy of **Divide and Rule.**

SOCIAL AND CULTURAL REFORMS

- **Raja Rammohan Roy** established the **Brahmo Samaj** at Calcutta in 1828 in order to purify Hinduism and to preach **monotheism**.
- He established the **Atmiya Sabha** in 1815.
- Raja Rammohan Roy is most remembered for helping Lord William Bentinck to declare the practice of Sati a punishable offence in 1829.
- **Henry Vivian Derozio** was the founder of the Young Bengal Movement.
- The **Arya Samaj** was founded by Swami Dayanand **Saraswati** at Bombay in 1875.
- He believed the Vedas were the source of true knowledge. His motto was **"Back to the Vedas".**
- He was against idol worship, child marriage and caste system based on birth.
- The first Dayanand Anglo-Vedic (DAV) School was founded in 1886 at Lahore.
- The **Prarthana Samaj** was founded in 1867 in Bombay by **Dr. Atmaram Pandurang.**
- The original name of **Swami Vivekananda** was Narendranath Dutta (1863-1902).
- He was famous disciple of Shri **Ramkrishna Paramahamsa**.
- Swami Vivekananda participated at the Parliament of Religions held in Chicago (USA) in September 1893 and raised the prestige of India and Hinduism very high.
- The **Theosophical Society** was founded in New York (USA) in 1875 by **Madam H.P. Blavatsky,** a Russian lady, and **Henry Steel Olcott,** an American colonel.
- **Pandit Ishwar Chandra Vidyasagar** helped J.D. Bethune to establish the Bethune School.
- **Jyotiba Phule** founded the Satyashodak Samaj In 1873.
- The **Aligarh Movement** was started by **Sir Syed Ahmad Khan** (1817-98) for the social and educational advancement of the Muslims in India.
- **Baba Dayal Das** founded the Nirankari Movement.
- The **Namdhari Movement** was founded by Baba Ram Singh.

THE FREEDOM STRUGGLE

- The **Indian National Congress** was founded on 28 December 1885 by Allan Octavian Hume.
- The first meeting was scheduled to be held in Pune but due to a plague outbreak there, the meeting was later shifted to Bombay.
- **Womesh Chandra (W.C.) Bonnerjee** was the **first President of the INC.**
- The **first session of the INC was** held **from 28–31 December 1885, and was attended by 72 delegates.**
- The decision to effect the **Partition of Bengal** was announced in July 1905 by the Viceroy of India, Lord Curzon.
- The partition took place in 16 October 1905 and separated the largely Muslim eastern areas from the largely Hindu western areas.
- Bengal was reunited in 1911.
- **Surat Split** is mainly known for separation of Congress partymen into moderates and extremists at the Surat session of Congress in 26 December 1907.
- The extremists were led by Lokmanya Tilak, Lajpat Rai and Bipin Chandra Pal, and the Moderates were led by Gopal Krishna Gokhale, Pheroze Shah Mehta and Surendranath Banerjee.
- The divided Congress re-united in the crucial Lucknow session of Congress in 1916.
- The **Indian Councils Act 1909**, commonly known as the **Morley-Minto Reforms**, was an Act of the Parliament of the United Kingdom that brought about a limited increase in the involvement of Indians in the governance of British India.
- The act was formulated by John Morley, secretary of state for India (1905–10).
- **Lord Minto** was the Viceroy of India (1905–10).
- The Act amended the Indian Councils Acts of 1861 and 1892.
- The **Swadeshi movement** started with the partition of Bengal by the Viceroy of India, Lord Curzon, 1905.
- It was the most successful of the pre-Gandhian movements. Its chief architects were Aurobindo Ghosh, Lokmanya Bal Gangadhar Tilak, Bipin Chandra Pal and Lala Lajpat Rai, V. O. Chidambaram Pillai, Babu Genu.

- The **All-India Muslim League** was founded on 30 December **1906.**
- The founding president of **Ghadar Party** was Sohan Singh Bhakna and Lala Hardayal was the co-founder of this party.
- The members of this party were the immigrant Sikhs of US and Canada.
- In 1914, after the Komagata Maru tragedy, Lala Hardayal fled to Europe following an arrest by the United States government for spreading anarchist literature.
- In 1916, two **Home Rule Movements** were launched in the country: one under the leadership of Bal Gangadhar Tilak and the other under Annie Besant.
- The objectives of the Home Rule League were: Establishment of self-government for India in British Empire.
- **Lucknow Pact**, (December 1916), agreement made by the Indian National Congress headed by Maratha leader Bal Gangadhar Tilak and the All-India Muslim League led by Muhammad Ali Jinnah.
- The pact dealt both with the structure of the government of India and with the relation of the Hindu and Muslim communities.
- **August Declaration (1917)**
  After the Lucknow Pact, the British policy was announced which aimed at "increasing association of Indians in every branch of the administration for progressive realisation of responsible government in India as an integral part of the British empire". This came to be called the August Declaration.
- **The Montague–Chelmsford reforms** or the Act of 1919 was based on this declaration.
- The Anarchical and Revolutionary Crimes Act, 1919 popularly known as the **Rowlatt Act**.
- The Rowlatt Act was passed by the Imperial Legislative Council in Delhi on March 21, 1919.
- This act effectively authorized the government to imprison any person suspected of terrorism living in the Raj for up to two years without a trial, and gave the imperial authorities power to deal with all revolutionary activities.
- Two leaders of the Congress, Dr. Satya Pal and Dr. Saifuddin Kitchlew, were arrested and taken to an unknown place.
- On April 13, 1919 people from neighbouring villages gathered for Baisakhi Day celebrations in Amritsar, which led to the infamous **Jallianwala Bagh massacre** of 1919. On the orders of Brigadier-General Reginald Dyer, the army fired on the crowd for ten minutes.
- On 13 March 1940, at Caxton Hall in London, Udham Singh killed Michael O'Dwyer.
- **Khilafat movement** force that arose in India in the early 20th century as a result of Muslim fears for the integrity of Islam.
- These fears were aroused by Italian (1911) and Balkan (1912–13) attacks on Turkey—whose sultan, as Caliph, was the religious head of the worldwide Muslim community—and by Turkish defeats in World War.
- A campaign in defence of the caliph was launched, led in India by the brothers Shaukat and Muhammad Ali and by Abul Kalam Azad.
- The non-co-operation movement was led by Mahatma Gandhi .
- After the Jallianwala Bagh incident, Gandhi started the **Non-Cooperation Movement**.
- Protestors would refuse to buy British goods, adopt the use of local handicrafts, picket liquor shops.
- On February 5, 1922, in the **Chauri Chaura** the police chowki was set on fire by the mob, killing 22 of the police occupants.
- The non-cooperation movement was withdrawn because of the Chauri Chaura incident.
- **Swaraj Party**, Indian political party established in late 1922–early 1923 by members of the Indian National Congress (Congress Party), notably **Motilal Nehru,** one of the most prominent lawyers in northern India (and the father of political leader Jawaharlal Nehru), and **Chittaranjan Das,** a nationalist politician from Bengal.
- **Simon Commission** was appointed in November 1927 to report on the Working of the Indian Constitution established by the Government of India Act of 1919.
- The Commission consisted of seven members; Sir John Simon, and Clement Attlee were Joint chairman.
- On February 3, 1928, the Simon Commission was confronted by throngs of protesters.
- The **Lahore protest** was led by Indian nationalist Lala Lajpat Rai, was severely beaten by local police. He died on November 17, 1928.
- The **Nehru Report** in August 1928 was a memorandum outlining a proposed new dominion status constitution for India.
- It was prepared by a committee of the All Parties Conference chaired by Motilal Nehru with his son Jawaharlal acting as secretary.
- The **Dandi March**, also known as the **Salt Satyagraha,** began on 12 March **1930** and was an important part of the Indian independence movement.
- **Mohandas Karamchand Gandhi** (commonly known as Mahatma Gandhi) led the Dandi March from his base, Sabarmati Ashram to the coastal village of Dandi.
- Gandhi broke the **salt laws** at 6:30 am on 6 April 1930.
- The three **Round Table Conferences** of 1930–32 were a series of conferences organized by the British Government to discuss constitutional reforms in India.

First Round Table Conference
(November 1930 – January 1931).
Second Round Table Conference
(September – December 1931)
Third Round Table Conference
(November – December 1932)

- The Round Table Conference was opened officially by Lord Irwin on November 12, 1930 at London and chaired by the **British Prime Minister, Ramsay MacDonald**.
- The second session opened on September 7, 1931.
- Mahatma Gandhi attended the second session.
- In the third Conference only forty six delegates attended since most of the main political figures of India were not present.

- The **Gandhi–Irwin Pact** was a political agreement signed by Mahatma Gandhi and the then Viceroy of India, Lord Irwin on 5 March 1931.
- It was signed before the Second Round Table Conference in London.
- The British Government agreed to withdraw all ordinances and end prosecutions and release all political prisoners.
- The **Communal Award** was made by the British Prime Minister **Ramsay Macdonald** on 16 August 1932.
- According to it, separate representation was to be provided for the Forward Caste, Lower Caste, Muslims, Buddhists, Sikhs, Indian Christians, Anglo-Indians, Europeans and Dalits.
- The **Poona Pact** refers to an agreement between Dr. Babasaheb Ambedkar and Mahatma Gandhi signed on 24 September 1932 at Yerwada Central Jail in Pune (now in Maharashtra), India.
- The concept of **separate electorates** for the Untouchables was raised by Dr. Ambedkar.
- The British government agreed with Ambedkar's contention, and British Prime Minister Ramsay. MacDonald's **Communal Award** to the depressed classes was to be incorporated into the Constitution in the governance of British India.
- Gandhi strongly opposed the Communal Award on the grounds that it would disintegrate Hindu society.
- He began an indefinite hunger strike at Yerwada Central Jail. A compromise was reached on September 24, 1932 between Gandhiji and Ambedkar.
- In March 1940, Congress passed a resolution offering the British Government support in war, if a provisional National Government is set up at Centre.
- The Congress did not approve the August Offer.
- The name **"Pakistan"** had been proposed by Choudhary Rahmat Ali in his Pakistan Declaration.

  In 1940 at the **Lahore Session** of the Muslim League, the **demand for a separate state of Pakistan was made.**
- It was based on the two-nation theory.
- Abul Kalam Azad opposed the demand for a separate state and fought against communal tendencies and for the freedom of the Indian people.
- The **Cripps Mission** was an attempt in late March 1942 by the British government to secure full Indian cooperation and support for their efforts in World War II.
- The Mission was headed by Sir Stafford Cripps.
- Cripps promised to give dominion status after the war as well as elections to be held after the war.
- Both the major parties, the Congress and the League rejected his proposals and the Mission proved a failure.
- **Quit India Movement** was a civil disobedience movement launched in India on 8 August **1942 by** Mohandas Karamchand Gandhi.
- Gandhiji gave the slogan "**Do or Die**".
- One of the greatest achievements of the Quit India Movement was that it kept the Congress Party united all through these challenging times.
- The movement was crushed by the British Government.
- The **Indian National Army** was an armed force formed by Indian nationalists in 1942 in Southeast Asia during World War II.
- The aim of the army was to secure Indian independence with Japanese assistance.
- Initially INA was formed in 1942. It was revived under the leadership of Subhas Chandra Bose in 1943.
- The **Rani of Jhansi Regiment** was under Lakshmi Sahgal, comprised female volunteers from Malaya and Burma.
- **Cabinet Mission** was composed of three Cabinet Ministers of England: **Sir Pethick Lawrence**, **Sir Stafford Cripps**, and **Alexander.**
- The Mission arrived on March 24, 1946.
- The objective of this Mission was to devise a machinery to draw up the Constitution of Independent India.
- Muslim League rejected the idea of the Interim Government.
- On July 27, the Muslim League Council met at Bombay where Jinnah reiterated the demand for Pakistan.
- On July 29, it rejected the plan and called the Muslims to resort to "Direct Action" to achieve the land of their dream "Pakistan".
- August 16, 1946 was fixed as "**Direct Action Day**".
- The Interim Government of India formed on 2 September 1946 from the newly elected Constituent Assembly of India.

  It existed till 15 August 1947.

Summary of Freedom Movement

S. No.	Event	Year	Significance
1.	Sepoy Mutiny	1857	First War of Independence due to dissatisfaction of the Indian soldiers
2.	Indian National Congress	1885	Initiated by A. O. Hume; first president, W. C. Bannerjee
3.	Swadeshi Movement	1905	Boycott of foreign goods
4.	Home Rule Movement	1916	Led by Dr (Mrs) Annie Besant
5.	Lucknow Pact	1916	Hindu-Muslim unity which weakened the British
6.	Khilafat Movement	1920	Mohd Ali and Shaukat Ali led the movement for restoration of Khilafat, alienating Muslims from the British
7.	Chauri-Chaura incident	1922	Mob clashed with police, killing 22 policemen. Gandhiji called off the civil disobedience movement.

8.	Non-cooperation Movement	1920-1922	With Gandhiji's support of the Khilafat movement, Hindus and Muslims launched the non-cooperation movement
9.	Swaraj party	1922	Ghandhiji's decision to call off the civil disobedience movement, led to the formation of the Swaraj party Initiated by Motilal Nehru.
10.	Dandi March	1930	Gandhiji launched the movement to break the salt law
11.	Civil Disobedience	1930	Non-violent non-cooperation movement led by Gandhiji
12.	Quit India Movement	1942	Led by Gandhiji; asking the British to leave India
13.	Direct Action Campaign	1946	Launched by Muslim league, resulted in heavy riots.

Interim Government

External Affairs and Commonwealth Relations : Jawaharlal Nehru
Defence : Baldev Singh
Home (including Information and Broadcasting) : Vallabhbhai Patel
Finance : Liaquat Ali Khan
Posts and Air : Abdur Rab Nishtar
Food and Agriculture : Rajendra Parsad
Labour : Jagjivan Ram
Transport and Railways : M. Asaf Ali
Industries and Supplies : John Matthai
Education and Arts : C. Rajgopalacharia
Works, Mines and Power : C.H. Babha
Commerce : I.I. Chundrigar
Law : Jogindar Nath Mandal
Health : Ghazanfar Ali Khan

- An idea for a **Constituent Assembly** of India was proposed in 1934 by M. N. Roy.
- The Constituent Assembly, consisting of indirectly elected representatives, was established to draft a Constitution for India (including the now-separate countries of Pakistan and Bangladesh).
- The Assembly met for the first time in New Delhi on 9 December 1946.
- **Sachchidananda Sinha** was the first president (temporary chairman) of the Constituent Assembly.
- **Rajendra Prasad** was the **first and permanent president of the Constituent Assembly.**

Important Dates

9 December 1946 : The first meeting of the Constituent Assembly.
11 December 1946 : Rajendra Prasad and H. C. Mukherjee were elected as assembly President and Vice-President.
22 July 1947 : National flag adopted.
24 January 1950 : "Jana Gana Mana" adopted as the national anthem, Rajendra Prasad elected the first president of India.

Principal Committees and Chairs

- **Committee on the Rules of Procedure:** Rajendra Prasad
- **Drafting Committee:** B.R. Ambedkar
- **Steering Committee:** Rajendra Prasad
- **Finance and Staff Committee:** Rajendra Prasad
- **Credential Committee:** Alladi Krishnaswami Aiyyar
- **House Committee:** B. Pattabhi Sitaramayya
- **Ad Hoc Committee on National Flag:** Rajendra Prasad
- **States Committee:** Jawaharlal Nehru
- **Union Powers Committee:** Jawaharlal Nehru
- **Union Constitution Committee:** Jawaharlal Nehru

- The Assembly completed the task of drafting a Constitution in two years, eleven months and eighteen days.
- The Indian Independence Act 1947 was also called 3 June Plan or Mountbatten Plan.
- The Mountbatten Plan declared that power would be handed over by 15 August 1947 on the basis of dominion status to India and Pakistan.
- **15 August 1947** was declared as the appointed date for the partition of India and Pakistan.
- **The Act** received the royal assent on 18 July 1947, and Pakistan came into being on August 14, and India on August 15, as two new countries.
- The boundaries between the two dominion states were to be determined by a **Boundary Commission** which was headed by **Sir Cyril Radcliff**.
- The authority of the British Crown over the princely states ceased and they were free to join either India or Pakistan or remain independent.
- Pakistan was to comprise the West Punjab, East Bengal, Territories of the Sind, North West frontier provinces, Syllhat divisions of Assam, Bhawalpur, khairpur, Baluchistan and 8 other princely states of Baluchistan.
- The Constituent Assemblies of both the states were free to make constitutions of their respective countries.
- Jawaharlal Nehru became the Prime Minister of India and Sardar Vallabhbhai Patel became the Home Minister.
- **Muhammad Ali Jinnah became the Governor-General of Pakistan, and Liaquat Ali Khan became the Prime Minister of Pakistan.**

Newspapers and Journals

Newspaper/Journal Name	Founder
Bengal Gazette(1780)(India's First Newspaper)	James Augustus Hickey.
Kesari	B.G.Tilak
Amrita Bazar Patrika	Sisir Kumar Ghosh and Motilal Ghosh
Vande Mataram	Aurobindo Ghosh
Kavivachan Sudha	Bhartendu Harishchandra
Rast Goftar(first newspaper in Gujarati)	Dadabhai Naoroji
Statesman	Robert Knight
Hindu	Vir Raghavacharya and G.S. Aiyar
Yugantar	Bhupendranath Data and Barinder Kumar Ghosh
Bombay Chronicle	Firoze Shah Mehta
Hindustan	M.M. Malviya
Mooknayak	B.R. Ambedkar
Comrade	Mohammad Ali
Tahzib-ul-Akhlaq	Sir Syed Ahmed Khan
Al-Hilal	Abul Kalam Azad
Al-Balagh	Abul Kalam Azad
Independent	Motilal Nehru
Punjabi	Lala Lajpat Rai
New India(Daily)	Annie Besant
Pratap	Ganesh Shankar Vidyarthi
Samvad Kaumudi (Bengali)	Ram Mohan Roy
Mirat-ul-Akbhar	Ram Mohan Roy(first Persian Newspaper)
Young India	M.K Ghandhi
Harijan	M.K Ghandhi
Hindustan Times	K.M. Pannikar

EXERCISE

1. Indus Valley Civilization was discovered in:
(a) 1911 (b) 1921
(c) 1931 (d) 1941

2. Which metal was unknown to Indus Valley Civilization?
(a) Gold (b) Silver
(c) Copper (d) Iron

3. In Indus Valley Civilization, the script was:
(a) Kharosthi (b) Brahmi
(c) Boustrophedus (d) None of these

4. Which of the following is the latest site found?
(a) Dholavira (b) Amri
(c) Lothal (d) Kalibangan

5. Harappa is located on the bank of river:
(a) Indus (b) Ravi
(c) Beas (d) Sutlej

6. The local name of Mohenjodaro is:
(a) Mound of Living (b) Mound of Survivor
(c) Mound of Dead (d) Mound of Great

7. Which of the following animals was unknown in Indus Valley Civilization?
(a) Lion (b) Bull
(c) Elephant (d) Horse

8. Which one of the following Indus Valley Civilization sites gives evidence of a dockyard?
(a) Harappa (b) Mohenjodaro
(c) Lothal (d) Dholavira

9. Indus Valley Civilization was discovered by:
(a) Dayaram Sahni (b) R.D. Banerji
(c) Cunningham (d) Wheeler

10. The Indus Valley Civilization people traded with the:
(a) Romans (b) Parthians
(c) Mesopotamians (d) Chinese

11. The earliest evidence of agriculture in Indian subcontinent has been obtained from:
(a) Brahmagiri (b) Chirand
(c) Mehargarh (d) Burzahom

12. Which of the following is not depicted on the Pashupati seal of Mohenjodaro?
(a) Rhinoceros (b) Tiger
(c) Bull (d) Elephant

13. Which amongst the following civilizations was not contemporary with the Harappan civilization?
(a) Greek civilization
(b) Egyptian civilization
(c) Mesopotamian civilization
(d) Chinese civilization

14. In the Indus valley civilization period. Lapis-Lazuli was imported from:
(a) Badakhshah (b) Iran
(c) Mesopotamia (d) Gujrat

15. Which of the following was one of the causes of Harappan decline?
(a) Ecological change (b) Earthquakes
(c) Aryan attack (d) All of these

16. Who is the most important God in Rigaveda?
(a) Agni (b) Indra
(c) Varun (d) Vishnu

17. Who wrote a book 'Return of the Aryans' ?
(a) Bhagvan Das Gidvani (b) L.D. Kalla
(c) Avinash Chandra Das (d) D.S. Trivedi

18. The Vedic river Vitasta has been identified with :
(a) Ravi (b) Jhelum
(c) Chenab (d) Beas

19. Which of the following Brahmana texts belongs to Atharvaveda?
(a) Shatpatha (b) Aitareya
(c) Gopatha (d) Panchavinsh

20. In Rigveda, maximum number of shlokas are written in the memory of :
(a) Indra (b) Brahma
(c) Vishnu (d) Shiva

21. The word Gotra occurs for the first time in :
(a) Rigveda (b) Samveda
(c) Yajurveda (d) Atharvaveda

22. In the Vedic Period, which animal was known as 'Aghanya'?
(a) Bull (b) Sheep
(c) Cow (d) Elephant

23. The famous dialogue between Nachiketa and Yama is mentioned in the :
(a) Chhandogyopanishad (b) Mundakopnishad
(c) Kathopanishad (d) Kenopanishad

24. Which of the following Upnishads is written in prose?
(a) Isa (b) Katha
(c) Brihadaranyaka (d) Svetasvatara

25. Which of the following is also called Adharvayuveda ?
(a) Rigveda (b) Yajurveda
(c) Samveda (d) Atharveda

26. The Rock-cut temples of Mahabalipuram were built under the patronage of the
(a) Chola kings (b) Pandya kings
(c) Pallava kings (d) Satavahan kings

27. Who sent Heiun-Tsang as an envoy to Harsha's court?
(a) Tai Tsung (b) Tung-Kuan
(c) Ku Yen-wa (d) None of these

28. Arab was defeated in 738 AD by
(a) Pratiharas (b) Rashtrakutas
(c) Palas (d) Chalukyas

29. Which one of the following is not a feature of North Indian temple architecture?
(a) Shikhara (b) Garbha Griha
(c) Gopuram (d) Pradakshina-path

30. Astanga samgraha is a text on
(a) Astronomy (b) Philosophy
(c) Polity (d) Medicine

31. Out of eighteen rulers of the family at least one -third were women. This statement is applicable to
(a) Bhaumakaras (b) Chalukyas
(c) Rastrakutas (d) Kakatiyas

32. By which ruler Pataliputra was chosen for the first time as a capital?
(a) Bimbisara (b) Ajatsatru
(c) Udayin (d) Sisunaga

33. Who among the following scholars established Vajrayana sect of Buddhism in Tibet?
(a) Shanta Rakshita (b) Padma Sambhava
(c) Dharm Raksha (d) Kumarajiva

34. The southern most Mahajanapada was
(a) Avanti (b) Asmaka
(c) Chedi (d) Matsya

35. Name of the Mahajanapada, which was a confederacy of eight republican clans?
(a) Vatsa (b) Magadha
(c) Vajji (d) Malla

36. The ruler of Bundelkhand defeated by Qutubuddin Aibak was
(a) Parmardi Deva (b) Lakshman Sen
(c) Uday Singh (d) Malayvarma Deva

37. Which of the following works of Amir Khusrow deals with the military expeditions of Alauddin Khilji?
(a) Qairanus Sadain (b) Miftah-Ul-Futuh
(c) Nuh Siphar (d) Khazain-Ul-Futuh

38. The city of Jaunpur was founded by
(a) Mohmmad Bin Tughlaq
(b) Firoz Shah Tughlaq
(c) Ibrahim Lodi
(d) Sikandar Lodi

39. The first Silver Tanka of Delhi Sultanate was issued by
(a) Qutubuddin Aibak (b) Iltutmish
(c) Razia Sultan (d) Ghiyasuddin Balban

40. The 'Tibb-i-Sikandari', which was compiled from Sanskrit sources dealt with
(a) Astronomy (b) Medicine
(c) Music (d) Philosophy

41. Most authoritative account of Malik Kafur's deccan campaign is given by
(a) Amir Khusrow (b) Hasan Nizami
(c) Minhaj (d) Ziauddin Barani

42. Amir Khusrow wrote his famous masanavi 'Ashiqa' on the order of
(a) Alauddin Khilji (b) Khizra Khan
(c) Rai Karan (d) Rani Kamla Devi

43. The statement. "India is not Arabia, it is not practically feasible to convert it into Qarul Islam." is associated with
(a) Iltutmish (b) Balban
(c) Alauddin Khilji (d) Muhammad Bin Tughlaq

44. Who among the following scholars has been given the title of Hujjat-ul-Islam?
(a) Shah Wali Ullah
(b) Abu Yazid Al Bistami
(c) Shaikh Junaid
(d) Abu Hamid Mohammad Al-Ghazali

45. Who destroyed the Nalanda University in 1193 AD and burnt it down?
(a) Muizuddin Muhammad Ghori
(b) Ikhtiyaruddin Muhammad bin Bakhtiyar Khilji
(c) Mahmud Ghazni
(d) Qutubuddin Aibak

46. Which Sultan of the Sultanate period introduced irrigation tax for the first time?
(a) Allauddin Khilji (b) Ghiyasuddin Tughlaq
(c) Muhammad Tughlaq (d) Firoz Tughlaq

47. Who among the following historians was made prisoner by the Mongols?
(a) Hasan Nizami (b) Minhaj-us-Siraj
(c) Amir Khusrow (d) Ziauddin Barani

48. Who among the following has given a detailed account of the postal system during the Sultanate period?
(a) Amir Khusrow (b) Ibn Battuta
(c) Sultan Firoz Shah (d) Ziauddin Barani

49. Who of the following Sultans of Delhi had abolished the tax on grain (also called Zakat on grain)?
(a) Alauddin Khilji (b) Ghiyasuddin Tughlaq
(c) Firoz Shah Tughlaq (d) Sikandar Lodi

50. Which Sultan of Delhi imposed Jaziya on the Brahmins also?
(a) Balban (b) Firoz Tughlaq
(c) Allauddin Khilji (d) Muhammad Bin Tughlaq

51. Which Sultan of Delhi assumed the title of Alexander the Great?
(a) Balban
(b) Alauddin Khilji
(c) Muhammad Bin Tughlaq
(d) Sikandar Lodi

52. Which Sultan of Delhi had established a separate agriculture department and had planned the rotation of crops?
(a) Iltutmish (b) Balban
(c) Alauddin Khilji (d) Muhammad Bin Tughlaq

53. Who were instrumental in deposing Raziya Begum?
(a) Afghans (b) Mongols
(c) Turkish (d) Arabs

54. Which one of the following kings of the medieval India began the 'Public Distribution System'?
(a) Balban
(b) Mohammad Bin Tughlaq
(c) Firoz Shah Tughlaq
(d) Alauddin Khilji

55. The Sultan of Delhi who is reputed to have built the biggest network of canals in India was
(a) Iltutmish (b) Ghiyasuddin Tughlaq
(c) Firoz Shah Tughlaq (d) Sikandar Lodi

56. Which of the dynasties ruled for the shortest period of time during to course of Delhi Sultanate?
(a) Slave dynasty (b) Khilji dynasty
(c) Sayyid dynasty (d) Lodhi dynasty

57. Malik Kafur was the General of
(a) Balban (b) Alauddin Khilji
(c) Muhammad Bin Tughlaq (d) Firoz Shah Tughlaq

58. In the Sultanate period, the highest rural authority for land revenue was
(a) Rawat (b) Malik
(c) Chaudhary (d) Patwari

59. Coins of which Muslim ruler have been image of Devi Lakshmi?
(a) Muhammad Ghori (b) Iltutmish
(c) Alauddin Khilji (d) None of these

60. Who among the following kings of Vijayanagar sent an ambassador to China?
(a) Bukka I (b) Harihar I
(c) Harihar II (d) Devaraya II

61. Who among the following Sufis has called India a paradise on earth?
(a) Baba Farid
(b) Shaikh Nizamuddin Auliya
(c) Amir Khurd
(d) Amir Khusrow

Hints & Solutions

1. **(b)** **2.** (d) **3.** (c) **4.** (a) **5.** (b) **6.** (c)
7. **(d)** **8.** (c) **9.** (a) **10.** (c) **11.** (c) **12.** (c)
13. **(d)** **14.** (a) **15.** (d) **16.** (b) **17.** (a) **18.** (b)
19. **(c)** **20.** (a) **21.** (a) **22.** (c) **23.** (c) **24.** (c)
25. **(b)** **26.** (c) **27.** (a) **28.** (a) **29.** (c) **30.** (d)
31. **(d)** **32.** (c) **33.** (b) **34.** (b) **35.** (c) **36.** (a)
37. **(d)** **38.** (b) **39.** (b) **40.** (b) **41.** (a) **42.** (a)
43. **(a)** **44.** (a) **45.** (b) **46.** (d) **47.** (c) **48.** (b)
49. **(d)** **50.** (b) **51.** (b) **52.** (d) **53.** (c) **54.** (d)
55. **(c)** **56.** (c) **57.** (b) **58.** (c) **59.** (a) **60.** (a)
61. **(d)**

Chapter 2 Indian Polity

MAKING OF THE CONSTITUENT ASSEMBLY

- The Indian National Congress had officially, for the first time, demanded a Constituent Assembly in 1935, the idea was the brainchild of **M. N. Roy.**
- The British government accepted the demand in the **'August Offer'** of 1940 and finally **'the Cripps Proposal'** on the framing of Constitution came out in 1942.
- Under the **'Cabinet Mission Plan'** the Constituent Assembly came into existence in Novem ber, 1946.

  Its main features were:
  1. Total strength=389.
     Out of these 296 were allotted to British-India and 93 to Princely states.
  2. Every province and Princely state was allotted seats in proportion to their population.
  3. The seats for British were divided among Muslims, Sikhs and General.
  4. The representatives from each community were elected by voting in the provincial legislative assembly.
  5. The heads of Princely states nominated their members.

  The elections were held in July-August, 1946.
- The **first meeting** was held on December 9, 1946 with only 211 members (Muslim league boycotted).
- Princely states decided to stay away so their seats remained vacant.

However, after the acceptance of **Mountbatten plan** on June 3, 1947 most of the Princely states joined. The other significant changes were declaring the assembly to be a fully sovereign body and also a legislative body.

Functions

The Constituent Assembly drafted the Constitution and also:

- Ratified India's membership of the Commonwealth in May 1949.
- Adopted the **National Flag** on **July 22, 1947**. It was designed by **Pingali Venkiah.**
- Adopted the **National song** on **January 24, 1950.**
- Adopted the **National anthem** on **January 24, 1950**.
- Elected **Dr. Rajendra Prasad** as the **first President of India** on January 24, 1950.

Drafting Committee

- The **Constituent Assembly** contained many committees for various purposes such as House committee, Rules of Procedure committee etc. but the most important of these was the Drafting Committee.
- It was set up on August 29, 1947 and was tasked with preparing a draft of the new Constitution.

The seven members of the Committee were:

1. Dr. B R Ambedkar (Chairman)
2. N Gopalaswamy Ayyangar
3. Dr. K M Munshi
4. T. T. Krishnamachari
5. Syed Mohammmad Sadullah
6. N. Madhav Rau
7. Alladi Krishnaswamy Ayyar

- The first draft of the Constitution was published in February, 1948. The people had eight months to discuss the draft. After discussions, suggestions and proposed amendments were considered and a second draft was prepared by the Assembly. The second draft was published in October, 1948. The Drafting Committee met for a total of **141 days** and took less than six months to prepare its draft.

Enactment of Constitution

- Enactment and enforcement of the Constitution took place on **November 26, 1949 and January 26, 1950**, respectively. However, some parts had come into force on 26 November, 1949 itself with the passing of the motion 'the Constitution as settled by the Assembly be passed'.
- In all 284 of the Assembly signed the official copies of the Indian Constitution which came into effect on Jan 26, 1950.
- The Constitution adopted on **Nov. 26, 1949**, contained **a Preamble, 395 Articles and 8 Schedules.**
- The Constituent Assembly took **2 years 11 months and 18 days** to complete the Constitution.

The Preamble

- The Preamble to Indian Constitution is **based on "Objective Resolution"** of Nehru. Jawaharlal Nehru introduced an objective resolution on December 13, 1947 and it was adopted by Constituent Assembly on 22 January, 1947.
- The Drafting Committee of the Assembly in formulating the Preamble in the light of "Objective Resolution" felt that the Preamble should be restricted to defining the essential features of the new state and its basic socio-political objectives

and that the other matters dealt with Resolution could be provided in the substantive parts of the Constitution.

- The Committee adopted the expression '*Sovereign Democratic Republic*' in place of '*Sovereign Independent Republic*' as used in the "*Objective Resolution*".
- The Committee added the word F**raternity** which was not present in the Objective Resolution. The Committee felt that the need for fraternal concord and goodwill in India was never greater than now.
- The term '**Preamble**' means the introduction to a statute. It is the introductory part of the Constitution.
- Initially, the Preamble was drafted by **Sh. B. N. Rau** in his memorandum of May 30, 1947 and was later reproduced in the Draft of October 7, 1947. In the context of the deliberations by the Constituent Assembly, the Preamble was reformulated.
- The Preamble does not grant any power but it gives a direction and purpose to the Constitution.
- It outlines the objectives of the whole Constitution. The Preamble contains the fundamentals of the Constitution. The Preamble to an Act sets out the main objectives which the legislation is intended to achieve.

THE PREAMBLE READS

> *"WE, THE PEOPLE OF INDIA,* **having solemnly resolved to constitute India into a** *SOVEREIGN, SOCIALIST, SECULAR, DEMOCRATIC, REPUBLIC* **and to secure to all its citizen:**
>
> **JUSTICE,** social, economic and political;
>
> **LIBERTY of thought,** expression, belief, faith and worship;
>
> **EQUALITY** of status and of opportunity; and to promote among them all
>
> **FRATERNITY** assuring the dignity of the individual and the unity and integrity of the nation:
>
> *IN OUR CONSTITUENT ASSEMBLY,* this 26th day of November 1949, do hereby *ADOPT, ENACT and GIVE TO OURSELVES THIS CONSTITUTION.*

- **The word socialist and secular have been added to the Preamble by 42nd amendment Act 1976.** Also unity of nation was amended to read unity and integrity of the nation.

Salient Features

- **Originally** our Constitution contained **395 Articles divided in 22 Parts and 8 Schedules**.
- Our Constitution is the most comprehensive constitution in the world.
- The Constitution, in **its current form,** consists of **a Preamble, 24 Parts containing 448 articles, 12 schedules.**
- It is designed to work as **Federal Government in normal times and as a Unitary Government in an emergency.**
- It establishes a **Parliamentary System** of Government in India.
- It introduces **adult franchise**.
- **India is a union of 29 States and 7 Union Territories.**
- It abolishes **untouchability** in India.
- It guarantees **Fundamental Rights** to all citizens of India.
- It lays down Directive Principles of State Policy for the guidance of Legislature and the Executive of the country.
- It establishes independence of judiciary from the executive.
- It declares Hindi as the official language of India which would replace English as early as possible.
- Provision has been made for amending the Constitution.

Sources of Indian Constitution

Indian Constitution has borrowed its provisions from following sources.

Country	Provisions Borrowed
Government of India Act, 1935	Federal scheme Declaration of emergency powers Ordinance defining the power of the President and Governors Office of the Governor Power of federal judiciary Administration at the centre and state level
United Kingdom	Parliamentary system Bicameral parliament Prime minister Council of ministers Single citizenship Office of CAG Writ jurisdiction of courts Rule of law
USA	Written constitution Fundamental rights Supreme Court President as executive head of the state Impeachment of the president, removal of SC and HC judges Vice President as chairman of Rajya Sabha Judicial review, independence of judiciary
Australia	Concurrent list Cooperative federalism Centre State relationship Joint sitting of two houses of parliament
USSR	Fundamental duties
Weimar Constitution of Germany	Suspension of fundamental rights during emergency Ballot system
Canada	Federal system Residuary powers Appointment of Governor Advisory jurisdiction of S.C
South Africa	Procedure of constitutional amendment Electing member to Rajya Sabha
Ireland	Concept of Directive Principles of State Policy Nomination of members to Rajya Sabha by the President Presidential election

IMPORTANT ARTICLES OF INDIAN CONSTITUTION

Part 1 – Art. 1 to Art. 4

- Article 1- Name and territory of the Union, (i.e. India)
- Article 2 – Admission and Establishment of the new state.
- Article 3 – Formation of new states and alteration of areas, boundaries, and name of existing states.

Part 2 – Art. 5 to Art. 11

- Article 5 – **Citizenship** at the commencement of the Constitution.
- Article 6- Rights of citizenship of certain person who have migrated to India from Pakistan.
- Article 10- continuance of rights of citizenship.
- Article 11- Parliament to regulate the right of citizenship by law.

Part 3 – Art.12 to Art.35

- Article 12- Definition of the state
- Article 13 Laws inconsistent with or in derogation of the Fundamental Rights.
- Originally, Constitution provided for 7 basic Fundamental Rights, now there is only six rights, one Right to Property U/A 31 was deleted from the list of Fundamental Rights by 44th Amendment Act 1978. It made a legal right U/A 300-A in Part XII of the Constitution.

Some important Fundamental Rights are as:

Right to Equality: Art. 14 to Art. 18

- Article 14- Equality before the law.
- Article 15- Prohibition of discrimination on the grounds of religion, race, caste, sex or place of birth.
- Article 16- Equality of opportunity in matters of public employment.
- Article 17- Abolition of the untouchability.
- Article 18- Abolition of titles

Right to Freedom: Art. 19 to art. 22

- Art.19 guarantees to all the citizens the six rights :
    1. Right to freedom of speech and expression.
    2. Right to assemble peacefully and without arms.
    3. Right to form associations or unions.
    4. Right to move freely throughout the territory of India.
    5. Right to reside and settle in any part of the territory of India.
    6. Right to practise any profession or to carry on any occupation, trade, and business.
- Article 20- Protection in respect of conviction for offences.
- Article 21-Protection of life and personal liberty.
- Article 22- Protection against arrest and detention in certain cases.

Right against Exploitation: Art.23 & Art. 24

- Article 23- Prohibition of traffic in human beings and forced labour.
- Article 24- Prohibition of employment of children in factories and mines under age of 14.

Right to Freedom of Religion: Art.25 to Art. 28

- Article 25- Freedom of conscience and free profession, practice and propagation of religion.
- Article 26- Freedom to manage religious affairs.
- Article 27- Freedom as to pay taxes for promotion of any particular religion.
- Article 28- Freedom from attending religious instruction.

Cultural and Educational Rights: Art. 29 & Art. 30

- Article 29- Protection of interest of minorities.
- Article 30- Right of minorities to establish and administer educational institutions.
- Article 32- Remedies for enforcement of Fundamental Rights.

Part 4-Directive Principles of States Policy: Art 36 to Art. 51

- Article 36- Definition
- Article 37- Application of DPSP
- Article 39A- Equal justice and free legal aid.
- Article 40- Organisation of Village Panchayat.
- Article 41- Right to work, to education, and to public assistance in certain cases.
- Article 43- Living Wages, etc. for workers.
- Article 43A- Participation of workers in management of industries.
- Article 44- Uniform Civil Code. (applicable in Goa only).
- Article 45- Provision for free and compulsory education for children.
- Article 46- Promotion of educational and economic interest of Scheduled Castes, ST, and OBC.
- Article 47-Duty of the State to raise the level of nutrition and the standard of living and to improve public health.
- Article 48-Organisation of agriculture and animal husbandry.
- Article 49- Protection of monuments and places and objects of natural importance.
- Article 50- Separation of judiciary from executive.
- Article 51- Promotion of international peace and security.

Part IV-A- Fundamental Duties: Art 51A

- It contained, originally 10 duties, now it contains 11 duties by **86th amendments Act 2002**.

Part 5 – Union (52-151)

- Article 52- The President of India.
- Article 53- Executive Power of the Union.
- Article 54- Election of President.
- Article 61- Procedure for Impeachment of the President.
- Article 63- The Vice-President of India.
- Article 64- The Vice-President to be ex-officio chairman of the Council of States (Rajya sabha)
- Article 66- Election of Vice-President.
- Article 72- Pardoning powers of President.
- Article 74- Council of Minister to aid and advice President.
- Article 76- Attorney-General for India.
- Article 79- Constitution of Parliament.
- Article 80- Composition of Rajya Sabha.
- Article 81- Composition of Lok Sabha.
- Article 83- Duration of Houses of Parliament.
- Article 93- The speakers and Deputy Speakers of the House of the People.
- Article 105- Powers, Privileges, etc. of the House of Parliament.
- Article 109- Special procedure in respects of Money Bills.
- Article 110- Definition of "Money Bills".
- Article 112- Annual Financial Budget.

- Article 114- Appropriation Bills.
- Article 123- Powers of the President to promulgate Ordinances during recess of parliament.
- Article 124- Establishment of Supreme Court.
- Article 125- Salaries of Judges.
- Article 129- Supreme Court to be Court of Record.
- Article 130- Seat of the Supreme Court.
- Article 136- Special leaves for appeal to the Supreme Court.
- Article 137- Review of judgement or orders by the Supreme Court.
- Article 141- Decision of the Supreme Court binding on all the courts.
- Article 148- Comptroller and Auditor- General of India.
- Article 149- Duties and Powers of CAG.

Part 6 – States (152-237)

- Article 153- Governors of State.
- Article 154- Executive Powers of Governor.
- Article 161- Pardoning powers of the Governor.
- Article 165- Advocate-General of the State.
- Article 213- Power of Governor to promulgate ordinances.
- Article 214- High Courts for states.
- Article 215- High Courts to be Court of Record.
- Article 226- Power of High Courts to issue certain writs.
- Article 233- Appointment of District judges.
- Article 235- Control over Sub-ordinate Courts.

Part 7 – 238 – Repealed

Part 8 – 239-242 – Union Territories

Part 9 – 243-243 O – Panchayats

- Article 243A- Gram Sabha.
- Article 243B- Constitution of Panchayats.

Part 9A – 243 P-243 ZG – Municipalities

Part 10 : Scheduled and Tribal Areas (-244)

Part 11 : Center- State Relations (Arts 245 – 263)

Part 12 : Finance, Property, Contracts and Suits (264 – 300A)

- Article 266- Consolidated Fund and Public Accounts Fund.
- Article 267- Contingency Fund of India
- Article 280- Finance Commission.
- Article 300-A- Right to property.

Part 13 : Trade, Commerce and Intercourse within the territories of India (301-307)

- Article 301-Freedom to trade, commerce, and intercourse.
- Article 302- Power of Parliament to impose restrictions on trade, commerce, and intercourse.

Part 14 : Services Under Centre and State (308-323)

- Article 312- All- India-Service.
- Article 315- Public Service Commissions for the Union and for the States.
- Article 320- Functions of Public Service Commission.

Part 14A : Tribunals (323 A – 323 B)

- Article 323A- Administrative Tribunals.

Part 15 : Elections (324 – 329)

- Article 324- Superintendence, direction and control of elections to be vested in an Election Commission.
- Article 325- No person to be ineligible for inclusion in or to claim to be included in a special, electoral roll on grounds of religion, race, caste, or sex.
- Article 326- Elections to the house of the people and to the legislative assemblies of states to be on the basis of adult suffrage.

Part 16 : Special Provisions to SC, ST, OBC, Minorities etc. (330 -342)

- Article 338- National Commission for the SC, & ST.
- Article 340- Appointment of a commission to investigate the conditions of backward classes.

Part 17 : Official Language (343- 351)

- Article 343- Official languages of the Union.
- Article 345- Official language or languages of a state.
- Article 348- Languages to be used in the Supreme Court and in the High Courts.
- Article 351-Directive for development of the Hindi languages.

Part 18 : Emergency (352-360)

- Article 352- Proclamation of emergency (National Emergency).
- Article 356- State Emergency (President's Rule).
- Article 360- Financial Emergency.

Part 19 : Miscellaneous (361-367)

- Article 361- Protection of President and Governors.

Part 20 : Amendment of Constitution (368)

- Article 368- Powers of Parliament to amend the Constitution.

Part 21 : Special, Transitional and Temporary Provisions (369 – 392)

- Article 370 – Special provision of J&K.
- Article 371A – Special provision with respect to the State of Nagaland.
- Article 371-J: Special Status for Hyderabad-Karnataka region.

Part 22 : Short Text, Commencement, Authoritative Text in Hindi and Repeals (392 – 395)

- Article 393 – Short title – This Constitution may be called the Constitution of India.

Right to Education (Article 21-A)

- The Constitution (**Eighty-sixth Amendment**) **Act, 2002** inserted Article 21-A in the Constitution of India to provide free and compulsory education of all children in the age group of six to fourteen years as a Fundamental Right in such a manner as the State may, by law, determine.

The Union & Its Territory

- **Article 1** stipulates that **India, that is Bharat, shall be Union of states**.
- The country is described as '**Union** 'because it is **indestructible**.
- The '**territory of India**' includes the entire area over which the Sovereignty of India extends.
- Under Articles 2 & 3, Parliament has the power to establish new States, form a new State from the territory of any State or by uniting two or more States, increase or decrease the area of any State, or after the boundaries or the name of any State.
- **First Linguistic State** – Andhra Pradesh.

States Reorganisation Act 1956

States Reorganisation Act 1956 was adopted by the Govt. of India that resulted in the formation of new states & UTs.

LIST OF NEW STATES & UTS CREATED AFTER 1956

STATES/UTs	YEAR
1. Maharashtra & Gujarat	1960
2. Dadra & Nagar Haveli	1961
3. Goa, Daman & Diu	1962
4. Goa (Statehood)	1987
5. Puducherry	1962
6. Nagaland	1963
7. Haryana, Chandigarh	1966
8. Himachal Pradesh (Statehood)	1971
9. Manipur, Tripura & Meghalaya (Statehood)	1972
10. Sikkim (full – fledged State)	1975
11. Arunachal Pradesh & Mizoram	1987
12. Chhattisgarh, Uttarakhand & Jharkhand	2000
13. Telangana	2014

Fundamental Rights

Fundamental Rights

- Magna Carta of India
- Part III (Article 12 to 35)
- Borrowed from USA & France
- Can be Suspended during Emergency except Art. 20 & 21
- FRs available only to citizens & Not to Foreigners- Art. 15, 16, 19, 29, 30

Right to Equality

Articles 14-18

(14) Equality before Law & Equal protection of law.

(15) Prohibition of discrimination on grounds of religion, race, sex etc.

(16) Equality of opportunity in public employment

(17) Abolition of untouchability.

(18) Abolition of titles.

Right to Freedom

Articles 19-22

(19) 6 Rights: Freedom of speech & expression, Assembly, Association, Movement, Residence & Profession.

(20) Protection in respect of conviction for offences.

(21) Protection of life & personal liberty.

(22) Protection against arrest & detention in certain cases.

Right Against Exploitation

Articles 23-24

(23) Prohibition of traffic in human beings & forced labour.

(24) Prohibition of employment of children in factories etc.

Right to Freedom of Religion

Articles 25-28

(25) Freedom of conscience & free profession, practice & propagation of religion.

(26) Manage religious affairs.

(27) Freedom from payment of taxes for promotion of any religion.

(28) Freedom from attending religious instruction or worship in certain educational institutions.

Curtural and Educational Rights

Articles 29-30

(29) Protection of interests of minorities.

(30) Right of minorities to establish & administer educational institutions.

Right to Constitutional Remedies

Articles 32

Includes writs:

(1) Habeas Corpus

(2) Mandamus

(3) Prohibition

(4) Certiorari

(5) Quo–warranto

Art. 32 is the heart & soul of the constitutions
-Dr. B.R. Ambedkar

- In case of any one of the Fundamental Rights being deprived or denied to the resident of the country, the individual or the party has the right to present their case in a court. In this case, the court has the flexibility to assign writs to the public in the form of *habeas corpus*, *mandamus*, *prohibition*, *quo- warranto* and *certiorari*.
- In the case of a national emergency, the Government has the flexibility to append or repeal the right of the citizen. According to Article 32, Indian citizens can stand up and fight for their fundamental rights if they are breached.

Types of Writs

Writs	Meaning	Purpose
Habeas Corpus	The Latin word means to have a body	It is a remedy to a common man when he is imprisoned without legal sanction.
Mandamus	The Latin word, means 'we order' or 'We command'	It is a remedy in which an order is passed on from a superior institution to a supplementary, subordinate court or authority that prohibits the court or government official from performing a certain act under the nature of statutory obligation.
Prohibition	Forbid	Prohibition is writ issued by the High Court or the Supreme Court to the local courts to prevent them from proceeding with a case which does not fall under its jurisdiction. When a subordinate court (Ex. Tribunals) exceeds its jurisdiction, Prohibition issued by Supreme Court or High Courts before the trial of the Courts.
Certiorari	Means 'to be informed' of	This writ orders issued to a subordinate court transfer a suit to a superior court. It is issued before a trial, when a lower court acts without jurisdiction.
Qua-Warranto	Means what is your Authority	Issued by the court to enquire into the legality of claim which a person asserts to a public office.

FUNDAMENTAL DUTIES

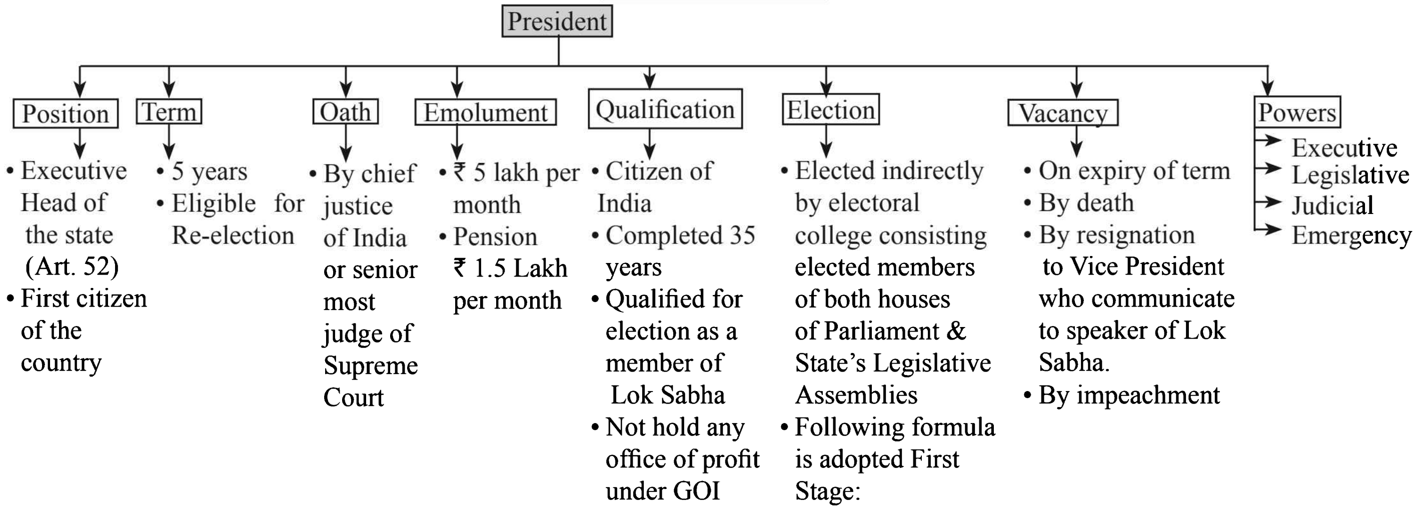
Part IV-A–Article 51-A, added by 42nd Amendment, 1976

It says that it shall be the duty of every citizen of India (originally there were 10 duties, now eleven such duties, after the 86th Constitution Amendment Act, 2002):

(i) To abide by the Constitution and respect its ideals and institutions, the National Flag and National Anthem,
(ii) To cherish and follow the noble ideals which inspired our national struggle for freedom,
(iii) To uphold and protect the sovereignty, unity and integrity of India,
(vi) To defend the country and render national service when called upon to do so,
(v) To promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities: to renounce practices derogatory to the dignity of women,
(vi) To value and preserve the rich heritage of our composite culture,
(vii) To protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures,
(viii) To develop the scientific temper, humanism and the spirit of inquiry and reform,
(ix) To safeguard public property and to abjure violence,
(x) To strife towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievements,
(xi) Who is parent or guardian, to provide opportunities for education to his child or ward between the age 6 and 14 years (inserted by the **86th Constitutional Amendment Act 2002.**)

THE UNION (ARTICLE 51-151)

President



President

Position
- Executive Head of the state (Art. 52)
- First citizen of the country

Term
- 5 years
- Eligible for Re-election

Oath
- By chief justice of India or senior most judge of Supreme Court

Emolument
- ₹ 5 lakh per month
- Pension ₹ 1.5 Lakh per month

Qualification
- Citizen of India
- Completed 35 years
- Qualified for election as a member of Lok Sabha
- Not hold any office of profit under GOI

Election
- Elected indirectly by electoral college consisting elected members of both houses of Parliament & State's Legislative Assemblies
- Following formula is adopted First Stage:

Vacancy
- On expiry of term
- By death
- By resignation to Vice President who communicate to speaker of Lok Sabha.
- By impeachment

Powers
- Executive
- Legislative
- Judicial
- Emergency

$$\text{Value of vote of an MLA} = \frac{\text{Total population of State}}{\text{Total no. of elected members in the State Legislative Assembly}} \times \frac{1}{1000}$$

$$\text{Value of vote of an MP} = \frac{\text{Total value of votes of all MLAs of all States}}{\text{Total no. of elected MPs}}$$

- At second stage, a complex system of calculating Quota of individual candidate is used which is based on the order of preference of candidates.

Powers and Functions

Executive Powers - Article 53

All executive powers of the Union are vested in him. The Supreme Command of the Defence Force is vested on the President.

Power of Appointment :

- President appoints the Prime Minister and other ministers; and they hold office during his pleasure.
- He appoints the **Attorney General of India, Comptroller** and **Auditor General of India**, the **Chief Election Commissioner** and other Election Commissioners, the Chairman and Members of the UPSC, the Governors of the states, the Chairman and the members of the Finance Commissions, etc.
- The President can appoint a commission to investigate into the conditions of SCs, STs and OBCs.

The Legislative Powers

- The President can summon or end a session of the Parliament and dissolve the Lok Sabha.
- He can address the Parliament at the commencement of the first session after the general election and the first session of each year.
- He can also summon a joint sitting of both the houses of Parliament which is presided over by the Speaker of the Lok Sabha.
- The President can appoint a member of the Lok Sabha to preside over its proceedings when the office of Speaker as well as Deputy Speaker are vacant.
- He also can appoint any member of the Rajya Sabha to preside over its proceeding when both the Chairman's and Deputy Chairman's office fall vacant.
- He can **nominate 12 members to the Rajya Sabha** with extraordinary accomplishments and **two** members to the **Lok Sabha** from the Anglo-Indian Community.
- His prior permission is needed for introducing Money and Financial bills only in the Lok Sabha.
- When a bill is sent to the President after it has been passed by the Parliament, he can give his assent to the bill or withhold his assent to the bill or return the bill (if it is not a **Money Bill** or a **Constitutional Amendment Bill)** for reconsideration of the Parliament.
- When a bill is passed by a State legislature is reserved by the Governor for consideration of the President, the President can give his assent to the bill, or withhold his assent to the bill or direct the Governor to return the bill (if it is not a **Money bill**) for reconsideration of the State Legislature.
- President can promulgate **ordinances** when both the Houses of the Parliament are not in session. These ordinances must be approved by the Parliament within the **six weeks** of its reassembly. The ordinance can be effective for a maximum period of **six months** and **six weeks** – Article 123.

Emergency Powers

- The President can declare three types of emergencies:

National Emergency (Art. 352)

- National emergency is caused by **war, external aggression** or **armed rebellion** in the whole of India or a part of its territory.
- President can declare national emergency **only on a written request** by the **Cabinet Ministers headed by the Prime Minister** and the proclamation must be approved by the **Parliament** within **one** month.
- It can be imposed for six months. It can be extended by six months by repeated parliamentary approval, up to a maximum of **three** years.
- Under national emergency, Fundamental Rights of Indian citizens can be suspended.
- The **Right to Life** and **Personal Liberty** cannot be suspended.

  Such an emergency has been invoked at three instances:
- 1962 (Indo-China war)
- 1971 (Indo-Pakistan war)
- 1975 to 1977 (declared by Indira Gandhi on account of "internal disturbance").

State Emergency or President's Rule (Art. 356)

A State Emergency can be imposed via the following:

1. If that State failed to run Constitutionally, i.e. constitutional machinery has failed - Article 356
2. If that State is not working according to the given direction of the Union Government – Article 365
3. Such an emergency must be approved by the **Parliament** within a period of **two** months.

- It can be imposed from **six** months to a maximum period of **three** years with repeated parliamentary approval every six months.
- If needed, the emergency can be extended for **more than three years,** by a constitutional amendment, for example in the case of **Punjab** and **Jammu** and **Kashmir**.
- During such an emergency, the Governor administers the State in the name of the President. The Legislative Assembly can be dissolved or may remain in suspended animation. The **Parliament** makes laws on the **66 subjects** of the **State List**. All **money bills** have to be referred to the Parliament for approval.

Financial Emergency Art - 360

- President can proclaim a Financial Emergency if financial stability or credit of India or any part thereof is threatened.
- This proclamation must be approved by the **Parliament** within **two** months.
- This type of Emergency has not been declared so far.

Financial Powers

- A **money and Financial bills** can be introduced in the Parliament only with the President's recommendation.
- The President lays the Annual Financial Statement, i.e. the Union budget before the Parliament.
- President can make advances out of the Contingency Fund of India to meet unforeseen expenses.
- The President constitutes a **Finance Commission** after every five years to recommend the distribution of the taxes between the Centre and the States.

Diplomatic Powers

- International **treaties** and **agreements** are signed on behalf of the President. However, they are subject to approval of the **Parliament**.
- The President represents India in international forums and affairs and may send and receive diplomats like ambassadors, high commissioners, etc.

Military Powers

- The President is the **supreme commander of the defence forces** of India.
- The President can declare **war** and conclude **peace**, subject to **Parliament's approval**.
- The President appoints the chiefs of Army, Navy and Air Force.

Judicial Powers

- The President appoints the Chief Justice of the Union Judiciary and other judges on the recommendation of Supreme Court's Collegium (5 Sr. most Judges including CJI) .
- The President dismisses the judges if and only if the two Houses of the Parliament pass resolutions to that effect by two-thirds majority of the members present.
- **Under Article 72** the President has the right to grant pardon.
- The President enjoys the judicial immunity.
- No criminal proceedings can be initiated against the President during his term in office.
- The President is not answerable for the exercise of his/her duties.

Veto Powers

The President of India is vested with three—absolute veto, suspensive veto and pocket veto.

Absolute Veto

- It refers to the power of the President to withhold his assent to a bill passed by the Parliament. The bill then ends and does not become an act.

1. **In 1954, President Dr Rajendra Prasad** withheld his assent to the PEPSU Appropriation Bill. The bill was passed by the Parliament when the President's Rule was in operation in the state of PEPSU.
2. **Again in 1991, President R Venkataraman** withheld his assent to the Salary, Allowances and Pension of Members of Parliament (Amendment) Bill. The bill was passed by the Parliament (on the last day before dissolution of Lok Sabha) without obtaining the previous recommendation of the President.

Suspensive Veto

Sending the bill back to the Parliament for reconsideration and which can be over ridden by the Legislature with an ordinary majority.

Pocket Veto

- In this case, the President neither signs nor rejects nor returns the bill, but simply keeps the bill pending for an indefinite period.

- **In 1986, President Zail Singh** exercised the pocket veto with respect to the Indian Post Office (Amendment) Bill.

The 24th Constitutional Amendment Act of 1971 made it obligatory for the President to give his assent to a Constitutional Amendment bill.

The Vice-President

Part V Article (63-73)

- Article 63 of the Indian Constitution says that there should be a Vice-President of India.
- The Vice-President shall be the ex-officio Chairman of Rajya Sabha (Article 64).
- The Vice-President can be removed from office by a resolution of the Council of States (Rajya Sabha), passed by a majority of its members at that time and agreed to by the House of the People (Lok Sabha). (Article 67)
- Vice President is entitled to a salary of Rs. 4 Lakh per month.
- **Dr. S Radhakrishnan** (13-May-52 to 12-May-62) was the first Vice-President of India.

Council of Ministers

- **Art 74 (1):** It provides that, "There shall be a Council of Ministers with the Prime Minister as its head to aid and advise the President who shall in exercise of his/her functions act in accordance with such advice.
- **Article 75** stipulates that the Prime Minister shall be appointed by the President. Other ministers shall be appointed by the President on the advice of the Prime Minister (Article 75 (i)).
- The Ministers hold office during the pleasure of the President, but they cannot be removed so long as they have the support of the majority in the Lok Sabha, in fact, according to the Constitution, Ministers are **collectively responsible** to the Lok Sabha.
- If the Lok Sabha passes a **'no-confidence motion'**, the entire Council of Ministers including PM has to resign. A **no-confidence motion** is a legislative motion brought by the members of the Lok Sabha, expressing lack of trust in the Council of Ministers. That is why, it is said that the **Ministers swim and sink together**.
- Regarding the functions of the Council of Ministers, these are the same as those of the Prime Minister. The proceedings of the Cabinet or Council of Ministers are kept secret. The Council of Ministers is a large body of Ministers. We have seen during recent years, the top category, known as the Ministers of Cabinet rank are about 20 to 25 and they hold the charge of important ministries.
- Then there is a group of ministers, called **Ministers of State**, some of them hold independent charges of ministries while others are attached to Cabinet Ministers. **Deputy Ministers** are attached to **Cabinet Ministers** or Ministers of State. The Cabinet meeting is attended only by the Ministers of Cabinet rank, but if need be the Ministers of State also may be invited to attend such meetings.
- Ministers may be taken from members of either House and minister who is member of one House has the right to speak and take part in the proceedings of the other House but cannot vote in the House of which he is not member (Art.88).
- A person who is not a member of either House can also become a minister for more than **6 months** unless he secures a seat in either House of Parliament (by election or nomination) in the mean time (Art 75 (5).
- **The Council of Ministers shall be collectively responsible to Parliament. (Art. 75 (3)**
- **Art 75 (2) envisages principle of individual responsibility which says that a minister shall hold office during the pleasure of the President.**

The Prime Minister

Prime Minister is the real executive of Government of India.

- **Art 74 (1):** It provides that, "There shall be a Council of Ministers with the Prime Minister as its head to aid and advise the President who shall in exercise of his functions act in accordance with such advice.
- The Prime Minister holds pre-eminent position, second only to the President.
- He is principal advisor to the President and holds enormous powers.
- He presides over the meeting of Council of Ministers.
- He allocates & reshuffles various portfolios among the Ministers.
- He guides, directs, controls & coordinates the activities of the Ministers.
- Along with other ministers he is also responsible to Lok Sabha and individually responsible to the President.
- He is the link between President and the Cabinet.
- **Art. 78** envisages duties of Prime Minister in respect of furnishing information to the President.
- Prime Minister is the key link between the Cabinet and the Parliament and keystone of Cabinet architecture.

- Present Prime Minister of India 2014: **Narendra Damodardas Modi**
- First female Prime Minister of India: **Indira Gandhi**
- **Jawaharlal Nehru** was the first Prime Minister and the longest serving.
- **Gulzarilal Nanda** is the first and the only acting Prime Minister of India.
- **Lal Bahadur Shastri** was the first PM who died abroad while in office in Tashkent. Gulzarilal Nanda has acted twice as the Prime Minister.
- **Chaudhary Charan Singh** the only PM never faced Parliament while being in office.
- **Morarji Desai** was the oldest PM and **Rajeev Gandhi** was the youngest PM.
- **Atal Bihari Vajpayee** (May 1996-June 1996) government had the shortest tenure 13 days.

Union Legislature

- **Part V** of the Constitution deals with Parliament. According to **Article 79**, there shall be a Parliament for the Union, which shall consists of:
- **President of India**.
- Two houses consists of Council of States (**Rajya Sabha** or Upper House of the people and **Lok Sabha** or Lower House).

- It is important to appreciate that making the President a part of the Parliament is in conformity with the principles and traditions of the parliamentary form of government.
- The **business of Parliament** is transacted either in **Hindi** or in **English**. However, the members are permitted to address the House in their **mother tongue**.

Rajya Sabha (Council of States)

- The **Upper House of Parliament** known as the Rajya Sabha held its **first sitting on April 3, 1952**.
- **Article 80** of the Constitution lays down the **maximum strength** of Rajya Sabha as **250**, out of which **12** members are nominated by the President, **238** are representatives of the States and of the two Union Territories.
- The **present** strength of Rajya Sabha, however, is **245**, out of which **233** are representatives of the States and Union Territories of Delhi and Puducherry and 12 are nominated by the President.
- The members nominated by the President are persons having special knowledge or practical experience in respect of such matters as **literature**, **science**, **art** and **social service**.
- The **Fourth Schedule** to the Constitution provides for allocation of seats to the States and Union Territories in Rajya Sabha.
- The allocation of seats is made on the basis of the **population** of each State.
- The Rajya Sabha is not subject to dissolution. **The members of the Rajya Sabha are elected for 6 years. One-third of the members retire every two years and new members are elected**.
- The retiring member can be **re-elected**. To be eligible to be a member of the Rajya Sabha, a person must (a) be a citizen of India, and (b) be at least **30** years of age.
- Other qualifications are the same as those for the members of the Lok Sabha.
- There should not be a gap of more than **six months** between the **two sessions**. The President summons and has the right to prorogue the sessions of the Parliament.
- **Lok Sabha can be dissolved by the President but not the Rajya Sabha, as it is a permanent house of the Parliament.**

Lok Sabha (People's House)

- Lok Sabha is known as the **Lower or House of People.**
- The Lok Sabha is the popular House of the Parliament because its members are directly elected.
- Its **first sitting** took place on **May 13, 1952**
- Normally, **three Sessions** of the Lok Sabha are held in a year, namely, the **Budget Session**, the **Monsoon Session** and the **Winter Session**.
- The **Budget Session** is the most important and the longest of the three Sessions, usually commencing sometime in the third week of **February** and ending by the middle of **May**.
- **The Monsoon Session** normally commences sometime in the middle of **July** and lasts till the third week of **August**.
- **The Winter Session** generally begins in the middle of **November** and comes to an end sometime in the last week of **December**.
- All the members of the Parliament are popularly elected, except not more than **two** members of the **Anglo-Indian** community, who are nominated by the President.
- **In the Constitution, the strength of the Lok Sabha was provisioned to be not more than 552 : 530 from the States, 20 from the Union Territories and 2 nominated from the Anglo-Indian community (Art. 81).**
- It is composed of representatives of the people from **543** constituencies, chosen by direct election on the basis of **adult suffrage**, and meets in the Lok Sabha Chambers of the Sansad Bhavan in New Delhi.
- Under the current laws, the strength of Lok Sabha is 545, including the two seats reserved for members of the Anglo-Indian community.
- A total of 131 seats (18.42%) are reserved for representatives of **Scheduled Castes (84) and Scheduled Tribes (47)**.
- The Bharatiya Janata Party (of the NDA) achieved an absolute majority with 282 seats out of 543 in the 16th Lok Sabha held in 2014.
- But the Constitution empowers the Lok Sabha to re-adjust the strength.
- The party with largest member after ruling party and having at least **1/10th** (54 MPs) of the strength of Lok Sabha is recognised as **Opposition Party.**
- Presently Uttar Pradesh tops the list followed by Maharashtra and West Bengal respectively. UP-80, Maharashtra- 48, West Bengal-42, Andhra Pradesh-42, Tamil Nadu- 39.
- **Election:** Lok Sabha members are directly elected by the people of the states on the basis of adult suffrage. However, **in case of Sikkim**' its sole representative in the House of the People is elected by the member of its **Legislative Assembly** (Article 371 F(e).
- **Qualifications** Article 84 states about the eligibility for membership of Parliament. Accordingly:
- He should be a citizen of India.
- He should **not be less than of 25 years** of age.
- He should be a **registered voter** in any of the Parliamentary Constituencies in India.
- He should not hold any **office of profit**.

Constitutional Amendment Bills

- Art. 368 deals with the power of the Parliament to amend the Constitution, and the procedure thereof.
- A Bill for this can be introduced in either House (the Lok Sabha or the Rajya Sabha) of the Parliament.
- A Constitution Amendment Bill is not treated as a Money Bill even if all its provisions attract Art. 110 (1) for the reason that such amendment are governed by Art. 368 which over rides Art. 110(1).

SPEAKER OF THE LOK SABHA

- After formation of a new Lok Sabha the President appoints a **Speaker pro-tem** who is the senior most member of the House.
- A Deputy Speaker is also elected to officiate in the absence of the Speaker.
- **The Speaker is the Chief Presiding Officer of the Lok Sabha.**
- The two officers are elected from amongst the Members of the Lok Sabha after a new Lok Sabha is constituted.
- The Speaker presides over the meetings of the House and his rulings on the proceedings of the House are final.
- He has the responsibility to uphold the dignity and the privileges of the House.
- In the absence of the Speaker, the Deputy Speaker performs the Speaker's duties.
- The Speaker continues to hold office even after the Lok Sabha is dissolved till the newly elected Lok Sabha is constituted.
- The Speaker and the Deputy Speaker may be **removed from their offices by a resolution passed by the House with an effective majority of the House after a prior notice of 14 days to them.**

Meira Kumar is the first woman Speaker of the Lok Sabha (2009-2014)
GMC Balyogi is the first speaker to die in the office (1998-2002)
Dr Balram Jakhar was the longest serving Speaker (1980-1989)
M A Ayangar was the first Deputy Speaker (1952-1956)
GV Mavlankar was the first Speaker of the Lok Sabha (1952-1956)
Sumitra Mahajan is the present Speaker of 16th Lok Sabha since June, 2014.

Joint Session of the House

- **Art 108 provides** that when a bill is passed by one house is sent to the other. The other house may:
- ▪ Reject the bill altogether.
- ▪ Disagrees on it and returns it with some amendments which are not ultimately considered by the originating house.
- ▪ Takes no action and more than 6 months time has passed.
- ▪ The President in such a case may summon a **joint sitting** of both the houses.
- At a **joint sitting of two houses**, the Speaker of the Lok Sabha and in his absence, the Deputy Speaker, or if he is also absent, Deputy Chairman of the Council of States and if he is also absent, such person as may be determined by the members present in the sitting presides. Lok Sabha by its numerical majority prevails over the joint sitting.
- This provision does not apply to money bill.
- There cannot be a joint sitting for **Constitution Amendment bills**. Nor do such bills require previous sanction of the President.
- President cannot summon a joint sitting if the bill has lapsed by reason of a dissolution of Lok Sabha.

THE SUPREME COURT

- The Supreme Court of India is the highest judicial forum and final court of appeal under the Constitution of India with the power of constitutional review.
- **It comprises the Chief Justice of India and 30 other judges**.
- It has original, appellate and advisory jurisdictions.
- A Division Bench comprises two to three justices and a Constitutional Art. 131 Bench comprises five or more judges.

Tenure and Qualification and Salary

- Judges of Supreme Court are appointed by the President of India, as per the recommendation of Supreme Court Collegium.
- The qualifications are:
  - – A citizen of India who has been a judge of one high court or more (continuously), for at least five years, or
  - – an advocate there, for at least ten years, or
  - – a distinguished jurist, in the opinion of the President/ SC. Collegium
- **Supreme Court judges retire** at the age of 65 which is 3 years more than the retirement age of a judge of the High Court. Hence a judge at the Supreme Court who has been elevated from a High Court serves at the Supreme Court for at least more than 3 years.
- **Article 125** of the Indian Constitution empowers the Indian Parliament to determine the salary, other allowances, of the Supreme Court judges.
- However, the Parliament cannot alter any of these privileges and rights to the judge's disadvantage after his appointment.

Impeachment

- A judge of the Supreme Court can be removed under the Constitution only on grounds of proven misconduct or incapacity and by an order of the President of India, after a notice signed by at least 100 members of the Lok Sabha (House of the People) or 50 members of the Rajya Sabha (Council of the States) is passed by a two-third majority in each House of the Parliament.

Jurisdiction

- **Original Jurisdiction**
- The Supreme Court has exclusive original jurisdiction on all cases between the Government of India and the States of India or between Government of India and states on one side and one or more states on other side or cases between different states.

- In addition, **Article 32** of the Constitution of India grants original jurisdiction to the Supreme Court on all cases involving the enforcement of **fundamental rights** of citizens.
- **Appellate Jurisdiction: Article 132** deals with Appellate Jurisdiction. The **Supreme Court is the highest court of appeal in the country.** Constitutional cases, civil cases and criminal cases, fall within this jurisdiction.

- The first woman judge of the Supreme Court was **Justice Fatima Beebi** in 1987.
- The second woman justice was **Gyan Sudha Mishra** in 2010
- The first Chief Justice of India was **HJ Kania** (1950-50)
- The shortest tenure so far is of KN Singh (Nov. 25-1991-Dec. 12, 1991.)

Advisory Jurisdiction

- The Supreme Court has special advisory jurisdiction in matters which may specifically be referred to it by the President of India under **Article 143** of the Constitution.
- The Supreme Court is a court of record **(Article 129)**.
- According to Article 139 (A) (inserted by the 44th Amendment, the Supreme Court may transfer from one or more High Court if these questions involve a significant question of law.

Part VI

THE STATES (ARTICLE 152-237)

The Governor (Article 153-162)

- The **Governor of a State is appointed by the President of India** (Article 155).
- The same Governor can act as Governor of more than one State (Article 153-162).
- According to Article 156 the Governor of the State holds office during the pleasure of the President.

Qualifications

(a) must be a citizen of India,
(b) must be at least 35 years old, and
(c) should not hold any office of profit during his/her tenure.

- The Governor like the President can grant pardons, reprieves, remission of punishment to persons convicted under the state Law.
- **Under Article 163 the Governor enjoys discretionary powers.** The courts cannot question his discretion.
- According to Article 171 the Governor can nominate some members from amongst those distinguished in literature, science, arts, cooperative movement and social services to state legislature.
- **The Governor is empowered to issue ordinances.**

Legislative Assembly (Vidhan Sabha)

- It is the lower and popular house of the State. Members are chosen by direct election on the basis of adult suffrage from territorial Constituencies (Article 170).
- Their number of members varies between 60 and 500. However certain States like Sikkim, Goa, Mizoram and Arunachal Pradesh have less than 60 members.
- The Governor may **nominate one Anglo-Indian to it**.
- The reservation of seats has been provided for SCs and STs on the basis of their population.
- According to Article 172, duration of Assembly is normally **5 years**. But it may be dissolved earlier by the Governor.
- Its term may also be extended by one year at a time by **Parliament** during national emergency, though this can in no case be extended beyond 6 months after the proclamation has ceased to operate.

Legislative Council (Article 169)

- It is the upper house.
- **Parliament** may by law create or abolish Legislative Council.
- It can be created, if the Legislative Assembly of the State passes a resolution to the effect by special majority.
- It is not an Amendment to the Constitution and therefore it can be passed like an ordinary piece of legislation.
- Article 171 contains various categories of members. According to this:
  - 1/3rd of its members are elected by Legislative Assembly.
  - 1/3rd by local bodies.
  - 1/6th nominated by the Governor.
  - 1/12th are elected by teachers.
  - 1/5th by university graduates.
- The maximum strength of Legislative Council can be 1/3rd of the total membership of Legislative Assembly, but in no case less than 40.
- Parliament has the final power to decide about its composition.
- It is not subject to dissolution. But **1/3rd** of its members retire on the expiry of every **2nd year.**

High Courts (Article 214-232)

- The High Courts stand at the head of the judiciary in a State.
- There shall be a High Court for each State Article-214.
- The Judiciary in the states consist of a High Court and subordinate courts.
- The Parliament can, however, establish by law, a common High Court for one or more states and one or more territory (Article 215).
- **There are 24 High Courts in India.**
- The **Calcutta High Court** is the **oldest** of all which was established in **1862**. The Bombay andMadras High Courts were established in the same year.
- Chhatisgarh, Uttarakhand (Nainital) and Jharkhand (Ranchi) High Courts were established in the year 2000.

The Panchayati Raj (Article 243-O)

- **Rajasthan is the first state in India**, where Panchayati Raj was implemented by the **73rd Amendment Act, 1992**.
- It gave Constitutional status to Panchayati Raj system.
- After Amendment Panchayati Raj added to the **11th Schedule of the Constitution**
- **29 items** related to Panchayats are there in Article 243(G).

The Three Tire System of Local Governance

- **Gram Panchayat** at Village Level
- **Panchayat Samiti** at Block Level
- **Zila Parishad** at District Level
- The Panchayat system has been established in all the states except **Nagaland, Meghalaya** and **Mizoram**.
- It also exists in all Union Territories except **Delhi**.
- Panchayat: system is provided for all States having a population more than 2 million.
- Every Panchayat can continue for five years from the date of its first meetings.

Committees to Study Panchayat System

Name	Established	Recommendation
Balwantrai Mehta	1957	Establish local bodies, devolve power and authority, basic unit of decentralised government to be Block/Samiti. Conceptualised PRIs as **3-tier system.**
K Santhanam	1963	Panchayats to have powers to levy tax on land revenue, etc. Panchayati Raj Finance Corporation to be set up.
Ashok Mehta	1978	District to be a viable administrative unit for planning. PRIs as two -tier system with Mandal Panchayat and Zila Parishad.
GVK Rao	1985	PRIs to be activated and supported, Block Development Office (BDO) to be central to rural development.
LM Singhvi	1986	Local self-governments to be Constitutionally recognized, non-involvement of political parties.

The Municipalities (Article 243P-243 ZG)

- **PART IX A added by 74th Amendment Act 1992**, gives a constitutional foundation to the local self government units in urban area.
- Most provisions for municipalities are similar to those contained in PART IX, e.g., structure, reservation of seats, functions, source of income, etc.
- **Nagar Panchayat**, is for an area being transformed from a rural area to an urban.
- **Municipal Council is for a smaller urban area**.
- **Municipal Corporation is for a larger urban area**. The Municipal Corporation is the topmost urban local government.
- The members of a Municipality are generally elected by direct election.
- The legislature of a state can provide for representation in municipalities of:
  - Persons having special knowledge or experience in municipal administration.

Municipal Governance in India was first introduced in **Madras in 1688.** The **Bombay and Calcutta** Corporations were established in **1726**.

UNION AND STATE RELATIONS

(Article 245-263)

- Legislative Relations
- Administrative Relations
- Financial Relations

Article 262 Adjudication of disputes relating to waters of inter-state rivers or river valleys.

Article 263 Inter-State Council

Inter States Council

Inter–State Council is one of the important extra judicial bodies formed in 1990 on the recommendation of **Sarkaria Commission. The Article 263** of Constitution empowers the President to appoint or establish an Inter–States Council for (1) enquiring into & advising upon inter–states disputes. (2) investigate & discuss on subjects in which States alone or States & Union have common interest.

The Council is headed by the Prime Minister & its members include 6 Cabinet Ministers & Chief Ministers of States.

Zonal Council

Zonal Councils were constituted on the recommendation of States Reorganization Commission 1956. In 1956, five zonal councils were established – North, South, East, West & Central. In 1971, the 6th Zonal Council was established, i.e. North–east Zonal Council. Its objectives are:–

(a) To promote collective approach & sorting out common problems of the member States.

(b) For providing cooperation for the implementation of development plans & progress.

Composition : The Union Home Minister is the ex–officio chairman of all the Zonal Councils. Each Zonal Council includes the Chief Ministers of the member States & the Administrators of the Union Territories. The Chief Secretaries of the member states are also included.

Finance, Property, Contracts and Suits (Article 264-300A)

Article 266 Consolidated Fund of India

Article 267 Contingency Fund of India

Part XIII

Inter-State Trade and Commerce

(Article 301-307)

Article 301: Freedom of trade, commerce and intercourse.

Article 302: Power of Parliament to impose restrictions on trade, commerce and intercourse.

Article 303: Restrictions on the legislative powers of the Union and of the States with regard to trade and commerce.

Article 304: Restrictions on trade, commerce and intercourse among states.

Article 305: Saving of existing laws providing for state monopolies.

Article 306: Power of certain States in Part B of the First Schedule to impose restrictions on trade and commerce (Repealed).

Article 307: Appointment of Authority for carrying out the purposes of Articles 301 to 304.

Part XIV

Services under the Union and the States

Article 308-323

- **Article 312: All India Services.**
- **Article 315: Public Services Commissions for the Union and for the States.**
- On the recommendation of the **Lee Commission** in the year 1926 the first Public Service Commission was set up.
- **1935 Government of India Act** provided for the establishment of a Federal Public Service Commission and Provincial Public Services Commission.
- **The Chairman and other members of the UPSC are appointed by the President of India.**
- At least half of the members are civil servants with at least 10 years experience in central or state services.
- **The tenure of each member is six years** or upto the age of 65, whichever is earlier.
- Members of the UPSC can be removed by the President on the charges of misbehaviour, if these charges are upheld by the Supreme Court.

Election Commission

(Article 324-329)

Article 324 says that the superintendence, direction and control of elections shall be vested in the Election Commission.

Article 325 provides for a single electoral roll for every constituency. No person shall be eligible or ineligible for inclusion in electoral rolls on the basis of race, religion, caste or sex.

Article 326 stipulates that elections shall be held on the basis of adult suffrage.

Political Parties

- As per the provisions of the Peoples Representation Act, 1951 political parties are registered with the Election Commission of India.
- The **Anti-defection law**, passed in 1985, prevents the MPs or the MLAs elected as candidates from one party forming or joining a new party, unless they comprise more than one-third of the original party, in the Legislature.

Recognition and Reservation of Symbols

- A party registered with the Election Commission may be granted recognition as a National or a State party on the basis of its performance in polls.

Meaning : Group of persons who agree on some ideology & seek to capture the power & form the government on the basis of collective leadership.

Type of Party System in India : Multi Party System :

Functions

- (i) Representation
- (ii) Elite Formation & Recruitment
- (iii) Goal Formulation
- (iv) Interest Articulation & Aggregation
- (v) Socialization & Mobilization
- (vi) Organization of Government.

IMPORTANT PARLIAMENTARY TERMS

- **Calling Attention:** Moved to call the attention of a Minister to matters of public importance. The 'Calling Attention' procedure does not exist in the Rajya Sabha, which has, instead the '**Motion of Papers**'
- **Floor Crossing:** The practice of floor crossing refers to the defection of a Member of Parliament from the party he/she was elected to another political party. The practice of defection indicates the lack of ideological hold of the party over its members and it leads to instability in the Government or disregard to the people's mandate.
- **Hung Parliament:** When in a General election no political party or coalition of the political parties is in a position to form a majority Government, such a Parliament is called a Hung Parliament.
- **Interim Government:** This Government is formed during the transitional phase of the history of the country. It is a full-fledged Government and can take any policy decisions. In India, the interim Government came to power with the Independence of India Act on 15th August and lasted till March, 1952.
- **Minority Government:** A form of Government which does not enjoy the confidence of the Lok Sabha on its own and survives on support of other political parties from outside the Government. For example, the Chandrashekhar Government in 1990 – 1991, the Deve Gowda and the I. K. Gujral Governments during 1996 – 1997 survived on the Congress support from outside.

- **Ordinance:** An ordinance is a law promulgated by the head of the State in a situation of urgency when the Legislature cannot frame the law because either it is not in session or it is dissolved. An ordinance has the same effect as a law made by the Legislature. However, it is a temporary measure and has to be approved by the Legislature within a prescribed period, otherwise it ceases to be in operation.
- **Question Hour:** The first one hour period (usually 11: 00 a. m. to 12: 00 a. m.) each day during the meetings of the Parliament is allotted for asking the questions by the members to be replied by the Ministers, is called the Question Hour. A ten days prior notice is required for asking questions in the Parliament by its members.
- **Quorum:** It refers to the required presence of the minimum member of members of a body to hold its meetings and conduct its business. For example, the presence of members (quorum of) is required to hold the meetings of the Parliament. In the absence of the quorum, the meeting is adjourned and no business is conducted.
- **Whip:** This is an official appointed by a political party to regulate and monitor the behaviour of its members in the Legislature. The violation of whip invites the disciplinary action against the erring party members.
- **Zero Hour:** It is a period which follows after the Question Hour when the members raise any issue of public importance on very short or even without any notice. **The procedure is not recognised under the Rules and Procedures of the Parliament, but has become conventional since 1970' s.**

Union Public Service Commission

- The Union Public Service Commission consists of **a Chairman and other** members appointed by the President and they hold office for a **period of 6 years** from the date of their appointment.
- It conducts examinations for appointment to the Services of the Union.
- Age of retirement for a member of **UPSC is 65** years and for a member of **PSC of a State** or a Joint Commission is **62 years**.

NITI Aayog

- NITI Aayog or **National Institution for Transforming India Aayog** is a policy think-tank of Government of India that replaces **Planning Commission** and aims to involve the States in economic policy-making in India.
- It will be providing strategic and technical advice to the Central and the State Governments. **The Prime Minister heads the Aayog as its chairperson.**
- Prime Minister has constituted three sub-groups of Chief Ministers within National Institution for Transforming India (NITI) Aayog.
- *First sub-group-* It will study the 66 centrally-sponsored schemes and recommend which schemes should continue, which should be transferred to States, and which to discontinue.
- *Second sub-group-* It will focus on skill development and creation of skilled manpower within states.
- *Third sub-group-* It will decide on the institutional mechanisms to be evolved for Swachh Bharat Abhiyaan, so that cleanliness becomes a part of life in perpetuity.

National Development Council (NDC)

- The National Development Council **was formed in 1952,** to associate the States in the formulation of the plans.
- All members of the Union Cabinet, Chief Minister of States, the Administrators of the Union Territories and members of NITI Ayog are members of the NDC.

Functions of the NDC are:

- Review working of National Plan.
- Recommend measures to meet targets of national plan.
- It is an **extra Constitutional** and extra legal body.
- The **PM is the ex-officio chairman** of NDC.

Finance Commission

- As per **Article 280 of** the Constitution of India the Finance Commission is established.
- It is a **quasi-judicial** body.
- It consists of a chairman and four other members.
- The President shall after the expiry of every **five years** by order constitute a finance commission.
- It shall be the duty of the Commission to make recommendation to the President with respect to:
  - The distribution between the Union and the States of **taxes** which are to be divided between them.
  - The principles which should govern the **grants-in-aid** of the revenues of the States out of the Consolidated Fund of India.
- Dr. N. K. Singh is the chairman of 14th Finance Commission of India.

Official Language

Article 343-351

- The Official Language of the Union shall be Hindi in Devanagari Script but the form of numericals to be used for the official purposes of Union shall be the international form of Indian numeriacals [Article 343 (1)].
- Art. 343 says that English language shall continue to be used for all official purposes of the Union.
- The Official Language of the Union shall be the official language for communication between one State and other and between a State and the Union [Article 346].
- Article 345 provides that the Legislature of a State may by law adopt any one or more of the languages in use in the State.
- Article 344 provides for the appointment of a Commission on official language.

Lokpal

In India, the institution of **Ombudsman** (**Swedish word** meaning **Commissioner**) has given the name of Lokpal & use it as an anti-corruption institution. The Dictionary defines the Ombudsman as 'an official to investigate complaints by individual against maladministration by public authorities. Lokpal is visualised as the country's watch dog. **The idea of creating Lokpal was first conceptualized in 1968 in 4th Lok Sabha.** Thereafter in 1971, 1977, 1985, 1989, 1996, 1998 & 2001 efforts were made to enact legislation to create the institution of Lokpal. **The Bill received Parliaments assent on 1st Jan 2013.**

The Bill as passed by Parliament creates a Lokpal at the Centre which shall consist of a **chairperson** & **upto 8 members. Half** of these members should have **higher judicial experience & other half** should have experience in **public administration**, **finance, insurance** & **banking laws**, anti **corruption** & **vigilance**. It also provides that half the members of Lokpal shall be from amongst SCs, STs, OBCs, minority & women.

The chairperson & members of Lokpal shall be appointed by a **Selection Committee** consisting of PM, **Speaker of Lok Sabha, Leader of Opposition** in **Lok Sabha**, **Chief Justice of India** & an **eminent jurist** to be nominated by the President based on the recommendations of the other members of the Selection Committee.

The jurisdiction of Lokpal extends to the PM, Ministers, Current & former MPs & members of legislative assemblies, government employees & employees of companies funded or controlled by the central or state government.

It specifies a time limit of **60 days** for completion of inquiry & 6 months for completion of investigation by CBI.

Lokayukta

The anti-corruption institution of Lokayukta is set up at the **state level**. He is appointed by the Governor of the State. In most of the States, the term of office fixed for Lokayukta is **of 5 years duration or 65 years of age,** whichever is earlier.

Advocate General

Each State shall have an Advocate General. He is the State's counter part of the Attorney General of India. He is appointed by the Governor of the State who holds office during the pleasure of the Governor. A person qualified to be a **High Court Judge** can be appointed Advocate– General. He has the **right to address & take part in the proceedings of the House of the State** Legislature. But **he has no right to vote.** His functions are similar to those of the Attorney – General.

Article 370 (J & K)

Under Article 370 of the Indian Constitution, Jammu & Kashmir is granted autonomy. It is a 'temporary provision' that accords special status to the State. All the provisions of the Constitution are not applicable to J&K, unlike other States. Except finance, defence, communications, and foreign affairs, Central Government needs the State Government's consensus for applying all other laws. Because of this article, residents of Kashmir follow separate set of laws in terms of citizenship, property ownership, and other rights.

Article 35A

Article 35A of the Constitution empowers J&K legislature to define state's permanent residents" and their permanent special rights and privileges. It was added to the constitution through a presidential order of 1954 with the then J & K government's concurrence.

Note: An NGO, "We the Citizens", Challenged 35A in S. Court in 2014 on grounds that it was not added to the Constitution through amendments under Art. 368. It was never presented before Parliament, and came into effect immediately, the group argued.

How J&K Different from Other States?

- Directive Principles of State Policy **(DPSP)** are not applied to J&K but applied to other States. Under DPSP = States are required to do some things for the welfare of community.
- President can't declare **financial emergency** (salaries and allowances reduction, etc.) in relation to J&K.
- **High Court of J&K** can issue **writs** only for enforcement of Fundamental Rights.
- **Right to property** is still guaranteed in J&K.
- Permanent residents of J&K have some special fundamental rights.
- Although **Supreme Court**, **EC** and **CAG** are applicable to J&K along with all other States.

AMENDMENTS OF CONSTITUTION

There are three types of bills that seek to amend the Constitution (Art. 368):

1. Bills that are passed by Parliament by **Simple Majority**.
2. Bills that have to be passed by Parliament by **Special Majority**.
3. Bills that have to be passed by **Special Majority** and also to be **ratified by not less than one-half of the State Legislatures**.

Important Amendments

- **The first Amendment Act** to the Indian Constitution was made in the year 1951.
  According to it, Articles 15, 19, 85, 87, 174, 176, 341, 342, 376 were amended and Articles **31A** and **3IB** inserted and Ninth Schedule was added.
- **The Constitution (24th Amendment) Act, 1971:** It affirmed the power of the Parliament to amend any part of the Constitution. After this amendment, the President is bound to assent to Constitution Amendment Bill. Education was transferred to the Concurrent List by this amendment.
- **The Constitution (31st Amendment) Act, 1973:** increased the elective strength of the Lok Sabha from 525 to 545. Under the Act, the upper limit of representatives of the States goes up from 500 to 525 and that of the Union Territories decreases from 25 to 20.
- **The Constitution (36th Amendment) Act, 1975:** By this Act, Sikkim became the 22nd State of the Indian Union.
- **The Constitution (37th Amendment) Act, 1975:** was passed by Parliament on April 26, 1975, to provide for a Legislative Assembly and a Council of Ministers to Arunachal Pradesh, the country's north-easternmost Union Territory.
- **The Constitution (39th Amendment) Act, 1975:** The Bill was passed by the Lok Sabha and got Presidential assent on August 9, 1975. The Act places beyond challenge in courts the election to Parliament of a person holding the office of Prime Minister or Speaker and the election of President and Vice-President.
- **The Constitution (42nd Amendment) Act, 1976:** It was enacted during the period of National Emergency. It was passed by Parliament on November 11, 1976 and received Presidential assent on December 18, 1976.
- The Amendment established beyond doubt the supremacy of Parliament over the other wings of Government; gave the Directive Principles precedence over the Fundamental Rights; enumerated for the first time a set of ten Fundamental Duties.

- **The Constitution (43rd Amendment) Act, 1978:** It restores civil liberties by deleting **Article 3ID** which gave powers to Parliament to curtail even legitimate trade union activity under the guise of legislation for the prevention of anti-national activities. The Supreme Court will now have power to invalidate State laws, a power taken away by the 42nd Amendment Act.
- **The Constitution (44th Amendment) Act, 1978:** Fundamental Rights guaranteed by Articles 20 and 21 cannot be suspended during a national emergency.
- The Right to Property was deleted from the list of Fundamental Right. It is now only a legal right under the Constitution.
- **The Constitution (45th Amendment) Act, 1980:** The Act extends reservation of seats for the Scheduled Castes and the Scheduled Tribes in Parliament and the State Assemblies and the representation of Anglo-Indians by nomination for a further period of 10 years.
- **The Constitution (55th Amendment) Act, 1987:** It grants Statehood to Arunachal Pradesh which consequently became the **24th State** of the Indian Union.
- **The Constitution (56th Amendment) Act, 1987:** It confers Statehood on Goa and forms a new Union Territory of Daman and Diu. Goa thus became the 25th State of the Indian Republic.
- **The Constitution (61st Amendment) Act, 1989:** It lowered the voting age from 21 to 18.
- **The Constitution (62nd Amendment) Act, 1989:** It provided for the extension by another 10 years of reservation of seats in the Parliament and State Assemblies for the Scheduled Castes and Tribes and reservation for Anglo Indian community by nomination.
- **The Constitution (63rd Amendment) Act, 1989:** It repealed Amendment 59 which empowered the Government to impose emergency in Punjab.
- **The Constitution (64th Amendment) Act, 1990:** It extended the President's rule in Punjab by six months.
- **The Constitution (66th Amendment) Act, 1990:** To bring land reforms within the purview of 9th Schedule of the Constitution.
- **The Constitution (69th Amendment) Act, 1991:** Delhi made National Capital Region. The Act also made provision for Legislative Assembly and a Council of Ministers for Delhi.
- **The Constitution (72nd Amendment) Act, 1992:** To make temporary provision for the determination of the number of seats reserved for the Scheduled Tribes in the State Assembly of Tripura, until the re-adjustment of seats is made on the basis of the first census after the year 2000 under article 170 of the Constitution.
- **The Constitution (73rd Amendment) Act, 1992:** To ensure direct election to all seats in Panchayats; to reserve seats for SCs and STs in proportion to their population; and for reservation of not less than one third of the seats in Panchayats for women.
- **The Constitution (74th Amendment) Act, 1992:** was made to ensure direct election to all seats in Nagarpalikas and Municipalities.
- **The Constitution (78th Amendment) Act, 1995:** It includes land reform laws in the Ninth Schedule so that they cannot be challenged before the courts.
- **The Constitution (79th Amendment) Act, 1999:** It extends the reservation of seats for SC, ST and Anglo-Indians in the Lok Sabha and Legislative Assemblies for next 10 years.
- **The Constitution (82nd Amendment) Act, 2000:** It provides that nothing in the Article 355 shall prevent the State from making any provisions in favour of the members of SC/ST for relaxation in qualifying marks with respect to examination/job/promotion.
- **The Constitution (83rd Amendment) Act, 2000:** The Act Amended Article 243 M to provide that no reservation in Panchayats be made in favour of SC/ST in Arunachal Pradesh where the whole population is tribal.

Schedules in Constitution

First Schedule	• List of States & Union Territories
Second Schedule	• Salary of President, Governors, Chief Judges, Judges of High Court and Supreme Court, Comptroller and Auditor General
Third Schedule	• Forms of Oaths and Affirmations
Fourth Schedule	• Allocate seats for each State of India in Rajya Sabha
Fifth Schedule	• Administration and control of Scheduled Areas and Tribes
Sixth Schedule	• Provisions for administration of Tribal Area in Asom, Meghalaya, Tripura, Mizoram & Arunachal Pradesh
Seventh Schedule	• Gives allocation of powers and functions between Union & States. It contains 3 lists 1. Union List (For central Govt.) 100 Subjects. 2. States List (Powers of State Govt.) 66 subjects 3. Concurrent List (Both Union & States) 52 subjects.
Eighth Schedule	• List of 22 languages of India recognized by Constitution • Sindhi was added in 1967 by 21 Amendment • Konkani, Manipuri and Nepali were added in 1992 by 71st Amendment Santhali, Maithili, Bodo and Dogri were added in 2003 by 92nd Amendment.
Ninth Schedule	• Added by Ist Amendment in 1951. Contains acts & orders related to land tenure, land tax, railways, industries.{Right of property not a fundamental right now}
Tenth Schedule	• Added by 52nd Amendment in 1985. Contains provisions of disqualification of grounds of defection
Eleventh Schedule	• By 73rd Amendment in 1992. Contains provisions of Panchayati Raj.
Twelfth Schedule	• By 74th Amendment in 1992. Contains provisions of Municipal Corporation.

EXERCISE

1. Which article of the Indian constitution provides for Uniform civil code for the citizens?
(a) Article 42 (b) Article 44
(c) Article 46 (d) Article 48

2. Which article of the constitution of India deals with the 'Right to constitutional remedies'?
(a) Article 19 (b) Article 14
(c) Article 21 (d) Article 32

3. Which part of the Indian constitution deals with centre-state financial relations?
(a) Part XV (b) Part XIV
(c) Part XII (d) Part X

4. In the constitution of India, the term 'federal' appears in
(a) The preamble
(b) Part III of the constitution
(c) Article 368
(d) None of the above

5. According to the constitution of India, the right to equality does not include
(a) equality before law
(b) absolute equality
(c) equality of opportunity
(d) abolition of untouchability

6. How many members of the constituent assembly signed the constitution of India?
(a) 284 (b) 294
(c) 274 (d) 244

7. In which year the 73rd constitutional amendment act (1992) was assented by the president?
(a) 1990 (b) 1991
(c) 1993 (d) 1994

8. Which of the following articles of the Indian constitution deals with citizenship in India?
(a) Article 333 to 337 (b) Article 17 to 20
(c) Article 05 to 11 (d) Article 01 to 04

9. According to the constitution of India, which one of the following rights cannot be taken away during emergency?
(a) Right to speak
(b) Right to freedom of movement
(c) Right to life
(d) Right to organize

10. Which of the following amendments had reduced the age of the voters from 21years to 18 years?
(a) 52nd amendment (b) 60th amendment
(c) 61st amendment (d) 62nd amendment

11. Indian federal structure is inspired by which model of the countries below?
(a) USA (b) Canada
(c) Switzerland (d) Russia

12. Concept of welfare state in Indian constitution is included in
(a) Fundamental Rights
(b) Directive principles of state policy
(c) Citizenship
(d) Provision of Election commission

13. Under which article the president of India can be removed by the process of impeachment
(a) Article 79 (b) Article 76
(c) Article 57 (d) Article 61

14. Under which article the parliament of India can legislate on any subject in the state list in national interest?
(a) Article 229 (b) Article 230
(c) Article 247 (d) Article 249

15. The phrase equality before law used in Article 14 of Indian constitution has been borrowed from the constitution of
(a) Britain (b) USA
(c) France (d) Canada

16. Which term is not used in the preamble of the Indian constitution?
(a) Republic (b) Integrity
(c) Federal (d) Socialist

17. Fundamental Duties enshrined in the Indian Constitution do not have any
(a) Legal sanction (b) Political sanction
(c) Social Sanction (d) Moral sanction

18. Under which constitutional Amendment has education for children aged 6 to 14 years become Fundamental Right?
(a) 93rd Amendment (b) 86th Amendment
(c) 91st Amendment (d) 92nd Amendment

19. The 73rd Amendment was brought into force to give effect to one of the Directive Principles of State Policy mentioned in
(a) Article 45 (b) Article 46
(c) Article 47 (d) Article 40

20. The first proclamation of Emergency under Article 352 was made by the President in
(a) 1975 (b) 1971
(c) 1965 (d) 1961

21. The Indian constitution is divided into
(a) 16 chapters
(b) 22 chapters
(c) 24 chapters
(d) 25 chapters

22. Which one of the following is not a feature of the Indian constitution ?
(a) Federal Government
(b) Independence of Judiciary
(c) Parliamentary Government
(d) Dual Citizenship

23. Which of the states of Indian federation has a separate constitution?
(a) Goa (b) Tamil Nadu
(c) Jammu & Kashmir (d) Himachal Pradesh

24. In how many articles of Indian constitution, Directive principles of the state policy are mentioned ?
(a) From Article 36-51 (b) From Article 36-52
(c) From Article 36-53 (d) From Article 36-54

25. The Constitution of India vests the executive powers of the Indian Union in which of the following ?
(a) The prime minister (b) The president
(c) The council of ministers (d) The parliament

26. How many articles are there in the Indian constitution?
(a) 395 (b) 396
(c) 398 (d) 399

27. By which name/names is our country mentioned in the constitution?
(a) India and Bharat
(b) India and Hindustan
(c) Bharat Only
(d) India, Bharat and Hindustan

28. Which provision relating to the fundamental rights is directly related to the exploitation of children?
(a) Article 17 (b) Article 19
(c) Article 23 (d) Article 24

29. Acquisition and termination of citizenship are in:
(a) Part II of the Constitution
(b) Citizenship Act, 1955
(c) Schedule I of the Constitution
(d) Various acts of the Parliament

30. Citizenship Act, 1955 was amended to confer citizenship by birth on those who were born on or after January 26, 1950 but before June 30, 1987. The cut-off date was included as:
(a) there were refugees from Sri Lanka and Bangladesh
(b) African nations were expelling Indian settlers
(c) fake applications were being received
(d) Indians were migrating from Burma

31. A person is a citizen of India even if born outside India if his/her:
(a) Father is a citizen of India
(b) Mother is a citizen of India
(c) Father is a citizen of India at the time of the person's birth
(d) Father or mother is a citizen of India at the time of the person's birth

32. To acquire citizenship by registration, a person must have been resident in India for
(a) six months (b) one year
(c) three years (d) five years

33. Right to Constitutional Remedies are available to:
(a) only citizens of India
(b) all persons in case of infringement of a fundamental right
(c) any person for enforcing a fundamental rights conferred on all
(d) an aggrieved individual alone

34. Which writ is called the bulwark of personal freedom?
(a) Mandamus (b) Habeas corpus
(c) Quo warranto (d) Prohibition

35. Proclamation of national emergency automatically suspends
(a) all fundamental rights
(b) right to freedom
(c) right to constitutional remedies
(d) no fundamental right

36. Enforcement of Directive Principles depends on :
(a) Courts
(b) Effective opposition in the Parliament
(c) Resources available to the Government
(d) Public cooperation

37. Which statement does not indicate the difference between Fundamental Rights and Directive Principles?
I. Directive Principles aim at promoting social welfare, while Fundamental Rights protect individuals from State encroachment
II. Fundamental Rights put limitations on State action but Directive Principles are positive instructions to the Government to move towards a just socio-economic order
III. Fundamental Rights were the unexpi term a year six months at most the period till the date for presidential election is notified included in the original constitution, but Directive Principles were added by the first Amendment
IV. Fundamental Rights can be amended but Directive Principles cannot be amended
(a) I and II (b) II and III
(c) III and IV (d) I, II and III

38. Fundamental Duties were included in the Constitution to:
(a) Give more importance to the Fundamental Rights
(b) Stop subversive and un-constitutional activities
(c) Prevent abuse of Fundamental Rights
(d) Give more power to the executive

39. Fundamental Duties of a citizen EXCLUDE:
(a) promoting communal harmony
(b) developing a scientific temper
(c) safeguarding public property
(d) protecting children from hazardous work

40. President holds office for a term of five years from the date:
(a) of his election
(b) of his entering the office
(c) specified in the Constitution
(d) notified by the Election Commission

41. Vice-president's letter of resignation is addressed to:
(a) Deputy Chairman of Rajya Sabha
(b) Chief Justice of India
(c) President of India
(d) Speaker of the Lok Sabha

42. The President sends his resig-nation letter to:
(a) Chief Justice of India
(b) Speaker
(c) Vice-president
(d) Prime Minister

43. An ordinance can be issued by the President:
(a) on any subject
(b) subject to constitutional limitations about legislation by the Parliament
(c) it is his discretion and also on the advice of the Council of Ministers
(d) at any time

44. President of India has the power of
I. absolute veto
II. suspensive veto
III. pocket veto
(a) II only (b) II and III
(c) I and II (d) I, II and III

45. Military powers of the President EXCLUDES:
(a) Supreme command of the armed forces
(b) President's power to declare war or peace is subject to control by the Parliament
(c) President needs the sanction of Parliament to approve training and maintaining of armed forces
(d) President is independent of all legislative control

46. President does NOT APPOINT the?
(a) Finance Commission
(b) Planning Commission
(c) Commission on Official Languages
(d) UPSC

47. Ministers are individually responsible to the:
(a) President
(b) Lok Sabha
(c) Prime Minister
(d) House of which they are members

48. Prime Minister is:
(a) Elected by Lok Sabha
(b) Elected by the Parliament
(c) Appointed by the President
(d) Nominated by the party with a majority in the Lok Sabha

49. One-third of the members of Rajya Sabha retire every
(a) year
(b) two years
(c) three years
(d) six years

50. A joint sitting of the Parliament is called:
I. during national emergency
II. to pass a Constitutional Amendment
III. when financial matters/bill is rejected by the other house
(a) I and III
(b) II and III
(c) I, II and III
(d) None of these

51. Money Bill:
(a) cannot be introduced in the Rajya Sabha
(b) has to be certified by the President
(c) can be amended by the Council of States
(d) both (a) and (b)

Hints & Solutions

1. **(b)** **2.** (d) **3.** (c) **4.** (d) **5.** (b) **6.** (c)
7. **(c)** **8.** (c) **9.** (c) **10.** (c) **11.** (b) **12.** (b)
13. **(d)** **14.** (d) **15.** (a) **16.** (d) **17.** (a) **18.** (b)
19. **(d)** **20.** (d) **21.** (b) **22.** (d) **23.** (c) **24.** (a)
25. **(b)** **26.** (a) **27.** (a) **28.** (d) **29.** (b) **30.** (a)
31. **(d)** **32.** (d) **33.** (c) **34.** (b) **35.** (b) **36.** (c)
37. **(a)** **38.** (b) **39.** (d) **40.** (b) **41.** (c) **42.** (c)
43. **(b)** **44.** (d) **45.** (d) **46.** (b) **47.** (a) **48.** (d)
49. **(b)** **50.** (d) **51.** (a)

Chapter 3 Geography

Universe

All existing matters, energy & space as a whole form universe. It contains both normal and dark matters. The normal matters are the visible parts such as sun, star, galaxies which contribute only 5% and the rest 95% are called the dark matter which is generally invisible.

Space

In astronomy & cosmology, space is the vast 3-dimensional region that begins where the earth's atmosphere ends. There are inter steller & intergalactic spaces.

- Study of Universe is known as **Cosmology**.
- **Big Bang Theory** explains the origin of the universe.
- Universe comprises galaxies, that are huge concentration of stars.

Galaxy

- **Galaxies** are also known as **Island Universe**.
- Galaxies may be–
  (i) Spiral (ii) Elliptical and (iii) Irregular
- The **Milky Way** is the galaxy that contains our Solar System.
- Latest known galaxy is the **Dwarf Galaxy**.

Star

- Stars account for most of the **Galactic Mass.**
- They tend to form groups called **Constellations**.
- A star goes through various stages of evolution.

The Life Cycle of a Star

- A **nebula** is a cloud of gas (hydrogen) and dust in space. **Nebulae** are the birthplaces of stars.
- A **star** is a luminous globe of gas producing its own heat and light by nuclear reactions **(nuclear fusion)**.
- Stars are born from nebulae and consist mostly of hydrogen and helium gas.
- **Red Giant stars** is a dying star, i.e. the later stages of the evolution of a star like the Sun, as it runs out of hydrogen fuel at its centre.
- In few billion years, the Sun will turn into a red giant star, expand and engulf the inner planets, possibly even the Earth. Red Giant stars are very cool, faint and small stars, approximately one tenth the mass and diameter of the Sun. **Proxima Centauri** and **Barnard's Star** are red dwarfs.
- **Red Dwarf stars** are the most common & longest lived stars.
- They are the smallest of the stars with low temperature.
- **White Dwarf** is very small, hot star, the last stage in the life cycle of a star like the Sun.
- **Black Hole** is very small, hot star, the last stage in the life cycle of a star like the Sun. The gravitational pull in a black hole is so great that nothing can escape from it, not even light. So, it is invisible.
- Renowned Indian physicist
  S. Chandrasekhar has given
  Chanderasekhar limit, which is about the formation of Black Holes.
- The closest star to the Earth is Sun.
- The closest star to our solar system is **The Proxima Centauri**.
- **Light year**, Astronomical unit (A.U.). **Parsec** is the unit of measurement of interstellar distance that is equal to 3.26 light years.

THE SOLAR SYSTEM

- The Sun, the nine planets (Pluto is not a planet now, considered as a dwarf planet) along with their satellites, the asteroids, the comets, the inter planetary dust and the electrically charged gases called **plasma**, together make up the solar system.
- Our solar system consists of an average star we call it the Sun, the planets – *Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune*. It also includes: the satellites of the planets; numerous comets, asteroids, and meteoroids; and the interplanetary medium.
- The Sun is an average star. It isn't the hottest, it isn't the coolest, it isn't the oldest. Nor is it brightest, biggest, etc.
- The Sun accounts for 99.85% of all the matter of the solar system.
- It is composed mainly of **hydrogen** and **helium**.
- **Nuclear fusion** in the core of the Sun is source of all its energy.
- The glowing surface of the Sun is called **Photosphere**.
- About it is red coloured Chromosphere and beyond it is **Corona** (visible during eclipses).
- The surface of the Sun changes continuously. Bright regions are called **Plages** and dark spots are called **Sun spots which** frequently form and disappear.

Sun Statistics

- Distance from the Earth – 150 mn km
- Diameter – 1391980 km
- Core temperature – 15000000°C
- Rotation time – 25 days
- Age – 5 billion years
- Composition – H_2 - 71%, He - 26.5% and other 2.5%
- Mass – 1.99×10^{33} kg

Solar Eclipse

- **Solar eclipse** is caused when the Moon revolving around the Earth comes in between the Earth and the Sun, thus making a part or whole of the Sun invisible from a particular part of the Earth.

Lunar Eclipse

During the revolution of Earth, when it comes between moon and the Sun the shadow of the Earth hides moon either fully or partially. This is called lunar eclipse.

Planet

A planet must meet three criteria:

(i) It must orbit the Sun,
(ii) It must be big enough for gravity to squash it into a round ball,
(iii) It must have cleared other objects out of the way in its orbital neighbourhood.

- The **Terrestrial Planets or Inner Planets** are the four innermost planets in the solar system, Mercury, Venus, Earth and Mars.
- The **Jovian Planets or Outer Planets** are Jupiter, Saturn, Uranus, and Neptune because they are all gigantic compared to Earth, and they have a gaseous nature.
- **Mercury** - It is the smallest and the closest planet to the Sun, without moon. Surface is full of craters.
- **Venus** - It is the second closest planet to the Sun, known as **evening** as well as **morning star**, rotates from east to west. It is the **hottest planet**. The atmosphere of venus is covered with thick clouds that strongly reflects sunlight.
- **Earth** - It is the third planet from the Sun with one moon. Perfect place for life. It consists of 78% nitrogen, 21% oxygen, and 1% other ingredients envelops it. **Moon** is the only natural satellite of Earth.
- **Mars** - It is the fourth planet from the Sun with two moons (**Phobos** and **Deimos**).

  It is known as the **Red Planet** because **iron** minerals in the Martian soil oxidize, or rust, causing the soil and the dusty atmosphere to look red. The planet is characterised by volcanoes, canyon systems, river beds, crated terrains and duncfields.
- **Jupiter** - It is the fifth planet, from the Sun. Its atmosphere is made up mostly of hydrogen (H_2) and helium (He). It has the fastest rotational velocity, completing one rotation in less than 10 hours.

  Jupiter has 67 known satellites and 4 Galilean moons. It has the biggest magnetosphere in the entire solar system.
- **Saturn** - It is the **second largest** planet of the solar system and surrounded by **rings** like structures. These rings are made of premordial dust and ice particles. More over Saturn is a gaseous planet. The planet has 62 prominent moons among which the largest moon is **Titan** which is the second largest in the entire solar system.
- **Uranus** - It is the seventh planet from the Sun. One day on Uranus takes about 17 hours (the time it takes for Uranus to rotate or spin once). Uranus makes a complete orbit around the Sun (a year in Uranian time) in about 84 Earth years. It has 27 moons. It is characterised by usual magnetic and electric field.
- **Neptune** - It is the eighth planet from the Sun. Its atmosphere is made up mostly of hydrogen (H_2), helium (He) and methane (CH_4). Triton is its largest moon. It is having a earth size blemish called as **Green dark spot**. It has 14 satellites among which **Triton** and **Nereid** are the prominent ones.

Pluto (not a planet now). It is now considered as a **dwarf planet**. It has slowest orbital velocity and hence, the longest year, **Charon**, is nearly half its size.

Dwarf planet– A dwarf planet is a planetary-mass object that is neither a planet nor a natural satellite. It shares its orbits around the Sun with other objects such as asteroids or comets. It is massive enough for its shape to be in hydrostatic equilibrium under its own gravity, but has not cleared the neighborhood around its orbit.

The first 5 recognised dwarf planets are – Ceres, Pluto, Eris, Haumea & Makemake.

Light year– A light-year is a unit of astronomical distance. It is the distance that light can travel in one year. It is approximately 9.5 trillion kilometres (or about 6 trillion miles).

Some facts about planets

1. Biggest Planet is **Jupiter**
2. Biggest Satellite is **Ganymede**
3. Blue Planet is **Earth**
4. Green Planet is **Uranus**
5. Brightest Planet is **Venus**
6. Brightest Planet outside Solar System is **Sirus**
7. Closest Star of Solar System is **Proxima Centauri**
8. Coldest Planet is **Neptune**
9. Evening Star is **Venus**
10. Farthest Planet from Sun is **Neptune**
11. Planet with maximum number of satellites is **Saturn**
12. Fastest revolution in solar system is by **Mercury**
13. Hottest Planet is **Venus**
14. Densest Planet is **Earth**
15. Fastest Rotation in Solar System by **Jupiter**
16. Morning Star is Venus
17. Nearest Planet to Earth is **Venus**
18. Nearest Planet to Sun is **Mercury**
19. Red Planet is **Mars**
20. Slowest Revolution in Solar System is by **Neptune**
21. Slowest Rotation in Solar System is by **Venus**
22. Smallest Planet is **Mercury**
23. Smallest Satellite is **Deimos**
24. Earth's Twin-is **Venus**
25. Atmosphere like Earth is on **Titan**

Moon

- The Moon is the Earth's only natural satellite.
- The Moon revolves around the Earth in 27 days 7 hours 43 minutes and 11.47 seconds and rotates on its own axis exactly the same time. That is why only one face of the Moon is seen from Earth.
- The total forces of the Moon and the Sun are in the ratio of 9 : 4.
- Study of the Moon is known as **Selenology**.

Statistics of Moon

- Diameter- 3500 km
- Mass- 7.35×10^{22} kg
- Distance from Earth- 384,400 km
- Circumference- 11,000 km
- Revolution time- 27.3 days
- Gravitational pull- 1/6th of that of the Earth

Asteroids, Meteoroids and Comets

- **Asteroids** or **Planetoids** are rocky bodies up to 800 km in diameter, although most are much smaller in diameter less than a km, i.e. Asteroids are the minor planets which especially belong to the inner solar system.
- They orbit the Sun in the asteroid belt, which lies between the **orbits of Mars and Jupiter**.
- **Meteoroids** are small fragments of rock and metal travelling through the space.
- Upon reaching the Earth's surface they are called **Meteorites**.
- **Comets :** They are the smallest units of the cosmic bodies which is made up of frozen gases, rocks and dusts.
- The tail of the comet always points away from the Sun because of the force exerted by solar wind and the radiation pressure.
- The most common comet is **Halley's comet** which is spotted every 76 years.

PHYSICAL GEOGRAPHY

Planet Earth

- The Earth is the **fifth biggest** planet in the solar system.
- The form of Earth is '**Oblate spheroid'**.
- The axis of the earth is inclined to the plane of Earth's orbit at an angle of 66 1/2°giving rise to different seasons and varying lengths of day and night.
- At equator, day and night are of equal length throughout the year.
- The Mid-day Sun shines vertically overhead at least once a year between the Tropic of Cancer and the Tropic of Capricorn. Thus, this region receiving the maximum heat is called **Torrid Zone**.
- **Temperate Zones** are the areas where climatic condition is not extreme. The area lies between the tropics and polar region (23½° × 66½°) having moderate climate.
- **Frigid Zones:** These are the two extremely cold zones situated in the Polar regions extending to the Arctic circle in the North and to the Antarctic circle in the South.
- **Equinox:** It is a day of the year when the duration of day and night is equal and the position of the Sun is in its zenith. In a year there are two equinoxes. September Equinox, i.e. **September 23**rd, and March Equinox **(March 21**st**)**.
- **Solstice**: Like equinoxes there are two solstices also, June 21st and December 21st. This is the time when Sun reaches either its highest or lowest point at noon resulting into shortest and longest day of the year in a hemisphere.
- Earth rotates on its own axis from west to east once in every 24 hours causing day and night.
- It revolves round the Sun in an orbit once in every 365 ¼ days causing the seasons of the year.

Latitudes and Longitudes

- **Latitude** is the angular distance of a point on the Earth's surface measured in degrees from the centre of the Earth.
- **Longitude** is the angular distance, measured in degrees along the equator, east or west of **Prime Meridian** (Prime Meridian that passes through **Greenwich** near **London**). It is also considered as **0°** longitude.
- **Equator**, i.e. **0°** is the biggest latitude that divides Earth into two equal hemispheres (North and South).
- **Tropic of Cancer** is 23.5° N
- **Tropic of Capricorn** is 23.5° S
- **Arctic Circle** is 66.5° N
- **Antarctic Circle** is 66.5° S
- This is the Prime Meridian from which all other meridians radiate eastwards and westwards up to 180°.

Standard Time and Time Zones

- The whole world has been divided into **24 standard** time zones.
- Each zone is separated by **15° longitu-des** or by **1 hour** or by **1° for 4 minutes**.
- In India, the longitude of **82° 30° E**, passing through the area near **Allahabad** is considered as the **Standard Meridian**. This is known as **Indian Standard Time** (IST). IST is 5 hours 30 minutes ahead of **GMT**.

  Tropic of Cancer passes through 8 states of India : Gujarat, Rajasthan, Madhya Pradesh, Chhattisgarh, West Bengal, Tripura and Mizoram.

International Date Line

- A traveller going eastward gains time from Greenwich where he will be 12 hours ahead of GMT.
- Similarly, going westwards, he loses 12 hours till he reaches 180° W.

The Earth's position with respect to the Moon

- **Apogee:** Period of the farthest distance between the Moon and the Earth (407,000 km).
- **Perigee:** Period of nearest distance between the Moon and the Earth (356,000 km).

Earth's position with respect to Sun

- **Perihelion:** Period of the nearest distance between Earth and the Sun (a 147 million km). The date of perihelion varies between 3rd to 5th Jan.
- **Apehelion:** Period of the farthest distance between the Earth and the Sun (appr. 152 km). The date of Apehelion varies between 4th to 6th July.

Lithosphere (Earth's Interior)

- **The Crust** is the outer most part of the Earth which is **solid**, **cool** and **brittle**. The thickness of the Earth's crust varies between 8 and 60 km which is divided into two parts: upper crust and lower crust. The density of crust varies between 2.8 to 3.0 g/cm^3. The temperature of crust varies between 200°C to 400°C from top to bottom.
- **The Mantle** -The mantle extends from 60 km to 2900 km of depth.

- **The Core**- Inner solid core also known as **Barysphere** having temperature up to 6000°C, goes up to a depth of 6371 km at the centre of the Earth. The average density of core ranges between 13.3 to 13.6 g/cm^3.

ROCKS AND MINERALS

- **Rocks** are naturally occuring hard substances made up of either single or multiple minerals compactly held together by cement like mineral matrix.
- As many as 87% of the minerals in the Earth's crust are **silicates**.

Types of Rocks

On the basis of modes of formation there are three types of rocks.

- **Igneous Rocks:** Igneous rock is formed through the cooling and solidification of **magma or lava** such as granite and diorite.
- **Sedimentary Rocks:** Sedimentary rocks are derived from the process of deposition and solidification of sediments after the process of **denudation**. For instance; Sandstone, limestone and chalk rock salts, gypsum or calcium sulphate, etc.
- **Metamorphic Rocks:** Metamorphic rocks arise from the transformation of existing rock types, in a process called **metamorphism**, which means "change in form". Gneiss phyllite, slate, schist, marble, quartzite, etc belongs to the category of metamorphic rocks.

Whole Earth's Composition

Elements	Percentage
Iron	35
Oxygen	30
Silicon	15
Magnesium	13
Nickel	2.4
Sulphur	1.9
Calcium	1.1
Aluminium	1.1
Others	1.0

Earth's Crust

Elements	Percentage
Oxygen	46
Silicon	28
Aluminium	8
Iron	6
Magnesium	2
Calcium	4
Potassium	2.3
Sodium	3.0
Others	1.0

GEOGRAPHICAL FEATURES

- Geographical features are the components of the Earth.
- **Landform:** Land forms are the recognizable unit of natural features on the earth's surface with varying shape, size and structure. It could be mountains, plateaus, valleys or small features like hills, eskers or canyons.
- **Landscape:** Large track of earth's surface or many related landforms with an aesthetic appeal together make up landscape.
- **Topography:** The arrangement of natural or artificial physical features of an area on the earth's surface, their inter relationship and configuration of structural entity is known as **topography**.
- **Terrain:** It is the physical characteristics of natural feature of an area, i.e. its landforms, vegetation and soils.

Classification of Landforms

Mountains: It is a naturally uplifted portion of earth's surface from its surroundings.

1. **Fold Mountains:** Folded mountains were developed due to the **tectonic activities** where the upper part of the earth's crust are folded and warped to produce rocky outcrops, hills or mountain. **Alps** in Europe, **Rockies** of North America, **Andes** of South America, **Himalayas** of Asia and **Atlantic** of North Africa.
2. **Block Mountains:** Block mountains have developed due to swelling of earth's crust bound by tectonic fault and characterised by massiveness, stup slopes, and comparatively smooth topography. **Varger** in France, **Black forest** mountains in Germany and **Salt Range** in Pakistan.
3. **Volcanic Mountains:** Mountain formed due to the accumulation of molten lava flowing out from a volcanic eruption. Hence they are generally cone shaped mountains with a depression at the top. **Mount Mauna Loa** in Hawai Islands, **Mt. Fuji Yoma** of Japan and **Mount Popa** in Central Myanmar.
4. **Residual or Dissected Mountains:** Nilgiris, Parasnath, Girnar and Rajmahal.

Plateau

- Plateaus are extensive area characterized by flat and rough top surface, steep sidewalls which rise above the neighbouring ground surface at least for 300 metres.
- Causes about 33% of the total earth's area.

Classification of plateau

1. **Plateau formed by exogenetic processes. These are–**
   - (i) **Glacial Plateau,** e.g. Garhwal plateau, Greenland, Antarctica.
   - (ii) **Fluvial Plateau,** e.g. Kaimur plateau, Bhander plateau, Rewa Plateau, Rohtas Plateau.
   - (iii) **Aeolian Plateau,** e.g. Potwar Plateau (Pak), Loess plateau (China).

2. **Plateau formed by endogenetic processes. These are–**
   (i) **Intermontane Plateau:** The plateaus which are partly or fully enclosed by mountains are known as intermontane plateaus. These are the results of the mountain-building process which was accompanied by a vertical uplift of the adjoining enclosed lands, e.g. Tibetan plateau, Bolivian plateau, Péruvien plateau, Columbian plateau and Mexican plateau.
   (ii) **Piedmont Plateau :** It is situated at the foot of a mountain, it is bounded on the opposite sides by a plain or an ocean. It is also called the plateau of **denudation** because areas which were formerly high have now been reduced in elevation by various agents of erosion, e.g. **Appalachian** plateau, **Patagonien** plateau (Argentina).
   (iii) **Dome Plateau :** It is formed when land mass is uplifted, e.g. Ozark Plateau (USA), Chota-nagapur plateau (Jharkhand).
   (iv) **Lava Plateau :** It is formed due to accumulation of thick layers of basaltic lava, e.g. Columbia plateau (USA), Mahabaleshwar plateau, Panchgani tableland.
   (v) **Continental Plateau :** They rise abruptly from the lowlands or from the sea, e.g. Deccan plateau of India, Ranchi plateau, Shillong plateau, Columbia plateau (USA), Mexican plateau, etc.
   (vi) **Coastal Plateau:** Example–Coromandel coastal upland of India.
   (vii) **Desert Plateau:** Example– Arabian Plateau.
   (viii) **Humid Plateau:** Example– Shillong Plateau, Assam Plateau, Mahabaleshwar Plateau etc.
   (ix) **Young Plateau:** Example– Idaho Plateau (USA), Colorado Plateau (USA), Mahabaleshwar Plateau, Khandala Upland (Maharashtra).
   (x) **Mature Plateau:** Example– Ranchi Plateau, Hazaribagh Plateau (Jharkhand), Appalachian Plateau (USA).
   (xi) **Rejuvenated Plateau:** Example Missouri Plateau (USA).

Plains: A relatively flat and a low-lying land surface with least difference between its highest and lowest points is called a plain. These are–

1. **Structural Plains** are resulted due to the upliftment of a part of sea floor bordered by a continent, generally called as continental shelf. Plains of Russian platform, Great Plains of USA and central lowlands of Australia.
2. **Erosional Plains** are formed when an erect tract of physical feature such as mountains, hills, etc. are worn down by the process of erosion. Northern Canada, Northern Europe and West Siberia are examples of ice - eroded plains.
3. **Depositional plains** are formed due to the massive deposition of sediments. It occured due to action of various agents, rivers, glaciers, winds, sea, waves, etc. The Indo-Ganga in the Indian subcontinent, the Huang Ho Plains of North China, the Po River plains in Italy and Nile river plains.

Delta: The depositional feature of almost triangular shape at the mouth of a river debouching either in lake or a sea is called Delta.

1. **Arcuate delta:** Nile, Ganga, Rhine, Niger, Irrawady, Volga, Indus, Danube, Mekong, Po, Rhone, rivers make such delta.
2. **Bird Foot Delta**: Mississippi and Omo river makes such delta.
3. **Eustarine delta:** Narmada, Tapi, Amazon, Mackenzie, Vistuala, Elb, Seine, Hudson rivers make such delta.
4. **Cuspate delta:** Ebro river makes such delta.
5. **Estuaries:** The surrounding where fresh water from the land meets salt water from the ocean are called Estuaries. Narmada, Tapi rivers make estuaries.

GEOGRAPHICAL PHENOMENA

Plate Tectonics

- The theory of plate tectonics states that lithosphere consists of several individual segments called **plates**.
- **Major Plates on Earth are.**
  (i) Antarctic plate
  (ii) North American and South American
  (iii) Pacific plate
  (iv) Indian – Australian – New Zealand plate
  (v) Africa/Eastern Atlantic Plate
  (vi) Eurasian plate
- **Pacific plate** is the largest plate while Juan de Fucaplate (off Western coast of North America) is the **smallest**.
- The collision of the Indian plate against the Eurasian plate, leading to the formation of the Himalayas.

Earthquakes

- An **earthquake** is basically the vibration of Earth produced by rapid release of energy, along a fault.
- **Focus:** Place of occurrence of an Earthquake inside the earth, where the energy is released. The ground ruptures at this spot, then seismic waves radiates outward in all direction.
- **Epicenter:** The point on the earth's surface is located directly above the focus of an earthquake.
- Seismic sensors called **Seismographs**, are located throughout the world can record the event.
- **Earthquake waves:** Earthquakes generate pulses of energy called **Seismic waves** that can pass through the entire Earth. These are –

1. **Primary(P) Waves :** These waves travel both through solid crust and mantle and liquid part of the Earth's core.
2. **Secondary (S) waves:** Travels only through solid parts of the Earth.
3. **Long (L) Waves:** It is confined mostly to the skin of the Earth's crust, thereby, causing most of the structural damage.
4. The magnitude as the intensity of energy released by an earthquake is measured by **Richter scale**. It ranges between 0 and 9.

Seismic Zones of India–

India is divided into 5 seismic zones.

- Zone 1 - Intensity V or below
- Zone 2 - Intensity VI
- Zone 3 - Intensity VII
- Zone 4 - Intensity VIII
- Zone 5 - Intensity IX and above

Volcano

- A volcano is an opening or rupture in planet's crust through which hot magma, volcanic ash and gases escape from the magma chamber below the surface.
- Volcanic eruptions cause earthquakes when they erupt and sometimes earthquakes can cause volcanic eruptions.They mainly happen by the edges of tectonic plates.
- **Products of Volcanic eruption**
  - ➢ Ash
  - ➢ Flying Rocks
  - ➢ Poisonous gases
  - ➢ Lava
  - ➢ Pyroclastic flows
  - ➢ Floods and Mudslides
- **Active Volcanoes**

On the basis of frequency of eruption the volcanoes can be divided into–

Active volcano: It has the capacity to erupt at regular basis and its frequency is quite more.

Dormant volcano: Though it has the capacity to erupt but frequency of eruption is almost nil.

Inactive volcanos don't have the capacity to erupt.

ATMOSPHERE

- **Composition:** The atmosphere is a mixture of many discrete gases as Nitrogen (78%), Oxygen (21%), Argon (0.93), Carbon dioxide (0.03)%, and others are Hydrogen, Helium, Krypton, yenon, Methane, Neon and ozone.
- **Troposphere:** Lower most part of the atmosphere. All weather phenomena takes place in this layer. Height of troposphere at poles is about 8 km while at equator is about 16 km due to greater heating at the equator.
- **Stratosphere:** Above troposphere is the stratosphere, which is primarily important because of the presence of **ozone**. This layer absorbs and scatters the solar ultraviolet radiation. It varies from 18–50 km.
- **Mesosphere:** It is a transitional layer. This is the coldest region of the atmosphere. Its height varies from 50–85 km. **Meteors** burn up in this layer.
- **Thermosphere:** It starts just above the mesosphere and extends to 600 km high. Aurora and satellites occur in this layer.
- **Ionosphere:** It is a layer of electrons and ionized atoms and molecules from 48 km to 965 km which has electrically conducting layers that help in Radio Communication. It overlaps into the mesosphere and thermosphere.
- **Exosphere:** The outermost layer of the Earth's atmosphere is known as Exosphere. It extends from the top of the thermosphere upto 10,000 km.

Structure of the Atmosphere

- Energy transfer in the atmosphere takes place in 3 ways: **radiation**, **conduction** and **convection**.
- The Earth's surface receives solar radiation at the rate of 1.94 calories per square centimetre per minute. This is called **Insolation (Incoming Solar Radiation)**.
- The vast amount of energy coming to and leaving the Earth's surface is through radiation.

Atmospheric Pressure

- Atmospheric pressure is the force per unit area exerted on a surface by the weight of air above that surface.
- Mean Sea level pressure of the atmosphere is **1013.2 mb**.
- Air pressure at sea level is higher than it is at the top of a mountain.
- Air pressure increases when air descends.
- Air pressure always decreases with increase in altitude.
- Similarly, when air rises, its volume increases and its pressure decreases.
- The temperature of air rises when its pressure rises and temperature of air falls when its pressure falls.
- The pressure of air falls when its temperature rises.
- The pressure of air rises when its temperature falls.
- High temperature along the equator causes the air to expand low pressure, it is called **Doldrums,** low pressure develops.
- Atmospheric pressure is measured with **Barometer**.

Pressure belts

- Atmospheric pressure is distributed across the latitudes in the form of pressure belts.
- These belts are seven in number: Polar High, Sub Polar Low, Sub Tropical High, Equatorial low, Sub Tropical High, Sub Polar Low and Polar High.

Wind

Because of horizontal differences in air pressure, air flows from the areas of high pressure to the areas of low pressure, ***the horizontal movement of the air is called wind.***

- **Planetary Winds** are the surface air flow in global scale which affects the climate acoss pressure belts.

  Some of the well known planetary winds are :

  Doldrums: Between 5° N to 5° S Latitude.

  Equatorial Westerlies: They blow from 15° N to 35° N Latitude.
- **Trade Winds:** They blow from the sub-tropical High Pressure Belt to the Equatorial Low Pressure Belt in the tropics between 30° North and 30° South latitudes.
- **Polar Winds:** They blow from the Polar High Pressure Belt to the Sub-polar Low Pressure Belt between 60° latitude and the Pole on both sides of the equator.
- **Westerlies:** The Westerlies, anti-trades, or Prevailing Westerlies, are prevailing winds from the west towards the east in the middle latitudes between 30 and 60° latitude. They originate from the high-pressure areas in the horse latitudes and tend towards the poles. These are :
  (i) **Roaring forties** - blow between 40°S to 50°S, it is known as roaring forties latitude winds.

- (ii) **Furious fifties** have its location around 50° to 60°s latitude.
- (iii) **Screaming (shrieking) Sixties** wind blows 60° Onwords in southern hemisphere.

- **Periodic Winds:** They reversed their direction periodically with season. E.g. Monsoon, land and sea breeze, mountain and valley breeze.
- **Local Winds:** They develop as a result of local differences in temperature and pressure. **Loo** is an example of local wind.

Cyclone

Cyclones: The system of wind rotating inward to an area of low pressure zone from its surrounding high pressure area.

- It is characterized by inward spiralling winds that rotate anti-clockwise in Northern hemisphere and clockwise in Southern hemisphere.

On the basis of the location cyclone are of two types.

Tropical Cyclone: Tropical cyclones are intense storm which follows circular tract over tropical oceans.

Temperate Cyclone: Temperate cyclones are formed in the middle and high latitude where there is large temperature variation owing to front genesis.

Anti-Cyclone

- Rapid outward movement of air masses with a high pressure at centre. The relation of wind is clockwise in northern hemisphere and anti-clock wise in southern hemisphere.

Hurricane

- Also called tropical cyclone. It is a disturbance of about 600 km across, spinning around a central area of very low pressure with wind speed above 118 km/hr.

Precipitation

This is the process when the atmosphere moisture which are previously in gaseous forms get condensed and comes down to earth's surface in the form of tiny droplets.

Precipitation are of three types **convectional**, **orographic** and **cyclonic**.

Humidity

- The amount of water vapour in the air is called **humidity**.
- The humidity of air depends upon the temperature, e.g. if the temperature rises then air can hold more water vapour.

Clouds

- A cloud is a mass of small water droplets or thin ice crystals.
- Different types of clouds are as follow:
- **Cirrus**: Feather like.
- **Cirrocumulus**: Ripples like.
- **Cirrostratus**: Transparent sheet like causes the Sun and the Moon to have '**halos**'.
- **Altocumulus**: Have bumpy-look
- **Altostratus**: Sheet like.
- **Stratocumulus**: Large globular masses.
- **Nimbostratus**: Dark grey and rainy looking, gives continuous rain.
- **Stratus**: Low clouds foggy in appearance.
- **Cumulus**: Round topped and flat based.
- **Cumulonimbus**: Special type of cumulous clouds spread out in form of an anvil. Often indicate convectional **rain**, **lightening** and **thunder**.

WORLD CLIMATIC TYPES

The Hot, Wet Equatorial Climate

- It is found between 5° and 10° north and south of the equator.
- Dominantly found in the lowlands of the Amazon,Congo, Malaysia and East Indies.
- The mean monthly temperature is always around 24 to 27°C.
- There is no winter.
- These regions are generally sparsely populated.
- Some plantation crops are also practised like natural rubber, cocoa, etc.

The Tropical Monsoon and Tropical Marine Climates

- It is found between 5° and 30° latitudes on either side of the equator.
- Best developed in the Indian subcontinent, Burma, Thailand, Laos, Cambodia, parts of Vietnam, South China and northern Australia.
- Tropical Marine climate is found in Central America, West Indies, Philippines, parts of East Africa, Madagascar, Guyana coast and eastern Brazil.
- Average temperature of warm dry summer months range between 27°C and 32°C.
- Trees are normally deciduous.
- Forests yields valuable timber like teak and sal.
- Agro-crops are rice, cane sugar, jute, etc.

The Savanna or Sudan Climate

- Found between 5°–20° latitudes on either side of the equator.
- It is found in Llanos of Orinico valley, the campus of Brazil, Central America, Southern Zaire, etc.
- Mean temperature in between 24°C and 27°C.
- Rainfall in between 100 cm and 150 cm.
- Trees are deciduous and hard.
- Tribes like Masai and Hausa are found in this region.

The Hot Desert and Mid-latitude Desert Climates

- It is located on western coasts of the continents between 15° and 30° N and S.
- Saharan desert, Great Australian desert, Arabian desert, Iranian desert, Thar, Namib, Atacama are some of the greatest deserts of the world.
- The hot deserts lie astride the Horse Latitude or Subtropical High Pressure Belts.
- Bushmen of Kalahari and Bindibu or Aborigines of Australia are nomadic hunters and food gatherers.
- Bedoium of Arabia, Tuaregs of Sahara, Gobi Mongols are some of the examples of Tribal groups.

Mediterranean climate

- Climate is characterized by hot, dry summer and cool, wet winter.
- Vegetation includes cork oak, eucalyptus, Jarrah and Karri.
- Evergreen coniferous trees are pines, firs, cedars.
- Viticulture is widely followed in the Mediterranean lands.

Temperate Continental (Steppe) Climate

- Bordering the deserts, away from the Mediterranean regions and in the interiors of the continents are the temperate grasslands.
- In N. America, they are known as **Prairies**.
- In Argentina and Urugway **Pampas**.
- In South Africa – **Veld**
- In Hungary - **Pustaz**.
- Summers are very warm and winters are very cold.
- Average rainfall range between 10 to 30 inches.

The China type Climate

- This type of climate is found on the eastern margins of continents in warm temperate latitudes just outside the tropics.
- Rainfall is more than moderate, anything from 25 inches to 60 inches.
- Vegetation includes pines, cypresses, bamboo, palms.

The Cool Temperate Eastern Margin (Laurentian type)

- The cool temperate Eastern Margin Climate feature both the maritime and continental climates.
- It is found in Canada, north east USA, Siberia, North China, Mancharia, Korea and northern Japan.
- Important crops includes soyabeans, groundnuts, sesame, rapeseeds, tung oil and mulberry.

The Arctic or Polar Climate

- Polar type climate and vegetation is found mainly north of the Arctic circle in the Northern Hemisphere.
- Winters are long and very severe, summers are cool and brief. Main vegetation includes mosses, lichens and sedges.
- In Green land, northern Canada and Alaska there is **Eskimos**.
- In the Eurasian tundra there are other nomadic tribes such as the **Lapps** of northern Finland and Scandinavia, the Samoyeds of Siberia, Yakuts, Koryaks and Chukchi of north-eastern Asia.

HYDROSPHERE

Oceans and Seas

- The Oceans comprise more than 70% of the earth's surface.
- The Seas receive almost 71% of all incoming solar energy due to its surface area.
- Oceans are the primary source of moisture in the atmosphere and much of the rain over the continents.
- Oceans are repository of a large number of useful metallic and non-metallic minerals such as petroleum, gas, salt, manganese, gold, diamonds, tin and Iron.
- Most characteristic feature of oceans and seas is their salinity.
- Salinity varies both horizontally and vertically and is maximum at tropics and decreases towards the equator and poles.

Continental shelves

- Continental shelf in the seaward extension of the continent from the shoreline to the continental edge.
- Continental shelves are rich in plankton, on which millions of fish thrive.
- The continental shelves are therefore the richest fishing grounds in the world, e.g. the Grand Banks of Newfound land, North Sea and Sunda Shelf.

Composition of Sea Water

Salt	Percentage
Sodium Chloride (NaCl)	77.8
Magnesium Chloride ($MgCl_2$)	10.9
Magnesium Sulphate ($MgSO_4$)	4.7
Calcium Sulphate ($CaSO_4$)	3.6
Potassium Sulphate (KSO_4)	2.5
Others	0.5

- Average temperature of surface water of the oceans is 26.7° C and temperature gradually decreases from equator towards the poles.

Ocean Ridge

- **Pacific Ocean** is the largest of all water bodies.
- **Mariana**, Tonga, Kuril, Philippine, Japan are the trench of Pacific ocean.
- Most striking feature of the Atlantic Ocean is the presence of mid-Atlantic Ridge. It extends from the north to the south paralleling the'S' shape of the ocean itself.
- Java or Sunda, Mauritius, Amirante trench are some of the important trench of the Indian Ocean.

Continental Slope: It is a steep slope, situated beyond continental shelf towards ocean and the slope generally varies between 2° to 5°. The average depth of water near continental slope varies between 200 m to 2000 m.

Deep Sea /Abyssal Plain: The extensive plain covering around 80% of the total area of ocean basin is known as **Abyssal plain**. The average depth varies between 3000 m to 6000 m. Some of the famous plains under this category are **Alaska plain**, Ameresian plain, Barracuda plain, Canary basin, Green land plain, etc.

Occan Deep: The long, narrow topographic depressions or trenches are called as **Ocean deep**. They generally run parallel to the coast. Ocean deeps are considered on the boundaries between two lithospheric plate. The challenger Deep in **Mariana Trench** is the greatest known deep in this world (10,994 meters/36070 feet).

Other major physical features

Associated with Ocean and Sea.

Bay: Bay are the small water bodies separated from the large water bodies by an inward curved piece of land. The famous bays of the world are, Hudson Bay, Bay of pig, Chesapeake Bay, Bay of Bengal, etc.

Gulf : These are the large part of ocean or sea partially land locked and opens up through straits only. The world famous gulfs are Gulf of Mexico, the southern coast of United State and Cuba, Gulf of California, Gulf of Arizona.

Tides

- The periodic phenomenon of alternate rise and fall in the sea levels is known as **Tide**.
- It is produced due to gravitational interaction of the Earth, the Moon and the Sun.
- **Spring tides:** On the full moon and the new moon, tides are highest which are called **Spring tides**.
- **Neap tides:** A tide just after the first or third quarters of the moon when there is least difference between high and low water is called **Neap tides**.

Waves

- Waves are the oscillatory movements in water mainly produced by winds, manifested by an alternate rise and fall in the entire sea surface.
- This movement may include event such as slippage of the sea floor along the earth quake fault, underwater volcanic explosion or under water landslides.

INDIAN GEOGRAPHY

- **India is the seventh largest** country in the world.
- It covers an area of 32,87,2631 sq. km. Lying entirely in the Northern Hemisphere, the mainland extends measuring 3214 km from the north to the south between extreme latitudes and about 2933 km from east to west between extreme longitudes.
- It has a land frontier of about 15200 km.
- India is situated North of the Equator between 8°4' and 37°6' north latitude and 68°7' and 97°25' east longitude and is surrounded by the Bay of Bengal in the East, the Arabian Sea in the West and the Indian Ocean to the South.
- The **Gulf of Mannar** and the **Palk Straits** separate India from Sri Lanka.
- There are as many as 200 islands in Andaman alone.

Four end points of India:

Eastern most point - **Kibithu** in Arunanchal pradesh (On River-Lohit)

Western most point - **Ghuar Mota** of kutch in Gujarat

Northern most point - Siachen glacier in state of Jammu and Kashmir

Southern most point :

Mainland- Kanyakumari (Cape Comorin)

India's Territory - India Point (Andoman & Nicobar

Mountain Ranges in India

- The Himalayan Range is the world's highest mountain range.
- The tallest peak of the world, **Mt. Everest**, is also a part of it.
- **Karakoram Range** lies in Jammu and Kashmir and comprises more than 60 peaks.
- **K2** (Mount Godwin Austen) is the second highest peak of the world, also a part of this range. Its height is 8611m or 28,251 fit.
- **Shivalik Hills** extend from the Arunachal Pradesh to West Bengal and from Uttarakhand to Kashmir and Himachal Pradesh. Jammu, Kangra and Vaishno Devi are a part of this range.
- **Vindhya Range** spreads across central India and extends across 1,050 km.
- **Aravalli Range** is India's oldest mountain range and spreads across the parts of Rajasthan, Delhi and Haryana. **Guru Shikhar** in **Mount Abu** is the highest peak of this range.
- **Satpura Range** stretches from Gujarat and runs to Maharashtra, Madhya Pradesh and Chhattisgarh.

Some important facts about peaks

- Highest Mt. Peak in India: K_2 *or Godwin Austin*
- Highest peak in Aravalli: Gurushikhar (in Mt. Abu)
- Highest peak in Satpura: Dhupgarh (Mahadeo Hills)
- Highest peak in E. Ghats: Mahendragiri (Orissa)
- Highest peak in W. Ghats: Anaimudi (Annamalai Hills - Kerala)
- Highest peak in Nilgiris: Doda Betta
- Hills in Southern Hill complex : Nilgiri, Annamalai, Cardamom & Palani
- Hills in Eastern Ghats: Shevaroy, Javadi, Palkonda, Nallamalai, Northern Circars
- Oblique ranges to Western Ghats in Maharashtra: Ajanta, Satmala, Harishchandra, Balaghat
- Satpura range from East to West: Amarkantak - Maikal- Mahadeo - Gawilgarh - Rajpipala
- Highest peak in Andaman and Nicobar islands : *Saddle Peak*
- The highest peak of Naga hills is Saramati peak.

Western Ghats: This is the north Eastern part of Deccan plateau and lies parallel to the western edge of **Deccan plateau**. The extensive stretch is 1600 km long and stretches from Maharashtra to Kanyakumari.

Eastern Ghats: On the contrary eastern ghats are discontinuous and irregular as they are dissected by rivers. The average height is 300-600 m along the 600 m length.

Difference between Eastern Ghats and Western Ghats

Western Ghats	Eastern Ghats
Form a continuous water divide.	Discontinuous and dissected by rivers.
Can be crossed through passes	Series of detached hills

Higher than Eastern Ghats	Lower than Western Ghats
Face Arabian sea and run along the western plateau	Face Bay of Bengal and run along the Eastern Plateau
Comparatively narrow	Comparatively broader
Highest Peak-Anaimudi	Highest Peak-Mahendragiri

International Boundaries with India

- India shares its international boundaries with Pakistan in the West, Nepal, China and Bhutan in the North-East.
- It is surrounded by Burma and Bangladesh to the East.
- **Sri Lanka** is located in the South of India.
- **Radcliffe** line separates India and Pakistan.
- The **McMahan Line** is the effective boundary between India and China.
- The **Durand Line** is boundary between India–Afghanistan and Pakistan–Afghanistan.

Indo-Gangetic Plains

- The Indo-Gangetic plain is dominated by three major rivers - the Ganges, Indus and Brahmaputra.
- It covers a large area, about 7,00,000 sq km in Northern and Eastern India.
- The plain consists of four divisions:

1. **The Bhabar Belt:** It is a narrow belt which is located in the foothills of the Himalayas.
2. **The Terai Belt:** It is located in the southern part of the Bhabar region and made up of newer alluvium.
3. **The Bangar Belt:** It includes older alluvium and has a low hill in the Gangetic plain, which is covered by the laterite deposits.
4. **The Khader Belt:** It is located on the lower side of the Bhabar belt and made up of new alluvium, which is brought by the rivers which flow down the plain.

The Peninsular Plateau

- Peninsular plateau with its characteristic features includes shallow valleys and rounded hills. It is divided into three different plateaus:
    1. **The Deccan Plateau:** The plateau area is triangular in shape and surrounded by the Vindhyas and the Western and Eastern Ghats.
    2. **The Malwa Plateau:** The Malwa plateau is distributed in parts of Gujarat, Rajasthan and Madhya Pradesh.
    3. **The Chota Nagpur plateau:** It is located in Eastern India. Chota Nagpur plateau covers part of Jharkhand, Bihar, Odisha and Chhattisgarh.

The Thar Desert

- The Thar desert extends across Gujarat, Haryana and Punjab; and covers more than 60% of the geographical area of Rajasthan. The region is also called as '**MARUSTHALI**'
- **Luni** is the seasonal river and gets very little rainfall.
- It has an arid climate and vegetation is sparse.
- **Ghaggar** flows through Rajasthan and disappears at the heart of the Thar Desert.

Major Island Group

- Two major island groups are situated on either side of Indian peninsula. **Andaman and Nicobar** island group lies on the eastern part, i.e. in **Bay of Bengal** and **Lakshadweep** island group lies on the western part of India, i.e. in Arabian Sea.
- Altogether there are **247** smaller islands from which **204** are in Bay of Bengal and **43** islands are in Arabian Sea.

Rainfall in India

- More than 80% of annual rainfall is received in the four rainy months, from June to September.
- The average annual rainfall is about 125 cm.

Important lakes in India

Lakes Name	State
Kolleru Lake, Pulicat Lake	Andhra Pradesh
Deepor Beel, Chandubi Lake, Haflong Lake, Son Beel	Assam
Kanwar Lake	Bihar
Hamirsar Lake, Kankaria Lake, Nal Sarovar, Sursagar Lake	Gujarat
Brighu Lake, Dashir Lake, Dhankar Lake, Kareri (Kumarwah) Lake, Khajjiar Lake, Macchial Lake, Maharana Pratap Sagar, Manimahesh Lake, Nako Lake, Pandoh Lake,	Himachal Pradesh
Prashar Lake, Renuka Lake, Suraj Taal, Chandra Taal	Himachal Pradesh
Badkhal Lake, Brahma Sarovar, Karna Lake, Sannihit Sarovar, Surajkund Lake, Tilyar Lake, Blue Bird Lake	Haryana
Dal Lake, Pangong Tso, Sheshnag Lake	Jammu & Kashmir

Bellandur Lake, Ulsoor Lake, Sankey Lake, Agara Lake, Karanji lake, Kukkarahalli lake, Lingambudhi Lake, Pampa Sarovar	Karnataka
Ashtamudi Lake, Maanaanchira Lake	Kerala
Upper Lake, Lower Lake	Madhya Pradesh
Moti Jheel	Uttar Pradesh
Gorewada Lake, Lonar Lake	Maharashtra
Umiam Lake	Meghalaya
Loktak Lake	Manipur
Palak Dil Lake, Tam Dil Lake	Mizoram
Anshupa Lake, Chilka Lake, Kanjia Lake	Odisha
Kanjli Wetland, Harike Wetland, Ropar Wetland	Punjab

Important Rivers of India

Name	Origin From	Fall into	Length (km)
Ganges	Combined Sources	Bay of Bengal	2525
Satluj	Mansarovar Rakas Lakes	Chenab	1050
Indus	Near Mansarovar Lake	Arabian Sea	2880
Ravi	Kullu Hills near Rohtang Pass	Chenab	720
Beas	Near Rohtang Pass	Satluj	470
Jhelum	Verinag in Kashmir	Chenab	725
Yamuna	Yamunotri	Ganga	1375
Chambal	M.P.	Yamuna	1050
Ghagra	Matsatung Glacier	Ganga	1080
Kosi	Near Gosain Dham Park	Ganga	730
Betwa	Vindhyanchal	Yamuna	480
Son	Amarkantak	Ganga	780
Brahmaputra	Near Mansarovar Lake	Bay of Bengal	2900
Narmada	Amarkantak	Gulf of Khambat	1057
Tapti	Betul Distt. of M.P.	Gulf of Khambat	724
Mahanadi	Raipur Distt. in Chattisgarh	Bay of Bengal	858
Luni	Aravallis	Rann of Kuchchh	450
Ghaggar	Himalayas	Near Fatehabad	494
Sabarmati	Aravallis	Gulf of Khambat	416
Krishna	Western ghats	Bay of Bengal	1327
Godavari	Nasik distt. in Maharashtra	Bay of Bengal	1465
Cauvery	Brahmagir Range of Western Ghats	Bay of Bengal	805
Tungabhadra	Western Ghats	Krishna River	640

Important River Valley Projects in India

Bhakra Nangal Project	Situated on Sutlej in Punjab. Highest in India. Ht. 226m. Reservoir is called Gobind Sagar Lake.
Mandi Project	On Beas in HP
Chambal Valley Project	On Chambal in MP & Rajasthan, 3 dams include Gandhi Sagar Dam, Rana Pratap Sagar Dam and Jawahar Sagar Dam

Damodar Valley Project	On Damodar in Bihar, based on Tennessee Valley Project USA
Hirakud Project	On Mahanadi in Odisha, World's Longest Dam: 4801m
Rihand Project	On Son in Mirzapur, Reservoir is called Gobind Vallabh Pant reservoir
Kosi Project	On Kosi in N. Bihar
Mayurkashi Project	On Mayurkashi in West Bengal
Kakrapara Project	On Tapi in Gujarat
Nizamsagar Project	On Manjra in Andhra Pradesh
Nagarjuna Sagar Project	On Krishna in Andhra Pradesh
Tungabhadra Project	On Tungabhadra in Andhra Pradesh & Karnataka
Shivasamudram Project	On Cauvery in Karnataka. One of the oldest river valley projects in India.
Tata Hydel Scheme	On Bhima in Maharashtra
Sharavathi Hydel Project	On Jog Falls in Karnataka
Kundah & Periyar Project	In Tamil Nadu
Farakka Project	On Ganga in WB. Apart from power and irrigation, also helps to remove silt for easy navigation.
Ukai Project	On Tapti in Gujarat
Mahi Project	On Mahi in Gujarat
Salal Project	On Chenab in J&K
Mata Tila Multipurpose Project	On Betwa in Uttar Pradesh and Madhya Pradesh
Thein Project	On Ravi, Punjab.
Pong Dam	On Beas, Punjab
Tehri Dam	On Bhgirathi, Uttarakhand
Sardar Sarovar Project	On Narmada, Gujarat/MP.

Types of Natural Vegetation (Forest) in India.

Based on the predominant type of vegetation and climatic condition the forest type can be categorised into–

A. Tropical Evergreen and Semi Deciduous forest

Predominant in western slope of western ghats, hills of north-eastern region and the Andaman and Nicobar island.

- These areas experience annual precipitation of 200 cm and mean annual temperature of these region is 22°C.
- Major species of these type of forests are rose wood, Mahigony, aini, abony.

B. Tropical Deciduous Forest

- These are the wide spread forests of India and also called as **Monsoon forests**.
- The rainfall requirement of these type of forests ranges between 70–200m. On the basis of rainfall availability these forests are further divided into **moist** and **dry** deciduous forests. The **moist** deciduous forests receive recorded rainfall of 100-200 cm and mostly found in the north eastern state, along the foothills of Himalayas, eastern slopes of western ghats and Odisha.

  On the other hand dry deciduous forest receive rainfall of 70 cm to 100 cm and found in the rainier areas of Peninsula and the plains of Uttar Pradesh and Bihar. One of the importand properties of these forests that the trees shed leaves during dry season.
- Major species of moist deciduous forest are teak, sal, shisham, hurra, Mahua, amla, Semul, Kusum and sandal wood, etc.

  Major species of dry deciduous forest are Tendu, Palas, Amaltas, Bel, Khair, Axlewood, etc.

C. Tropical Thorn Forest:

- They are found in the semi-arid regions of southwest Punjab, Haryana, Rajasthan, Gujarat, Madhya Pradesh and Uttar Pradesh.

  These areas receives seasonal rain fall of 25 cm to 50 cm. The plant species of these kind of forests are date, Palm , Khair, Neem, Khejri, Palas, etc. The height of the plants in these areas are not more than 2 m.

D. Montane forest:

These type of forest are predominant in the higher altitude where there is decrease in Temperature. These can be subdivided into 3 categories:

(i) Wet Temperate Forest
(ii) Temperate forest
(iii) Alpine forest

(i) Wet Temperate Forest:

- They are generally found at an altitude of 1800 to 3000 cm above sea level and generally experience a rainfall 150 cm to 300 cm. The mean annual temperature required is 11° to 14° C.

- They have mainly occupied, high hills of Tamil Nadu and Kerala, Eastern Himalayan Region including hills of West Bengal, Assam, Arunachal Pradesh, Sikkim, Nagaland.
- Important plant species are Deodar, Chilauni, Indian chestnut, Birch, Plum, Cinnamomum, Listea, Mongolia, Blue Pine, Oak , Hemlock, etc.

(ii) Himalayan Moist Temperature Forest:

- They are found at an altitude of 1500 m to 3300 m. They receives 150 cm to 250 cm of rainfall.
- They occupy the areas such as Kashmir, Himachal Pradesh, Uttaranchal, Darjeeling and Sikkim.
- Important plant species of these forests are pines, Cedars, silver.

(iii) Alpine Forest Himalayan Dry Temperates :

(a) These forest grows in the areas where the south-west monsoon are weak and the precipitation is less than 100 cm.

(b) They grow in the inner dry ranges of Himalaya such as Ladakh, Lahut, Chamba, Kinnaur, Garhwal, and Sikkim.

E. Littoral & Swamp Forest

They are further divided into:

(a) Beach forest
(b) Tidal forest or Mangrove forest
(c) Fresh Water Swamp.

(a) Beach forest

(i) It requires 75 cm to 500 cm of rainfall.
(ii) Generally found in sea beaches and river delta.
(iii) Important plant species
are callophylum littoralis
Pandanus, Thespesia,
Barringtonia, Pongamia, cocos Mucifera, Spinzfix littoreus etc.

(b) Tidal or Mangrove Forest

- These are mainly found on both east and west sea coast of India and the soil of these forest is formed of silt, Silt-loam, silt clay and sand.
- Sundari tree is the famous plant species of this region. Other than this Palm, Coconut, Keora, Agar are also grown in some parts of this delta.

(c) Fresh Water Swamp:

Primarily occupied the area where rain or swollen river water is collected for sometime.

Important plant species are solia tetrasperma, Acer, Putrajiva, Holoptdia, Cepha lanthus, Borring tonia, Olea, phoeba, Ficus, Murraya, Adhatoda, and canna.

Features of Sunderbans

- **State**: West Bengal
- **Area**: 9630 sq.km
- **Endemic flora**: Sundari, passur, Nypa
- **Endemic fauna**: Bengal tiger, Bengal monitor lizard, Salvator lizard.
- The main threat includes excess fishing, aquaculture practices and harvesting of timber and firewood.

Climate of India

- India has 'Tropical Monsoon' type of climate.
- The word monsoon has been derived from the Arabic word '**Mausam**' which means seasonal reversal of the winds during the course of the year.
- The whole of India has a tropical monsoonal climate.
- Alternating seasons is the chief characteristic of India's climate.

  Factors Affecting the Climate of India Latitude (8°0′ N and 37°0′ N latitudes), Himalaya Mountains, Altitude, Distance from the sea.
- Western disturbances are responsible for the winter rain in Northern India.
- Air currents in the upper layers of the atmosphere known as jet steams could determine the arrival of the monsoons and departure of the monsoons.

CENSUS 2011

- It is the 15th National Census survey conducted by the Census Organization of India.
- Mr. C. Chandramouli -Commissioner & Registrar General of the Census 2011.
- Survey has been conducted in 2 phases - house listing and population.

MOST POPULATED METROS		
1	Mumbai	18,414,288
2	Delhi	16,314,838
3	Kolkata	14,112,536
4	Chennai	8,696,010
5	Bangalore	8,499,399

TOP GROWTH RATE		
1	Dadra and Nagar Haveli	55.88 %
2	Daman and Diu	53.76 %
3	Puducherry	28.08 %
4	Meghalaya	27.95 %
5	Arunachal Pradesh	26.03 %

TOP LITERATE STATES		
1	Kerala	94.00 %
2	Lakshadweep	91.85 %
3	Mizoram	91.33 %
4	Goa	88.70 %
5	Tripura	87.22 %

BEST SEX RATIO		
1	Kerala	1084
2	Puducherry	1037
3	Tamil Nadu	996
4	Andhra Pradesh	993
5	Manipur	992

Indian Population Census 2011 covered a number of parameters during the survey like population, growth rate in population, rate of literacy, density of population, sex ratio and child sex ratio (0-6 years).

- **Population of India** – 1,210,193,422 with 623, 724, 248 males and 586,469, 174 females.
- **Total literacy rate:** 74.04%.
- **Density of population:** 382 persons/sq.km
- **Sex ratio:** 940 females per 1000 males
- **Child sex ratio:** 914 females per 1000 males

HIGH POPULATION		
1	Uttar Pradesh	199,812,341
2	Maharashtra	112,374,333
3	Bihar	104,099,452
4	West Bengal	91,276,115
5	Andhra Pradesh	84,580,777

WORLD GEOGRAPHY

Asia

- Largest of all continents.
- Stretches from 10°S and 8°N latitude and 25°E to 170°W longitude.
- World's highest point- **Mt. Everest**.
- World's lowest point- **Dead Sea**.
- **Important Mountains** - Himalayas, Karakoram, Kunlun Tienshan, Altai, Elbruz, Sulaiman, Zagros, Urals, Yablonovy,Hindukush.
- **Important Lakes:** Lake Baikal Onega, Ladoga and Peipus in Russia, Lake Akan, Mashu, Bima, Shikotsu in Japan, Qinghai and Khanka in China, Dal, Chilka, Vembanad, Pulicat and Sukhna in India, Lake Matano and Toba in Indonesia, etc.
- **Important Plateaus:** Anatolia plateau, Plateau of Iran, Arabia, Tibet, Tarim Basin, Mongolia, Deccan, etc.
- **Rivers:** Salween, Hwang-Ho, Amur, Ganga, Indus, Brahmaputra, Mekong, Yangtse, Si-Kiang, Lena, Ob, Irrawady.
- **Deserts:** Gobi, Taklamakan, Ordos, Karakum, Kyzyl kum, Thar, Dash-e-Lut, Dash-e-kavir.

Climate:

- In summer the Sun shines directly over the Tropic of Cancer, making the interiors of Asia very hot.
- Because of the warm rising air, low pressure develops over vast area.
- Moist winds from the sea all around are sucked into these low pressure centres. These are the '**Summer Monsoon**' winds which bring rain to most parts of South and South East Asia.
- In Winter the Sun shines over the Tropic of Capricorn.

Natural Vegetation

- **Equatorial Forests:** Mahogany, ebony, rosewood and palms.
- **Tropical Forests:** Teak, sal, rosewood, banyan.
- **Deserts:** Cacti, shrubs and thorny bushes.
- **Steppes:** Dry grasslands(from Ukraine to Lake Balkash and Siberia).
- Mediterranean Woodlands (Cedars, grapes and citrus fruits)
- Temperate forests (Oak, Camellia, Camphor, Bamboo and Mulberry)
- Taiga(temperate grasslands): spruce, fir, cedar, larch and pine.
- **Tundra:** Snow covers most of the time; grass, shrub, moss, lichens.
- **Minerals:** Oil, Natural gas.
- Iron ore, Tin, Coal, Mica, Lead, Bauxite and Chromite.

Races

- The **Arabian groups** - includes Arabs, Iranians, Jews, Turks.
- The **Indian groups** - include people of Indian subcontinent.
- The **Mongoloid group** - includes Chinese, Japanese, Koreans and people of South East Asia.

Africa

- Second largest continent.
- Stretches from 37°N to 35°S latitude.
- The Equator passes through almost the middle of the continent.
- Special feature is its **Great Rift Valley**.
- Important **mountains** - Atlas, Tibesti, East African mountains, Ahaggar mountains, Drakensberg, Mt. Kenya, **Kilimanjaro** (highest mountain in Africa).
- **Sahara**, the largest hot desert in the world, stretches across the entire width of North Africa.
- Other **deserts** are Kalahari, Namib, Nubian desert.
- Important **rivers** - River **Nile** (longest in the world).
- River Congo, River Niger, River Zambezi, River Limpopo (crosses the tropic of Capricorn twice), River orange.

Important Dams

- Aswan Dam -River Nile
- Kariba Dam - Zambezi
- Kainji Dam - Niger
- Cabora Bassa Dam – Zambezi

Important lakes of Africa: Lake Victoria, Taaganyika, Nyasa, Chad, Nasser, Kariba, Assal, etc.

Climate

As a large continent, Africa experiences a variety of climate. They are tropical monsoon, humid and sub humid tropical climate, mediterranean hot summer, hot desert climate, tropical wet/dry climate.

Natural Vegetation

Tropical Rain Forest: Mahogany, ebony and teak, oil palms, rubber-producing trees, orchid and lilic.

Tropical Savannas: Oil palms, rubber tree and african Abony.

Tropical Steppes and Deserts: Thorny Acacia euphorbias, dwarf palm, and juice tree.

Mediterranean Forest: Cork oak, olive tree, cedar pine and iron wood.

Montane forest: bamboo, wild variety of coffee and banana.

Mangrove forest: Papyrus, tall grasses, and lotus.

Races

Pygmies: A short height tribal community predominant in Rwanda, Burundi, Uganda, the Democratic Republic of Congo (DRC), the Republic of Congo (ROC), the central African Republic Cameroon, the Equatorial Guinea, Gabon, Angola, Botswana, etc.

Bushmen: A group of yellow skinned nomads spreads along Botswana, Namibia South Africa, Zambia, Zimbabwe and Angola.

Zalus: They are the typical African tribes and descendants of Nguni speaking people who occupied, kwazulu-Natal province of Africa.

Yosai: The semi nomadic tribe concentrated in Kenya.

Bantus: A community Bantu spoken people concentrated in Rwanda, Angola, Burundi, Zimbabwe and South Africa.

Tropical wet and dry climate zone which further divided into equatorial, Tropical and Sub tropical, etc.

South America

- South America is a long triangular shaped continent. It is **4th largest** continent.
- Stretches from 12°N to 55°S latitude.
- **Mountains- The Andes** (longest mountain range in the world.), Aconcagua, Ojendal Salado, Chimborazo, Cotopaxi,
- **Lakes- Titicaca** (highest navigable lake in world), Poopo, Argentino, Junin, Buenos Aires,Nahuel Huapi.
- **Angel falls** (on Orinoco River) is the highest in the world.
- **Deserts:** Patagonia (Argentina), Atacama (Western Coast), Monte desert (Argentina)
- **Climate and Vegetation:** Hot wet Equatorial Climate, **Selvas** (Dense rainforests), **Savanaa** (grasslands), **Pampas** (grasslands of Argentina), **Patagonia** (temperate desert).
- The Pacific Coastlands lie between Andes and the Pacific Ocean.

Important Crops

- Coffee – Brazil
- Cotton – Brazil
- Soybean – Brazil
- Wheat – Argentina
- Sugarcane – Argentina
- Sunflower – Argentina
- Beef – Argentina
- Fisheries – Peru

Minerals

- Petroleum – Venezuela (Maracaibo lake), Trinidad
- Gold – Ecuador, Brazil
- Silver – Peru
- Copper – Peru
- Tin – Bolivia
- Diamonds – Guyana
- Emeralds – Colombia
- Iron ore – Brazil
- Nitrates – Atacama desert
- Aluminium – Brazil
- Lead – Peru
- Zinc – Peru
- Coal – Colombia

Tribes

- **Bantu** – Central and Southern Africa
- **Berbers** – Algeria, Morocco, Tunisia
- **Masais** – East Africa
- **Hottentots** – Kalahari
- **Bushmen** – Kalahari
- **Pygmies** – Congo
- **Zulu** – South Africa
- **Tuaregs** – Sahara
- **Wolof** – Senegal
- **Fon** – Benin
- **Demba** – Zambia
- **Bambara** – Mali
- **Ashanti** – Ghana
- **Amhara** – Ethiopia

North America

- **Third largest continent** after Asia and Africa.
- Extends from **7°N to 85°N latitude** and east to west from 20°W to 179°W. Spreads over an area of 24 million sq. km.
- The Tropic of Cancer and the North circle pass through the continent.
- Includes three large countries - USA, Canada, and Mexico.
- **The Western Cordilleras:** Young Fold mountains (Alaska to South America).
- **Mountain Ranges-** Rocky Mountains, Alaska Range, Coast Mountains, Mt. Logan.
- Cascades, Sierra Nevada and Sierra Madre, **Mt. McKinley** (highest peak of North America in Alaska).
- **Lakes -** Superior, Michigan, Huron, Erie and Ontario, Memphremagog, St. Clair, Champlain.
- **Deserts:** Great Basin desert, Painted desert.
- **Mojave desert -** Yuha desert.
- **Chihuahuan desert -** Baja California desert.
- **Sonoran desert-** Tehuacan desert.
- **Moab desert-** Mohave desert.
- **Important Rivers:** Mississippi, Missouri, St. Lawrence, Mackenzie, Colorado, Hudson, Potomac, Ohio, etc.
- **Death valley** in California is the lowest point (– 86 m below sea level)
- **Dam:** Colorado river (Davis dam, Hoover dam, Parker dam and Buchanan dam)

Climate and Vegetation

- **Tundra :** Arctic Circle, Arctic Ocean and Hudson Bay.
- Summers and Winters are cool and long; Lichens, mosses and Low berry.
- **Taiga :** Winters (long and cold), Summer(short and warm.)
- **Trees:** Pine, Fir, larch.

Temperate Eastern Margin

- Northern part of this region is influenced by cold labrador current and southern is influenced by trade wind.
- Major plant species includes Maple, Oak, Elm and Ash tree.

Cool Temperate West Margin

Influenced by warm Alaska current Westerly rain through out the year and warm summers and wild winters.

Coniferous trees are predominant here.

Mediterranean Climate

Influenced by trade wind in summer which make hot dry summer. As the climate is unfavourable for plant growth only scrub like vegetations are common here.

Hot Desert: Great deserts like Mohave and Sonora are present on the South Western part of North America. Because the mountains to the east act as a rain shadow for Trade wind.

Common plant species are Cacti, Sage, Thorn bushes, and Coarse Grasses. The Joshua tree is a taller cactus.

Grasslands: Prairies

- **Winds:** Chinook, Blizzards, Hurricanes, Tornadoes.
- **Minerals:** Gold, Iron, Copper, Silver, Nickel, etc.

Tribes

- Abenaki – Alent
- Apache – Arawak
- Aymara – Caddo
- Cayuga – Ponca
- Crow – Seneca
- Innu – Shoshone
- Yurok – Wichita

Australia

- World's **largest island** and **smallest continent**.
- The tropic of **Capricorn** cuts the continent almost into half.

- The **Great Barrier Reef** (largest coral reef in the world) is situated in Australia.

The location of Australia is in between India and Pacific Ocean and it stretches west to east from 114° E longitude to 154° E longitude and from 10°S to 40°S Latitude.

The island was discovered by **Captain cook** in 1770.

- **River-** Murray and Darling.
- **Deserts-** Gibson Desert, Great Sandy Desert, Great Victoria Desert, Simpson Desert, Tittle sandy desert. Strzelecki Desert, Tanami Desert, Rangipo Desert.
- Both temperate and tropical climate is experienced in Australia.
- The winter lands of New South Wales of victoria, Tasmania, the south-eastern Australia, South west port of Australia comes within this temperate zone where 4 prominent seasons dominate the whole year. They are
    - Summer
    - Autumn
    - Winter
    - Spring
- Tropical wet and dry climate zone which is further divided into equatorial, tropical and sub tropical etc.

Climate and Vegetation

Natural Vegetation:

The Predominant vegetation types are –

Tropical rain forest region with dense cover of coconut and palms, mangrove growing near shoreline

The deciduous forest region with tall and short tree , shrubs, small plants and mosses.

The dry desert and desert scrub: It is the region with vegetation such as cactic. **Grassland** – Prominent Grasslands of Australia are Savanna and Downs.

- **Crops-** Wheat, Barley, oats, maize, sugarcane, tobacco and cotton.
- **Largest** number of **sheep** in the world.
- **Largest** producer of **bauxite** in the world.
- **Industries-** iron and steel, agricultural machinery, motor vehicles, electrical goods, chemical, ships, etc.
- **Metals-** Uranium (Kalgoorlie and Koolgardie), Lead, Zinc, Silver and Manganese.
- **Original Inhabitants.** Aborigines.

Antarctica

- It is the **fifth** largest continent.
- It is completely covered by permanent ice and snow.
- **Temperature:** falling to – 90°C.
- **Mosses** and **lichens** are found all over clinging to rocky surfaces.
- **Animals-** krill, whales, seals, sea birds and penguins.
- **Highest peak-** Vinson Massif.
- **Mountain range-** Queen Maud Range (Longest mountain range).
- **Volcano-** Mount Sidley (highest volcano).
- **Aurora Australia** (Southern Hemisphere) and **Aurora Borealis** (Northern hemisphere) are fantastic display of lights in winters.

Europe

- It is the **second** smallest continent.
- Stretches from 35°N to 80°N latitude and from 10°W to 60°E longitude.
- Separated from Asia by Russia's **Ural** mountains and the Caspian and Black sea.
- **Highest point-** Mt. Elbrus.
- **Lowest point-** Caspian sea (28 m below sea level).
- **Mountains-** Ural Mt. Scandinavian, Mt. Old Block. The Alpine Alps, Jura.
- Carpathian Balkan.
- **Deserts-** Halendi, Bedowska, Deliblatska Pescara, Oltenian Sahara, Tabernas Desert.
- **Rivers-** Rhone, Ebro, Po, Danube, Dnieper, Don, Rhine, Seine, Thames, Elbe.
- Mild climate , moderate rain.
- Tundra, Taiga, Steppes (temperate grasslands).
- **Trees-** Elm, Oak, Beech Ash, Olive(most important tree)
- **Minerals-** Iron ore, Petroleum, Mercury, Sulphur, Copper, Coal.
- European belong to white race known as **Caucasian race**.
- There are three distinct **branches**: **Nordic people** (tall, fair with very light hair and eyes.) **Mediterranean people** (shorter with dark skin, hair and eyes) and **Mongoloid people** (heavily built, as Lapps and Finns).

EXERCISE

1. The Indian subcontinent was originally part of a huge mass called
(a) Indian (b) Aryavarta
(c) Angaraland (d) Gondwana land

2. Which one of the following is the dominant element of the earth crust?
(a) Aluminium (b) Iron
(c) Oxygen (d) Silicon

3. The highest salinity is found in which of the following lakes?
(a) Van Lake (b) Dead sea
(c) Balkash lake (d) Baikal lake

4. The deepest lake of the world is
(a) Baikal (b) Crater
(c) Nyasa (d) Tanganyika

5. Which one of the following sea is the largest in area?
(a) Sea of Okhotsk (b) Sea of Japan
(c) Sea of China (d) Bering Sea

6. The biggest island of the Indian Ocean is
(a) Maldives (b) Madagascar
(c) Lakshadweep (d) Sumatra

7. Which one of the following ocean currents is different from others?
(a) Gulf stream (b) Kuroshivo
(c) North Atlantic Drift (d) Labrador

8. Earth's Albedo is largely affected by
(a) Cloudiness
(b) Dust particles in atmosphere
(c) Atmospheric layer
(d) Nature of the earth's surface

9. The largest volume and mass of the earth is found in
(a) Crust (b) Mantle
(c) Outer core (d) Inner core

10. The clockwise movement of winds in the cyclones of southern hemisphere is mainly caused by
(a) Centrifugal force (b) Deflective force
(c) Frictional force (d) Pressure force

11. Which one of the following currents has a warming influence on the neighbouring coast?
(a) Benguela (b) Agulhas
(c) Canaries (d) Oyasio

12. Which one of the following local winds is different from the other three?
(a) Khamsin (b) Foehn
(c) Sirocco (d) Mistral

13. Atmospheric layer which reflects radio waves is called
(a) Exosphere (b) Ionosphere
(c) Stratosphere (d) Troposphere

14. The layer of the atmosphere which contains dust particles and water vapour is called
(a) Stratosphere (b) Troposphere
(c) Ionosphere (d) Mesosphere

15. Gulf stream is
(a) A river in the Gulf
(b) An ocean current
(c) A second name of jet stream
(d) A local wind

16. Which of the following is not igneous rock?
(a) Granite (b) Conglomerate
(c) Basalt (d) Rhyolite

17. Jet stream is
(a) Fast blowing westerlies in upper part of Troposphere.
(b) Ocean current
(c) Monsoon winds
(d) None of these

18. Peanuts are the main crop of
(a) Georgia (b) Gambia
(c) Ghana (d) Guatemala

19. The leading producer of both rice and wheat in the world is
(a) China (b) India (c) Russia (d) U.S.A.

20. Which one of the following is a fossil source of energy?
(a) Wood (b) Solar radiation
(c) Tidal waves (d) Petroleum

21. The largest exporter of steel in the world is
(a) China (b) Japan (c) Russia (d) Ukraine

22. In which of the following crops the international trade is low in comparison to total produce?
(a) Coffee (b) Rice (c) Rubber (d) Wheat

23. Which of the following countries is the greatest producer of bauxite in the world?
(a) Argentina (b) India
(c) South Africa (d) Brazil

24. The neighbouring country of India which has the largest area is
(a) Bangladesh (b) China
(c) Pakistan (d) Nepal

25. Which one of the following countries has the longest international boundary with India?
(a) China (b) Pakistan
(c) Bangladesh (d) Myanmar

26. How many countries share land boundaries with India?
(a) Five (b) Six (c) Seven (d) Nine

27. Which is the world's largest delta?
(a) Sunderbans delta (b) Ganga-Brahmaputra delta
(c) Beas-Chenab delta (d) Godavari delta

28. In which part of India does the Great Indian Desert lie?
(a) Western (b) Eastern
(c) Northern (d) Southern

29. Lakshadweep Islands are ___________ Islands located in the Arabian Sea
(a) Coral (b) Maldives
(c) Both 'a' and 'b' (d) None of them

30. Which of the following is the largest state of India?
(a) Bihar (b) Rajasthan
(c) Madhya Pradesh (d) None of these

31. Which of the following rivers does not drain into the Bay of Bengal?
(a) Mahanadi (b) Krishna
(c) Yamuna (d) Ganga

32. Which is the coldest inhabited place of the world?
(a) Kargil (b) Srinagar (c) Leh (d) Drass

33. What do you call the hot and dry winds?
(a) Hawa (b) Zoo
(c) Loo (d) None of them

34. What do you mean by Natural Vegetation?
(a) Small plants
(b) Plants which grow on their own without interference or help from human beings
(c) Forests
(d) None of them

35. Which are the monsoon forests?
(a) Tropical evergreen forests (b) Tropical deciduous forests
(c) Tropical rain forests (d) None of them

36. In Brazil, Tropical Grasslands are called
(a) Savannah (b) Campos
(c) Llanos (d) Pampas

37. Tafilalet Oasis is found in
(a) Morocco (b) Libya
(c) Egypt (d) Algeria

38. Where is the Ganga-Brahmaputra basin situated?
(a) It lies in the sub-tropical region
(b) It lies in the north-temperate region
(c) It lies beside the Nile river
(d) None of them

39. Name one of the important rivers which flows through Ladakh?
(a) Ganga (b) Yamuna
(c) Brahmaputra (d) Indus

40. In which continent is the world's largest desert situated?
(a) Asia (b) Africa
(c) Australia (d) South America

41. How many countries does the Sahara desert touch?
(a) 10 (b) 8 (c) 11 (d) 5

42. Which of the following is the largest river basin in the world?
(a) Nile basin (b) Yamuna basin
(c) Amazon basin (d) Hwang-Ho basin

43. Which of the following is known as the gold capital of the world?
(a) Egypt (b) South Africa
(c) Kimberley (d) Johannesburg

44. Merino is a species of
(a) sheep (b) elephant
(c) fish (d) cow

45. How many layers does the earth have?
(a) 5 layers (b) 3 layers
(c) 2 layers (d) 1 layer

46. The continental masses are mainly composed of
(a) silica (b) alumina
(c) (a) and (b) both (d) None of these

47. The oceanic crust is mainly composed of :
(a) silica (b) magnesium
(c) (a) and (b) both (d) None of these

48. Mantle extends up to a depth of :
(a) 1900 km (b) 2900 km
(c) 3900 km (d) 4900 km

49. What are fossils?
(a) The remains of the dead plants and animals
(b) Molten magma
(c) Igneous rocks
(d) All the above

50. The movement of earth plates occurs due to :
(a) molten magma (b) crust
(c) mantle (d) None of these

51. Earthquake occurs because
(a) When magma inside earth comes out
(b) High pressure wind blows
(c) Lithosphere plates move, causing the earth's surface to vibrate.
(d) None of these

52. The radius of the earth is ________km.
(a) 6000 (b) 6371
(c) 6800 (d) 7000

53. Igneous rocks are characterised by
(a) full of fossils and fauna (b) stratification
(c) deposition of sediments (d) None of these

54. A volcano is a
(a) vent in the earth's crust through which molten material erupts suddenly.
(b) opening in the earth's surface through which water comes out.
(c) force that works on the surface of the earth.
(d) None of these

55. Which of the following is a cold desert ?
(a) Thar (b) Sahara
(c) Ladakh (d) None of these

56. What does Khapa-Chan mean ?
(a) Sand land (b) Snow land
(c) Water area (d) All of these

57. What do you mean by a 'reserve'?
(a) It is that portion of the actual resource, which can be developed profitably with the available technology
(b) This is a resource that cannot be developed further
(c) It requires a lot of time and energy of human beings
(d) None of them

58. Physical factors responsible for soil erosion is /are
(a) slope of the land
(b) intensity of rainfall
(c) velocity of wind blowing in that area
(d) All of them

59. Bauxite is an ore of _________
(a) aluminum (b) iron
(c) gold (d) copper

60. What is Geothermal Energy?
(a) It is muscular energy
(b) It is energy produced by human beings
(c) It is the natural heat found in the interiors of the earth
(d) None of them

61. Atmospheric pressure depends on
1. Altitude 2. Temperature
3. Earth rotation4.Moon's pull
(a) 1, 2 and 3 (b) 2 and 3
(c) 1 and 2 (d) 1, 2, 3 and 4

Hints & Solutions

1. (d) **2.** (c) **3.** (a) **4.** (a) **5.** (a) **6.** (b)
7. (d) **8.** (a) **9.** (b) **10.** (b) **11.** (b) **12.** (d)
13. (b) **14.** (b) **15.** (b) **16.** (b) **17.** (a) **18.** (b)
19. (a) **20.** (d) **21.** (a) **22.** (b) **23.** (d) **24.** (b)
25. (c) **26.** (c) **27.** (b) **28.** (a) **29.** (a) **30.** (b)
31. (c) **32.** (d) **33.** (c) **34.** (b) **35.** (b) **36.** (b)
37. (a) **38.** (a) **39.** (d) **40.** (b) **41.** (c) **42.** (c)
43. (d) **44.** (a) **45.** (b) **46.** (c) **47.** (c) **48.** (b)
49. (a) **50.** (a) **51.** (c) **52.** (b) **53.** (b) **54.** (a)
55. (c) **56.** (b) **57.** (a) **58.** (d) **59.** (a) **60.** (c)
61. (a)

Chapter 4 Economy

INTRODUCTION

- India's a **developing economy** with agriculture being its backbone.
- It is a **mixed economy** where both public and private ownership prevail.
- It is a World's fourth largest in terms of real GDP after USA, China and Japan.
- Estimated to be **third largest economy** with a GDP size of $15 trillion by 2030.

Features

- Low per capita income
- Heavy Population Pressure
- **Pre-dominance** of Agriculture
- Unemployment
- Low Rate of **Capital Formation**
- Poor Technology
- Backward Institutional and social framework
- Under-utilization of Resources
- Price instability
- Dependence on Imports
- Income **Disparities**
- Poverty

HISTORY OF PLANNING IN INDIA

- **1934:** First attempt to **initiate** economic planning in India was made by **Sir M.Visvesvarayya**, through his book **'Planned Economy For India'.**
- **1938:** 'National Planning Commission' was set up under the chairmanship of **J.L. Nehru** by the Indian National Congress.
- **1944: 'Bombay Plan'** was presented by 8 leading industrialists of Bombay.
- **1944: 'Gandhian Plan'** was given by S. N. Agarwal.
- **1945: 'People's Plan'** was given by **M. N. Roy**.
- **1950: 'Sarvodaya Plan'** was given by **J. P. Narayan.** A few points of this plan were accepted by the Government.

The Planning Commission

- It was set up on **March 15, 1950** under the chairmanship J.L. Nehru, by a **resolution** of Union Cabinet.
- It is an extra-constitutional, **non-statutory body.**
- Prime Minister is the ex-officio Chairman, one deputy-Chair appointed by the PM and some full time members.
- On May 29 ,2014, according to reports of IEO, Planning Commission submitted to PM Modi, Planning Commission to be replaced by "Control Commission".
- In January **2015**, Cabinet **resolution replaced the Planning Commission by NITI Aayog.**

PLANS

First Plan (1951 - 56)

- Based on **Harrod-Domar Model.**
- Community Development Program launched in 1952
- Focus on **agriculture, price stability, power** and **transport**.

Second Plan (1956 - 61)

- Also called **Mahalanobis Plan.**
- Focus - **rapid industrialization**
- Target Growth: 4.5% ; Actual Growth: 4.27%

Third Plan (1961 - 66)

- Target Growth: 5.6% ; Actual Growth: 2.4%
- Agriculture was given to priority to support the exports and industry.
- Aimed to make India a '**self-reliant**' and '**self-generating**' economy.
- Complete failure in reaching the targets due to unforeseen events - Chinese aggression (1962), Indo-Pak war (1965), severe drought 1965-66.

Three Annual Plans (1966-69) Plan holiday for 3 years

- The main reasons for plan holidays were the war, lack of resources, and increase in inflation.
- Equal priority was given to agriculture, its allied activities, and industrial sector.
- During the Annual Plans, the economy absorbed the shocks generated during the Third Plan.

Fourth Plan (1969 - 74)

- Target growth rate was 5.6%, actual growth rate was 3.3%.
- Main emphasis was on growth rate of agriculture to enable other sectors to move forward

Fifth Plan (1974-79)

- The fifth plan was prepared and **launched by D.D. Dhar**.
- Target growth rate was 4.4% and the actual growth rate was 5.0%.
- Expansion of tourism.

- It proposed to achieve two main objectives: **'removal of poverty'** (Garibi Hatao) and **'attainment of self reliance'.**
- The plan was terminated in 1978 (instead of 1979) when Janta Party Govt. rose to power.

Rolling Plan (1978 - 80)

- There were two Sixth Plans. Janta Government put forward a plan for 1978-1983. However, the government lasted for only 2 years. Congress Govt. returned to power in 1980 and launched a different plan.

Sixth Plan (1980 - 85)

- Target growth rate was 5.2% and the actual growth rate was 5.4%.
- It was a great success and marked the beginning of **economic liberalisation**.
- Focus - Increase in national income, modernization of technology, ensuring continuous decrease in poverty and unemployment, population control through family planning, etc.

Seventh Plan (1985 - 90)

- Target growth rate was 5.0% and the actual growth rate was 6.01%.
- Focus - rapid growth in food-grains production, increased employment opportunities and productivity within the frame-work of basic tenants of planning.

Eighth Plan (1992 - 97)

- It was postponed by two years because of political uncertainty at the Centre.
- **Modernization of industries was a major highlight.**
- Main economic outcomes were rapid economic growth, high growth of agriculture and allied sectors, and manufacturing sector, growth in exports and imports, improvement in trade and current account deficit.
- Target growth rate: 5.6%; Average growth rate: 6.78%

Ninth Plan (1997- 2002)

- Target growth was 7.1% and the actual growth was 6.8%.
- It was developed in the context of four important dimensions: Quality of life, generation of productive employment, regional balance and self-reliance.

Tenth Plan (2002 - 2007)

- Target growth: 8.1%
  Growth achieved: 7.7%
- **20 point program was introduced.**
  - It targetted a GDP growth of 8% per annum.
  - Reduction in gender gaps in literacy and wage rates by at least 50%
  - Providing gainful and high-quality employment at least to the addition to the labour force.
  - Reduction of poverty rate by 5%.

Eleventh Plan (2007 - 2012)

- Accelerate GDP growth from 8% to 10%.
- Reduce Total Fertility Rate to 2.1
- Increase agriculture growth to 4%.
- Emphasis on social sector and delivery of service therein.
- Empowerment through education and skill development.

Twelfth Five Year Plan (2012-2017)

Major objective: Faster, Sustainable and More Inducive Growth.

Planning Commission in its meeting held on April 2011, the Prime Minister, Dr. Manmohan Singh, addressed the Planning Commission concerning the twelth Five Year Plan of India. The main points of the Twelfth Plan are:

Resource Allocation Priorities in 12th plan

- Health and Education received less than projected in Eleventh Plan. Allocations for these sectors will have to be increased in 12th plan.
- Health, Education and Skill Development together in the Centre's Plan will have to be increased by at least 1.2% point of GDP.
- Infrastructure, including irrigation and watershed management and urban infrastructure, will need additional 0.7 percentage point of GDP over the next 5 years.
- PPP model must be encouraged, including in the social sector, i.e. health and education. Efforts on this front need to be intensified.
- Distinction between plan and non-plan being reviewed by Rangarajan Committee.

Important Points

- Planning Commission has been replaced by NITI Aayog.
- Montek Singh Ahluwalia was the last Deputy Chairman of the Commission (resigned on 26 May 2014).
- Five-Year Plans (FYPs) are centralized and integrated national economic programs.

NATIONAL INCOME OF INDIA

- **National Income** is the money value of all the final goods & services which produced by a country during one year.
- India is now the world's **3rd largest** economy in terms of real prices and purchasing power.
- For national income, the Indian economy is divided into 14 broad sectors which are grouped into 3 main categories.

Sector	Activity
Primary Sector	Agriculture and Allied Sector
	Forestry
	Fishing
	Mining & Quarrying
Secondary Sector or Industrial sector	Manufacturing
	Electricity, Gas and Water Supply
	Construction
Tertiary Sector or Service Sector	Trade, Hotels and Restaurants
	Transport
	Storage
	Communication
	Financing, (Banking Insurance)
	Real Estate and Business Services
	Community, Social, Personal and other Services

Measures/Concepts of National Income

1. **Gross Domestic Product (GDP):** GDP is the total money value of all final goods & services produced within the geographical boundaries of the country (produced by resident citizens + foreign nationals) during a given period of time, generally one year.

$\boxed{GDP = Q \times P,}$

Q = Total quantity of final goods & services.
P = Price of final goods & services.

2. **Gross National Product (GNP):** GNP is the money value of total output or production of final goods & services produced by the nationals of a country during a given period of time, generally a year. In this case, the income of all the resident & non-resident citizens of a country is included whereas the income of foreign nationals who reside within the geographical boundary of the country is excluded.

$\boxed{GNP = GDP + (X - M)}$

X = Export of goods & services
M = Import of goods & services
X – M = Net Factor Income from Abroad (NFIA)

So, $\boxed{GNP = GDP + NFIA}$

3. **Net National Product (NNP): can be calculated in 2 ways:-**

(i) NNP at market price:

$\boxed{NNP = GNP - Depreciation}$

Depreciation means wear & tear of goods produced. NNP at market price includes Indirect taxes and excludes subsidies.

(ii) NNP at factor cost: NNP at factor cost calculates National Income only on the basis of cost incurred to produce the goods & services. This cost is the payment made to the factors of production.

$$\boxed{NNP_{fc} = NNP_{mp} - \text{Indirect Taxes} + \text{Subsidy}}$$

When NNP is obtained at factor cost, it is known as National Income.
Likewise, GDP at factor cost also can be calculated.

$$\boxed{GDP_{fc} = GDP_{mp} - \text{Indirect Taxes} + \text{Subsidy}}$$

4. **Personal Income :** It is that income which is actually obtained by nationals in one year.

P.I. = National Income – Undistributed Profits of Corporation – Payments for Social Security Provisions – Corporate Taxes + Government Transfer payments + Business Transfer payments + Net Interest paid by government.

Social Security Provisions = Payments made by employees towards pension & provident fund

Transfer payments = Payments made not against any productive activity. eg. – old age pension, unemployment compensation, disaster relief payment, etc.

5. **Disposal Personal Income (DPI):** Income that is available to individuals that can be disposed at their will.

$\boxed{DPI = \text{Personal Income} - \text{Direct Taxes.}}$

6. **National Income at constant price & current price**

NI @ CONSTANT PRICE = Total quantity of all final goods & services produced in a particular year × Price of base year.

Base year of National Income accounts is the year chosen to enable inter – year comparisons. The new series changes the base to 2011–12 from 2004–05

NI @ CURRENT PRICE = Total quantity of all final goods & services produced in a particular year × Price of goods & services in that particular year.

NATIONAL RURAL HEALTH MISSION

- Focus will be post-menopausal problems, osteoporosis and breast and cervical cancer.
- Dovetailing of NRHM with IGMSY [Indra Gandhi Matritva Sahyog Yojana] (conditional cash transfer for maternity benefit) and National Food Security Bill (NFSB) will be undertaken.
- Training Anganwadi and ASHA workers (Accredeted Social Health Activist) on issues relating to nutrition, counselling, child rights and gender discrimination
- Work of ASHAs/AWWs, will be valued and recognised.

Child labour v/s Right to Education (RTE)

- RTE = Every child between the ages of 6 and 14 has right to free (and compulsory) elementary education
- Child Labour (Prohibition and Regulation) Act of 1986 makes a distinction between hazardous and non-hazardous categories of work for children under 14 years.

Rashtriya Bal Swasthya Karyakram

- This scheme was launched in 2013.
- To provide comprehensive healthcare and improve the quality of life of children focus on 4D.
- Defects at birth (cleft lip, down's syndrome, Talipes etc.).
- Diseases (dental, heart, asthama etc.).
- Deficiencies (Vit.A deficiency = Bitot spot).
- Development delays including disability.

ICDS

- Integrated Child Development Service started in 1975.
- Beneficiary-children below the age of six, lactating mothers, pregnant mothers.
- Provides for nutritional and health status, immunization, health checkups, pre-school and non-formal education
- Has convergence with reproductive and child health (RCH) program under National Rural Health Mission

Dhanlakshmi

Conditional cash transfer for girl child, launched in 2008, for fulfilling following conditions:

- birth and registration of birth
- immunization
- enrolment and retention in school

For this scheme, 12th FYP wants conditional transfer of assets (like home via IAY) instead of cash transfer.

Rajiv Gandhi National Creche

- Scheme provides for day-care facilities to 0-6 year-old children of working mothers by opening crèches and development services
- Requirement: combined monthly income of both the parents should not exceed ₹12,000 for availing of the facilities.

INDUSTRIES: PUBLIC SECTOR ENTERPRISES, NAVRATNAS AND MAHARATNAS

- Public Sector Enterprises (PSE) is a government-owned corporation owned by Union Government of India, or one of the many state or territorial governments, or both.
- They are under the Department of Public Enterprises of Ministry of Heavy Industries and Public Enterprises.
- There are currently 254 PSU companies in India.

Financial autonomy

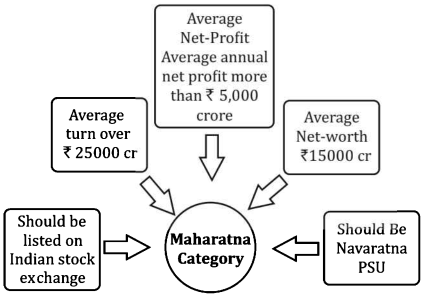
- **Maharatna**
- **Navratna**
- **Miniratna**

  CPSEs (itself divided into Category I & Category II)

  In persent, There are 8 Maharatna, 16 Navratna and 75 Miniratna CPSE'S.

Criteria for giving Maharatna Status

- Company already holds Navratna status.
- It is listed on the Indian stock exchange fulfilling the minimum prescribed public shareholding according to the SEBI regulations.


Average Net-Profit Average annual net profit more than ₹ 5,000 crore
Average turn over ₹ 25000 cr
Average Net-worth ₹15000 cr
Should be listed on Indian stock exchange
Maharatna Category
Should Be Navaratna PSU

8 Maharatna CPSEs, namely:

1. Bharat Heavy Electricals Limited
2. Coal India Limited
3. GAIL (India) Limited
4. Indian Oil Corporation Limited
5. NTPC Limited
6. Oil & Natural Gas Corporation Limited
7. Steel Authority of India Limited
8. Bharat Petroleum Corporation Limited.

Criteria for giving Navratna Status

- Company must have 'Miniratna Category – I' status along with a Schedule 'A' listing.
- It should have at least 3 'Excellent' or 'Very Good' Memorandum of Understanding (MoU) during the last five years.

There are **16 Navratna** CPSEs in the country, these are:

1. Bharat Electronics Limited
2. Container Corporation of India Limited
3. Engineers India Limited
4. Hindustan Aeronautics Limited
5. Hindustan Petroleum Corporation Limited
6. Mahanagar Telephone Nigam Limited
7. National Aluminium Company Limited
8. National Buildings Construction Corporation Limited
9. NMDC Limited
10. Neyveli Lignite Corporation Limited
11. Oil India Limited
12. Power Finance Corporation Limited
13. Power Grid Corporation of India Limited
14. Rashtriya Ispat Nigam Limited
15. Rural Electrification Corporation Limited
16. Shipping Corporation of India Limited

INDUSTRIAL POLICY 1991

(A) Objectives

- to maintain a *sustained growth* in productivity.
- to enhance gainful employment.
- to achieve *optimum utilisation of human resources*.
- to attain *international competitiveness*.
- to transform India into a major partner and players in the global arena.

(B) Main Focus on

- *deregulating* Indian industry.
- allowing the industry *freedom and flexibility* in responding to market forces, and
- providing a policy regime which *facilitates and fosters growth* of Indian industry.

(C) Policy Measures

- *Liberalisation* of Industrial Licensing Policy.
- Introduction of *Industrial Entrepreneur's Memorandum* (*i.e.* no industrial approval is required for industries not requiring compulsory licensing).
- Liberalisation of Locational Policy.
- Liberalised policy for Small Scale Sectors.
- Non-Resident Indians Scheme (NRIs are allowed to invest upto 100% equity on non-repatriation basis in all activities except for a small negative list).
- *Electronic Hardware Technology Park* (EHTP), *Software Technology Park* (STP) Scheme for building up strong electronic industry to enhance exports.
- Liberalised policy for Foreign Direct Investment (FDI).
- Abolition of the MRTP limit.
- FERA was replaced by highly liberal FEMA.

MAJOR INDUSTRIES IN INDIA

Classification of Industries:

A. On the basis of source of raw materials

- Agro based industry (cotton textile, jute textile and sugar).
- Mineral based industry (iron and steel, machine tools and aluminium).

B. On the basis of main role played by the industry

- Basic industries: these are the industries whose finished products are used as the raw materials for other industries.
- Consumer goods industries: these are the industries whose finished products are directly used for consumption by consumers.

C. On the basis of capital investment

- Small scale industry
- Large scale industry

D. On the basis of ownership

- Public sector undertaking (SAIL, HAL, BEML)
- Private sector undertaking
  (TISCO, Mahindra and Mahindra, Birla Cement)

- Joint sector undertaking (Oil India Limited)
- Co-operative industries (Sugar Industry in Maharashtra)

E. Based on the bulk of raw materials and finished products

- Heavy industries
- Light industries

In India, industries are concentrated in four main regions:

1. West Bengal, Jharkhand and Chhatisgarh
2. Maharashtra and Gujarat region
3. Gangetic Plains
4. South India

FIRST TIME IN INDIA

Cotton Industry	1818 Fort Gloster (Kolkata)
Iron and Steel Industry	1870 Kulti (West Bengal)
Sugar Industry	1900 Bihar
Jute Industry	1855 Rishara (West Bengal)
Paper Industry	1812 Serampur (W. Bengal)
Petroleum Industry	1956 Digboy (Assam)
Cement Industry	1904 Chennai (Tamil Nadu)

Agro-based Industries of India:

These industries depend on agricultural products as raw materials for the manufacturing products.

Cotton Textile Industry

- **Mumbai is called the Manchester of India,** for the large concentration of cotton mills in and around the city.
- India is one of the leading producers of cotton textile, ranking third in the world.

Jute Industry

- India is the **largest producer of raw jute** and jute goods and is the second largest exporter after Bangladesh. Also faces competition from Brazil and Thailand.
- Most of the 70 jute mills are located on the 98 km belt on both sides of River Hooghly in West Bengal.

Sugar Industry

- India ranks second in the world in the production of sugar and **first in producing gur and khandsari.**
- Major sugar producing states: Maharashtra, UP, Gujarat, Bihar, MP, Haryana, Karnataka, Andhra Pradesh and Tamil Nadu.
- Problems faced: seasonal nature, transport delays, outdated and inefficient machineries.

Paper Industry

- Major centres are Kolkata, Titagarh, Kakinada and Bhadravati.
- India's production falls short of the demand.
- A large quantity of paper has to be imported.

Mineral-based Industries of India

Iron and Steel Industry

- **India ranks 5th in the world in steel production and first in the production of sponge iron**.
- Most of the steel plants are controlled by Steel Authority of India Limited (SAIL) that was established in 1974 and is responsible for development of steel industry.
- **First large scale steel plant TISCO at Jamshedpur in 1907** followed by IISCO at Burnpur in 1919. Both belonged to private sector.
- **The first public sector unit was' Vishveshvarraya Iron and Steel Works' at Bhadrawati.**
- Bhilai, Durgapur and Rourkela were established during the second five year plan. Bokaro was established during the third five year plan while the steel plants at Salem, Vijay Nagar and Vishakhapatnam were established in the fourth five year plan.

Aluminium Smelting

- It is the second most metallurgical industry in India.
- There are eight aluminium smelting plants in India.

Chemical and Fertilizer Industry

- India ranks 12th in the world in the production of different types of chemicals.
- India is the third largest nitrogenous fertilizer producer of the world.
- India exports cement to South and East Asia, Middle East and Africa.

Committees on Indian Economy

AC Shah Committee	Non-Banking Financial Company
Bimal Jalan Committee	Market Infrastructure Instruments
Malegam Committee	Functioning of Micro Finance
Birla Committee	Corporate Governance
Kirit Parikh Committee	Rationalisation of Petroleum Product Prices
Chaturvedi Committee	Improving National Highways in India
SR Hashim Committee	Urban Poverty
Abhijit Sen	Wholesale Price Index
C Rangarajan	Services Price Index
Abid Hussain Committee	Development of Capital Markets
Damodara Committee	Customer Service in Banks
Khandelwal Committee	Human Resource in Commercial Banks
Patil Committee	Corporate Debt
VK Sharma Committee	Credit to Marginal Farmers
Sarangi Committee	Non-Performing Assets
Khanna Committee	Regional Rural Banks
Dantawala Committee	Lead Bank Scheme
Gadgil Committee	Financial Inclusion

EXERCISE

1. The central banking functions in India are performed by the:
1. Central Bank of India
II. Reserve Bank of India
III. State Bank of India
IV. Punjab National Bank
(a) I, II (b) II (c) I (d) II, III

2. Development expenditure of the Central government does not include:
(a) defence expenditure
(b) expenditure on economic services
(c) expenditure on social and community services
(d) grant to states

3. ICICI is the name of a:
(a) chemical industry (b) bureau
(c) corporation (d) financial institution

4. On July 12, 1982, the ARDC was merged into:
(a) RBI (b) NABARD
(c) EXIM Bank (d) None of the above

5. In which of the following types of economy are the factors of production owned individually?
(a) Capitalist (b) Socialist
(c) Mixed (d) Both (a) and (b)

6. Poverty in less developed countries is largely due to:
(a) voluntary idleness
(b) income inequality
(c) lack of cultural activities
(d) lack of intelligence of the people

7. The most appropriate measure of a country's economic growth is its:
(a) Gross Domestic Product (b) Net Domestic Product
(c) Net National Product (d) Per Capita Real Income

8. Which of the following committees examined and suggested financial sector reforms?
(a) Abid Hussain Committee (b) Bhagwati Committee
(c) Chelliah Committee (d) Narasimham Committee

9. Which of the following contributes the maximum earnings in Indian Railways?
(a) Passenger Earning (b) Goods Traffic Earning
(c) Sundry Earning (d) Other Coach Earning

10. SEBI is a
(a) constitutional body (b) advisory body
(c) staturory body (d) non-statutory body

11. Who has presented the Union Budget of India maximum number of times?
(a) Choudhary Charan Singh (b) Pranab Mukherjee
(c) VP Singh (d) Morarji Desai

12. Who prints and supplies the currency notes in India?
(a) Security Press, Noida (b) Security Press, Mumbai
(c) RBI, Delhi (d) Security Press, Nasik

13. Indian Economy is..............economy.
(a) mixed (b) socialist
(c) free (d) Gandhian

14. The 'Father of Economics' is:
(a) Max Muller (b) Karl Marx
(c) Adam Smith (d) Paul

15. National Sample Survey (NSS) was established in
(a) 1950 (b) 1951 (c) 1952 (d) 1943

16. Agriculture Income Tax is assigned to the State Government by:
(a) the Finance Commission
(b) the National Development Council
(c) the Inter-State Council
(d) the Constitution of India

17. National Income is the:
(a) Net national product at market price
(b) Net national product at factor cost
(c) Net domestic product at market price
(d) Net domestic product at factor cost

18. Who among the following was the first Chairman of the Planning Commission?
(a) Dr Rajendra Prasad (b) Pt Jawaharlal Nehru
(c) Sardar Vallabhbhai Patel (d) JB Kriplani

19. Planning Commission was established in the year:
(a) 1950 (b) 1947 (c) 1975 (d) 1960

20. During which Plan the growth rate of agricultural production was negative?
(a) Third Plan (b) Second Plan
(c) First Plan (d) None of these

21. The Planning Commission of India is:
(a) a constitutional body
(b) a statutory body
(c) a non-statutory body
(d) an independent and autonomous body

22. Which one of the following statements most appropriately describes the nature of the Green Revolution?
(a) Intensive cultivation of crops
(b) Seed-fertilizer-water technology
(c) Intensive agriculture district programme
(d) High-yielding varieties programme

23. Who gave the call for 'Evergreen Revolution' in India?
(a) MS Swaminathan (b) APJ Abdul Kalam
(c) Dr Manmohan Singh (d) MS Ahluwalia

24. Abid Hussain Committee is related to reforms in industries.
(a) private sector (b) large
(c) public sector (d) small

25. Name the First Indian private company to sign an accord with Government of Myanmar for oil exploration in second offshore blocks in that country:
(a) Reliance Energy (b) GAIL
(c) ONGC (d) Essar Oil

26. National Development Council (NDC) was constituted in:
(a) 1948 (b) 1950 (c) 1952 (d) 1947

27. Planning in India was started in:
(a) 1951 (b) 1950
(c) 1952 (d) None of these

28. 'Gadgil Formula' is concerned with:
(a) 4th plan (b) 6th plan
(c) 1st plan (d) 3rd plan

29. 'Mukherjee Committee' was constituted during:
(a) 5th plan (b) 4th plan
(c) 6th plan (d) 8th plan

30. Who made the first attempt to estimate the National Income of India?
(a) Dadabhai Naoroji (b) RC Dutt
(c) V K R V Rao (d) PC Mahalanobis

31. Which of the following bank is a commercial bank?
(a) SBI
(b) Regional Rural Banks (RRBs)
(c) Cooperative Bank
(d) All of the above

32. The Imperial bank of India was established in:
(a) 1945 (b) 1931 (c) 1921 (d) 1936

33. Mumbai Stock Exchange was set up in:
(a) 1875 (b) 1948 (c) 1952 (d) 1891

34. UTI is now controlled by:
(a) IDBI (b) Finance Ministry
(c) RBI (d) SBI

35. State Bank of India (SBI) came into existence in:
(a) 1948 (b) 1955 (c) 1935 (d) 1949

36. NABARD was established in:
(a) 1982 (b) 1964 (c) 1980 (d) 1990

37. IDBI was established in:
(a) 1964 (b) 1972 (c) 1982 (d) 1955

38. RBI was nationalized in:
(a) 1949 (b) 1935 (c) 1969 (d) 1955

39. The largest bank of India is:
(a) RBI (b) SBI
(c) Central Bank (d) Bank of India

40. The headquarter of RBI is in:
(a) Mumbai (b) Delhi
(c) Kolkata (d) Chennai

41. SEBI (Securities and Exchange Board of India) was constituted in:
(a) 1986 (b) 1982 (c) 1988 (d) 1992

42. The majority of workers in India are:
(a) casual workers (b) self-employed
(c) regular salaried workers (d) None of these

43. Which of the following institutions does not provide loans directly to the farmers?
(a) NABARD
(b) State Bank of India
(c) Regional Rural Bank
(d) Primary Agricultural Credit Society

44. The apex institution in the area of rural finance is:
(a) RBI (b) SBI
(c) NABARD (d) All of these

45. Who was the Chairman of the first Finance Commission?
(a) K Santhanam (b) A K Chandra
(c) P V Rajamannar (d) KC Niyogi

46. Who is the Chairman of the 13th Finance Commission?
(a) Vijay Kelkar (b) K C Pant
(c) C Rangarajan (d) Montek Singh Ahluwalia

47. National Rural Employment Guarantee Scheme (NREGS) came into force in:
(a) 2004 (b) 2006 (c) 2002 (d) 2005

48. Community Development Programme was launched in India is:
(a) 1948 (b) 1952 (c) 1950 (d) 1951

49. Green Revolution in India was launched in:
(a) 1971-72 (b) 1960-61
(c) 1966-67 (d) 1980-81

50. Which of the following is/are included in the primary sector?
(a) Agriculture (b) Mining
(c) Forestry (d) All of these

51. Which of the following is related to secondary sector?
(a) Manufacturing (b) Transport
(c) Trade (d) All of these

52. Service sector (tertiary sector) includes:
(a) trade (b) transport
(c) health and education (d) All of these

53. Vat has been introduced on the recommendation of:
(a) Kelkar Committee (b) Rangarajan Committee
(c) L K Jha Committee (d) None of these

54. In India, VAT was implemented on:
(a) 1 April, 2004 (b) 1 April, 2005
(c) 1 April, 2006 (d) 1 March, 2005

55. Which state published the Human Development Report for the first time in India?
(a) Kerala (b) MP
(c) UP (d) Rajasthan

56. Disguised unemployment in India is prevalent in:
(a) service sector (b) manufacturing sector
(c) agriculture sector (d) None of these

Hints & Solutions

1. (b) **2.** (a) **3.** (d) **4.** (b) **5.** (a) **6.** (b)
7. (d) **8.** (d) **9.** (b) **10.** (c) **11.** (d) **12.** (c)
13. (c) **14.** (c) **15.** (c) **16.** (a) **17.** (d) **18.** (b)
19. (a) **20.** (a) **21.** (c) **22.** (b) **23.** (a) **24.** (c)
25. (d) **26.** (c) **27.** (a) **28.** (a) **29.** (d) **30.** (a)
31 (a) **32.** (c) **33.** (a) **34.** (a) **35.** (b) **36.** (a)
37. (a) **38.** (a) **39.** (a) **40.** (a) **41.** (c) **42.** (b)
43 (a) **44.** (c) **45.** (d) **46.** (a) **47.** (b) **48.** (b)
49. (c) **50.** (d) **51.** (a) **52.** (d) **53.** (c) **54.** (b)
55. (b) **56.** (c)

Chapter 5 General Science

PHYSICS

Physics is the branch of science which deals with the study of matter, energy, and the interaction between them.

PHYSICAL QUANTITIES

In physics, large number of physical quantities can be broadly classified into two categories– Scalars & Vectors.

- A **scalar** is a physical quantity that has only a magnitude (size) E.g. : Distance, speed, time, power, energy, etc.
- A **vector** is a physical quantity that has both a magnitude and a direction. E.g. Velocity, displacement, acceleration, force, etc.

Some physical quantities like moment of **inertia**, **stress**, etc. are neither scalar nor vector. They are **tensor**.

Fundamental and Derived physical Quantities and their units

Seven Fundamental Physical Quantities and their Units

Physical Quantity	SI Unit	Symbol
Length	meter	*m*
Mass	kilogram	*Kg*
Time	second	*S*
Electric Current	ampere	*A*
Temperature	kelvin	*K*
Luminous intensity	candela	*Cd*
Amount of substance	mole	*mol*

Some Derived Physical Quantities and their Units

S. No	Physical Quantity	cgs unit	SI unit	Relation
1.	Force	dyne	newton	1 newton = 10^5 dyne
2.	Work	erg	joule	1 joule = 10^7 erg

NEWTON'S LAWS OF MOTION

- **First law of Motion -** *An object at rest will remain at rest or in uniform motion remains in uniform motion unless acted on by an external unbalanced force.*
  This law is often called the law of inertia. i.e., resistance to change.
- **Second law of Motion -** *The rate of change of momentum of a body is directly proportional to the unbalanced external force applied on it.*
  i.e., $\vec{F} \propto \frac{dp}{dt}$ or, $\vec{F} = k\frac{dp}{dt}$ or $\vec{F} = m\vec{a}$
  Force **F** = **ma** where m = mass of the object and a = acceleration produced.
  Impulse: If a large force acts on a body or particle for a smaller time, then impulse (J) = **product** of **force** and **time**. Then, J = Ft **F** = force, and t = time So, J = Ft = mat.
  Impulse = Change in momentum.
- **Third law of Motion -** *For every action* there is an equal and *opposite reaction.*

Instances of Newton's Laws of Motion

First law of Motion

- A magician pulls a tablecloth out from under dishes and glasses on a table without disturbing them.
- A person's body is thrown outward as a car rounds a curve on a highway.

Second law of Motion

- Pushing a child on a swing is easier than pushing an adult on the same swing, because the adult has more inertia.
- A soccer player kicks a ball with his foot and the toes are left stinging.
- Two students are in a baseball game. The first student hits a ball very hard and it has a greater acceleration than the second student who bunts the ball lightly.

Third law of Motion

- Rockets are launched into space using jet propulsion where exhaust accelerates out from the rocket and the rocket accelerates in an opposite direction.

CIRCULAR MOTION

- *Motion of a body along a circular path is called circular motion.*
- **Centripetal force -** while a body is moving along a circular path an external force required to act radially inward. This force is called centripetal force. Centripetal force $F_e = \frac{mv^2}{r}$
  where *r* = radius of circular path.
  A pseudo force that is equal and opposite to the centripetal force is called **centrifugal force**.
  Cream separator, centrifugal dryer, etc, work on the principle of centrifugal force.

FRICTION

Friction is a force that is created whenever two surfaces move or try to move across each other.

- Friction always opposes the motion or attempted motion of one surface across another surface.
- Friction is dependent on the texture of both surfaces.
- Friction is also dependent on the amount of contact force pushing the two surfaces together.

Instances where friction is important

1. Walking
2. Driving
3. Picking something up
4. Car brakes
5. Erosion in the environment
6. Burning up meteors in the atmosphere before they hit Earth.
7. Striking a match/building a fire.
8. Rubbing your hands together when it's cold.
9. Friction keeps knots from coming undone (like in shoelaces)

WORK & ENERGY

- **Work** refers to an activity involving a force and movement in the direction of the force.
  Work done w = Fs cosθ
  Positive work : If θ < 90°
  Zero work : If θ = 90°
  Negative work : If θ > 90°
- A force of 20 newtons pushing an object 5 meters in the direction of the force does 100 joules of work.
- The **SI unit** of work is the **joule** (J),
- Capacity of doing work is called *energy*.
- It may exist in potential, kinetic, thermal, electrical, chemical, nuclear, or other various forms.
- To do 100 joules of work, you must expend 100 joules of energy.
- Energy cannot be created or destroyed. It can only be transferred to other objects or converted into different forms. This is **Law of Conservation of energy.**
- The SI unit of energy is joule.
- It is a scalar quantity.
- The energy associated with motion is called **kinetic energy (K)**.
  $K=\frac{1}{2}MV^2$ where M is mass and V is the velocity.
- The energy associated with position is called **potential energy (U)**.
  U = mgh; where g is acceleration due to gravity and h is height of the object.

Conversion of Energy from one form to another :

Dynamo : Mechanical Energy into Electrical Energy.
Electric Motor : Electrical Energy into - Mechanical Energy.
Microphone : Sound Energy into Electrical Energy.
Loud Speaker : Electrical Energy into Sound Energy.
Electric Bulb : Electrical Energy into Light and Heat Energy.
Solar Cell : Solar energy into electrical energy.
Candle : Chemical Energy into light and heat energy.
Sitar : Mechanical Energy into Sound energy.

POWER

- **Power** is the rate of doing work.
- **Power = Work / time**
- It is equivalent to an amount of energy consumed per unit time.
- The **SI** unit of **power** is **joule/second**.
- **One horse** power is equivalent of **746** watt.
  Board of Trade Unit (B.O.T.U.) : kwh (Kilo watt hour)
  1 kwh = 1 Unit
  $= 3.6 \times 10^6$ joule
  This is to measure domestic electric energy consumption.

GRAVITATION

- **Gravitation** is a natural phenomenon by which all physical bodies attract each other.
- On Earth, gravity gives weight to physical objects employing a downward force to keep them grounded.
- Gravitational force is always attractive. For example, earth always attracts us but never repels.
- It is **weakest force** among the four natural forces in nature i.e. electromagnetic, weak and strong nuclear force.
- If there are two objects of mass m_1 and m_2 and they are placed at distance r apart. Then force between them will be:
  $F = G(m_1m_2)/r^2$
  where G is the universal gravitational constant.
  This is called **Newton's Universal Gravitational law.**
- $G = 6.67 \times 10^{-11}$ Nm²/kg²
- Gravitational force is a central and conservative force.
- They can operate over a very long distances.
- According to Newton's theory, the gravitational attraction between the planets and the sun holds the planets in elliptical orbits around the sun.
- The earth's moon and moons of the other planets are held in orbits by the attraction between the moons and the planets.
- The force of gravity depends upon the **object's mass** or the amount of matter in the object.
- The weight (w) of an object is equal to the mass of the object multiplied by the acceleration due to gravity(g).
  W = mg
- $g_{maximum}$ at poles and $g_{minimum}$ at equator.
- $g_{moon} = \frac{1}{6} g_{earth}$
- The value of 'g' decreases with altitude, depth from the earth's surface.
- **g** decreases due to rotation of earth.

Weight of a body in a lift

(i) If lift is stationary or moving with uniform speed (either upward or downward), the apparent weight of a body is equal to its true weight.
(ii) If lift is going up with acceleration, the apparent weight of a body is more than the true weight.
(iii) If lift is going down with acceleration, the apparent weight of a body is less than the true weight.
(iv) If the cord of the lift is broken, it falls freely. In this situation the weight of a body in the lift becomes zero. This is the situation of weightlessness.

(v) While going down, if the acceleration of lift is more than acceleration due to gravity, a body in the lift goes in contact of the ceiling of lift.

- **Escape speed (ve)** is the minimum speed with which an object just crosses the earth's gravitational field and never comes back.

$$V_e = \sqrt{\frac{2GM}{R}} = \sqrt{2gR}$$

- The escape velocity of Earth is about 11.2 kilometres per second and on moon it is 2.4 km/sec.

SATELLITES

- A **satellite** is a smaller object in space which orbits around a larger object Planet in space.
- It can be either artificial, like the communication or weather satellites that orbit the Earth, or they can be natural, like our Moon.
- A **geostationary satellite** is an earth-orbiting satellite, placed at an altitude of approximately 35,800 kilometres (22,300 miles) directly over the equator.
- Geostationary satellite revolves in the same direction the earth rotates (west to east). Its time period is 24 hours.
- It is used for Communication, television broadcasting, weather forecasting , defence and intelligence.
- **Polar orbiting satellites** closely parallel the earth's meridian lines, thus having a highly inclined orbit close to 90°.
- They pass over the North and South poles each revolution.
- They are used for weather forecasting, earth-mapping, earth observation, etc.

MECHANICAL PROPERTIES OF SOLIDS AND FLUIDS

- **Elasticity and plasticity:** The property by virtue of which the body regains its original shape after the removal of deforming force is called **elasticity**. And if the body retains its deformed shape after the removal of deforming force is called **plasticity**.
- **Rubber** is less elastic than steel.
- **Hooke's law:** Within elastic limit stress is directly proportional to strain, i.e. stress $\propto$ strain or stress = Y strain

or, $$Y = \frac{\text{stress}}{\text{strain}}$$

where Y = Young's
Modulus of elasticity

- **Pressure** is defined as force acting normally on an unit area of the surface.

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

Its unit is **N/m^2**. It is a scalar quantity.

- **Atmospheric pressure** is measured by an instrument called the **barometer**.
- **Sudden fall** in barometric reading is the indication of **storm.**
- **Slow fall** in barometric reading is the indication of **rain**.
- Slow rise in the barometric reading is the indication of **clear weather.**
- The pressure exerted by liquid column at the surface given as ***p* = *hdg***, where ***d*** is the density of liquid, ***h*** is height of liquid column.
- In a static liquid at same horizontal level, pressure is same at all the points.

Pascal's Law of Pressure : If gravitational attraction is negligible in equilibrium condition, pressure is same at all points in a liquid.

- The pressure exerted anywhere at a point of confined liquid is transmitted equally and undiminished in all directions throughout the liquid.
- **Hydraulic lift**, hydraulic **press** and hydraulic **breaks** are based on the **Pascal's law of pressure**.

Atmospheric pressure decreases with altitude.
That is why

- It is difficult to cook on the mountain.
- The **fountain pen** of a passenger leaks in aeroplane.
- **Bleeding** occurs from the nose of the man.
- It is difficult to breath on higher altitude due to less amount of air.
- **Water** starts to boil below **100°C**.

Surface Tension (T) : It is the force (*F*) acting normally on unit length (*l*) of imaginary line drawn on the surface of liquid

i.e. $T = \frac{F}{l}$

- Its unit is N/m.
- The surface tension **decreases** with rise in temperature and becomes zero at the critical temperature.
- Due to the surface tension, **rain drops** are spherical in shape.

Archimedes' Principle : When a body is immersed partly or wholly in a liquid, there is an apparent loss in the weight of the body, which is equal to the weight of liquid displaced by the body.

- All objects placed in a liquid experience an upward force which allows the body to float if it displaces water with weight equal to the weight of the body. This upward force is called the **buoyant force** and the law is called the **law of buoyancy**.
- The weight of water displaced by an iron ball is less than its own weight. Whereas water displaced by the immersed portion of a ship is equal to its weight. So, small ball of iron ball sink in water, but large ship float.
- **Hydrogen** filled ballon float in air because hydrogen is lighter than air.

Law of Floatation: A body floats in a liquid if

- The density of material of body is less than or equal to the density of liquid.
- When body floats in neutral equilibrium, the weight of the body is equal to the weight of displaced liquid. The centre of gravity of the body and centre of gravity of the displaced liquid should be in one vertical line for the condition.
- **Density (d):** It is the mass per unit volume.

$$d = \frac{M}{V}$$

- **Density of water** is maximum at **4°C.**
- **Capillarity**: The phenomenon of rise or fall of liquids in a capillary tubes.

- The oil in the wick of a lamp rises due to capillary action.
- **Viscosity:** The property of a fluid by virtue of which an internal frictional force acts between its different layers when it is in motion.
- **Bernoulli's theorem:** For a non-viscous, incompressible fluids flowing streamline from one point to another point, then at every point of its path, pressure, energy, potential energy and kinetic energy per unit volume remains constant.

  Blowing of roofs by storms, sprayer action of carburetor, etc. are based on Bernoulli's principle.

HEAT

- **Heat** is a form of energy which causes sensation of hotness or coldness.

  Its unit is joule or calorie.
- 1 cal = 4.2 joule
- It always flows from a substance at a higher temperature to the substance at a lower temperature.

Temperature : It indicates the degree of hotness or coldness of a body.

- Temperature is measured by **thermometer**.
- Temperature measuring units are Kelvin, °C or °F.

Relation between Temperature on different scales.

$$\frac{C-0}{100}=\frac{F-32}{180}=\frac{R-0}{80}=\frac{K-273}{100}=\frac{Ra-492}{180}$$

OR

$$\frac{C}{5}=\frac{F-32}{9}=\frac{R}{4}=\frac{K-273}{5}=\frac{Ra-492}{9}$$

- The normal temperature of a human body is 37°C or 98.6°F.
- At –40° temperature, celsius and fahrenheit thermometers read the same.
- **Thermal expansion :** Increase in length, area or volume on heating.

Methods of Heat Transfer

- **Conduction:** It is that mode of transmission of heat in solid where heat is transferred from a region of higher temperature to a region of lower temperature by the aid of particles of the body without their actual migration.
- **Convection:** It requires a medium and is the process in which heat is transferred from one place to other by actual movement of heated substance (usually molecule of fluid).
- Radiation has the following properties:

(a) Radiant energy travels in straight lines and when some object is placed in the path, its shadow is formed at the detector.

(b) It is reflected and refracted or can be made to interfere. The reflection or refraction are exactly as in case of light.

(c) It can travel through vacuum.

(d) Intensity of radiation follows the law of inverse square.

(e) Thermal radiation can be polarised in the same way as light by transmission through a nicol.

Latent Heat

- The amount of heat required to change phase (liquid to gas or liquid to solid etc.) without change in temperature is called **latent heat.** $Q = mL$ where, L = latent heat
- Why are steam burns more severe than hot water burns. It is because latent heat of steam is more than hot water.
- Latent heat of fusion of ice is 80 cal/g
- Latent heat of steam is 538 cal/g.

Specific Heat

- The amount of heat that is required to raise the temperature of a unit mass of a substance by one degree (14.5°C to 15.5°C) is known as **Specific heat**.

Specific heat of Different materials

Material	Specific heat (J/Kg K)
Water	4200
Ice	2100
Iron	460
Kerosene oil	210
Mercury	140
Lead	130

(i) Cooking utensils are made of aluminum, brass & steel because of their low specific heat and high conductivity.

(ii) Due to low specific heat of sand, deserts are hot in day and cool in night.

Newton's law of cooling

The rate of loss of heat by a body is directly proportional to the difference in temperature between the body and its surrounding.

i.e., $\frac{dT}{dt} = E \propto (T - T_0)$

where T and T_0 are the temperature of body and surroundings.

Sublimation : It is the process of conversion of a solid directly into vapour, e.g., Iodine (dark solid), Dry ice (solid CO_2), etc.

Hoar Frost: It is just the reverse process of sublimation. e.g. Frost and snowflakes.

WAVES

- A **wave** is a kind of oscillation (disturbance) that travels through space and matter.
- Wave motions transfer energy, not matter from one place to another.
- **Transverse wave:** In it the vibrations of particles are perpendicular ⊥ to the direction of travel of the wave. It has crests and troughs.
- **Longitudinal wave:** In it the vibrations of particles are parallel to the direction of travel of wave. It has compressions and rarefactions.
- The repetition of sound due to reflection of sound waves, is called an **echo**.
- **Intensity** is defined as the amount of energy passing per unit area held around that point per unit time.
- **Quality** is that characteristics of sound which differentiate between two sounds of same intensity and same frequency.
- **Sonar:** It stands for **sound navigation** and **ranging**. It is used to measure the depth of a sea to locate the enemy submarines and shipwrecks.

Sounds

- Sound is transmitted through gases, plasma, and liquids as longitudinal waves, also called **compression waves**.

- It requires a medium to propagate.
- Through solids, however, sound can be transmitted as both longitudinal waves and transverse waves.
- Audible sound for human is from **20 Hz** to about **20000 Hz**.
- **Pitch** is the property of sound that we perceive as higher and lower tones.
- Sound can be produced at a desired frequency by different methods.
- The amplitude of a sound wave is the degree of motion of air molecules within the wave which corresponds to the change in air pressure that accompanies the wave.
- The distance at which a sound can be heard depends on its intensity.
- Sounds higher than **20000 Hz** are called **ultrasonics**.
- Sounds less than 20 Hz are called **infrasonics**.
- When temperature is increased the speed of sound is increased.
- Speed of sound in air is 330 m/s.

Speed of Sound in Different Mediums

Medium	Speed of sound (In m/s)
Air(0°C)	332
Air (20°C)	343
Steam (at 100°C)	405
Mercury	1450
Water (20°C)	1482
Sea water	1533
Iron	5130
Glass	5640

LIGHT

- **Light** is a form of energy which produces sensation of vision on our eyes.
- Light is made of discrete packets of energy called **photons**.
- **Photons** carry momentum, have no mass, and travel at the speed of light, i.e. **300,000 km/sec**.
- All light has both particle and wave like properties. For example–
  - Particle like; use of detectors in digital camera for the detection and storage of image data.
  - Wave like; use of instrument for diffraction of light into a spectrum for analysis.
- It is a **transverse wave**.
- One of the physical properties of light is that it can be **polarized**.
- Sun's light reaches to earth in 8 **minutes** 19 seconds (i.e. 499 seconds).
- **Roemer** was the person who measured speed of light in AD 1678.
- The light reflected from moon reaches to earth in **1.28** second.
- Objects, which emit light by themselves are called **Luminous bodies**, eg. sun, stars, electric bulb, etc.

  Non-luminous bodies do not emit light themselves but reflect light falling on them, eg. planets, moon, etc.
- **Transparent, translucent and opaque matter**

Matter	Nature	Example
Transparent	It allows most of light to pass through.	glass, water, etc.
Translucent	It allows a part of light falling on it to pass through.	oiled paper
Opaque	It does not allow the incident light to pass through.	mirror, metal, wood, etc.

- **Speed of light in different mediums**

Medium	Speed of light
Glass	2×10^8 m /sec
Turpentine oil	2.04×10^8 m /sec
Water	2.25×10^8 m/sec
Vacuum	3×10^8 m/sec

- **Ultraviolet radiation** is an electromagnetic radiation that has wavelength from 400 nm to 10 nm, shorter than that of visible light but longer than X-rays. It is used in water purification.
- **Infrared radiation** is emission of energy as electromagnetic waves in the portion of the spectrum just beyond the limit of the red portion of visible radiation.
- Range between 10^{-6} m and 10^{-3} m. It is used to treat muscular strain, in green house etc.
- **X-rays** are electromagnetic radiation having a shorter wavelength and produced by bombarding a target made of tungsten, with high speed electrons. Uses in medical diagonosis.
- **Microwaves** are short, high frequency waves lying roughly between very high frequency (infrared) waves and conventional radio waves.
- Their wavelength range - 10^{-3} m to 10^{-2} m. It is used in microwave oven.
- **Electromagnetic** wave and **Dis-coverers**.

Waves	Discoverer
γ-Rays	Henry
X-Rays	W. Roentgen
Ultra-Violet rays	Ritter
Visible radiation	Newton
Infrared rays	Herschel
Short radio waves or (Hertz Hertzian Waves)	Heinrich
Long radio waves	Marcony

Reflection of light

It is the turning back of light in the same medium.

Laws of Reflection

There are two laws of reflection

(i) The angle of incidence is equal to the angle of reflection. ($\angle i = \angle r$)

(ii) The incident ray, the normal and the reflected ray lie in the same plane.

Reflection by Plane Mirror

(a) The image formed by the plane mirror is always erect, of the same size and at the same distance as the object is.

(b) To see the full image in a plane mirror, its length is just half the height of the man and it has to be kept in specific position.

(c) When two plane mirrors are held at angle θ with their reflecting surfaces facing each other and an object is placed between them, images are formed by successive reflections.

Number of image for med $n = \frac{360°}{\theta}$

1. If n is fractional number, number of images will be whole part of this number.
2. If n is whole number
   - (i) (Even whole number), then Number of images = n – 1
   - (ii) (Odd whole number)
     - (a) For symmetrical object number of images = n – 1
     - (b) For asymmetrical object (number of images = n)

Mirror formula

If an object is placed at a distance u from the pole of a mirror and its image is formed at a distance v (from the pole) then $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

Spherical mirror

Spherical mirrors are of two types

(i) Concave mirror
(ii) Convex mirror

Uses of concave mirror

(i) As a shaving mirror.
(ii) As a reflector for the head lights of a vehicle, search light.
(iii) In opthalmoscope to examine eye, ear, nose by doctors.
(iv) In solar cookers,

Uses of convex mirror

(i) As a rear view mirror in vehicle because it provides the maximum rear field of view and image formed is always erect.
(ii) In sodium reflector lamp.

Refraction of Light

The bending of the light ray from its path in passing from one medium to the other medium is called refraction of light.

- If the refracted ray bends towards the normal relative to the incident ray, then the second medium is said to be **denser** than the first medium. But if the refracted ray bends away from the normal, then the second medium is said to be **rarer** than the first medium.

  Relative Refractive Index : When light passes from one medium to the other, the refractive index of medium 2 relative to 1 is written as ${}_1\mu_2$ and is defined as

$$ {}_1\mu_2 = \frac{\mu_2}{\mu_1} = \frac{(c/v_2)}{(c/v_1)} = \frac{v_1}{v_2} $$

where c = speed of light in air or vacuum = 3×10^8 m/s.

Laws of Refraction

(i) The incident ray, the normal to the refracting surface at the point of incidence and the refracted ray all lie in the same plane called the plane of incidence or plane of refraction.

(ii) $\frac{\sin i}{\sin r} = \text{constant}$

For any two given media and for light of a given wavelength. This is known as **Snell's law**.

Also, $\frac{\sin i}{\sin r} = {}_1\mu_2 = \frac{\mu_2}{\mu_1} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2}$

where ${}_1\mu_2$ = Refractive index of the second medium with respect to the first medium.

Some Phenomena based on Refraction

(i) **Twinkling** of stars
(ii) **Oval Shape** of sun in the morning and evening.
(iii) Rivers appear **shallow**
(iv) Coins appear **raised** in glass filled with water.
(v) Pencils appear **broken** in the beaker filled with water.
(vi) Sun appears **above horizon** at sunset and sunrise.
(vii) Writing on a paper appears **lifted** on putting glass slab on it.
(viii) An object in a denser medium appears to be **nearer** when seen from a rarer medium, eg. fish in water, a coin at the base of a water filled vessel.

HUMAN EYE

The normal range of vision for a healthy human eye is from 25 cm (least distance of distinct vision to infinity (for point).

Defects of Vision & Remedies

Myopia or Near(short) sightedness:

- A person suffering from Myopia can't see the far (distant) object clearly but can see nearby object clearly.

Causes:

- The eye ball is too long (i.e. elongated) so image is formed before retina.
- Lens being too curved for the length of the eye ball.
- Combination of above, i.e. elongated eyeball & curved lens.
- Shortening of focal length of eye lens.
- Over stretching of ciliary muscles.

Remedy: Concave lens is used to diverge the rays at retina.

Hyperopia or Hypermetropia (long (far) sightedness)

- A person suffering from it can't see near object clearly but can see distant object clearly.

Causes:

- The eye ball is too short so image is formed beyond the retina.
- Cornea is not curved enough,
- Eye lens is farther back in the eye.
- Increase in the focal length of eye lens.
- Stiffening of ciliary muscles.

Remedy: Convex lens is used to converge the rays at retina.

Target group

- It can affects both children and adults.
- People whose parents are farsighted,
- It can be confused with presbyopia (i.e. ." after 40" vision).

Astigmatism

Astigmatism is the most common refractive problem responsible for **blurry vision**. **Cylindrical** lens is used to correct astigmatism.

Presbyopia ("after 40" vision)

After age 40, and most noticeably after age 45, the human eye is affected by presbyopia, which results in greater difficulty maintaining a clear focus at a near distance with an eye which sees clearly at a far away distance.

Cataract

- It is the clouding of the lens of the eye that prevent a person to see.
  Because light rays can't pass through the cloudy lens, Vision of a person becomes cloudy, blurry, foggy, or filmy.

Causes:

- Protein builds up in the eye lens & make it cloudy.
- Cloudy protein layers prevent rays to pass through eye lens.
- New lens cells form on the outside of the lens, making older cells compacted into the center of the lens to form cataract.

Remedy:

- It can be corrected with suitable eye glasses (lenses).
- Cataract surgery is performed when eye glass does not suit.

Dispersion of light:

- The splitting of white ray of light into its seven constituents colours (VIBGYOR) is called **dispersion of light.**
- The band of seven constituents colours is called **spectrum**.

Microscope

- It is used to see magnified image of a tiny objects.

Telescope

- It is used to increase the visual angle of distant object.
- It is used to see far off objects clearly.

ELECTRICITY

- **Electricity** is the set of physical phenomena associated with the presence and flow of electric charge.
- **Electric charge** is a property of some subatomic particles, which determines their electromagnetic interactions.
  The **SI unit** of charge is **coulomb** (c).
- **Electric current (I)** is a movement or flow of electrically charged particle electronic per unit time. Typically measured in **ampere (A).**
  $I = Q/t$
- Moving charges produce a magnetic field.
- Electrical currents generate magnetic fields, and changing magnetic fields generate electrical currents.
  Conductors are the substances which allow the passage of electric charge with low resistance. E.g., silver, copper etc.
  Silver is the best conductor of electricity followed by **copper.**
  Insulators are substances which do not allow passage of electric charge, rubber, wood, mica, glass, ebonite etc.
- **Ohm's law :** The electric current I flowing through a conductor is proportional to the voltage V across its ends, i.e. $V \propto I$ or $V = RI$, where R is the **resistance** of the substance.
- The **resistance** is the obstruction offered to the flow of electric current.
  It is directly proportional to its length and inversely proportional to its cross-sectional area (A), i.e. $R \propto \frac{L}{A}$
  The unit of resistance is **ohm (Ω) :** $1\Omega = 1\ VA^{-1}$.
  or, R —, where ρ is called resistivity of the material.

Coulomb's Law: The electrostatic force of interaction (repulsion or attraction) between two electric charges q_1 and q_2 separated by a distance r, is directly proportional to the product of charges, i.e. $q_1 \times q_2$ and inversely proportional to the square of distance between them, i.e.

$$F \alpha q_1 q_2 \text{ and } F \alpha \frac{1}{r^2}$$

$$\Rightarrow F = K\frac{q_1 q_2}{r^2}\ K = 9 \times 10^9\ Nm^2C^{-2}$$

Electric Field: The region around an electric charge in which the electric effect (attraction or repulsion) can be experienced with another charge is called the electric field.

F = qE

where **E = electric field.**

Electric cell: It is the device used to convert chemical energy into electrical energy.

Emf of cell (E): It is the potential difference across the terminals of a cell when it is not in use.

Potentiometer

It is used to measure the exact potential difference between two points of an electric circuit or electromotive force (emf) of a cell.

Internal resistance of cell : It is the resistance offered by the electrolyte.

- One **kilowatt (kW)** = 1,000 watts
- One **megawatt (MW)** = 1,000 kilowatts = 1,000,000 watts
- One **gigawatt (GW)** = 1,000 megawatts = 1 billion watts.
- **Ammeter :** Measures current
- **Voltmeter :** Measures the potential difference between two points in a circuit.
- **Fuse** is a safety device that protects an **electric circuit** from becoming overloaded.

Transformer

- Transformer is a device which converts low voltage AC into high voltage Ac and vice-versa.
- It is based on **electromagnetic induction**.

Application /uses: As voltage regulators for –

(i) T.V, refrigerator, computer, air conditioner, etc.
(ii) Induction furnaces.
(iii) for welding purposes.

AC Generator/Dynamo/Alternator

- It is an electric device used to convert mechanical energy into electrical energy.
- It works on the principle of electromagnetic induction.

D.C. Motor

- It converts direct current energy from a battery into mechanical energy of rotation.

- **Its uses**

(i) In D.C. fans, exhaust, ceiling, table fans, etc.
(ii) In pumping water.
(iii) In running tram-cars, trains, etc.

MODERN PHYSICS

- The nucleus of an consists of protons and neutrons together called nucleons. Size of the nucleus Redius of the nucleus $R = R_0A^{1/3}$
  where $R_0 = 1.1 \times 10^{-15}$m, A = atomic mass.

Difference between stable and unstable nucleus

Stable nucleus	Unstable nucleus
Low atomic number	High atomic number
Low mass number	High mass number
Nucleus of small size	Nucleus of bigger size
$\frac{n}{p} = 1$	$\frac{n}{p} > 1$

- **Photoelectric effect :** It is the phenomenon of emission of electrons by metals when illuminated by light of suitable frequency.
  Einstein's photoelectric equation:

$$(E_K)_{max} = \frac{1}{2}mV^2_{max} = eV_0$$

- **Photoelectric current depends on:**
  (i) the intensity of incident light,
  (ii) the potential difference applied between the two electrodes, and
  (iii) the nature of the emitting material.

X-Rays

X-rays are electromagnetic radiations of very short wavelength (0.1 Å to 100 Å) and high energy which are emitted when fast moving electrons or cathode rays strike a target of high atomic mass.

Properties of X-Rays :

(i) These are highly **penetrating rays** and can pass through several materials which are opaque to ordinary light.
(ii) They **ionize the gas** through which they pass. While passing through a gas, they knock out electrons from several of the neutral atoms, leaving these atoms with +ve charge.
(iii) They cause **fluorescence** in several materials. A plate coated with barium platinocyanide, ZnS (zinc sulphide), etc becomes **luminous** when exposed to X-rays.
(iv) They affect **photographic plates** especially designed for the purpose.
(v) They are not deflected by electric and magnetic fields, showing that they are not charged particles.

Radioactivity

It is the phenomenon in which nuclei of a given species transform by giving out α or β or γ-rays;

α-rays are helium nuclei; **β-rays** are electrons and **γ-rays** are electromagnetic radiation of wavelengths shorter than X-rays.

Nuclear Fission

The process of splitting of a heavy nucleus into two nuclei of comparable size and release of large energy is called **fission**. U^{235} nucleus captures a thermal neutron. This forms a compound nucleus U^{236} in excited state.

- **Atom bomb** is based on nuclear fission.

Nuclear Fusion

The process in which two or more lighter nuclei combine to form a heavy nucleus is known as nuclear fusion.

$$4\,{}_1H^1 \longrightarrow {}_2He^4 + 2\,{}_{+1}e^0 + 2v + Q$$

- The binding energy per nucleon of product is greater than the reactants. The energy released per nucleon is large ~ 6.75 MeV.
- Fusion is possible at high pressure (~ 10^6 atom) and high temperature (~ 10^8 °C).
- **Hydrogen bomb** is based on nuclear fusion.

Nuclear Reactor or Atomic Pile

- Nuclear reactor is an arrangement, in which controlled nuclear fission reaction takes place.
- First nuclear reactor was established in Chicago University under the supervision of Prof **Enrico Fermi**.
- Heavy water, graphite and beryllium oxide are used to slow down the fast moving neutrons. They are called **moderator**.
- The cold water, liquid oxygen, etc. are used as coolant to remove heat generated.
- Cadmium or boron rods are good absorber of neutrons and called the control rods.

Uses of Nuclear Reactor

(i) To produce electrical energy from the energy released during fission.
(ii) To produce different isotopes, which can be used in medical, physical and agriculture science.

There are several components of nuclear reactor which are as follows

- **Fissionable Fuel** U^{235} or U^{239} is used.
- **Moderator** Moderator decreases the energy of neutrons, so that they can be further used for fission reaction. **Heavy water** and **graphite** are used as moderator.
- **Control Rod** Rods of cadmium or boron are used to absorb the excess neutrons produced in fission of uranium nucleus, so that the chain reaction continues to be controlled.
- **Coolant** A large amount of heat is produced during fission. Coolant absorbs that heat and prevents excessive rise in the temperature. The coolant may be water, heavy water or a gas like He or CO_2.

CHEMISTRY

- Chemistry is the branch of science which deals with study of matter and various changes it undergoes.

Classification of Matter

- **Matter** is defined as anything that occupies space and has mass.
- At a given temperature, an element is in one of the three states of matter- **Solid, Liquid** or **Vapour** (Gas).

Solids

- Solids possess definite shape and volume.
- They have strongest intermolecular interactions.
- They are generally hard and rigid.
- Examples – Metals, bricks, wood, etc

Liquids

- They possess definite volume but no definite shape.
- They have intermediate intermolecular forces between constituent particles.
- They can flow, so they are called fluids, e.g. water, milk, mercury, oil,etc.

Gases

- Gases have neither a definite volume nor definite shape.
- They takes the volume and shape of the container.
- They are highly compressible and have minimum intermolecular interactions..
- E.g.– air, oxygen, hydrogen, etc.

ATOM

- An **atom** is the **smallest unit** of an element.
- An atom has a central **nucleus** which is very small compared to the rest of the atom and contains majority of the atomic mass.
- The nucleus carries a **positive charge**.
- The **nucleus** of an atom consists of **protons** and **neutrons**.
- Atoms consists of protons, neutrons, and electrons.
- Electrons revolves around the nucleus.
- **Protons** have a **positive** charge.
- **Electrons** have a **negative** charge.
- **Neutrons** have **no charge**.
- In a neutral atom total charge on proton is equal in magnitude to total charge on electrons.
- Since opposite charges attract protons and electrons attract each other.

ISOTOPES AND ISOBARS

- **Isotopes** are atoms that have **same atomic number** but different mass numbers.
- Isotopes have the same atomic number because the number of protons inside their nuclei remains the same. They have different mass numbers because they have different numbers of neutrons.
- For instance, $^{35}_{17}Cl$ and $^{37}_{17}Cl$ are isotopes.
- **Isobars** are atoms that have **same atomic mass** but different atomic numbers.
- Isobars have different atomic numbers because they have different numbers of protons. They have the same atomic mass because they have just enough neutrons to make the same total of nucleons.
- For instance, $^{76}_{32}Ge$ and $^{76}_{34}Se$ are isobars.

ELEMENTS AND COMPOUNDS

- Everything in the universe is made of a combination of a few basic substances called **elements**.
- The element is the simplest form of matter composed of atoms having identical number of protons in each nucleus. Elements of the periodic table are majority divided into s-block, p-block, d-block and f-block
- A compound is made up of different elements but looks and behaves quite differently.
- A **compound** is a pure substance that contains atoms of two or more chemical elements in definite proportions that cannot be separated by physical means and are held together by chemical bonds.

AIR AND WATER

Air is colorless, odorless, tasteless, gaseous mixture, mainly contains nitrogen (approximately 78 %) and oxygen (approximately 21 %) with lesser amounts of argon, carbon dioxide, hydrogen, neon, helium, and other gases.

- **Water** consists of hydrogen and oxygen in the ratio of 2:1 by volume and 1:8 by mass.
- **Hard water** has bicarbonates, chlorides sulphates of Ca and Mg. This water is unfit for washing and use in industrial boilers.
- **Heavy water is deuterium oxide** (D_2O), molecular mass = 20). It is called heavy due to the presence of deuterium, the heavy hydrogen.

SUBSTANCES & CHEMICAL COMPOSITIONS

Common Name	Chemical Name	Composition	Formula
Alum	Potash	Potassium, Sulphur, Aluminium, Hydrogen and Oxygen	$K_2SO_4Al_2(SO_4)_3$
Bleaching Powder	Calcium hypochlorite	Calcium, Chlorine and Oxygen	$CaCl(OCl)$
Blue Vitriol	Copper sulphate	Copper, Sulphur and Oxygen	$CuSO_4.5H_2O$
Caustic Potash	Potassium hydroxide	Potassium Hydrogen, and Oxygen	KOH

Chalk	Calcium carbonate	Calcium, Carbon and Oxygen	$CaCO_3$
Caustic Soda	Sodium hydroxide	Sodium, Hydrogen and Oxygen	$NaOH$
Baking Soda	Sodium bicarbonate	Sodium, Hydrogen, Carbon and Oxygen	$NaHCO_3$
Common Salt	Sodium chloride	Sodium and Chlorine	$NaCl$
Epsom Salt	Magnesium sulphate	Magnesium, Sulphur, and Oxygen	$MgSO_4.7H_2O$
Galena	Lead sulphide	Lead and Sulphur	PbS
Green Vitriol	Iron sulphate	Iron, Sulphur and Oxygen	$FeSO_4.7H_2O$
Glauber's salt Gypsum	Sodium sulphate Calcium Sulphate dihydrate	Sodium, Sulphur, Oxygen and hydrogen	$Na_2SO_4.10H_2O$ $CaSO_4.2H_2O$
Laughing gas	Nitrous oxide	Nitrogen and Oxygen	N_2O
Lime water	Calcium hydroxide	Calcium, Hydrogen, and Oxygen	$Ca(OH)_2$
Litharge	Lead monoxide	Lead and Oxygen	PbO
Plaster of Paris	Calcium sulphate hemihydrate	Calcium, Sulphur, Hydrogen and Oxygen	$2CaSO_4.H_2O$
Quartz	Sodium silicate	Sodium, Silica and Oxygen	Na_2SiO_3
Quick lime	Calcium oxide	Calcium and Oxygen	CaO
Red lead	Triplumbic	Lead and Oxygen	Pb_3O_4
Sal ammoniac	Ammonium Chloride	Nitrogen, Hydrogen and chlorine	NH_4CI
Soda ash or washing soda	Sodium carbonate	Sodium, Carbon, Hydrogen and Oxygen	$Na_2CO_3.10H_2O$
Soda bicar bonate	Sodium bicarbonate	Sodium hydrogen, Carbon and Oxygen	$NaHCO_3$
White vitriol	Zinc sulphate	Zinc, Sulphur, Hydrogen and Oxygen	$ZnSO_4.7H_2O$

METALS AND NON-METALS

- There are two types of elements- metals and non- metals.
- About 80% known elements are metals.

Metals

- Elements which are hard, ductile, brittle, and malleable, possess lustre and conduct heat and electricity are termed **metals**.
- Except **Mercury and gallium**, all metals are solid.
- **Metals** have usually high melting points and boiling points.

Non-Metals

- Non metals are electronegative elements which have a tendency to gain one or more electrons to form negative ions called **anions**.
- Non metals are **non-lustrous** and bad conductors of heat and electricity.

Occurrence of Metals

- **Minerals** are naturally occurring chemical compounds of fixed composition and characteristics, physical form and properties.
- The most common groups of minerals are **silicates**, **oxides**, **sulphides**, and **carbonates** etc.

Uses of Some Metals and Non-Metals Compounds

(i) **Silver Nitrate** ($AgNO_3$) is called **lunar caustic** and is used to prepare the ink used during voting.

(ii) **Hydrogen Peroxide** (H_2O_2) is used as an oxidishing agent, bleaching agent, as an insecticide and for washing old oil paintings.

(iii) **Ferrous Oxide** (FeO) is used to prepare ferrous salts and green glass.

(iv) **Ferric Oxide** (Fe_2O_3) is used in jeweller's rouge.

(v) **Silver Iodide** (AgI) is used for artificial rain.

(vi) **Mercuric Chloride** ($HgC1_2$) is used to prepare calomel and as a poison.

Catalyst

A catalyst is a material that is added to a reaction mixture to accelerate the process but is itself not consumed.

Fuels

- The substance, which produce heat and light on combustion are called **fuels**.
- **LPG** (Liquified petroleum gas) is a mixture of hydrocarbons containing three or four carbon atoms, such as propane, butane and pentane.
  A strong foul smelling substance, called ethyl mercaptan (C_2H_5SH) is added to LPG to detect its leakage as LPG is odourless gas.

COAL

- Coal is made up of **carbon**.
- The common varieties of coal are **anthracite**, **bitumen**; **lignite** and **peat** containing 95, 70, 40 and 10-20 percent carbon respectively.
- CNG, gasoline or diesel is obtained by fractional distillation of crude oil.

Some Important Fuels and their Compositions

Fuel	Composition	Sources
Water Gas	Carbon monoxide (CO) + Hydrogen (H_2)	By passing steam over red not coke
Producer Gas	Carbon monoxide (CO) + Nitrogen (N_2)	By passing insufficient air over red hot coke
Goal Gas	Hydrogen + Methane + Ethylene (C_2H_4) + Acetylene (C_2H_4) + CO + Nitrogen	By fractional distillation of wood
Natural Gas	Methane (83%) + Ethane	From petroleum
Liquefied Petroleum Gas (LPG)	Butane (C_2H_2) + Propane (C_3H_8)	From oil wells
Compressed Natural Gas (GNG)	Methane (CH_4) 95%	From petroleum
Biogas or Gobar Gas	Methane (CH_4) + Carbon dioxide (CO_2) + Hydrogen (H_2) + Nitrogen (N_2)	From organic wastes

ACIDS, BASES AND pH SCALE

- **Acids** are chemical compounds that taste sour, turn blue litmus red, and often react with some metals to produce hydrogen gas.
- Acids- HNO_3, HNO_2, H_2SO_4, H_3PO_4, H_3PO_3, H_2CO_3, etc.
- **Bases** are chemical compounds that taste bitter, turn red litmus blue and feel **slippery**. Base: (NaOH), ($Ca(OH)_2$), (KOH), (RbOH), etc.
- When aqueous (water) solutions of an acid and a base are combined, a neutralization reaction occurs.
- The **pH** of a solution measures the hydrogen ion concentration in that solution.
- Anything above pH 7 is alkaline, anything below pH 7 is considered acidic.
- **Human blood** pH should be slightly **alkaline** (7.35 – 7.45).

Uses of Some Acids and Bases

Acids	Uses
Nitric acid, oxalic acid	Photography
Sulphuric acid	Petroleum exploration
Hydrochloric acid	Leather industry
Benzoic acid, formic acid, citric acid, acetic acid etc.	Preservation for food stuff
Bases	
Calcium hydroxide and calcium oxide	Manufacture of bleaching powder
Magnesium hydroxide	Antacid in sugar industries
Sodium hydroxide	Manufacture of hard soaps and drugs, paper and textile industry, Petroleum refining
Potassium hydroxide	Manufacture of soft soaps

Sources of Some Naturally Occurring Acids

Acid	Source
Citric acid	Lemon, orange, grapes
Maleic acid	Unripe apple
Tartaric acid	Tamarind
Acetic acid	Vinegar
Lactic acid	Milk
Hydrochloric acid	Stomach
Oxalic acid	Tomato

Acidic & basic nature of some household substances

Acidic		Basic (Alkaline)	
1.	Bathroom acid	1.	Milk of magnesia (Antacids)
2.	Vitamin C tablets (Ascorbic acid)	2.	Toothpaste
3.	Lemon juice	3.	Soap solution or detergent solution.
4.	Orange juice	4.	Solution of washing soda.
5.	Tomato juice	5.	Slaked lime & white wash
6.	Vinegar		
7.	Fizzy drinks (Colas & Sodawater)		

pH VALUE OF SOME IMPORTANT SUBSTANCES

Sodium Hydroxide: Alkaline	14.0
Ammonia	11.0
Baking Soda	8.3
Human Blood	7.4
Pure Water: Neutral	7.0
Milk: Acid	6.6
Tomatoes	4.5
Wine and Beer	4.0
Apples	3.0
Vinegar	2.2
Lemon Juice	2.0
Battery Acid	1.0
Urine(Human)	5.5 to 7.5
Tears	7.4
Sea water	8.5
Milk (Cow)	6.3 to 6.6
Coffee	5.0
Tooth paste	9.0

- **Plastics** consist of very long molecules, each composed of carbon atoms linked into chains.
- Polythene is composed of over 200000 carbon atoms.
- Although some plastics are made from plant oils, the majority are made from fossil fuels.
- **Polymers** are large long chain like molecules formed by the chemical linking of many smaller molecules.
- The small molecular building units are called **monomers**.
- **Monomers** are joined into chains by a process of repeated linking known as **polymerization**.
- **Starch** and **wool**- Natural polymers
- **Nylon** and polyethylene- Synthetic polymers
- Natural **rubber** is obtained from milky white fluid **Latex**.
- The simplest unit of rubber is **isoprene** (C_5H_8).
- **Vulcanization** gives strength, hardness, and elasticity to rubber.

RADIOACTIVITY

- **Radioactivity** is discovered by French physicist **Henry de Becquerel** in 1896, who observed that uranium mineral gave off invisible radiation.
- **Pierre and Madam Curie** showed similar phenomenon in other metals like polonium, francium and radium.
- Radiations are of three kinds: Alpha, Beta and Gama
- **Alpha particles** Each particle contains a pair of neutrons and a pair of protons.
- It is **positively charged helium atom** that has very little penetrating power.
- **Beta Particles** These are negatively charged light particles. Their penetrating power is greater than that of alpha particle.
- **Gamma Particles** These are **electromagnetic radiations** of low wavelength, high frequency, and high energy.
- Their **penetrating power** is very great as they can pass through several centimetres of lead.
- With the **emission of an α-particle,** atomic number of an element is decreased by 2 and mass number is decreased by 4.
- With the **emission of a β-particle** atomic number of an element is increased by 1 and mass number does not change.

NUCLEAR REACTIONS AND ATOMIC ENERGY

- A nuclear reaction is a process in which two nuclei or nuclear particles collide, to produce different nuclei than the initial particles.
- Nuclear reactions are of two types : Nuclear **fission** and Nuclear **fusion**.
- **Nuclear fission** is the fragmentation of a large nucleus into two smaller nuclei and the liberation of a large amount of energy.
- **Atom bomb** is based on nuclear fission. U^{235} and P_u^{239} are used as fissionable material.
- Atom bomb was discovered by **Otto Hahn**.
- On **6 august 1945**, an atom bomb was dropped on **Hiroshima** city in Japan. The second was dropped on **Nagasaki**. The bomb was made of **Plutonium**-239
- **Nuclear Fusion**
  It is a nuclear reaction in which lighter nuclei fuse to form a nucleus of greater mass. In this reaction also an enormous amount of heat is produced.
- **Hydrogen bomb** is based on nuclear fusion.
- **Atomic energy** Energy produced by nuclear fission and nuclear fusion is called nuclear energy or Atomic energy.
- In this process the loss of mass is converted into energy.

CARBON AND ITS COMPOUNDS

- All organic compounds contain carbon, and the vast majority also contains hydrogen bonded to carbon.
- It is non-metal.
- Its atomic number is 6 & A mass is 12.
- Carbon which formed the back bone of organic chemistry exhibit allotropy.

Allotropes

- Allotropes are substances which have same chemical properties but different physical properties.
- They have different crystalline modifications.
- Above properties of substances are called allotropy.

Allotropes of Carbon

Diamond

- It has crystalline structure.
- It is purest form of carbon.
- It is hardest natural substance.
- It is highly transparent
- It is bad conductor of electricity & heat.
- It has very high refractive index.
- It is chemically inert.
- It forms tetrahedral crystals.
- It has high melting point & density
- It is used in jewellry & industries.

Graphite

- It has crystalline structure
- It is called black lead
- It is soft, dark grey etc.
- It is good conductor of electricity & heat.
- It is chemically more reactive than diamond.

Uses : It is used in making –

(a) pencils,
(b) moderator in nuclear reactor
(c) lubricant in machinery.

Amorphous Carbons

- They does not have crystalline structure.
- They are product of pyrolysis.
- Pyrolysis is the process of decomposing a substance on heating
- Coal & Soot (carbon black) are the examples.

- **Diamond, graphite, charcoal, coke, coal** etc. are different forms of carbon.

ATOM

Glass is a mixture of an alkali silicate with the silicate of a base, that is, silica, sodium silicate and calcium or lead silicate.

Type & Uses

(i) **Milky Glass** is prepared by adding tin oxide (SnO_2), calcium phosphate [($Ca_3(PO_4)_2$] or cryolite (Na_3AIF_6) to the melt glass.

(ii) **Flint Glass** contains lead oxide (PbO) and used in optical instruments like lenses, prisms.

(iii) **Soda or Soft Glass** is sodium calcium silicate (Na_2O. CaO. $6SiO_2$). It is the ordinary glass and used for making bottles, window panes, etc.

(iv) **Potash Glass or Hard Glass** contains potassium carbonate (K_2CO_3). It has higher softening temperature. It is used for making beakers, flasks, funnel, etc.

(v) **Crown Glass** contains potassium oxide (K_2O), Barium oxide (BaO), boric oxide (B_2O_3) and silica (SiO_2). It is used for **optical** apparatus.

(vi) **Crook's Glass** contains cesium oxides. It is used for **spectacles** as it absorbs UV rays.

(vii) **Glass Laminates** is made by fixing polymer sheet between layers of glass. It is used to make windows and screens of cars, trains and aircraft.

(viii) **Jena Glass** contains B_2O_3 and alumina. It is resistant to acids and alkalies. It is used for making laboratory bottles, for keeping acids and alkalies.

Some Chemical Substances and Their Uses

Soaps and Detergents: Soaps are the sodium or potassium salts of fatty acids. They are made by the saponification of fats. Detergents are made from some petroleum products.

Antibiotic: Medicinal compounds produced by moulds and bacteria, capable of destroying or preventing the growth of bacteria in animal systems. For example penicillin, chloramphenicol etc.

Antibody: Kinds of substances formed in the blood, tending to inhibit or destroy harmful pathogens, etc.

Antigen: Substance capable of stimulating formation of antibodies in a host. It is the foreign substance which enters the host and use its system to sustain. For example bacteria, virus etc.

Antipyretic: A substance used to lower body temperature.

Pesticides: They are used to kill pests. Pests are living organism, who destroy crops or eat away grains.

Insecticides: They are used to kill insects for example D.D.T aluminium phosphate gammexene.

Fungicide: They are used to kill fungus. For example. Copper sulphate, Bordeax mixture.

Rodenticides: They are used to kill rodents. For example, Aluminium phosphide, Thalium sulphate.

Herbicides: They are used to kill weeds Benzipram, benzadox.

Sulphadrugs: Alternatives of antibiotics, sulphanilamide, sulphadiazine, Sulpha gunamidine.

Antacids: Substances which neutralise the excess acid and raise the pH to appropriate level in stomach are called antacids.

Epsom salt: Hydrated magnesium sulphate ($MgSO_4 \cdot 7H_2O$), used in medicines to empty bowels.

Chloroform: A sweetish, colourless liquid. It is used as a solvent and anaesthetic.

Saccharin: A white crystalline solid which is 550 times sweeter than sugar, but does not have any food value. It is used by diabetic patients.

DDT: Dichloro diphenyl tricholoro ethane, a white powder used as an insecticide.

CHEMISTRY

INTRODUCTION

Biology is the study of life and living organism, including their structure, function, evolution, distribution, identification and Taxonomy

- **Aristotle** is often called "the father of biology".
- **Leeuwenhoek** invented a simple microscope and studied living cells.
- **Alexander Flemming** discovered Penicillin.
- **Carolus Linnaeus** introduced Binomial Nomenclature for naming plants and animals.
- **Charles Robert Darwin** proposed the theory of Pangenesis to explain inheritance and also proposed Origin of species by Natural Selection.
- **Gregor Johann Mendel** discovered principles of inheritance.
- **Lamarck** discarded the idea of fixity of species.
- **Louis Pasteur** proposed 'Germ theory of disease. He also proposed pasteurization for sterilization.
- **Robert Hooke** assembled a compound microscope and discovered cells in cork.
- **William Harvey** discovered blood circulation.
- **T.H. Morgan** laid foundation of gene theory.
- **David Baltimore** is known for his discovery of reverse transcriptase.
- **Charles Darwin** is famous for the theory of Natural selection.
- **Hippocrates** is considered to be the *"father of western medicine"*.
- **Edward Jenner** is famous for creating the first effective vaccine for smallpox- (*father of immunology*)
- **Joseph Lister** is famous for using antiseptics for cleaning and sterilizing wounds.
- **Robert Brown** discovered the cell nucleus.
- **William Watson (1909)** introduced the term Genetics.
- **Watson and Crick** gave the model of DNA.
- **In 1866 Ernst Haeckel** coined word "ecology".
- **Hippocrates and Aristotle** laid the foundation of ecology.
- **Camillo golgi** discovered golgi body.
- **Salim Ali** known as the "*birdman of India*".
- **Har Gobind Khorana** is a biochemist who won the Nobel Prize in 1968 for demonstrating how the *nucleotides in nucleic acids control the synthesis of proteins*.

Cells

- All living organism are constituted of structural and functional units called cells.
- ***Robert Hook*** coined the term **'*cell*'** in 1665.
- Cells are grouped into tissues, tissues into organ and organs into organ system.
- Smallest cells- **Mycoplasmas**.
- Largest isolated single cell- egg of an ostrich

Prokaryotic Cells

- Morphologically most primitive cells.
- It is without nucleus.
- A single membrane surrounds the cell.
- It is found in bacteria, blue green algae, mycoplasma.
- The plasma membrane is semi permeable in nature.
- Many prokaryotes have small circular DNA molecules called *plasmids*.
- Cell devision occurs by fission or budding.

Eukaryotic Cells

- The eukaryotic cells occur in all protists, fungi, plants and the animals.
- Eukaryotic cells are typically composed of plasma membrane, cytoplasm and its organelles viz. mitochondria, endoplasmic reticulum, golgi complex a true **nucleus**, etc.

Cell Wall

- Cell wall is present in plants.
- Cell division occurs by mitosis and meiosis.
- Cell wall is unique feature of plant cell which is made up of *cellulose* and is totally absent in animals.

Cell Membrane

- Cell membrane is composed of lipids.
- The function of plasma membrane is the transport of the molecules across it.

Fluid mosaic model of plasma membrane

- S.J. Singer and G. Nicolson in 1972 proposed the most accepted model of membrane structure.
- Lipids are amphipathic.
- One of the most important function of plasma membrane is the transport of the molecules across it.
- **Plastids** are found in plants and are also found in protists, euglena.
- **Lysosomes** are popularly called "suicide bags"

Ribosomes

- Ribosomes were first observed by *Palade*.
- 70s in prokaryotes and 80s in eukaryotes
- Ribosomes are present only in grandular endoplasmic reticulum.
- Except mammalian RBC in all living cells have ribosomes.

Nucleus

- It is centrally located spherical and largest component of all eukaryotic cell. Nucleolus is present in nucleus.
- *Robert Brown* named it Nucleus.
- A typical nucleus consists of four structures:
  - (i) nuclear membrane,
  - (ii) nucleoplasm
  - (iii) chromatin and
  - (iv) the nucleolus.

Mitochondria

- These are also called "*Powerhouse of cells*".

CLASSIFICATION OF ORGANISM

- Most acceptable classification was given by R. H. Whittaker (1969). These are Monera, protista, Fungi, Plantae, Animalia.

(a) Monera

- All prokaryotes (cell without nucleus) such as Bacteria, Cyanobacteria, archiobacteria.
- All are microscopic and filamentous bacteria is also present in this kingdom.

(b) Protista

- All are unicellular.
- Autotrophic, parasitic and saprophytic mode of nutrition.
- Ex-euglena, paramaecium, etc.

(c) Fungi

- Non green plants.
- Saprophytic mode of nutrition.
- Chitin is present in cell wall.
- Ex-Mucor, Albugo, etc.

(d) Plantae

- All plants except some algae, fungi, diatoms.
- Multicellular.
- Autotrophic, i.e. can make their own food.

(e) Animalia

- Multicellular, Eukaryotic (cell with nucleurs) organism.
- Considered as largest kingdom.
- Heterotrophs, i.e., depend on other organism for their food.

GENETICS

- Study of genes is known as **genetics**.

Gene

- It is a segment of DNA and *basic unit of heredity*. These are located on chromosomes.
- **DNA** is found in nucleus, and also found in mitochondria and chloroplast.
- It stands for **deoxyribonucleic acid (DNA)**.
- It is double stranded.
- It consists of Nitrogenous bases-**Adenine, Thymine, Cytosine** or **Guanine**, 5-carbon sugar and a phosphate molecule.
- **RNA** is single stranded.
- It consists of phosphate, ribose sugar, nitrogenous bases-**Adinine, Uracil, Cytosine**, and **Guanine**.
- **Mendel** conducted cross hybridization experiments on green pea plant (*Pisum sativum*).

Mutation

- Sudden change in the sequence of DNA is known as mutation.
- There are various chemical and physical factors that induce mutation is known as mutagens. Such as – UV radiation, carcinogenic chemical like – nicotine, nitric oxides, etc.

Sex Determination

- X and Y are the sex chromosomes which are responsible for the determination of sex. 46 chromosomes are present in human body cell. In which 22 pairs of these are *autosomes* & 23nd is sex chromosomes, i.e., x & y.

Genetic disorder

- It is caused due to abnormality in an individual DNA.

PLANT PHYSIOLOGY

Photosynthesis

- It is the process by which plants makes their food in the presence of sunlight, CO^2, water and chlorophyll.

$$6CO_2 + 12H_2O \xrightarrow[\text{Chlorophyll}]{\text{Light}} C_6H_{12}O_6 + 6O_2 + 6H_2O$$

Respiration

- It is the process of oxidation which occurs in three steps. Glycolysis, Krebs Cycle and Electron transport system.

  It occurs in Cytoplasm (Glycolysis) and rest cycle in Mitochondria.

  $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H2O$ + energy ATP

Transpiration

- Loss of water in the form of water vapour from plant through a small pore **stomata** is known as Transpiration.
- Plants obtains nitrogen from soil in the form of nitrites, nitrates and salts.

Nitrogen assimilation

- It is carried out by Ammonification, Nitrification and Denitrification.

Growth regulators

- There are some growth regulators. e.g.;-auxin, gibberllines, Cytokinins, Ethylene, Abcisic acid, etc.

Human Physiology

- Human physiology is the science of the functioning of human organs and the cells that compose them. It studies the mechanical, physical and biochemical functions that determine the heath of an individual.
- Human physiology is based on four functional levels of body units. The most basic is *molecular level* which includes chemicals that are necessary for cells to function. The next levels are tissue, organ and system physiology.

Animals & their teeth

Man (Child)	20
Man (adult)	32
Horse	44
Dog	42
Cow & Sheep	32
Cat	30
Rabbit	28
Mouse	16

DIGESTION OF FOOD

Name of the Digestive juice	Name of the enzymes	Substrate	End product
Saliva	Ptyalin (Salivary amylase)	Starch	Maltose
Pancreatic juice	Amylopsin (pancreatic amylase)	Starch, Glycogen	Maltose and Glucose
Intestinal juice	Sucrase (invertase), Maltase, Lactase	Sucrose; Maltose, Lactose	Glucose and fructose, Glucose, and galactose
Gastric Juice	Pepsin, Rennin	Proteins, Casein	Proteoses and peptones, Calcium caseinate
Pancreatic Juice	Trypsin, Chymotrypsin, Carboxyl peptidases	Proteins, Peptides	Proteoses and Peptides Amino acid.
Intestinal juice	Amino peptidase, Dipeptidase	Peptides	Amino acids

VITAMIN REQUIRED BY THE BODY

- FG Hopkins discovered vitamines, however the term, “vitamin” was coined by C. Funk.
- Vitamins are divided into two group:
  (a) Fat soluble vitamins - Vitamin A, D, E, and K.
  (b) Water soluble vitamins - Vitamin B and C.

Vitamin	Chemical Name	Function in Body	Deficiency Disease	Sources
B_1	Thiamine pyrophosphate	Part of coenzyme for respiration	**Beri-beri:** nerve and heart disorders	Found in whole grain cereals, etc.
B_2	Riboflavin	Part of coenzyme FAD needed for respiration	**Ariboflavinosis:** skin and eye disorders	Milk, yogurt, etc.
B_{12}	Cyanoco-balamin	Coenzyme needed for making red blood cells, etc.	**Pernicious anaemia**	Animal products etc.
B_5	Nicotinic acid (‘niacin’)	Part of coenzymes NAD, NADP used in respiration	**Pellagra:** skin, gut and nerve disorders	Widespread in foods.
C	Ascorbic acid	Not precisely known	**Scurvy:** degeneration of skin teeth and blood vessels.	Lemon, orange, etc.
A	Retinol	Visual pigment, rhodopsin	**Xeropthalmia:** ‘dry eyes’	Milk, eggs, etc.
D	Cholecalciferol	Stimulates calcium absorption by small intestine, needed for proper bone growth	**Rickets:** bone deformity	Found in dairy products, etc.
E	Tocopherol	Not precisely known	**Infertility**	Found primarily in plant oils, green, leafy vegetables, etc.
K	Phylloquinone	Involved in blood clotting	**Possible haemorrage**	Green, leafy vegetables, etc.

Minerals required by the body

Minerals	Source	Function
Sodium (Na)	Table salt large amounts is present in processed foods, etc.	for proper fluid balance, etc.
Chloride	Table salt, large amounts is present in processed foods, etc.	for proper fluid balance, etc.
Potassium	Meats, milk, etc.	for proper fluid balance, etc.
Calcium	Milk and milk products, etc.	Important for healthy bones and teeth, etc.
Phosphorus	Meat, fish, poultry, eggs, milk, processed foods.	Important for healthy bones and teeth, etc.
Magnesium	Nuts and seeds; etc.	Found in bones, etc.
Sulfur	Occurs in foods as part of protein, meats, etc.	Found in protein molecules.
Iron	Organ meats; etc.	found in red blood cells.
Iodine	Seafood, foods grown in iodine-rich soil, etc.	Found in thyroid hormone.

PROTEIN DEFICIENCY DISEASES

- **Marasmus** is produced by a simultaneous deficiency of proteins and calories.
- **Kwashiorkar** is produced by protein deficiency.

Respiratory System

- The organ system which aids in the process of respiration is called the Respiratory system.

Respiratory Organ	Animals
Lungs	Mammals, Birds, Reptiles and Amphibians
Gills	Fish, Crabs, Tadpole larva of Frog
Skin	Earthworm, Leech, Amphibians
Trachea	Insects

Human respiratory system

- Human respiratory system consists of external nostrils, nasal cavity, nasopharynx, larynx, trachea, bronchiole and lungs.

Circulatory System

- These are of two types open circulatory system and closed circulatory system.

Open Circulatory System

- Generally present in arthopods and molluscs.

Closed Circulatory System

- Annelids and chordates have a closed circulatory.

Heart beat and pulse

- The human heart beats at the rate of about 72-80 per minute in the resting condition.

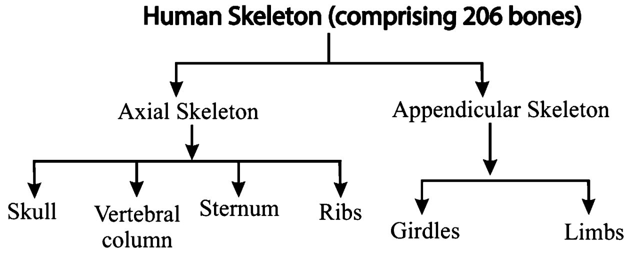
Electrocardiograph

ECG stands for Electrocardiogram. It is the graphic record of electronic current produced by the excitation of cardiac muscles.

Excretion

- It is process of removal of undigested wastes from the body.
- Kidney plays a major role in the elimination of water waste in the form of urine.
- Urine contains ammonia, urea, uric acid, etc.

SKELETAL SYSTEM



ENDOCRINE SYSTEM

Endocrine system is the collection of ductless glands that produce hormones directly into blood. These hormones regulate metabolism, growth and development, tissue function, sexual function, reproductions sleep and mood among other things.

Hormones and their action

S. No.	Endocrine gland	Hormone	Action
1	**Pituitary (Master gland)**	Growth hormones, Anti-diuretic hormone Adeno – Corticotrophic hormone	Regulates the growth of bone and tissue. Controls the amount of water reabsorbed by the water. Defending the body against physiological stress e.g. exposure to cold. Follicle stimulating hormone stimulates ovary to produce female hormone.
2	**Pineal**	Melatonin	Regulates, circadian and sexual cycle
3	**Thyroid**	Thyroxine	Regulates rate of growth and metabolism. Too little-over weight and sluggishness. Too much-thin and over active.
4	**Thymus**	Thymosin	Helps in production of lymphocytes

5	**Adrenal**	Cortisone	Aids in conversion of proteins to sugar, cortex of this gland produces the hormone.
6	**Pancreas**	Insulin	Regulates sugar metabolism. Too little insulin leads to high sugar level in blood and weakness (a condition called **diabetes**)
7	**Ovary**	Estrogen	Development of secondary sexual characters e.g. development of breasts in female.
8	**Testis**	Testosterone	Development of many masculine features such as growth of moustaches and beard

Diseases related to Endocrine System

- Hormone levels that are too high too low cause diseases.
- Hormonal diseases also occur if body does not respond to hormones.
- Stress, Infection and changes in the blood's fluid and electrolyte balance can also influence hormone levels.
- The most common endocrine diseases are diabetes, hypo/chyperthyroidism, hypoglycemia,

Important facts of human body

Blood volume	5 to 5.5 L (in 70 kg body)
Blood platelets	2,00,000 - 4,00,000 per cubic mm
Blood clotting time	2-5 minutes
Longest bone	Femur (Thigh bone)
Smallest bone	Ear-ossicle and stapes
Normal body temperature	98.6° F or 37°C
Weight of brain	1424 g
Total number of bones in the human body	206
Total number of muscles in the body	639
WBC	5000-7000/cub.ml
RBC	5m/cub.ml OR 50,00000/cub.ml
Largest muscle in the body	Gluteus maximus (Buttock muscle)
Largest organ of human body	Skin
Largest endocrine gland	Thyroid
Menopause age	40-50 years
Minimum regeneration power	In brain cells
Thinnest skin	Conjunctiva
Number of cells in body	75 trillion
Hb (Hemoglobin) content in body	(i) 12-17 g/dl (male) (ii) 12-15 g/dl (Female) (iii) New born: 14-24 g/dl (vi) Child: 11-16g/dl
Normal BP	120/80 mm Hg
Pulse rate	72/minute
Breathing rate	16-20/minute
ESR (Erythrocyte Sedimentation Rate)	4-10 mm/hour
Normal sperms count	200-350 million/ejaculation & 40-300 million/ml

AND DEFENCE MECHANISM IMMUNITY

- The term **immunity** refers to the specific resistance exhibited by the host towards infections by micro-organisms (*pathogens*) and their products.

Innate immunity

- It is developed in an individual without having the disease or immunization, e.g.,

Acquired Immunity

- The resistance against infectious disease that an individual acquires during life is known as acquired immunity.

MERS: Middle East Respiratory Syndrome (MERS) is new viral disease related to respiratory illness.

Ebola: Ebola hemorrhagic fever (Ebola HF) is a severe, often-fatal disease in humans and non-human primates (monkeys, gorillas, and chimpanzees).

AIDS: Acquired Immuno Deficiency Syndrome (AIDS) is caused by Human Deficiency Virus (HIV).

COMMON HEART DISEASES

- **Coronary artery disease or Arthrosclerosis**
- **Angina** (angina pectoris)**:**
- **Heart Failure** (congestive heart failure)

COMMON LUNG DISEASES

- **Asthma**
- **Bronchitis (Inflammation of the Bronchi):**

COMMON BRAIN DISEASES

- **Epilepsy:** Epilepsy is a condition where a person has recurrent seizures, abnormal discharge of electrical activity in the brain cells

Cancer: Cancer is a complex genetical disease which occurs due to the environmental factors. Cancer causing agent (*carcinogen*) may be present in food and water, in air in sunlight and in chemicals.

BACTERIAL DISEASES

Disease	Pathogen	Affected Organ	Symptom
Anthrax	Bacillus anthracis	Skin and intestine	Skinulcer, sore throat, nausea, fever, breathlessness
Cholera	Vibrio cholerae	Intestine	Vomiting, acute diarrhoea, muscular cramps, dehydration etc.
Diphtheria	Corynebacterium diphtheriae	Respiratory tract	Difficulty in respiration (mainly in child of age 2-5 yrs).
Gonorrhoea (sexual disease)	Neisseria gonorrhoea	Urinary tract	Swelling in urinary tract.
Leprosy or Hansen's disease	Mycobacterium leprae	Chronic infection of skin and nerve	Ulcers, nodules, scaly scabs (the infected part of the body becomes senseless).
Plague (i) Bubonic plague	Pasteurella, Yersinia pestis	Blood disease	High fever, weakness and haemorrhage which turn black.
(ii) Pneumonic plaque	"	Lungs	Haemorrhage of bronchi, lungs.
(iii) Septicemic plague	"	Blood	Anaemia, fever, chills leading to death with in two days.
Tetanus (lock jaw)	Clostridium tetani	Central nervous system	Painful contraction of neck and jaw muscles followed by paralysis of thoracic muscles.
Tuberculosis	Mycobacterium tuberculosis	Lungs	Repeated coughing, high fever.
Whooping cough or Pertussis	Bacillus pertussis	Respiratory system	Continuous coughing.
Pneumonia	Diplococcus pneumoniae	Lungs	Sudden chill, chest pain, cough, high fever.
Typhoid	Salmonella typhi	intestine	High fever, diarrhoea and headache.

VIRAL DISEASES

Disease	Pathogen	Affected Part	Symptom
AIDS (Acquired Immuno Deficiency Syndrome)	HIV (Human Immuno Deficiency Virus)	White blood cells	Weak immune system.
Chicken pox	Vericella virus	Whole body	High fever, reddish eruption on body
Small pox	Variola virus	Whole body	Light fever, eruption of blood on body
Dengue fever	RNA containing dengue virus	Whole body, particularly head, eyes and joints	High fever, backache, headache, retro-orbital pain behind the eye ball.
Ebola virus disease	Ebola Virus (filovirus)	Whole body	Fatal hemorrhagic fever, liver and kidney disfunction vomiting, headache.
Hepatitis (Epidemic Jaundice) (i) Hepatitis - A (ii) Hepatitis - B	Hepatitis virus Hepatitis - A virus Hepatitis - B virus	Liver	Loss of appetite, nausea, whitish stool and jaundice. Not fatal Fatal
Herpes	Herpes virus	Skin	Swelling of skin.
Influenza (flu)	Influenza virus	Whole body	Inflammation of upper respiratory tract, nose throat and eyes.

Measles German	Rubella virus	Whole body	Loss of appetite, reddish eruption on the body.
Polio or poliomyelitis	Polio virus	Throat, backbone and nerve	Fever, backbone and intestine wall cells are destroyed. It leads to paralysis.
Rabies (hydrophobia)	RNA virus called rabies virus	Nervous system	Encephalitis, fear of water, high fever, headache, spasm of throat and chest leading to death.
Swine influenza (flu)	H_1N_1 flu virus	Whole body (muscles)	Headache, tiredness, sore throat, vomiting, breathing problems.

PROTOZOAN DISEASES, THEIR VECTORS AND AFFECTED PART DISEASES

Disease	Pathogen (Causative agent)	Vector	Parts Affected and Symptoms
African trypanosomiasis	*Trypanosoma gambienes*	Tsetse fly (Glossina palpalis)	Blood and nervous tissue. Man feels sleepy, may cause death.
Amoebic dysentery (Amoebiasis)	*Entamoeba histolytica*	None, Infection by contamination	Colon (intestine). Develop loose motion with blood, pain in abdomen
Diarrhoea	*Giardia*	None, infection by contamination	Digestive system causes loose motions, vomitting
Filaria or elephantiasis	*Wuchereria bancrofti*	Culex mosquito	Swelling of legs, testes and other body parts.
Kala azar or dumdum fever	*Leishmania donovani*	Sand flies (Phlebotomus)	Spleen and liver enlarge and high fever develops.
Malaria	*Plasmodium Vivex*	Female Anopheles mosquito	Periodical attacks of high fever, pain in joints accompanied by chill, heavy perspiration and fast pulse.

FUNGAL DISEASES IN HUMAN BEINGS

Disease	Pathogen (fungi)	Symptoms
Asthma or aspergillosis	*Aspergillus fumigatus*	Obstruction in the functioning of lungs.
Baldness	*Tinea capitis*	Hair fall
Athlete's foot	*Tinea pedis*	Skin disease, cracking of feet.
Ringworm	*Tricophyton Verrucosum*	Round red spot on skin
Scabies	*Acarus scabiei*	Skin itching and white spot on the skin.

SOME VIRAL DISEASES IN ANIMALS

Animal	Virus	Disease
Buffalo	Pox virido orthopox	Small pox
Cow	Herpes virus	Herpes
Cow	Variola vera	Small pox
Cow	Blue tongue virus	Blue tongue
Dog	Street rabies virus	Rabies

BLOOD

- **Blood** is a liquid connective tissue.
- Blood has a fluid matrix called plasma.
- **Plasma** is a pale coloured fluid which contributes 55% of blood volume. Plasma contains 90 to 92 % of water.
- Blood corpuscles are of three types: Red blood corpuscles (RBCs) ,white blood corpuscles(WBCs) and Blood platelets.
- RBC's are formed in the red bone-marrow.
- RBC lack, nucleus.
- **Life span of RBCs** (Erythrocytes) is about 120 days.
- **WBCs (Leueocytes)** are responsible for immunity.
- **WBCs** are manufactured in bone marrow.
- **Neutrophils** and monocytes are phagocytic cells (destroy foreign bodies)
- **Basophils** are involved in inflammatory reactions.
- **Eosinophils** are associated with allergic reactions.
- **Lymphocytes** are responsible for immune response.
- **Platelets** (thrombocytes) are responsible for clotting of blood during accidents.
- For a healthy adult person the average **systolic/diastolic pressure** is 120/80 mm of Hg in arteries near heart.
- **Blood pressure** is measured by sphygmomanometer.

- **The Rh factor** is a type of protein on the surface of red blood cells. Most people who have the **Rh factor** are **Rh**-positive. Those who do not have the **Rh factor** are **Rh**-negative.

BLOOD GROUP

- **Karl Landsteiner** (1900) discovered the blood group in human.
- There are four groups of blood A, B, AB and O.
- **Universal Donor :** 'O' blood group person is '**universal donor**', i.e can give blood to all the four blood groups (O, A, B, and AB).
- **Universal Recipient :** '*AB*' blood group person is **universal recipient**', i.e can take blood from all the four groups (AB, A, B, O).

VACCINES AND THEIR DOSES

Age	Vaccination	Dose
Birth to 12 months	• **DPT** (triple vaccine, against diptheria, whooping cough/ pertussis and tetanus) • **Polio** (Sabin's oral, previously Salk's injectible) • **BCG** (Bacillus Calmette Guerin)	• Three doses (commonly oral) at intervals of 4-6 weeks. • Three doses at intervals of 4-6 weeks. • Intradermal and one vaccine
8-24 months	• **DPT** • **Polio** (oral) • **Cholera** vaccine (can be repeated every year before summer)	• Booster dose • Booster dose • One
9-15 months	• **Measles** vaccine (MMR or Measles, Mumps and Rubella)	• one dose
5-6 years	• **DT** (Bivalent vaccine against diphtheria and tetanus) • **TAB** (vaccine against Salmonella typhi, S. paratyphi A and S paratyphi B) or Typhoid Paratyphoid vaccine	• Booster dose • Two doses at intervals of 1-2 months
10 years	• Tetanus, TAB (typhoid)	• Booster dose
16 years	• Tetanus, TAB	• Booster dose

VACCINES AND INVENTORS

Vaccine	Developed by	Country	Year
Small Pox	Edward Jenner	England	1796
Cholera	Louis Pasteur	France	1880
Diphtheria and Tetanus	Emil Adolf Von Behring and Shibasaburo Kitasato	Germany/ Japan	1891
TB Vaccine	Albert Calmette and Camille Guerin	France	1922
Polio Vaccine	Jonas E. Salk	US	1952
Oral Polio Vaccine	Albert Bruce Sabin	US	1955
Measles Vaccine	John F. Enders, Thomas peeble	US	1953
Rabies Vaccine	Louis Pasteur	France	1885
Typhus Vaccine	Charles Nicolle	France	1909
Rubella Vaccine	Paul D. Parkman & Harry M. Meyer jr		1966
Scurvy Vaccine	James Lind		1753

MEDICAL SCIENCE DISCOVERIES

Invention	Inventor	Year
• Anesthetic	William Morton	1846
• Anthrax vaccine	Louis Pasteur	1881
• Antiseptic	Joseph Lister (Scotland)	1867
• Artificial heart	Denton Cooley	1969
• Artificial hip	John Charnley	1972 (perfected)
• Artificial skin	Dr. John F. Burke and Ioannis Yannas	1979
• Birth control pill	Gregory Pincus, John Rock and Min-Chueh Chang	1960 (approved by FDA)
• Cholera and T.B. Germs	Robert Koch (Germany)	1883
• Blood	William Harvey (Britain)	1628 (published)
• Blood transfusion (modern)	Dr. Thomas Blundell	1818
• Cholera vaccine	Louis Pasteur	1880
• Contact lenses (glass)	Adolf Fick	1887
• Corneal transplants	Eduard Zirm	1905
• Cough drops	James Smith and sons	1847
• Disposable syringe	Colin Murdoch	1956
• DNA	Frances Crick, James Watson and Rosalind Franklin	1953
• Gas mask	Garrett Augustus Morgan	1912
• Genetics	Johann Gregor Mendel	1865
• Heart transplant	Christiaan Barnard	1967
• Insulin (discovery)	Frederick Banting and Charles Best	1921

• Iron lung	Philip Drinker	1929
• Pacemaker (human)	Wilson Greatbatch	1960 (first use)
• Pasteurisation	Louis Pasteur	1864
• Pathology	Giovanni Battista Morgagni	1761
• Penicillin	Alexander Fleming	1928
• Plastic surgery	Archibald Hector McIndoe	1940s
• Polio vaccine	Jonas Salk	1953
• Quinine	Pierre Joseph Pelletier and Joseph Bienaime Caventou	1820

Biology in human welfare

Animal Husbandry

- It deals with the care, breeding & management of domesticated animals that are useful to humans.

Poultary Farming

- Poultary is a rearing of domesticated fowls, ducks, geese, turkeys, guinea fowls and pigeons.

Fisheries

- **Pisciculture** is the rearing, breeding and catching of fishes.

Apiculture

- Apiculture is rearing and breeding of honeybees for the production of **honey**.

Animal Breeding

- Animal breeding is the production of new breeds of domesticated animals with improved traits.

Plant Breeding

- Plant breeding refers to the modification and improvement of genetic material of plants resulting in the development of crops which are more beneficial to human beings.

Crop	Variety	Resistance to diseases
Wheat	Himgiri	Hill bunt & leaf and stripe rust.
Cauliflower	Pusa snowball K-1 Pusa shubra	Blight black rot, Black rot and curl.
Brassica	Pusa Swarnim (Karan rai)	White rust.
Cowpea	Pusa Komal	Bacterial blight.
Chilli	Pusa Sadabahar	Chilly mosaic virus, Tobacco mosaic virus and leaf curl.

Biotechnology and its application

- It deals with large scale production and marketing of products and processes using living organism, cells or enzymes. This technology has application in agriculture, food processing industry, bioremediation, medicine diagnostics, waste treatment and energy production.

Genetically Modified Plants

- Golden Rice: It is a genetically modified variety of Rice.
- Bt Cotton : Bacillus *thuringiensis*
- Flavr savr variety of tomato: Flavr savr is the first genetically engineered crop in which tomatoes have longer shelf life.

Benefits of Transgenic Animals

- Transgenic animals are used to study gene regulation
- Biological products

EXERCISE

1. Mass is the measure of
(a) matter contained (b) weight
(c) force (d) none of these

2. The mass is measured by
(a) a beam balance (b) a spring balance
(c) micro balance (d) none of these

3. A hydrometer is used to measure –
(a) density (b) mass
(c) weight (d) R.D.

4. Among the following the derived quantity is
(a) mass (b) length (c) density (d) time

5. The SI unit of current is
(a) kelvin (b) ampere
(c) newton (d) volt

6. One micron equals to
(a) 10^{-3} m (b) 10^{-9} m
(c) 10^{-6} m (d) 10^{-2} m

7. The SI unit of density
(a) gram/metre^3 (b) kilogram/metre^3
(c) gram/cm^3 (d) kg/cm^3

8. Which of the following is not a fundamental unit?
(a) newton (b) kilogram
(c) metre (d) second

9. The unit of .... is a derived unit –
(a) temperature (b) length
(c) velocity (d) luminous intensity

10. The SI unit of weight is :
(a) kilogram (b) newton
(c) newton metre (d) kilo metre

11. When a substance is heated its density
(a) increases (b) decreases
(c) remains same (d) none of these

12. In SI units, candela is the unit of
(a) current (b) temperature
(c) luminous intensity (d) none of the above

13. Practical unit of heat is
(a) Calorie (b) Horse power
(c) Joule (d) Watt

14. If force and displacement of particle in direction of force are doubled. Work would be –
(a) Double (b) 4 times
(c) Half (d) 1/4 times

15. If velocity of a body is twice of previous velocity, then kinetic energy will become –
(a) 2 times (b) 1/2 times
(c) 4 times (d) 1 times

16. The unit of work is
(a) newton (b) joule
(c) metre (d) second

17. 1 kilowatt hour is equal to –
(a) 1 joule (b) 100 joule
(c) 36 joule (d) 3.6×10^3 kilo joule

18. When a stone is thrown upward to a certain height, it possesses –
(a) potential energy (b) kinetic energy
(c) wind energy (d) sound energy

19. kilowatt hour is the unit of –
(a) time (b) power
(c) energy (d) force

20. A fast wind can turn the blades of a windmill because it possesses
(a) potential energy (b) kinetic energy
(c) chemical energy (d) heat energy

21. The stability of a pond ecosystem depends on
(a) micro-organisms and fishes
(b) micro-organisms and zoo planktons
(c) fishes and reptiles
(d) producers and consumers

22. The main factor which determines the balance of nature is
(a) human activities
(b) Rabit and habitat
(c) environmental conditions
(d) availability of food

23. The golgi bodies are related to
(a) Respiration (b) Excretion
(c) Secretion (d) Circulation

24. The most abundant compound in cytoplasm is
(a) fat (b) water
(c) protein (d) carbohydrates

25. Mitochondria usually occur in
(a) Vegetative cells
(b) Reproductive cells
(c) Both vegetative and reproductive cells
(d) None of these

26. Which of the following is not a renewable resource?
(a) Thorium (b) Geothermal heat
(c) Tidal power (d) Radiant energy

27. Which one of the following pairs is not correctly matched?
(a) Hevea Tree—Brazil
(b) Sumatra Storm—Malaysia
(c) Kajan River—Borneo
(d) Dekke Toba fish—Brazil

28. Which of the following resources is renewable one?
(a) Uranium (b) Coal
(c) Timber (d) Natural Gas

29. How many neck canal cells are found in the archegonium of a fern?
(a) One (b) Two
(c) Three (d) Four

30. Which angiosperm is vesselless?
(a) Hydrilla (b) Trochodendron
(c) Maize (d) Wheat

31. Myrmecology is study of
(a) Insects (b) Ants
(c) Crustaceans (d) Arthropods

32. HIV often changes is shapes due to the presence of an enzyme called
(a) Reverse Transcriptase
(b) Enterokinase
(c) Nucleotidase
(d) Nucleoditase

33. The cells which are closely associated and interacting with guard cells are
(a) Transfusion tissue
(b) Complementary cells
(c) Subsidiary cells
(d) Hypodermal cells

34. Conversion of starch to sugar is essential for
(a) Stomatal opening
(b) Stomatal closing
(c) Stomatal formation
(d) Stomatal growth

35. Soil erosion can be prevented by
(a) Increasing bird population
(b) Afforestation
(c) Removal of vegetation
(d) Overgrazing

36. Natural sources of air pollution are
(a) Forest fires
(b) Volcanic eruptions
(c) Dust storm
(d) Smoke from burning dry leaves

37. Which of the following Genetically Modified vegetable is recently being made available in Indian market?
(a) Carrot (b) Radish
(c) Brinjal (d) Potato

38. The smallest organelle in the cell is
(a) Lysosome (b) Ribosome
(c) Mitochondria (d) Peroxisome

39. Cyanobacteria have-
(a) A well-defined nucleus and chloroplast.
(b) A well-defined nucleus but no chloroplast.
(c) Incipient nucleus and vesicles containing chlorophyll.
(d) Incipient nucleus but no chloroplast or pigment.

40. Which of the following cellular components can be used to distinguish a prokaryotic cell from a eukaryotic cell?
(a) Nucleus (b) Plasma membrane
(c) DNA (d) Proteins

41. Active transport through the plasma membrane occurs through the action of
(a) diffusion (b) membrane proteins
(c) DNA (d) water

42. Zinc is
(a) non-malleable. (b) brittle.
(c) ductile. (d) (a) and (b).

43. The only non-metal that has luster is
(a) Sulphur (b) Phosphorus
(c) Silicon (d) Iodine

44. Which of the following is a liquid metal?
(a) Mercury (b) Bromine
(c) Water (d) Sodium

45. The property of metals to be hammered into their sheets is called
(a) malleability (b) ductility
(c) tensile strength (d) sonorous nature

46. Select the metal that is soft
(a) Aluminium (b) Copper
(c) Sodium (d) Lead

47. The process of protecting iron, from rusting, by coating with zinc is called
(a) Rusting (b) Roasting
(c) Smelting (d) Galvanizing

48. Graphite is a/an –
(a) alloy (b) metal
(c) metalloid (d) non metal

49. The white phosphorus is stored –
(a) in air (b) under water
(c) under kerosene (d) under CS_2

50. The chief ore of aluminium is –
(a) bauxite (b) cryolite
(c) alunite (d) feldspar

51. Which is the best variety of coal?
(a) Peat (b) Lignite
(c) Anthracite (d) Bituminous

52. Which is a fossil fuel?
(a) Natural gas (b) Biogas
(c) Producer gas (d) None of these

53. Which of the following cells do not have a nucleus ?
(a) Brain cell
(b) Cardiac muscle fibres
(c) Paraecium
(d) Mature human RBC

54. Which cell organelle is known as the control centre of the cell?
(a) Nucleus (b) Chloroplast
(c) Mitochondria (d) Endoplasmic reticulum

55. Energy currency of the cell is –
(a) AMP (b) GTP
(c) ATP (d) All

56. Which of the following organelles are semiautonomous organelle ?
(a) Mitochondria
(b) Ribosomes
(c) Chloroplast
(d) Both (a) and (c)

57. In the mitochondrion energy is stored in the form of
(a) adenosine triphosphate (ATP)
(b) adenosine monophosphate (AMP)
(c) citric acid
(d) adenosine diphosphate (ADP)

58. The site of protein synthesis in plants is the
(a) Chloroplast
(b) Ribosomes
(c) Pyrenoids
(d) Mitochondria

59. Synthesis of any protein in a cell is determined by
(a) type of ribosomes
(b) mitochondria
(c) sequence of nucleotides in DNA
(d) sugar and phosphate of DNA

60. The plasma membrane is
(a) permeable
(b) semipermeable
(c) differentially permeable
(d) impermeable

61. A form of condensation that reduces visibility and causes breathing problems is
(a) Dew
(b) Frost
(c) Smog
(d) Mist

Hints & Solutions

1. (a) **2.** (a) **3.** (a) **4.** (c) **5.** (b) **6.** (c)
7. (b) **8.** (a) **9.** (c) **10.** (b) **11.** (b) **12.** (c)
13. (a) **14.** (b) **15.** (c) **16.** (b) **17.** (d) **18.** (a)
19. (c) **20.** (a) **21.** (d) **22.** (a) **23.** (c) **24.** (b)
25. (c) **26.** (a) **27.** (d) **28.** (c) **29.** (a) **30.** (b)
31. (b) **32.** (a) **33.** (c) **34.** (a) **35.** (a) **36.** (c)
37. (c) **38.** (b) **39.** (c) **40.** (a) **41.** (b) **42.** (d)
43. (d) **44.** (a) **45.** (a) **46.** (c) **47.** (d) **48.** (a)
49. (b) **50.** (a) **51.** (c) **52.** (a) **53.** (d) **54.** (a)
55. (c) **56.** (d) **57.** (a) **58.** (b) **59.** (c) **60.** (b)
61. (c)

Chapter

6

Current Affairs

ECONOMY

Budget 2020: Highlights

This year's Union Budget centres around three ideas — Aspirational India, Economic development, A Caring Society. From the common man to industry and market — all have a wide range of expectations from this year's budget.

This year's Economy Survey projected economic growth to rebound and hit 6%-6.5% in the next financial year starting April 1.

Personal tax rates reduced

- 10% income tax for income tax for income between ₹5- ₹7.5 lakh
- For income tax between ₹7.5 lakh- ₹10 lakh, he or she will have to pay 15%
- Those earning ₹10 lakh- ₹12.5 lakh, will be charged 20% income tax
- Proposed an outlay of ₹27,300 crore for the development of industry and commerce during 2020-21

Power to power sector

- To provide ₹273 billion or promotion of industry and commerce
- Firms operating old thermal power plants advised to shut units if emission norms not met
- To allocate ₹44 billion for clean air incentives in cities with over 1 million people
- FY21 divestment target pegged at ₹2.1 lakh crore

Skill India initiative

- Proposed ₹3,000 crore for 'Skill India' to provide relevant skill training to the youth in the country.
- To sell govt stake in IDBI Bank to private investors
- Plans to sell stake in LIC through IPO
- FY21 fiscal deficit target pegged at 3.5% of GDP

Connecting India

- ₹6,000 crore allocated for BharatNet programme
- Around 1 lakh gram panchayats to be linked with BharatNet

To clean air and pollution free cities

- Power plants with emissions above prescribed limits will be asked to close down.
- India's commitment towards tackling climate change made at Paris conference kickstarts from January 1, 2021.
- ₹4,400 crore allocated for states that work towards clean air.

Your money becomes safer

- Deposit insurance coverage increased to ₹5 lakh from the existing ₹1 lakh.

Swachh Bharat Mission

- The total allocation proposed for Swachh Bharat Mission is ₹12,300 crore

For health sector

- Provided an additional ₹69,000 crore for the health sector
- Proposed to attach a medical college to a district hospital in PPP model

Say 'no' to pollution

- Govt will encourage states which formulate plans for air pollution scheme soon. ₹4,400 crore allocated for 2020-21
- ₹8,000 crore allocated over 5 years for National Mission On Quantum Technology.

For Indian Railways

- 4 station re-development projects in railways via PPP models
- To develop solar capacity in Indian railways
- Plan more Tejas like trains to connect tourist locations
- To launch ₹18,600 crore worth Bengaluru Suburban Transportation project

Push for renewable energy sector

- ₹20,000 crore for the renewable energy sector
- To construct 2500 access control highway; 9000 km eco-development corridors; 200 coastal and port roads; 2000 km strategic highways
- Delhi-Mumbai expressway and 2 other corridors will be completed by 2023

Transport infrastructure

- Proposed to provide ₹1.7 lakh crore for transport infrastructure in 2020-21
- Cente to provide 20% equity for Bengaluru Suburban Transportation Raj
- 100 more airports to be developed by 2024 to support Central government's "Udaan" scheme

For agricultural sector

- Pegged the agricultural credit target at ₹15 lakh crore for fiscal 2020-21
- Indian Railways will set up Kisan Rail in public–private partnership (PPP) mode for cold supply chain to transport perishable goods
- Nabard refinance scheme will be expanded

For education sector

- 150 higher education institutions to offer apprenticeship diplomas by March 2021; will promote 'Study In India' initiative.
- To provide ₹99,300 crore for educational sector in FY21
- By 2030, India will have largest working age population in the world. This population needs both job and life skills. New education policy to be announced soon.
- Proposed to attach a medical college in existing district hospitals

16 action points plan for farmers

- Krishi Udan scheme to boost agricultural exports in both international as well as domestic routes
- Target for Agricultural credit has been increased to ₹15 lakh crore from ₹12 lakh crore
- Agriculture and irrigation has been allotted ₹2.83 lakh crore for FY21
- Rural Development and Panchayati Raj have been allotted ₹1.23 lakh crore
- Expansion of NABARD Refinancing Scheme while MGNREGS to be used to develop fodder farm
- Fish production to be raised to 200 lakh tonnes by 2022-23
- By 2025, milk processing capacity to be doubled to 108 MT
- Government proposes measures to improve situation in 100 water-stressed districts
- Government to set up 20 lakh to benefit farmers
- Kisan Rail to be set up in PPP mode for perishable goods
- One product for one district, so that focus is given at district level for horticulture to gain momentum
- Government to focus on Zero Budget farming
- e-NAM to be integrated with financing of negotiable warehousing receipts
- Farm markets to be liberalised
- Balanced use of fertilizers in the farm lands
- In a bid to liberalise agricultural markets, the govt plans handhold farmers

Atmanirbhar Bharat Abhiyan : COVID-19 Relief Package

- The COVID-19 pandemic has adversely affected the Indian economy and society in varied ways. In this article, you can read the details of the Atmanirbhar Bharat Abhiyan – which is the name given to the full-fledged economic stimulus package announced by the Union Government. This comes under the economy, polity, disaster management and current affairs segments of the UPSC syllabus.
- The government had initially announced the Pradhan Mantri Garib Kalyan Yojana (PMGKY) as interim measures for those affected by the COVID-19 pandemic. To read about all the important government schemes for the UPSC exam and other government exams, click on the linked article.

Atmanirbhar Bharat Abhiyan

- The Atmanirbhar Bharat Abhiyan (meaning self-reliant India scheme) was announced in four tranches by the Union Finance Minister Nirmala Sitharaman in May 2020.
- The economic stimulus relief package announced by the government is touted to be worth ₹20 Lakh crores. This includes the already announced ₹1.70 lakh crore relief package, as the PMGKY, for the poor to overcome difficulties caused by the coronavirus pandemic and the lockdown imposed to check its spread.

Important Facts about Atmanirbhar Bharat Scheme

The Prime Minister announced that an Atmanirbhar Bharat or a self-reliant India should stand on the following five pillars:

1. Economy
2. Infrastructure
3. 21st century technology driven arrangements and system
4. Demand
5. Vibrant Demography

The 20 lakh crore worth package is almost 10% of the GDP of the country.

The package emphasises on land, labour, liquidity and laws.

The package includes measures across many sectors such as MSME, cottage industries, middle class, migrants, industry, etc. Several reforms are announced to make India a self-reliant economy and mitigate negative effects in the future. Some of the reforms are:

6. Simple and clear laws
7. Rational taxation system
8. Supply chain reforms in agriculture
9. Capable human resources
10. Robust financial system

Let's take a look at how India's relief package stands in comparison to those announced by other countries:

Country	Percentage of GDP
USA	13% (2.7 trillion USD – largest in absolute monetary terms)
Japan	21.1%
Sweden	12%
Australia	10.8%
Germany	10.7%

In the following sections, we discuss the four tranches of the economic relief package as announced by the FM.

Atmanirbhar Bharat Abhiyan – Tranche 1

The first tranche contained 16 specific announcements and they spanned across the MSME, NBFC, real estate, power sectors, etc.

Category	Measures
Employees/tax payers	• Extended deadline for income tax returns for the financial year 2019-20 (due date pushed to 30 Nov 2020) • The rates of Tax Deduction at Source (TDS) and Tax Collection at Source (TCS) have been cut by 25% for the next year. • EPF support, provided to low-income organised workers in small units under the PMGKY, is being extended for another 3 months. • PF payments have been reduced from 12% to 10% for both employers and employees for the next 3 months.
MSMEs	• The ₹3 lakh crore emergency credit line announced will ensure that 45 lakh units will have access to working capital to resume business activity and safeguard jobs. • Provision of ₹20,000 crore as subordinate debt for 2 lakh MSMEs which are stressed or deemed non-performing assets. • A ₹50,000 crore equity infusion is planned, through an MSME fund of funds with a corpus of ₹10,000 crore. • The definition of an MSME is being expanded to allow for higher investment limits and the introduction of turnover-based criteria. Read more on May 20, 2020 CNA. • Global tenders will not be allowed for government procurement up to ₹200 crore. • The government and central public sector enterprises will release all funds due to MSMEs within 45 days.
NBFCs	• ₹30,000 crore special liquidity scheme, under which investment will be made in investment grade debt papers of NBFCs. • Partial credit guarantee scheme extended under which the govt. guarantees 20 per cent of the first loss to the lenders — NBFCs, HFCs and MFIs with low credit rating.
Discoms	• ₹90,000 Cr. liquidity Injection has been announced.
Real Estate	• States and UTs have been advised to extend the registration and completion date of real estate projects by six months.

Atmanirbhar Bharat Abhiyan – Tranche 2

The second tranche focuses on providing free food grains to migrant workers who do not possess ration cards.

Provision	Details
Free food grains	• The Centre will spend ₹3,500 crore for providing free food grains for migrant workers without ration cards for the next 2 months. This is an extension of the PMGKY.
Credit facilities	• Street vendors will be given access to easy credit through a ₹5,000 crore scheme, which will offer ₹10,000 loans for initial working capital. • Plans to enrol 2.5 crore farmers who are not yet part of the Kisan Credit Cards scheme, along with fish workers and livestock farmers, and provide them with ₹2 lakh crore worth of concessional credit. • NABARD will provide additional refinance support worth ₹30,000 crore to rural banks for crop loans.
Subvention relief	• Small businesses who have taken loans under the MUDRA-Shishu scheme, meant for loans worth ₹50,000 or less, will receive a 2% interest subvention relief for the next year.
Affordable rental housing	• A scheme to build rental housing complexes through PPP mode would be launched under the existing Pradhan Mantri Awas Yojana (PMAY) scheme. • Both public and private agencies will be incentivised to build rental housing on government and private land, while existing government housing will be converted into rental units. • The credit linked subsidy scheme for lower middle class housing under PMAY will also be extended by one year to March 2021.
One Nation One Ration Card Scheme	• By August 2020, the ration card portability scheme will allow 67 crore NFSA beneficiaries in 23 connected States to use their cards at any ration shop anywhere in the country.
MGNREGA	• States are directed to enrol migrant workers returning to their native places in the MGNREGA scheme.

Atmanirbhar Bharat Abhiyan – Tranche 3

The third tranche of the economic relief package focuses on agricultural marketing reforms. Many of the reforms announced are long pending and are expected to have a positive impact for both the farmers and the consumers.

Provision	Details
Inter-state trade	• Plans to enact a central law to permit barrier-free inter-State trade of farm commodities and e-trading. • This will allow farmers to sell produce at attractive prices beyond the current mandi system.
Contract farming	• Plans to ensure a facilitative legal framework to oversee contract farming. • This would provide farmers with assured sale prices and quantities even before the crop is sown and also allow private players to invest in inputs and technology in the agricultural sector.
Deregulating produce	• The Centre will be deregulating the sale of six types of agricultural produce, including cereals, edible oils, oilseeds, pulses, onions and potatoes, by amending the Essential Commodities Act, 1955. • Stock limits will not be imposed on these commodities except in case of national calamity or famine or an extraordinary surge in prices. These stock limits would not apply to processors and exporters.
Agriculture infrastructure	• Investment of 1.5 lakh crore rupees to build farm-gate infrastructure and support logistics needs for fish workers, livestock farmers, vegetable growers, beekeepers and related activities.

Atmanirbhar Bharat Abhiyan – Tranche 4

The final tranche focuses on the sectors of defence, aviation, power, mineral, atomic and space. There is a huge emphasis on privatisation. One concern with this set of reforms is that they look more like industrial reforms rather than an economic reform package or stimulus.

Sector	Provisions
Defence	• Provisions for banning the import of some weapons and platforms to indigenise defence production. • There is a provision for a separate budget for domestic capital procurement. This would help reduce the defence import bill and encourage domestic production. • The FDI limit in defence manufacturing under automatic route will be raised from 49% to 74%. • Ordnance Factory Boards (OFB) would be corporatized and listed on the stock market to improve autonomy, efficiency and accountability.
Minerals	• The government monopoly on coal would be removed with the introduction of commercial mining on a revenue sharing basis. • The private sector would be allowed to bid for 50 coal blocks. Private players would also be allowed to undertake exploration activities.
Space	• Private involvement in space will be encouraged. • A level playing field for private players will be created in the space sector, allowing them to use ISRO facilities and participate in future projects on space travel and planetary exploration. • The government will ease geo-spatial data policy to make remote-sensing data more widely available to tech entrepreneurs, with safeguards put in place.
Aviation	• Six more airports are up for auction on private public partnership mode, while additional private investment will be invited at 12 airports. • Measures to ease airspace restrictions have been announced which would make flying more efficient. • Rationalising of the MRO (maintenance, repair and operations) tax structure with an aim to make India an MRO hub.
Power	• Power departments/utilities and distribution companies in U.T.s would be privatized based on a new tariff policy to be announced.
Atomic	• Research reactors in PPP mode would be set up for the production of medical isotopes.

FDI in India rose up by 18 per cent to reach USD 73 billion in 2019-20

- Union Commerce and Industry Minister, Piyush Goyal on May 28 stated that the total Foreign Direct Investment (FDI) in India has grown by 18% to reach 73 billion in FY 2019-20. He further asserted that this long- term investment will help in job creation.
- As per the data released by the Department for Promotion of Industry and Internal Trade (DPIIT), this jump in the investment has been the highest in four years. The Union minister further added that the total FDI has doubled up from 2013-14 when it was only USD 36 billion.
- Piyush Goyal attributed the investment inflow as a strong vote of confidence in Make in India Programme launched by Narendra Modi's Government.
- The Union Minister shared the news of increased investment in India on his official twitter account mentioning that this will spur the job creation in India.

European Union Proposed 750 billion- euro COVID-19 recovery fund

- The Commissioner Paolo Gentiloni on May 27 announced that the European Union (EU) has proposed a 750 billion-euro recovery fund to help the economy of the countries as they go into deep recession induced by Coronavirus Pandemic.
- Paolo Gentiloni confirmed the size of the fund announced by the EU. He is in charge of economic affairs at the European Union's Executive Body.
- The announcement by the European Union came as the 27- nation trading bloc has entered its deepest-ever recession as COVID-19 ravages the economies of the nations.
- In order to keep the health care systems, jobs, and businesses alive, every country has broken the European Union's deficit limit.
- Earlier, leaders of France and Germany had agreed on a one-time $543 billion fund. The proposal aimed at adding further cash to an arsenal of financial measures that the bloc has been deploying in order to cope with the economic fallout.
- The plan involved the European Union borrowing money in the financial markets to help the countries and the sectors that have been affected by the pandemic.
- The blueprint of the European Commission is likely to resemble the Franco-German Plan in many ways while also attaching the funds to the EU's next long-term budget.

RBI Governor's address: Policy Repo Rate reduced from 4.4% to 4%, Reverse repo rate reduced to 3.35%

- The Reserve Bank of India's Governor Shaktikanta Das addressed the impact of coronavirus on the global and Indian economy during his address on May 22, 2020. In a major announcement, the RBI Governor announced reduction in policy repo rate by 40 basis points from 4.4 percent to 4 percent. The reverse repo rate has been reduced to 3.35 percent.
- The RBI Governor revealed that its Monetary Policy Committee had met over the last 3 days in an emergency meeting to review to current global and domestic outlook and the depth of the impact of COVID-19. The six-member MPC then voted 5:1 to reduce repo rate by 40 basis points in interest rate. The reverse repo rate was also reduced to maintain an accommodative stance. It was decided that that deduction in policy rate will be provided as long as necessary to mitigate growth.

NABARD released ₹20,500 crore to co-operative banks and RRBs

- National Bank for Agriculture and Rural Development (NABARD) on May 18 had announced that it has released Rs. 20,500 crore to regional rural banks and co-operative banks for on-lending to the farmers.
- The disbursed amount is part of the ₹25,000 crore which was a refinance facility provided by the Reserve Bank of India (RBI) to NABARD. It aimed at refinancing regional rural banks, microfinance institutions (MFIs) and co-operative banks.
- NABARD had lent ₹5000 crore to RRB's and co-operative banks, in the first quarter of the last fiscal year.
- The fund given by NABARD aims at a means of front-loading the resources of the co-operative banks and RRBs which will ensure the adequate liquidity with them to finance the farmers for taking up the Kharif and pre-monsoon 2020 operations.

Unemployment rate in India reached 27.11% amid COVID-19 pandemic: CMIE

Centre for Monitoring India Economy (CMIE) has shown data that reports the unemployment rate in India has reached 27.11% for the week ending on May 3 from the level of 6.74% in the week that ended on March 15, 2020.

Since the government has suspended all the economic activities to combat the spread of COVID-19, the unemployment rate in India has spiked tremendously.

The Mumbai based think tank stated that the unemployment rate was seen highest in the urban areas, constituting most of the red zones due to the highest number of COVID-19 cases.

The unemployment rate had a moderation of 21.05 per cent in the week which ended on April 26 from 26.19% in the week before.

- The unemployment rate of 29.22 per cent can be seen in urban areas while rural areas reported the rate to be 26.16 per cent.
- In the week ending on April 26, the unemployment rate in urban areas stood at 21.45% and in rural areas, it was 20.88 percent.
- As per the data from CMIE, the monthly unemployment rate in April was 23.52 percent from March's 8.74%.

MGNREGA got sanction of ₹33,300 crores by Centre

Rural Development Minister Narendra Singh Tomar on April 29 announced that the Centre has sanctioned ₹33,300 crores under MGNREGA so far in the current fiscal year.

The sanction has been done to liquidate the outstanding dues of previous years as well as to meet the expenditure till June 2020.

Narendra Singh Tomar interacted with various rural development ministers of various states through a video conferencing and stated that focus should be on groundwater recharge, irrigation works, and water conservation.

- The sanction of ₹33,300 crore has been done under MGNREGA, out of it ₹20,624 crores have been given to liquidate all the outstanding dues of the previous year towards material and wages.
- The amount sanctioned by the government will be enough to meet the expenses of the scheme until June 2020.
- Rural Development minister also assured the state's and UT's that sufficient financial resources have been made available for different rural development schemes and Centre has already released ₹36,400 crores to them.

MSMEs to get Liquidity support scheme from SIDBI

- Small Industries Development Bank of India (SIDBI) has announced the launch of the Liquidity support scheme for micro, small and medium enterprises (MSMEs) that have been hugely impacted by COVID-19 pandemic.
- SIDBI stated that it has received Rs. 15,000 crore from Reserve Bank of India (RBI) in order to provide financial help to MSMEs. RBI provided the help through a Special Liquidity Facility (SLF).
- SIDBI will provide the liquidity lines to non-banking finance companies (NBFC's), microfinance institutions (MFI's), and banks who will refinance the MSME's.
- In its measures to support COVID-19 hit businesses, Reserve Bank of India (RBI) stated that the funding was provided to SIDBI. The announced schemes will cover all eligible entities with an investment-grade rating, irrespective of an organization's size to ensure wide coverage.

NATIONAL

Lok Sabha Speaker nominated 15 MPs to delimitation panel on J&K, four northeastern states

- The Lok Sabha Speaker has nominated 15 MPs as associate members of the delimitation panel on Jammu and Kashmir and northeastern state.
- The nominated MPs belong to Jammu and Kashmir, Assam, Arunachal Pradesh, Manipur and Nagaland. They will assist the panel in redrawing parliamentary and assembly constituencies of J&K and the northeastern states.
- The 15 MPs include two Union ministers Kiren Rijiju and Jitendra Singh and former Jammu and Kashmir Chief Minister Farooq Abdullah.

  The delimitation commission had recently written to Lok Sabha Speaker Om Birla and presiding officers of the assemblies of the four concerned northeastern states to nominate associate members of the panel. The union territory of Jammu and Kashmir has no legislative assembly at present. It was bifurcated into a UT with a provision of a legislature.
- The members of the Parliament and legislative assemblies of the states for which the commission has been set up were nominated as associate members to help the panel complete its task.
- Union minister Kiren Rijiju and Tapir Gao have been nominated to represent Arunachal Pradesh in the commission.
- Five Members of Parliament including former J&K CM Farooq Abdullah, Union Minister Jitendra Singh and others such as Jugal Kishore Sharma, Hasnain Masoodi and Mohammad Akbar Lone have been nominated as the delimitation panel's associate members from Jammu and Kashmir.

Char Dham project: BRO achieved major breakthrough in construction of Chamba tunnel

- The Border Roads Organisation achieved a significant breakthrough recently by digging up a 440m long tunnel below Chamba town. The development provides a major boost to the Char Dham road project in Uttarakhand.
- The BRO managed to link up the north and south portals of the tunnel, which is a major step forward. The 6 km road and 440 metre tunnel is being constructed at a cost of Rs 88 crore. The tunnel is expected to be completed by October 2020.
- Elaborating on the same, Lt General Harpal Singh said that the tunnel is being constructed using Austrian technology. He revealed that the total budget of the Char Dham project is Rs 12000 crore.
- Char Dham road project aims to connect the char dhams, the four pilgrimage places that are highly revered by the Hindus- Badrinath, Kedarnath, Yamunotri and Gangotri.

Centre launched 'National Migrant Information System' to track movement of migrants

- The central government on May 16 launched the 'National Migration Information System' to facilitate the smooth movement of migrant workers traveling across the country.
- The online dashboard has been developed by National Disaster Management Authority (NDMA) on the existing NDMA-GIS portal. It will help in capturing the information regarding the movement of workers who have been stranded in different states.
- The Ministry of Home Affairs (MHA) has informed the states to upload data on NMIS to ensure better coordination, contact tracing, and movement monitoring of the migrant workers.

Rajnath Singh commissioned Indian Coast Guard Ship 'Sachet', two interceptor boats

- The Defence Minister Rajnath Singh on May 15 commissioned Indian Coast Guard Ship (ICGS) sachet and two interceptor boats C-451 and (IBs) C-450 in Goa. The event took place via video conferencing from Delhi.
- An ICG spokesperson informed that the ship 'Sachet' has been first in the series of five offshore patrol vessels (OPVs) and has been designed and built indigenously by Goa Shipyard (Ltd). The ship is fitted with communication equipment, navigation, sensor, and machinery.
- This is the first time in the Indian maritime history that the coast guard ship was commissioned through the digital medium. This step, however, has added muscle to the operations of the maritime security agencies.
- Along with Rajnath Singh, D G Krishnaswamy Natarajan, Director General of ICG and Ajay Kumar Defence Secretary were present at the occasion. While, Ministry of State for Defence, Shripad Naik was present at the Vasco facility of Goa Shipyard Ltd. at the time of the commissioning.
- The ICG spokesperson informed that the ships will be deployed extensively for coastal security, Exclusive Economic Zone Surveillance (EEZ), and other duties.
- With the commissioning, the Indian Coast Guard has reached a landmark of 150 boats and ships and 62 aircraft. While 40 ships are at different stages of construction at different Indian Shipyards.

Atmanirbhar Bharat Abhiyan

- Prime Minister Narendra Modi announced **Aatm Nirbhar Bharat Abhiyan package** worth ₹20 lakh crore to make India self-reliant during his address to the nation on May 12, 2020.
- While urging people to be **'vocal about local'**, the Prime Minister said that the special economic package will aim to bring relief to all those who have worked hard day and night for the nation including the labourers and farmers and the hardworking Indian taxpayers-the middle class and the industry, which has contributed significantly to India's growth.
- The special economic pack will focus on land, labour, liquidity and laws. PM Modi said that the package will play an important role in .paving the way for an **"Aatmanirbhar Bharat"**.
- The Prime Minister highlighted the need for India to become **Atmanirbhar or self-reliant** and said that this will lead to a prosperous world. He noted how India's efforts were being praised and recognised across the world.

According to PM , India's 5 Pillars of Self-Reliance include:

1. **Economy** that will bring not just incremental change but a quantum jump.
2. **Infrastructure** that will become modern India's symbol.
3. **System** that will be technology-driven and not based on policy of past century.
4. **Demography** that is our strength, will serve as a source of energy for self-reliant India.
5. **Demand** and supply cycle of India will boost the economy and provide the power to harness its full potential.

IMD included Gilgit-Baltistan, Muzaffarabad in its weather forecasts

- The India Meteorological Department has started releasing the weather forecasts of Gilgit-Baltistan and Muzaffarabad. IMD included the regions as part of its Jammu & Kashmir meteorological sub-division.
- Gilgit-Baltistan has been in the northwest subdivision of Pakistan Occupied Kashmir (POK). While India has always claimed the entire Jammu & Kashmir as a part of India.
- IMD stated that since Jammu & Kashmir and Ladakh were announced as two separate Union Territories of India, it started mentioning the regions in its national weather bulletin.
- M. Mohapatra, Director-General of Meteorology, IMF explained that the department will share the weather forecast of the regions that come under the Indian Territory. As Ladakh, which was a part of J&K earlier, has been mentioned in the forecasts ever since it became the Union Territory, it was decided to include Gilgit-Baltistan and Muzaffarabad as well. The department has also been planning on setting up a meteorological station in Ladakh soon.

Unemployment rate in India reached 27.11% amid COVID-19 pandemic: CMIE

- Centre for Monitoring India Economy (CMIE) has shown data that reports the unemployment rate in India has reached 27.11% for the week ending on May 3 from the level of 6.74% in the week that ended on March 15, 2020.
- Since the government has suspended all the economic activities to combat the spread of COVID-19, the unemployment rate in India has spiked tremendously.
- The Mumbai based think tank stated that the unemployment rate was seen highest in the urban areas, constituting most of the red zones due to the highest number of COVID-19 cases. The unemployment rate had a moderation of 21.05 per cent in the week which ended on April 26 from 26.19% in the week before.
- The unemployment rate of 29.22 per cent can be seen in urban areas while rural areas reported the rate to be 26.16 per cent.
- In the week ending on April 26, the unemployment rate in urban areas stood at 21.45% and in rural areas, it was 20.88 percent.
- As per the data from CMIE, the monthly unemployment rate in April was 23.52 percent from March's 8.74%.

INTERNATIONAL

Trade Unions seek ₹7,500 cash support from centre

- The central trade unions have sought **cash support amounting to ₹7500** from the central government for all the vulnerable households.

- Ten central trade unions, barring RSS-affiliate Bhartiya Mazdoor Sangh, have jointly written a letter to Prime Minister Narendra Modi urging him to grant cash support worth ₹7500 per month to every non-income tax paying household for a period of three months.
- The trade unions have sought this cash support to help the needy households get through the economic crisis brought on by the coronavirus pandemic, which has left many jobless.
- Ten central trade unions have sought cash support worth ₹7500 for each poor family and have also urged PM Narendra Modi to arrange cost-free travel for the stranded workers during the lockdown.
- The trade unions wrote to the Prime Minister saying that there is an urgent need for cash support for the working people for their survival-related requirements.
- They have urged the centre to transfer ₹7500 per month to all the needy, non-income tax paying, households for a period of three months at least.

India, Israel discussed joint research & development for COVID-19 diagnosis

- Indian and Israel on May 25 discussed joint research and development on Artificial Intelligence (AI) technology and big data.
- The discussion held between the two countries was the part of India's Prime Minister Narendra Modi and his Israel counterpart's vision that focuses on expanding the scientific cooperation between the two countries.
- Israel's PM Netanyahu and PM Modi had earlier held discussions in March 2020, on the outbreak of COVID-19 pandemic along with its possible impact on the supply lines in Israel.
- The news was shared by the Israel Embassy on its official twitter handle in series of tweets mentioning that CSIR and DRDO held discussions with Head of Israel's Directorate of R&D along with the ambassadors of India and Israel regarding the scientific cooperation to combat COVID-19.

APEC economy to be reduced by 2.7 per cent in 2020

- The Asia-Pacific Economic Cooperation (APEC) region has been expected to post an economic decline by 2.7 percent in 2020 because of the Coronavirus pandemic.
- As per the APEC Secretariat, this will be the most significant fall since the zero -growth rate logged in 2009 because of the financial crisis.
- The region with 21 member countries had recorded an economic growth rate of 3.6 percent. The countries are expected to see this fall due to the ongoing global health crisis that has dangerously impacted the world economy.
- As per the report released by APEC (The Asia-Pacific Economic Cooperation), the region's unemployment rate is projected to rise by 5.4 percent in 2020 which was 3.8 percent in 2019 that means an additional 23.5 million workers will be unemployed in 2020.

SPORTS

Rohit Sharma nominated for Rajiv Gandhi Khel Ratna Award 2020

- Rohit Sharma has been nominated by the Board of Control for Cricket in India (BCCI) for the prestigious Rajiv Gandhi Khel Ratna Award 2020. Among other nominations, the BCCI nominated Shikhar Dhawan, Deepti Sharma and Ishant Sharma for Arjuna Awards.
- The Union Ministry of Youth Affairs and Sports had sought invitations for the awards from the board. The period of consideration for the nominations is from January 1, 2016-December 31, 2019.
- Speaking on the nominations, BCCI President Sourav Ganguly stated that they went through a lot of data and considered various parameters before shortlisting the nominees. He said that Rohit Sharma has set new benchmarks as a batsman and achieved scores that people thought were not possible in the shorter formats of the game so he is worthy of the honour for his consistency, conduct, commitment and leadership skills.

Bala Devi, Sandesh Jhingan nominated for Arjuna Award

- The All Indian Football Federation (AIFF) has nominated N Bala Devi and Sandesh Jhingan for the Arjuna Award of 2020. The decision was reported by goal.com.
- Arjuna Award is an honour that has been bestowed by the Ministry of Youth Affairs and Sports. It recognises the achievements of the athletes in their respective fields.
- In 2019, Gurpreet Singh Sandhu was awarded the Arjuna award which made him the 26th footballer to receive this prestigious award.

Players nominated for Arjuna Award:

N Bala Devi: In January 2020, N Bala Devi became the Indian Woman professional footballer who played in Europe. She was also signed by Scottish Club Rangers for a deal which was of 18 months.

With all these achievements, Bala is also the top scorer of the Indian women's team. Since 2010, she has netted 52 goals in 58 appearances.

Sandesh Jhingan: Sandesh Jhingan first made his international debut in 2015. He has been a regular in the national team. Sandesh Jhingan has so far represented India in 38 football matches.

AWARD

Indian Army Major Suman Gawani to be honoured with UN Military Gender Advocate Award

- Indian Army Major Suman Gawani has been selected for the prestigious United Nations Military Gender Advocate

Award (2019). The Army Major and woman peacekeeper had served with the United Nations Mission in South Sudan (UNMSS).

- Suman Gawani has been awarded for her outstanding contribution to the peacekeeping efforts in UNMISS. This is the first time that an Indian Peacekeeper has been given the UN Military Gender Advocate Award.
- Along with Major Suman Gawani, Carla Monteiro de Castro Araujo, a Brazilian Naval officer, will also receive the award by United Nations Secretary-General Guterres, on May 29 which is an International Day of UN Peacekeepers.
- On the news, Major Gawani informed that she was earlier scheduled to visit New York for the award ceremony but due to the COVID-19 pandemic and worldwide lockdown, she will be receiving an award and will be honoured in an online ceremony on May 29. She further added that she will be the first Indian to receive this award.

Pulitzer Prize 2020: Three photojournalists from J&K won the prize

- Three photojournalists from Jammu & Kashmir have won Pulitzer Prize 2020 in feature photography. Yasin Dar, Mukhtar Khan, and Channi Anand who won the top honours have been working with Associated Press (AP).
- The awards were announced virtually on May 5. Their coverage in the J&K region during government-imposed restrictions as a move to end Jammu & Kashmir's special status was recognized through this prestigious award.
- Following the norms of social distancing and worldwide lockdown, the Board administrator of Pulitzer Prize, Dana Canedy announced the winners from her loving room through a live stream on YouTube instead of a ceremony at New York's Columbia University.
- The announcement was also made through the official twitter handle of Pulitzer prize. The tweet mentioned the names of the photojournalists as well as congratulated them on their winning in feature photography.

APPOINTMENT

NDB elected Brazil's Marcos Troyjo as its new President

NDB's Board of governors unanimously elected Marcos Troyjo as the president. As per the bank's officials, he will take charge of the position on July 7, 2020.

Thierry Delaporte became new Wipro CEO and MD

Thierry Delaporte was the Chief Operating Officer (COO) of the Capgemini group. In January 2020, Wipro had informed that Abidali Z Neemuchwala had decided to step down as the CEO and MD of the IT company.

Pulitzer winning Indian-origin physician appointed to New York's commission on economic recovery

Another Indian-origin higher education leader, Satish Tripathi has also been named as a member of the commission by New York Governor Andrew Cuomo.

Indian economist appointed as World Bank's Practice Manager for Climate Change in South Asia

In his new role, Abhas Jha will primarily support the South Asia region (SAR) Disaster Risk Management and Climate Change team to connect and collaborate across Global Practice boundaries.

Delhi High Court Judge set to take charge as DSCRC President

Justice Sangita Dhingra Sehgal's name was approved by the Union Cabinet in November 2019, for the appointment as the President of DSCRC on a whole-time basis.

Health Minister Harsh Vardhan set to take charge as Chairman of WHO Executive Board

Harsh Vardhan would be formally elected at the Executive Board meeting of the World Health Organisation on May 22.

Mustafa Al Kadhimi chosen as Iraq's new Prime Minister

Mustafa Kadhimi has become Iraq's first proper Prime Minister after Adel Abdul Mahdi resigned in November 2019 due to massive anti-government protests.

Sameer Aggarwal promoted as new Walmart India CEO

Sameer Aggarwal will succeed Krish Iyer who is set to retire on March 31 after serving Walmart India for 8 years.

Former CJI Ranjan Gogoi nominated to Rajya Sabha

The retired Chief Justice had headed the benches that delivered several historic verdicts including the Babri Masjid-Ram Janmabhoomi title dispute and the Rafale fighter jet case.

Ajay Bhushan Pandey appointed as India's new Finance Secretary

Ajay Bhushan Pandey has been appointed as the new Finance Secretary of India, succeeding Rajiv Kumar.

Bimal Julka became Chief Information Commissioner of India

Earlier, Bimal Julka was working as Information Commissioner but later he was promoted as the Chief Information Commissioner.

SCHEMES OF GOVERNMENT

Pradhan Mantri Jan Dhan Yojana (PMJDY)

- Hon'ble Prime Minister announced Pradhan Mantri Jan Dhan Yojana as the National Mission on Financial Inclusion in his Independence Day address on 15th August 2014, to ensure comprehensive financial inclusion of all the households in the country by providing universal access to banking facilities with at least one basic bank account to every household, financial literacy, access to credit, insurance and pension facility.
- Under this, a person not having a savings account can open an account without the requirement of any minimum balance and, in case they self-certify that they do not have any of the officially valid documents required for opening a savings account, they may open a small account. Further, to expand the reach of banking services, all of over 6 lakh villages in the country were mapped into 1.59 lakh Sub Service Areas (SSAs), with each SSA typically comprising of 1,000 to 1,500 households, and in the 1.26 lakh SSAs that did not have a bank branch, Bank Mitras were deployed for branchless banking.
- Thus, PMJDY offers unbanked persons easy access to banking services and awareness about financial products through financial literacy programmes. In addition, they receive a RuPay debit card, with inbuilt accident insurance cover of ₹2 lakh, and access to overdraft facility upon satisfactory operation of account or credit history of six months. Further, through Prime Minister's Social Security Schemes, launched by the Hon'ble Prime Minister on 9th May 2015, all eligible account holders can access through their bank accounts personal accident insurance cover under Pradhan Mantri Suraksha Bima Yojana, life insurance cover under Pradhan Mantri Jeevan Jyoti Bima Yojana, and guaranteed minimum pension to subscribers under Atal Pension Yojana.
- PMJDY was conceived as a bold, innovative and ambitious mission. Census 2011 estimated that out of 24.67 crore households in the country, 14.48 crore (58.7%) had access to banking services. In the first phase of the scheme, these households were targeted for inclusion through opening of a bank account within a year of launch of the scheme. The actual achievement, by 26th January 2015, was 12.55 crore.
- As on 27.3.2019, the number of accounts has grown to 35.27 crore. Further, in 2011, only 0.33 lakh SSAs had banking facility and through provision of Bank Mitras in 1.26 lakh branchless SSAs, banking services were extended throughout rural India. The inclusive aspect of this is evident from the fact that 20.90 crore (60%) of PMJDY accounts are in rural areas and 18.74 crore (over 53%) PMJDY account holders are women.
- The deposit base of PMJDY accounts has expanded over time. As on 27.3.2019, the deposit balance in PMJDY accounts was ₹96,107 crore. The average deposit per account has more than doubled from ₹1,064 in March 2015 to ₹2,725 in March 2019.
- The Bank Mitra network has also gained in strength and usage. The average number of transactions per Bank Mitra, on the Aadhaar Enabled Payment System operated by Bank Mitras, has risen by over eightyfold, from 52 transactions in 2014-15 to 4,291 transactions in 2016-17.
- With the outbreak of Covid-19 in India, the Finance Minister of India, Nirmala Sitharaman made an announcement to provide ₹500 per month to every Women Jan-Dhan Account Holders for the next three months. This announcement was made on 26th March, 2020 as an initiative towards the loss caused by the outbreak.

Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY)

- The PMJJBY is available to people in the age group of 18 to 50 years having a bank account who give their consent to join / enable auto-debit. Aadhar is the primary KYC for the bank account. The life cover of ₹2 lakh is for the one year period stretching from 1st June to 31st May and is renewable. Risk coverage under this scheme is for ₹2 lakh in case of death of the insured, due to any reason.
- The premium is ₹330 per annum which is to be auto-debited in one installment from the subscriber's bank account as per the option given by him on or before 31st May of each annual coverage period under the scheme. The scheme is being offered by the Life Insurance Corporation and all other life insurers who are willing to offer the product on similar terms with necessary approvals and tie up with banks for this purpose.
- As on 31st March, 2019, cumulative gross enrollment reported by banks subject to verification of eligibility, etc. is over 5.91 crore under PMJJBY. A total of 145763 claims were registered under PMJJBY of which 135212 have been disbursed.

Pradhan Mantri Suraksha Bima Yojana (PMSBY)

- The Scheme is available to people in the age group 18 to 70 years with a bank account who give their consent to join/ enable auto-debit on or before 31st May for the coverage period 1st June to 31st May on an annual renewal basis.
- Aadhar would be the primary KYC for the bank account. The risk coverage under the scheme is ₹2 lakh for accidental death and full disability and ₹1 lakh for partial disability.
- The premium of ₹12 per annum is to be deducted from the account holder's bank account through 'auto-debit' facility in one instalment. The scheme is being offered by Public Sector General Insurance Companies or any other General Insurance Company who are willing to offer the product on similar terms with necessary approvals and tie up with banks for this purpose.
- As on 31st March, 2019, cumulative gross enrolment reported by Banks subject to verification of eligibility, etc. is over 15.47 crore under PMSBY. A total of 40,749 Claims were registered under PMSBY of which 32,176 have been disbursed.

Pradhan Mantri Mudra Yojana

- The scheme was launched on 8th April 2015. Under the scheme a loan of upto ₹50,000 is given under sub-scheme 'Shishu'; between ₹50,000 to 5.0 Lakhs under sub-scheme 'Kishore'; and between 5.0 Lakhs to 10.0 Lakhs under sub-scheme 'Tarun'.
- Loans taken do not require collaterals. These measures are aimed at increasing the confidence of young, educated or skilled workers who would now be able to aspire to become first generation entrepreneurs; existing small businesses, too, will be able to expand their activates.
- As on 31.03.2019, ₹3,21,722 crores sanctioned (₹ 142,345 cr. - Shishu, ₹104,386 cr. Kishore and ₹74,991 cr. - Tarun category), in 5.99 crores accounts.

NATIONAL NEWS:

PM Modi launches India's first seaplane service in Gujarat:

Prime Minister **Narendra Modi** has launched the country's first seaplane service between the **Statue of Unity** near **Kevadiya** in Gujarat's Narmada district and **Sabarmati** Riverfront in **Ahmedabad.**The flight will be able to accommodate **12 passengers** and tickets will cost **Rs 4,800** per person.`The **19-seater** seaplane will be managed by private airline **SpiceJet.**

Sports Authority of India's (SAI):

The Minister of State for Youth Affairs and Sports, Kiren Rijiju has launched the new logo of Sports Authority of India's (SAI) on 30 September 2020 at Delhi's Major Dhyan Chand Stadium.

PM SVANidhi portal:

To begin with, the ministry launched the API integration between the PM SVANidhi portal and SBI's eMudra portal. Ministry would perform similar integration with other banks as well for which a consultative meeting will be held shortly.

The country's largest para-military force:

The country's largest para-military force, Central Reserve Police Force (CRPF) has collaborated with IIT Delhi, Defence Research and Development Organisation, and Joint Advanced Technology Centre (JATC) to augment its Research and Development capabilities.

4th India Energy Forum by CERA Week:

PM Narendra Modi has inaugurated the 4th India Energy Forum by CERAWeek organised by HIS Markit. The theme of this edition is **"India's Energy Future in a World of Change"**. India is the third largest and the fastest-growing aviation market in terms of domestic aviation and Indian carriers are projected to increase their fleet size from 600 to 1200 by 2024.

Official Development Assistance (ODA):

India will receive an Official Development Assistance (ODA) loan of an amount of JPY50 billion (approx. Rs. 3,500 crore) from the government of Japan as the COVID-19 Crisis Emergency Response Support in order to fight the COVID-19 crisis.

Helpline "KIRAN":

Social Justice and Empowerment Ministry have launched a toll-free **mental health rehabilitation helpline "KIRAN".** The helpline was launched in view of the growing incidence of Mental Illness, particularly in the wake of COVID-19 pandemic.

The 'Grih Pravesham' event in Madhya Pradesh:

Prime Minister Narendra Modi has addressed the 'Grih Pravesham' event in Madhya Pradesh through video conferencing. Under this, 1.75 Lakh Families in Madhya Pradesh were delivered pucca houses under the Pradhan Mantri Awas Yojana- Grameen (PMAYG).

"Indian Defence Industry Global Outreach for Collaborative Partnership: Webinar and Expo":

A webinar was held between with India and Israel, under the aegis of Department of Defence Production, Ministry of Defence through SIDM. The Theme of webinar was "Indian Defence Industry Global Outreach for Collaborative Partnership: Webinar and Expo".

118 mobile apps have been blocked:

Ministry of Electronics and Information Technology, Government of India has decided to block 118 mobile apps in view of the emergent nature of threats. 118 mobile apps have been blocked by the Ministry of Electronics and Information Technology by invoking it's power under section **69A of the Information Technology Act** read with the relevant provisions of the Information Technology (Procedure and Safeguards for Blocking of Access of Information by Public) Rules 2009.

"MSME Saksham":

The Small Industries Development Bank of India (SIDBI) has launched one-stop knowledge portal named as "MSME Saksham" in association with Trans Union CIBIL.

India's first 'Kisan Rail':

The Indian railways begin its "Kisan Rail" services to transport perishable goods. India's first 'Kisan Rail' will run between Devlali in Maharashtra's Nashik and will reach Danapur in Bihar. The train will cover the journey of 1,519 km.

Submarine Optical Fibre Cable (OFC):

Submarine Optical Fibre Cable (OFC) connecting Andaman & Nicobar Islands to the mainland has been launched. The 2300 Kms long submarine cable will boost the endless opportunities in the Andaman & Nicobar Islands by providing better internet & mobile connectivity.

National Overseas Portal and National Tribal Fellowship Portal:

Ministry of Tribal Affairs has launched the Tribal Health and Nutrition Portal "Swasthya" and E news letter on health and nutrition "ALEKH". The ministry has also announced the opening of National Overseas Portal and National Tribal Fellowship Portal.

"Make in India to Make for World":

Prime Minister Narendra Modi unfurled the national flag and delivered his seventh consecutive Independence Day speech from the iconic Red Fort. In the 1 hour 26-minute speech, he focused on the themes of "Aatma Nirbhar Bharat (self-reliant India)", "Vocal for local" and "Make in India to Make for World".

POLICIES & SCHEMEMS:

The Survey of Villages and Mapping with Improvised Technology in Village Areas (SVAMITVA):

Prime Minister Narendra Modi has launched the programmed of physical distribution of Property Cards under the SVAMITVA scheme through video conferencing. The Survey of Villages and Mapping with Improvised Technology in Village Areas **(SVAMITVA) is a Central Sector Scheme**, which was launched in April 2020 to provide the 'record of rights to document the residential properties' to village household owners in rural areas and issue Property Card.

Geographic information system (GIS):

Union Housing and Urban Affairs Minister, Hardeep Singh Puri has launched the **'e-Dharti Geo Portal'** to integrate legacy drawings such as maps and lease plans in the management information system and make its geographic information system (GIS)- enabled.

Armed Forces Headquarters Civil Services (AFHQ CS) cadre:

Defence Minister Rajnath Singh has approved the setting up of 3-member committee headed by Lt. Gen. Shekatkar (retired) to review the effective utilization of the Armed Forces Headquarters Civil Services (AFHQ CS) cadre. Two other members of the committee are R. Chandrasekhar, a retired AFHQ cadre officer, and AN Das from the MoD finance wing.

The Khadi and Village Industries Commission (KVIC):

Unique employment generation program "Khadi Agarbatti Aatmanirbhar Mission" has been approved by the Union Minister for MSME, Shri Nitin Gadkari. The programme has been proposed by the Khadi and Village Industries Commission (KVIC) to make India Aatmanirbhar in Agarbatti production.

Nekara Samman Yojane:

Karnataka government has launched a relief scheme "Nekara Samman Yojane" for weavers. State government has allocated a sum of Rs 10.96 crore under the programmed. As per the state government, the Silk, cotton, wool and other handloom weavers have been made eligible under the scheme.

Navin Rojgar Chhatri Yojana:

Uttar Pradesh government has launched"Navin Rojgar Chhatri Yojana" for all-round development of the Scheduled Castes. He also transferred financial assistance of 17.42 crore online to 3,484 people under the 'Pandit Deendayal Upadhyay Swarojgar Yojana'.

SPORTS:

Jio named title sponsor for BCCI's Women T20 Challenge 2020:

The Board of Control for Cricket in India (BCCI) has announced Jio as the Title Sponsor of the 2020 edition of the Women's T20 Challenge. The partnership will also have the support of **Reliance Foundation Education** and **Sports For All (RF ESA).**Three teams are **Velocity, Supernovas and Trailblazers** will play each other once to decide the finalists on November 9, a day before the IPL final.

Amit Panghal :

Indian boxers Amit Panghal, Sanjeet and Ashish Kumar have won gold medals at the recently concluded Alexis Valentine International Boxing Tournament held in Nantes, France.

Lewis Hamilton:

Lewis Hamilton (Mercedes-Great Britain) has won the 2020 Portuguese Grand Prix, held at Algarve International Circuit, Portugal. This was the 12th round of the 2020 Formula One World Championship. This is Hamilton's 8th win of the season and 92nd career race victory

Visnu Shivaraj Pandian 10m air rifle:

India's Visnu Shivaraj Pandian has won the 10m air rifle event at the fifth edition of the International Online Shooting Championship. The 16-year-old Visnu shot 251.4 to win the title by a clear margin of two points. The world No. 27 Etienne Germond of France came second followed by Martin Strempfl of Austria at third place.

P Iniyan:

Indian Grandmaster P Iniyan has won the 48th Annual World Open online chess tournament.

Members of the Asian Football Confederation's task force:

Retired Colonel Dr Girija Shanker Mungali has been appointed as one of the seven members of the Asian Football Confederation's task force. The taskforce will regulate the football clubs in Asia and Australia. He is currently serving as the Chairman of the Club Licensing Committee of the All India Football Federation (AIFF).

Poonam Khatri:

Indian Police Officer, Poonam Khatri has claimed World Championship status after her silver medal at the Wushu World Championship last year has been upgraded to a Gold medal.

Novak Djokovic:

Novak Djokovic has defeated Argentine Diego Schwartzman, 7-6, 5-3, to win 2020 Men's Single Italian Open title and his fifth overall Rome title. In Women's single, Simona Halep defeated champion Karolina Pliskova, 6-0, 2-1, to win her first Italian Open title.

Mahendra Singh Dhoni:

Former Indian Captain and the World Cup winner, Mahendra Singh Dhoni has announced his retirement from the

International Cricket. He represented India in 350 ODI's, 98 T20 Internationals (T20Is) and 90 test matches.

All India Football Federation (AIFF):

All India Football Federation (AIFF) has launched the web platform "E-Pathshala" in partnership with the Sports Authority of India (SAI). It has been split into three parts:My Football Culture, My Skills and My Training.

Ronnie O'Sullivan:

Ronnie O'Sullivan defeated Kyren Wilson with a score of 18-8 to win the World Snooker Championship 2020.

Khelo India Games:

India will host the BRICS Games 2021, which will be aligned with the Khelo India Games scheduled for next year.

Fit India Youth Club:

"Fit India Youth Club" initiative has been launched by the Union Minister of Youth and Sports, Kiren Rijiju. Fit India Youth Club is an nation-wide initiative which has been launched to promote fitness among every citizen.

National Anti-Doping:

National Anti-Doping Agency's first mobile app named as "NADA App" has been launched. It aims to bridge the gap between NADA and the athletes by offering easily-accessible information on various aspects of sport, prohibited substances as well as dope-testing.

India's most valuable Test player:

India all-rounder Ravindra Jadeja has been named as India's most valuable Test player in the 21st century by the Wisden magazine. He was also rated as the second-most valuable Test player worldwide behind Sri Lanka legend Muttiah Muralitharan.

Women's cricketer of the year:

At the Cricket South Africa annual awards 2020, Quinton de Kock was named as the men's cricketer of the year, while Laura Wolvaardt was named as the women's cricketer of the year.

AGREEMENT/BILLS & ACTS:

Kaleidoscope:

Infosys has announced that it would acquire product design and development firm, Kaleidoscope Innovation for up to $42 million. Kaleidoscope is a US-based firm and would bring to Infosys a diverse talent pool with extensive knowledge of design and engineering.

The Government of Rajasthan signed a (MoU):

The Government of Rajasthan signed a Memorandum of Understanding (MoU) with the Small Industries Development Bank of India (SIDBI) to develop its micro, small and medium enterprises (MSMEs) ecosystem. This MoU will support the state government to have a better understanding and provide better solutions for the problems of MSMEs.

The Ministry of AYUSH and Ministry of Women and Child Development:

A Memorandum of Understanding has been signed between the Ministry of AYUSH and Ministry of Women and Child Development to control Malnutrition as a part of POSHAN Abhiyaan. The MoU will see some time-tested and scientifically proven Ayush-based solutions being adopted for controlling malnutrition in the country.

Tata Steel and Council of Scientific & Industrial Research (CSIR):

Tata Steel and Council of Scientific & Industrial Research (CSIR) have signed an MoU to collaborate in the area of Carbon Capture, Utilisation & Storage (CCUS). The MoU has been signed considering the importance of Carbon Capture, Utilisation & Storage (CCUS) in India's fight against Climate Change and Global Warming, meeting the growing energy demands and building a strong ecosystem to meet commitments under Paris Agreement.

Bombay Stock Exchange (BSE) & Chamber of Commerce and Industries (ICCI):

Bombay Stock Exchange (BSE) has signed an agreement with Inventivepreneur Chamber of Commerce and Industries (ICCI) to support small and medium enterprises (SMEs) and start-ups, and promote their listing on the exchange.

The Indian Institute of Technology, Kanpur (IIT-K):

The Indian Institute of Technology, Kanpur (IIT-K) and the Archaeological Survey of India have signed an agreement with two institutions from Italy, seeking restoration and protection of historical monuments.

Flipkart & (IIT) Patna:

An Memorandum of understanding (MoU) has been signed by India's homegrown ecommerce player "Flipkart" with Indian Institutes of Technology (IIT) Patna. The MoU will encourage industry focused applied research in the areas of Artificial Intelligence (AI), Natural Language Processing (NLP) and Machine Learning (ML)

Kozhikode (IIM-K) with the Switzerland-based HELP Logistics:

A Memorandum of Understanding (MoU) has been signed by the Indian Institute of Management Kozhikode (IIM-K) with the Switzerland-based HELP Logistics. The partnership between the two entities seeks to produce humanitarian logistics in India and the region by offering consulting services as well as logistics training for the humanitarian community such as United Nations bodies, government institutions and non-governmental organizations

Swiggy Money:

Swiggy has launched its digital wallet 'Swiggy Money' in partnership with ICICI Bank to provide its users a single-click checkout experience.

Emergency Medical Services:

India and Maldives have signed an agreement for the establishment of 'Emergency Medical Services' in Male, Maldives. The Emergency Medical Service would be financed by India under grant assistance of 20 million USD for neighboring countries.

Punjab government with the IIT Ropar:

Punjab government has signed an agreement with the IIT Ropar in the area of skill development.

SCIENCE AND TECHNOLOGY:

Harsh Vardhan launches SERB-POWER schemes to support women scientists:

The Union Minister of Science and Technology, **Harsh Vardhan** has launched the **'SERB – POWER'** schemes which aim to encourage and support emerging as well as eminent women researchers to undertake R&D activities in frontier areas of science and engineering.

SERB-POWER stands for **Science and Engineering Research Board** – Promoting Opportunities for Women in Exploratory Research.

Satellites Improve Life:

World Space Week (WSW) is observed from October 4 to 10 every year to celebrate science and technology, and their contribution towards the betterment of the human condition. The 2020 theme is "Satellites Improve Life.

The Stratospheric Observatory for Infrared Astronomy:

Two new studies published in Nature Astronomy suggest there could be much more water than previously thought, including ice stored in permanently shadowed "cold traps" at lunar Polar Regions. Using data from the Stratospheric Observatory for Infrared Astronomy (SOFIA) Airborne Telescope, researchers scanned the lunar surface at a more precise wavelength than had been used before — six microns instead of three. This allowed them to distinguish the spectral fingerprint of molecular water.

The Centre for Development of Advanced Computing (C-DAC):

The Centre for Development of Advanced Computing (C-DAC) will be commissioning India's largest HPC-AI supercomputer 'PARAM Siddhi – AI'. This initiative will place India among the top countries in global AI supercomputing research and innovation. The initiative was headed by Abhishek Das, Scientist and Program Director (HPC-AI Infrastructure Development) at C-DAC, who conceived the idea and designed the architecture for the largest HPC-AI infrastructure in India.

World's largest Solar Tree:

World's largest Solar Tree has been developed by the CSIR-CMERI and has been installed at the Residential Colony of CSIR-CMERI in Durgapur, West Bengal.

United Nations Environment Programme (UNEP):

A 17-year-old girl, Khushi Chindaliya has been appointed as Regional Ambassador for India by the United Nations Environment Programme (UNEP)- Tunza Eco-Generation. In her new role, Khusi will raise awareness about climate change and the importance of environmental conservation and the need to safeguard environmental treasures.

The Chakr DeCoV device:

The IIT Delhi incubated startup Chakr Innovation has launched a special decontamination device called 'Chakr DeCoV', to decontaminate N95 masks. The Chakr DeCoV device is designed in the shape of a cabinet.

Raman a 3-D printed rocket engine:

Skyroot Aerospace, a Spacetech startup has successfully test fired an upper stage rocket engine "Raman" and has become the first Indian private firm to exhibit the potential to build a homegrown rocket engine. "Raman" is a 3-D printed rocket engine which has been named after Nobel laureate CV Raman.

SHAKTI & VEGA microprocessors:

"Swadeshi Microprocessor Challenge– Innovate Solutions for #Aatmanirbhar Bharat" has been launched by the Union Minister of Law & Justice, Communications and Electronics & Information Technology, Ravi Shankar Prasad. It aims to invite innovators, startups and students to use two microprocessors namely "SHAKTI (32 bit) and VEGA (64 bit)" to develop various technology products. SHAKTI & VEGA microprocessors have been developed by IIT Madras and Center for Development of Advance Computing (CDAC) respectively.

Pavitrapati & Aushada tara:

Defence Institute of Advanced Technology, DIAT (DU) has launched two products namely "Pavitrapati" & "Aushada tara" to fight against COVID-19.

Covid-19 from Chest X-ray images:

IIT Gandhinagar has developed an Artificial Intelligence (AI)-based deep learning tool for detection of Covid-19 from Chest X-ray images.

MediCAB:

Indian Institute of Technology Madras (IIT-M) start-up Modulus Housing has developed a portable hospital unit called 'MediCAB'. It was launched recently in Wayanad District of Kerala.

DEFENCE:

India Successfully test fires BrahMos Missile from Sukhoi 30 MKI

The Indian Air Force (IAF) successfully test-fired an air-launched version of the BrahMos supersonic cruise missile from a Sukhoi fighter aircraft in the Bay of Bengal. This test was the longest range BrahMos strike that was undertaken by the **Sukhoi 30 MKI platform.**

Anti-tank guided missile 'NAG':

Defence Research and Development Organization (DRDO) successfully carried out the final trial of the third generation, anti-tank guided missile 'NAG', from the Pokhran field firing ranges in Rajasthan.

Supersonic Missile Assisted Release of Torpedo:

The Defence Research and Development Organization (DRDO) has successfully flight tested the "Supersonic Missile Assisted Release of Torpedo" (SMART) from Wheeler Island off the coast of Odisha.

BrahMos surface-to-surface supersonic cruise:

BrahMos surface-to-surface supersonic cruise missile featuring indigenous Booster and Airframe Section along with many other 'Made in India' subsystems was successfully flight tested from ITR, Balasore in Odisha.

ABHYAS:

Defence Research and Development Organisation (DRDO) has conducted a successful flight test of ABHYAS, a High-speed Expendable Aerial Target (HEAT) from the Interim Test Range, Balasore in Odisha. ABHYAS can be used as a target for evaluation of various missile systems. ABHYAS has been designed and developed by the Aeronautical Development Establishment (ADE) of the DRDO.

Russian Kavkaz 2020:

India will take part in the multilateral military "Russian Kavkaz 2020" strategic command-post exercise to be held in Astrakhan, Russia. The Indian contingent includes 150 Army personnel and a smaller number of personnel from the Navy and Air Force.

International Military and Technical Forum:

India Pavilion at the Army-2020 International Military and Technical Forum was inaugurated by Secretary (Defence Production) Raj Kumar and Indian Ambassador DB Venkatesh Verma at Moscow, Russia.

Passage Exercise PASSEX:

Indian Navy has conducted a Passage Exercise (PASSEX), a high-end joint naval exercise with the US Navy in the Indian Ocean.

Drones 'Bharat':

Defence Research and Development Organisation (DRDO) has provided drones named'Bharat' to the Indian Armyto provide accurate surveillance along the Line of Actual Control in high altitude and mountainous terrains of Eastern Ladakh.

Malabar-2020:

India has invited Australia to participate in its trilateral naval exercise "Malabar-2020" which is scheduled to be held in November 2020, in the Bay of Bengal and the Arabian Sea. In 2020, the exercise will be held in a 'non-contact – at sea' format. It aims to increase cooperation and enhance safety and security in the maritime security domain

APPOINTMENTS/RESIGNATIONS

Charanjit Singh Attra:

The State Bank of India (SBI) has appointed Charanjit Singh Attra as its new Chief Financial Officer (CFO) with effect from 01 October 2020. The post was lying vacant after the former Deputy MD & CFO Prashant Kumar, was appointed as the CEO of Yes Bank in March 2020.

Rohan Jaitley:

Advocate Rohan Jaitley, the son of late Union Minister Arun Jaitley, has been elected unopposed as the President of the Delhi and District Cricket Association (DDCA).

Rajiv Kumar:

Rajiv Kumar has taken the charge as the new Election Commissioner (EC) of India.

Preeti Sudan:

The World Health Organisation's independent panel for pandemic preparedness and response appointed former health secretary, Preeti Sudan as one of its 11 panellists from across the world.

Rajesh Khullar:

A 1988 batch IAS officer, Rajesh Khullar has been appointed as Executive Director at World Bank in Washington DC.

Sunil Sethi:

The Khadi and Village Industries Commission has appointed Sunil Sethi as its Advisor. Sunil Sethi is the Chairman of the Fashion Design Council of India. He has been appointed for a period of one year. He will succeed fashion designer Ritu Beri.

Sashidhar Jagdishan:

The Reserve Bank of India has approved the appointment of Sashidhar Jagdishan as the next Chief Executive Officer (CEO) of HDFC Bank. He will replace Aditya Puri.

Soma Mondal:

Soma Mondal has been selected by the Public Enterprises Selection Board (PESB) as the next chairman of Steel Authority of India Limited (SAIL).

Rajiv Kumar:

The Government of India has appointed Rajiv Kumar as the new Election Commissioner of India. He will be appointed as the election commissioner "with effect from the date he assumes the office.

Vini Mahajan:

IAS Vini Mahajan has become the 1st woman chief secretary of Punjab.

Hardik Satishchandra:

Hardik Satishchandra Shah has been appointed the Private Secretary (PS) to Prime Minister Narendra Modi on co-terminus basis.

Naveen Tahilyani:

Naveen Tahilyani has been appointed by Tata AIA Life Limited as its MD & CEO. He will take over from the current CEO Rishi Srivastava, who has been appointed as chief executive officer, group agency distribution, AIA Group, Hong Kong.

AWARDS & HONOURS:

Malayalam writer Paul Zacharia selected for Ezhuthachan Puraskaram 2020:

Noted Malayalam writer, Paul Zacharia has been selected for this year's Ezhuthachan Puraskaram, the Kerala government's highest literary honour.

The Right Livelihood Award:

The Right Livelihood Award Foundation has announced the four winners of the 2020 Right Livelihood Award 2020 which is also known as the alternative Nobel Prize in Stockholm. The four activists Ales Bialiatski of Belarus, Nasrin Sotoudeh of Iran, Bryan Stevenson of the United States(US) and Lottie Cunningham Wren of Nicaragua shared the 2020 award for their contribution towards equality, democracy, justice and freedom.

Aishwarya Sridhar:

A 23-year-old, Mumbai based girl, Aishwarya Sridhar became the first Indian woman to win the 2020 Wildlife Photographer of the Year award. It is the 56th year of the prestigious award. Her image titled 'Lights of passion', won among 50,000 entries from over 80 countries across the world.

Late Indian actor Om Puri:

Late Indian actor, Om Puri was honoured with a Lifetime Achievement Award at the third edition of the India International Film Festival of Boston (IIFFB 2020). The award was received by his wife Nandita Puri. The three-day film festival, based in Boston USA. Another highlight of the festival was a conversation with chef Vikas Khanna, recipient of the "Pride of India Award".

Nityanand Nayak:

Noted Odia poet, Nityanand Nayak will be conferred the prestigious Sarala Puraskar for his poetry work 'Setebelaku Nathiba', published in 2017.

COVID-19 5-star airport rating:

The Fiumicino International Airport (FCO) in Rome, Italy, has become the first airport in the world to be certified with "COVID-19 5-star airport rating" from Skytrax, a U.K.-based airport and airline review firm. FCO, also known as the Leonardo Da Vinci International Airport, is the busiest airport in Italy.

Ig Nobel Prize 2020:

Prime Minister of India, Narendra Modi has been awarded the Ig Nobel Prize 2020 for Medical Education. He has been awarded the prestigious award for "using the COVID-19 pandemic to teach the world that politicians can have a more immediate effect on life and death than scientists and doctors can"

Gan Samragni Lata Mangeshkar award:

The Maharashtra government has announced the Gan Samragni Lata Mangeshkar award for the year 2020-21 to veteran female playback singer Usha Mangeshkar.

SKOCH Gold Award:

SKOCH Gold Award has been awarded to the Ministry of Tribal Affairs (MoTA) for its "Empowerment of Tribals through IT enabled Scholarship Schemes" project. The 66th SKOCH 2020 Competition was held with name "INDIA RESPONDS TO COVID THROUGH DIGITAL GOVERNANCE".

National Award to Teachers 2020:

Ms. Sudha Painuli has been selected for National Award to Teachers 2020. She is the first NAT Awardee from the Eklavya Model Residential Schools (EMRS) established under Ministry of Tribal Affairs. She is among the 47 outstanding teachers selected for the award.

Diana Award:

A 13-year-old student of the British School New Delhi, Freya Thakral has received the 2020 Diana Award for her "Recycler App" which wasdevelopedto connect users with waste-handlers as a measure to help the ragpickers of Delhi.

Elites Excellence Awards-2020:

Chief Minister Darpan website and mobile app prepared for monitoring Chhattisgarh Government's ambitious Suraji Gaon Scheme and other flagship schemes, has been awarded "Elites Excellence Awards-2020" at the national level.

Top Publicist award:

Sachin Awasthi has been honoured with the "Top Publicist" award in the Global Humanitarian Awards 2020.

OBITUARY:

Former Turkish Prime Minister Mesut Yilmaz passes away:

Veteran Politician and former prime minister of Turkey, **Mesut Yilmaz** has passed away. He was the Chief of the now-defunctional centre-right Motherland Party or ANAP from 1991 to 2020.

Ram Vilas Paswan:

Union minister of consumer affairs, food and public distribution, Ram Vilas Paswan passed away. He was born on 5 July 1946. He was also the president of the Lok Janshakti Party, eight-time Lok Sabha member and current Rajya Sabha MP.

Shobha Naidu:

Renowned Kuchipudi dancer, Shobha Naidu passed away. Some of the famous awards won by her include, Padma Shri in 2001, Sangeet Natak Akademi in 1991.

Kaumudi Munshi:

The "Nightingale of Gujarat", Kaumudi Munshi passed away due to COVID-19. During the early stage of her career, Munshi sang mostly in Gujarati, gaining fame with songs like 'Sachi re maari satre bhavani maa'.

The former President of India**, Pranab Mukherjee** passed away.

Kapila Vatsyayan:

Veteran scholar of Indian classical dance, art, architecture and art history, Kapila Vatsyayan passed away. She was the founding Director of the Indira Gandhi National Centre for the Arts. She was the former Member of Parliament and had served as Education Secretary.

Jaswant Singh:

The former Union Minister, Jaswant Singh passed away. He was born in Jasol village of Barmer district in Rajasthan in 1938. He had served as the external affairs minister, defence minister and finance minister of India, during the Prime Minister Atal Bihari Vajpayee's Cabinet.

Abhilash:

Veteran songwriter, Abhilash passed away. He was best known for the song 'Itni Shakti Hame Dena Daata' from the 1986 film Ankush.

Pranab Mukherjee:

The former President of India, Pranab Mukherjee passed away at the age of 84. He was the president between 2012 and 2017. He was awarded the Bharat Ratna in 2019. He was the fifth president to receive this Bharat Ratna award.

Shirley Ann Grau:

The famous fiction writer and Pulitzer Prize-winner, Shirley Ann Grau passed away. Shirley won the Pulitzer Prize for her fourth book, "The Keepers of the House" in 1965.

Bijay Mohanty:

Veteran Odia Actor, Bijay Mohanty passed away. His performance in his debut film, Chilika Tire, earned him several accolades including the National Film Award.

Olivia de Havilland:

Two-Time Oscar Winner, Olivia de Havilland passed away. She won an Oscar award for the movie 'To Each His Own' under the category Best supporting actress.

Lee Kun-hee:

The chairman of South Korea's largest conglomerate, Samsung Group, Lee Kun-hee has passed away.

SUMMITS AND CONFERENCES:

12th BRICS Summit:

The 12th BRICS Summit is scheduled to be held on 17th November 2020 via video conference. This is the first time in the history of the forum that the meeting will be held virtually, due to the global COVID pandemic. The Summit is being held under the Chairmanship of Russia. The theme of the Meeting of the Leaders of BRICS countries is "BRICS Partnership for Global Stability, Shared Security and Innovative Growth".

The first-ever virtual G20 Global Summit:

The first-ever virtual G20 (Group of Twenty) Youth 20 (Y20) Global Summit was virtually hosted from Al Khobar, Saudi Arabia for exchanging ideas and dialogues for the empowerment of youth Post COVID, where Indian side was represented by Union Minister of Youth Affairs and Sports, Kiren Rijiju.

BRICS Culture Ministers' Meeting:

The 5th BRICS Culture Ministers' Meeting was held under the chairpersonship of Russian Federation.

School Education in 21st Century:

A two-day conclave on 'School Education in 21st Century' commenced virtually. The conclave has been organised by Ministry of Education as part of Shikshak Parv 2020. Shikshak Parv is being celebrated from 8th-25th September, 2020 to felicitate the teachers and to take New Education Policy 2020 forward. The conclave was addressed by the Prime Minister Shri Narendra Modi under the National Education Policy- 2020 (NEP-2020).

10th Meeting of the BRICS:

10th Meeting of the BRICS High Representatives on National Security was held virtually by the current chair of BRICS i.e. Russia. National Security Advisor Ajit Doval represented India in a virtual meet of top security officials from Brazil-Russia-India-ChinaSouth Africa (BRICS) grouping.

NITI Aayog will organize a summit on Artificial Intelligence (AI):

The Ministry of Electronics and Information Technology (MeitY) and NITI Aayog will organize a summit on Artificial Intelligence (AI), RAISE 2020- 'Responsible AI for Social Empowerment 2020′ from October 5-9, 2020. RAISE 2020 will be a global meeting of minds to exchange ideas and chart a course for using AI for social transformation, inclusion and empowerment in areas like Healthcare, Agriculture, Education and Smart Mobility, among other sectors.

The 13th Session of the India-UAE:

The 13th Session of the India-UAE Joint Commission Meeting on Trade, Economic and Technical Cooperation was held to review the continuing growth of broad based cooperation between the two countries. The session was cochaired by Dr. Subrahmanyam Jaishankar, Minister of External Affairs of India and Sheikh Abdullah Bin Zayed Al Nahyan, Minister of Foreign Affairs and International Cooperation of the United Arab Emirates.

Confederation of Indian Industries (CII):

Confederation of Indian Industries (CII) has organised the "India@75 Summit – Mission 2022" focusing on 'reinventing technology in India'

Institute of Liver and Biliary Sciences (ILBS):

Institute of Liver and Biliary Sciences (ILBS) has organised "2nd Empathy e-Conclave" in collaboration with Airport Authority of India (AAI). The theme of 2nd Empathy e-Conclave is "Keep your Liver Safe in COVID times".

AIIB 2030-Supporting Asia's Development over the Next Decade:

The 5th Annual Meeting of the Board of Governors of Asian Infrastructure Investment Bank (AIIB) was held virtually. The round table discussion was held with the theme 'AIIB 2030-Supporting Asia's Development over the Next Decade'.

EXERCISE

1. Recently, which state has launched the 'Digital Seva Setu Programme' for rural areas?
(a) Telangana (b) Andhra Pradesh
(c) Haryana (d) Gujarat

2. What is the name of the awareness campaign launched by PM Modi for COVID-19 Appropriate Behavior especially during the upcoming festive seasons and winter season?
(a) 'Jan Arogya Campaign'
(b) 'Jan Andolan Campaign'
(c) 'Go Corona Campaign'
(d) 'Yuddh Corona ke viruddh'

3. Recently, who among the following inaugurated 'Gyan Circle Ventures' – Technology Business Incubator of IIIT Sri City, Andhra Pradesh?
(a) Ravi Shankar Prasad
(b) Nitin Gadkari
(c) Ramesh Pokhriyal Nishank
(d) Piyush Goyal

4. Who among the following launched the physical distribution of property card programme under the SVAMITVA Scheme?
(a) Narendra Singh Tomar
(b) Prime Minister Narendra Modi
(c) Thaawar Chand Gehlot
(d) Nitin Gadkari

5. What does 'I' signify in full form of the SVAMITVA Scheme?
(a) Institute (b) Information
(c) Improvised (d) Immediate

6. Which is the first state in India to make its public schools completely digital?
(a) Maharashtra (b) Andhra Pradesh
(c) Kerala (d) Gujarat

7. Recently, Suraksha Kavach Exercise was conducted between?
(a) Maharashtra Police and Indian Army
(b) Indian Navy and Indian Coast Guard
(c) Delhi Police and Indian Army
(d) Indian Army and Railway Protection Force

8. Recently, who among the following launched 'Tech for Tribals' initiative?
(a) TRIFED
(b) IIT-Kanpur
(c) Chhattisgarh MFP Federation.
(d) All of the above

9. Recently, who among the following has launched the Impact Based Cyclone Based Warning System?
(a) Indian Navy
(b) World Meteorological Organization
(c) India Meteorological Departments
(d) DRDO

10. Strengthening Teaching-Learning and Results for States (STARS) project will be implemented by the Education Ministry in partnership with __________.
(a) UNESCO (b) UNICEF
(c) World Bank (d) ADB

11. India and the World Bank launched STARS Project, what does 'R' stand for?
(a) Revolution (b) Rewards
(c) Remark (d) Results

12. Which among the following countries topped in CRI Index 2020?
(a) Germany (b) Norway
(c) Denmark (d) Japan

13. What is the name of recently developed India's largest HPC-AI Supercomputer?
(a) PARAM Siddhi –AI
(b) Prathush (Cray XC40)
(c) Mihir (Cray XC40)
(d) Pranay Siddhi –AI

14. 'all AI 2020 Virtual Summit' was recently organized by which of the following tech giants?
(a) TCS (b) Intel India
(c) Infosys (d) Wipro

15. Who among the following partnered with Intel to launch applied AI (Artificial Intelligence) Research (INAI) Center in Hyderabad?
(a) IIIT-Hyderabad
(b) Public Health Foundation of India (PHFI)
(c) Both (a) and (b)
(d) Atal innovation Mission

16. Recently, Union Minister of Consumer Affairs Ram Vilas Paswan passed away. He was the founder of which of the following political parties?
(a) Lok Janshakti Party (LJP)
(b) Rashtriya Janata Dal (RJD)
(c) Rashtriya Lok Samata Party
(d) Janta Dal (United)

17. Recently, Delhi and neighbouring States have been directed to implement air pollution control measures under the very poor and severe category air quality of the Graded Response Action Plan (GRAP). GRAP was prepared in 2016 by?
(a) National Green Tribunal (NGT)
(b) Ministry of Environment and Forest (MoEFCC)
(c) Environmental Pollution (Prevention and Control) Authority (EPCA)
(d) Central Pollution Control Board (CPCB)

18. What is the brand name of India's first ever premium cotton launched on 2nd World Cotton Day 2020?
(a) Komal (b) Shakti
(c) Kasturi (d) Kumkum

19. Consider the following statements regarding Rudram anti-radiation missile:
1. It is an air-to-air missile.
2. It is jointly developed by India and Russia.
Which of the above is or are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

20. Recently, the Union Cabinet has approved the Ratification of seven chemicals listed under the Stockholm Convention on Persistent Organic Pollutants (POPs). The convention signed in which year?
(a) 2001 (b) 1992
(c) 2014 (d) 2008

21. Recently, which among the following has become the first state to have a Tree Plantation Policy?
(a) Uttar Pradesh (b) Delhi
(c) Chattisgarh (d) Madhya Pradesh

22. In October 2020, Chaitanya Venkateswaran, an 18-year-old woman from Delhi held the post of the ________ High Commissioner in India for a day.
(a) United State's (b) British
(c) French (d) Russian

23. Who among the following has won the 2020 Nobel Prize in Chemistry for developing CRISPR/Cas9 genetic scissors?
1. Emmanuelle Charpentier
2. Harvey J Alter
3. Jennifer A Doudna
4. Michael Houghton
(a) 1 only (b) 4 only
(c) 1,2,3 only (d) 1,3 only

24. Who among the following has been awarded the 2020 Nobel Prize for Literature?
(a) Louise Glück
(b) Peter Handke
(c) Michele Hutchison
(d) Marieke Lucas Rijneveld

25. FNCAS9 Editor Linked Uniform Detection Assay (FELUD (a) test for Covid-19 has been developed by?
(a) CSIR
(b) ICMR
(c) National Institute of Virology
(d) None of the above

26. What is the name of India's first indigenous anti-radiation missile, which was recently test fired by DRDO?
(a) SURYA (b) AKASHA
(c) RUDRAM (d) DHRUVA

27. Which of the following states recently launched the "Mukhya Mantri Saur Swarojgar Yojana"?
(a) Maharashtra (b) Uttarakhand
(c) Madhya Pradesh (d) Gujarat

28. Second World Cotton Day 2020 was observed on which of the following dates?
(a) October 7 (b) October 15
(c) September 7 (d) September 15

29. Nobel Peace Prize 2020 has been awarded to which of the following organisations?
(a) International Campaign to Abolish Nuclear Weapons (ICAN)
(b) Oxfam
(c) World Food Programme (WFP)
(d) Food and Agriculture Organisation (FAO)

30. Wildlife Week is annually celebrated across India between ___________ with an aim to protect and preserve the flora and fauna of India.
(a) 5th to 11th October
(b) 4th to 10th October
(c) 3rd to 9th October
(d) 2nd to 8th October
(e) 1st to 6th October

31. Recently PM Modi has inaugurated the 'Arogya Van' in which state of the country?
(a) Madhya Pradesh (b) Assam
(c) Uttar Pradesh (d) Gujarat

32. Name the initiative launched by the Railway Protection Force (RPF) of Indian Railways to ensure safety and security of women passengers during their train journeys.
(a) Meri Saheli (b) Naari
(c) Sakhi (d) Kusum Sewa

33. Mesut Yilmaz who has passed away recently was the former Prime Minister of which country?
(a) Myanmar (b) Japan
(c) Turkey (d) Syria

34. India's first Sea Plane service has been inaugurated in which state?
(a) Maharashtra (b) Madhya Pradesh
(c) Goa (d) Gujarat

35. When is the World Vegan Day observed?
(a) 2 November (b) 1 November
(c) 31 October (d) 30 October

36. Name the scheme launched by the SERB of the Department of S&T to financially support women scientists and researchers with S&T projects.
(a) SERB – IDEA (b) SERB – LIFE
(c) SERB – FOCUS (d) SERB – POWER

37. India recently undertook the longest range successful testing of air launched version of BrahMos cruise missile using which aircraft?
(a) Sukhoi (b) HAL Tejas
(c) Dassault Rafale (d) Dassault Mirage

38. When is the National Unity Day observed in India?
(a) 30 October (b) 29 October
(c) 31 October (d) 28 October

39. Rashtriya Ekta Diwas or the National Unity Day is observed to commemorate the birth anniversary of which leader?
(a) Subhas Chandra Bose
(b) Sarojini Naidu
(c) Sarvepalli Radhakrishnan
(d) Sardar Vallabhbhai Patel

40. The International Day to End Impunity for Crimes against Journalists is an UN-recognized day observed annually on ____________.
(a) 1 November (b) 2 November
(c) 3 November (d) 4 November

41. The Panna Tiger Reserve has been included in the 'World Network of Biosphere Reserves' list of the UNESCO. In which state is the Panna Tiger Reserve located?
(a) Madhya Pradesh (b) Gujarat
(c) Uttar Pradesh (d) Rajasthan

42. Which of the following state will soon feature India's first "Tyre Park", where artworks made from scrap and defective parts will be on display?
(a) Gujarat (b) Uttar Pradesh
(c) West Bengal (d) Maharashtra

43. Indian boxers Amit Panghal, Sanjeet and Ashish Kumar have won gold medals at the recently concluded Alexis Valentine International Boxing Tournament held in ________.
(a) Japan (b) Germany
(c) India (d) France

44. The Board of Control for Cricket in India (BCCI) has announced _____________ as the Title Sponsor of the 2020 edition of the Women's T20 Challenge.
(a) BSNL (b) Vi (c) Jio (d) Airtel

45. Noted Malayalam writer, ____________ has been selected for this year's Ezhuthachan Puraskaram, the Kerala government's highest literary honour.
(a) Ponjikkara Rafi (b) C. V. Sreeraman
(c) E. V. Krishna Pillai (d) Paul Zacharia

46. Which day of the year is observed as the Infantry Day by the Indian Army every year?
(a) October 27 (b) October 28
(c) October 26 (d) October 25

47. Naresh Kanodia, who passed away recently, was a veteran actor of which film industry?
(a) Bengali (b) Marathi
(c) Gujarati (d) Odia

48. Which of the following ministries organized "Women of India -Shifting Gears" as part of "Dekho Apna Desh" webinar series?
(a) Ministry of Culture
(b) Ministry of Women and Child Development
(c) Ministry of Youth Affairs and Sports
(d) Union Ministry of Tourism

49. Which entity signed a loan agreement with Government of India to enhance support for the Namami Gange Programme?
(a) World Bank
(b) Bill and Melinda Gates Foundation
(c) European Union
(d) Asian Development Bank

50. After Covid-19 and Swine flu, which of the following diseases has recently been reported from China?
(a) Covid-19 (b) Swine flu
(c) Bubonic Plague (d) Bird flu

51. Which of the following mobile apps is not in the category of 'banned' by Indian Government?
(a) Zoom (b) Tik-Tok
(c) Weibo (d) Helo

52. From which Chinese city there is report of Bubonic plague recently?
(a) Wuhan (b) Bayannur
(c) Suzhou (d) Guiyang

53. Which of the following bodies/ministries has launched the behaviour change campaign called 'Navigating the New Normal' recently?
(a) NITI Aayog
(b) NIMHANS
(c) IBHAS
(d) Central Institute of Psychiatry

54. Which of the following IITs launched India's first online B.Sc. degree in Programming and Data science?
(a) IIT-K (b) IIT-M (c) IIT-D (d) IIT-Kgp

55. Name the Indigenously Developed Torpedo Decoy System recently inducted into Indian Navy
(a) Naag (b) Dhanush
(c) Takshek (d) Maareech

56. According to a recent UNICEF report, in which of the following countries millions of children are on the brink of starvation?
(a) South Sudan (b) Nigeria
(c) Syria (d) Yemen

57. Which of the following flu strains with pandemic potential has been recently identified in China?
(a) H1N1 (b) G4 EA H1N1
(c) H1N2 (d) H3N2

58. China's National Security Law criminalizes __________ types of activity?
(a) 1 (b) 2 (c) 3 (d) 4

59. Which of the following rebel forces are active in the Yemen?
(a) Houthi (b) Taliban
(c) ISIS (d) Hezbollah

60. Which of the following persons has recently been conferred with Prof. P. C. Mahalanobis Lifetime Achievement Award in Official Statistics 2020?
(a) Dr. Bimal Jalan
(b) Prof. Raj Chetty
(c) Siddhanta Mukherjee
(d) Dr. C. Rangarajan

61. Who has recently been appointed as Permanent Representative of India to the United Nations and other international organisations in Geneva?
(a) Rajiv Kumar Chander (b) Indra Mani Pandey
(c) Syed Akbaruddin (d) Taranjit Singh Sandhu

62. Who has recently assumed the charge of the interim chairman of International Cricket Council (ICC)?
(a) Shashank Manohar (b) N Srinivasan
(c) Niranjan Shah (d) Imran Khwaja

63. Which of the following states has become the first Indian state having 100% Household with LPG connections?
(a) Uttarakhand (b) Bihar
(c) Assam (d) Himachal Pradesh

64. Which of the following agencies launched the first mobile application for information on banned substances for sportspersons?
(a) BCCI (b) IOA
(c) SAI (d) NADA

65. From which Chinese city there are reports of Bubonic plague recently?
(a) Wuhan (b) Bayannur
(c) Suzhou (d) Guiyang

66. World Breastfeeding Week (WBW) is observed annually on August 1-7. What is the theme for WBW 2020?
(a) "Support Breast feeding for a healthier planet"
(b) "Empower Parents, Enable Breastfeeding"
(c) Breastfeeding: Foundation of Life"
(d) Sustaining Breastfeeding Together"

67. Which of the following states will launch 'Play little, Study little' scheme for school students?
(a) Uttar Pradesh (b) Telangana
(c) Assam (d) Tripura

68. Which Indian has entered the Forbes list of world's top 10 richest people?
(a) Azim Premji (b) Uday Kotak
(c) MukeshAmbani (d) Shiv Nadar

69. Which state's High Court has issued a notice to Twitter, centre, state government over communal tweets?
(a) Delhi (b) Telangana
(c) Bombay (d) Madras

70. Which country has temporarily suspended the issuance of work visas?
(a) UK (b) France
(c) Germany (d) US

71. Which international body has asked Myanmar to ensure safe return of Rohingyas?
(a) UNHRC (b) United Nations
(c) UNSC (d) ICJ

72. Which state government has planned to launch Indira Rasoi Yojana?
(a) Madhya Pradesh (b) Maharashtra
(c) Rajasthan (d) Uttar Pradesh

73. India stands at ___________ position in the world in terms of foreign exchange reserves.
(a) 10th (b) 9th (c) 6th (d) 5th

74. Which country's President has ordered against the use of his/her photograph for the poll campaign?
(a) India (b) Sri Lanka
(c) Maldives (d) US

75. India is planning to procure 21 MiG-29 fighter jets from which country under its latest defence deal?
(a) France (b) Germany
(c) US (d) Russia

76. Which of the following states has launched 'Balram' scheme to provide credit to 7 lakh landless farmers?
(a) Jharkhand (b) Odisha
(c) Chhatisgarh (d) Madhya Pradesh

77. Which new pandemic potential virus candidate has been detected in China?
(a) S8 (b) G4 (c) C5 (d) A7

78. The MSME Ministry has launched which portal for MSME registration?
(a) Udyam (b) Udaan
(c) Satyam (d) Saransh

79. Which country's Federal Communications Commission has designated two Chinese companies as national security threats?
(a) India (b) UK
(c) France (d) US

80. Recently which of the following countries eliminated both measles and rubella?
(a) India (b) China
(c) Sri Lanka (d) Indonesia

81. India's largest data centre building is located in which of the following states?
(a) Andhra Pradesh (b) Telangana
(c) Gujarat (d) Maharashtra

82. Which of the following is South-East Asia regional director of World Health Organisation?
(a) Dr Soumya Swaminathna
(b) Dr Gagandeep Kang
(c) Dr Poonam Khetrapal Singh
(d) Dr Harsh Vardhan

83. Which of the following companies wins won CII-ITC Sustainability Award 2019?
(a) NHPC (b) Infosys
(c) Wipro (d) NTPC

84. Which of the following companies announced to invest Rs 730 crore in Jio platforms?
(a) Amazon (b) Qualcomm Ventures
(c) L Catterton (d) Vista Equity Partners

85. Which State Government is all set to launch Roko-Toko campaign aimed at those not wearing masks?
(a) Bihar (b) Rajasthan
(c) Haryana (d) Madhya Pradesh

86. Reimagine Campaign is launched by_______.
(a) CII (b) ASSOCHAM
(c) FICCI (d) NASSCOM

87. Recently highway projects worth _____________ launched in Haryana?
(a) Rs 500 crore (b) Rs 1000 crore
(c) Rs 10,000 crore (d) Rs 20,000 crore

88. Which of the following countries joined India in "PASSEX" exercise recently?
(a) United States (b) Japan
(c) United Kingdom (d) Russia

89. MANODARPAN initiative of MHRD is to provide ___________ support to students?
(a) Financial (b) Psychological
(c) Physical (d) Educational

90. Which of the following is world's largest warship?
(a) USS Princeton (b) USS Sterett
(c) USS Ralph Johnson (d) USS Nimitz

91. The World Anti-Doping Agency (WADA) has extended the suspension of the India's National Dope Testing Laboratory (NDTL) by ___________ months?
(a) 3 (b) 4 (c) 6 (d) 12

92. Recently which of the following Atomic Power Projects unit achieved 'criticality'?
(a) Kudankulam (b) Narora
(c) Kakrapar (d) Kaiga

93. Which of the following countries accused India of targeting import duties on a number of ICT products and demanded for set up of dispute panel on this issue?
(a) Taiwan & Japan
(b) Pakistan & Turkey
(c) United Kingdom & France
(d) Russia & China

94. Which of the following countries recently becomes signatory of the International Solar Alliance (ISA)?
(a) Fiji (b) Nicaragua
(c) Cuba (d) Cambodia

95. Which of the following was not part of first edition of Global Fintech Fest (GFF)?
(a) FCC (b) PCI (c) NPCI (d) CII

96. According to National Education Policy-2020, what is the target year for 100% Gross Enrolment Ratio in school education?
(a) 2022 (b) 2025 (c) 2030 (d) 2032

97. Which country presided over the 6th BRICS Environment Ministers' Meeting?
(a) Brazil (b) Russia (c) India (d) China

98. Which State launched MagNet project recently?
(a) Manipur (b) Nagaland
(c) Madhya Pradesh (d) Maharashtra

99. Which of the following ministries received SKOCH Gold Award recently?
(a) Ministry of Agriculture & Farmers Welfare
(b) Ministry of Health and Family Welfare
(c) Ministry of Tribal Affairs
(d) Ministry of Corporate Affairs

100. How many scholarship schemes have been integrated with DBT Portal by Ministry of Tribal Affairs?
(a) 5 (b) 7 (c) 10 (d) 15

101. Which country has developed the largest solar tree?
(a) India (b) Russia
(c) United States (d) China

102. What is the name of the farthest star galaxy detected by India?
(a) Messeir 82 (b) Cartwheel Galaxy
(c) AUDFs01 (d) Maffei 1

103. India and Russia are to hold bilateral naval exercise INDRA 2020 in
(a) Andaman Sea (b) Indian Ocean
(c) Baltic Sea (d) Caspean Sea

104. Which country launched Indo-Pacific strategy?
(a) Germany (b) France
(c) China (d) India

105. Name the first ever Mars mission of United Arab Emirates.
(a Explore (b) Leap
(c) Lead (d) Hope

106. International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI) is situated in _________________.
(a) Hyderabad (b) Mumbai
(c) Bengaluru (d) Chennai

107. UAE's Hope Probe launched from a spaceport located in_____________.
(a) India (b) Japan
(c) UAE (d) United States

108. Recently scientists have found warm interiors on which of the following planets?
(a) Mercury (b) Neptune
(c) Mars (d) Venus

109. Where is located the Largest Solar Power Plant of Indian Navy Commissioned?
(a) Kutch (b) Mumbai
(c) Kochi (d) Ezhimala

110. Which of the following is not part of BelYo, India's first ever CoVid-19 blockchain platform?
(a) BelfricsBT (b) YoSync
(c) IIIT-Bangalore (d) IIIT-Bombay

111. How many volcanic structures have been identified on Venus?
(a) 21 (b) 37
(c) 81 (d) 96

112. Name the rover launched by NASA to potentially find signs of ancient microbial life on Mars.
(a) Opportunity (b) Curiosity
(c) Sojourner (d) Perseverance

113. The Indian Institute of Technology that deployed remote patient monitoring solutions for CoVid-19.
(a) IIT-M (b) IIT-B
(c) IIT-K (d) IIT-P

114. What is the minimum period for which Mars Perseverance rover is scheduled to stay on Mars?
(a) 1 Mars Year (b) 1 .5 Mars Year
(c) 2 Mars Year (d) 2.5 Mars Year

115. The first herbal-based immunity-boosting room freshener product is named
(a) Anti-Covid Air (b) Herbal Air
(c) Healthy Air (d) None of these

116. Which institute has developed a neural-based (machine learning-based) practical approach for automatic interpretation of 3D seismic data?
(a) Indian Institute of Technology, Kanpur
(b) Indian Institute of Science, Bangalore
(c) Wadia Institute of Himalayan Geology
(d) Both a and b

117. Who completed world's first jump from a solar-powered aircraft?
(a) Raphael Domjan (b) Joseph Dell
(c) Michael Relph (d) Tom Heck

118. Which of the following states/UTs is NOT included in the list of states which are expected to witness a double-digit contraction?
(a) Assam (b) Goa (c) Gujarat (d) Delhi

119. In which year the "cyber diplomacy toolbox" of European Union was established?
(a) 2009 (b) 2012 (c) 2017 (d) 2019

120. The military intelligence unit of which country has been sanctioned by EU for involvement in significant cyber-attacks or attempted cyber-attacks?
(a) Russia (b) China
(c) Iran (d) Pakistan

121. What was the source of massive explosion in Beirut?
(a) Potassium nitrate (b) Ammonium nitrate
(c) TNT (d) Nitrocellulose

122. Which of the following territories has been shown by Pakistan as it own according to its recent released political map with which Indian territory as its own?
(a) Parts of J & K (b) Parts of Gujarat
(c) Both a & b (d) None of the above

123. Asia accounts for__________ of total work force of global migrant workers.
(a) 1/2 (b) 1/3 (c) 1/4 (d) 1/5

124. Saad Hariri served as the_____________ of Lebanon.
(a) President (b) Prime Minister
(c) Governor (d) Finance Minister

125. Which of the following resulted in the depletion of ozone over Brahmaputra River Valley?
(a) Ethane (b) Ethene
(c) Propane (d) All the above

126. Which of the following has recently been honoured with Paul Harris Fellow recognition?
(a) O. Panneerselvam
(b) Edappadi K Palaniswami
(c) Dr. U.R. Rao
(d) Dr K Kasturirangan

127. Who has recently resigned as the chief executive officer of BCCI?
(a) Jay Shah (b) Hemang Amin
(c) Shashank Manohar (d) Rahul Johri

128. Jack Charlton was the member of England team which won the FIFA world cup in __________.
(a) 1958 (b) 1962
(c) 1966 (d) 1970

129. Who assumed as the interim CEO of BCCI?
(a) Jay Shah (b) Hemang Amin
(c) Rahul Johri (d) Rahul Dravid

130. Which of the following has recently been designated as a global terrorist by the United Nations?
(a) Hafiz Saeed (b) Zahid Zargar
(c) Ayman Al-Zawahiri (d) Noor Mehsud

131. Who was the first woman election commissioner of Maharashtra?
(a) Meeran Borwankar (b) Vijaya Rahatkar
(c) Neela Satyanarayan (d) Neeta Thakre

132. Who has recently been nominated as Vice-Chairman of International Union of Railways (UIC)?
(a) Ashok Kumar (b) Arun Kumar
(c) Vinod Kumar Yadav (d) Dr. B.P. Nanda

133. Benjamin Mkapa who passed away recently served as the president of which country?
(a) South Africa (b) Congo
(c) Fiji (d) Tanzania

134. Who among the following has been chosen as the member of new UN Youth Advisory Group by Secretary General of United Nations?
(a) Meera Jaishankar
(b) Deepika Padukone
(c) Sunita Narayan
(d) Archana Soreng

135. Select the period for which Sahil Seth appointed as an honorary advisor to the steering committee for the BRICS Chamber of Commerce and Industry (CCI).
(a) 2020-2022 (b) 2020-2023
(c) 2021-2024 (d) 2021-2022

136. Lee Teng-hui who passed away recently served as the president of which country?
(a) Malaysia (b) Vietnam
(c) Taiwan (d) Indonesia

137. For how many terms had Manoj Sinha been elected to Lok Sabha?
(a) One term (b) Two term
(c) Three term (d) Four term

138. Nobel Peace Prize winner late John Hume played the lead role in which of the peace treaties?
(a) Good Friday Accord
(b) Christmas Truce
(c) Wye river memorandum
(d) Ohrid Agreement

139. Who is appointed as UNICEF's celebrity advocate in India?
(a) Sachin Tendulkar (b) Shahrukh Khan
(c) Ayushmann Khurrana (d) Priyanka Chopra

140. Kesavananda Bharti who passed away recently was a
(a) politician (b) priest
(c) lawyer (d) None of the above

141. Who has been appointed as the new chairman of National School of Drama?
(a) Anupam Kher (b) Paresh Rawal
(c) Naseeruddin Shah (d) Shabana Azmi

142. Who is the recipient of the Indira Gandhi Peace Prize for the year 2019?
(a) Sir David Attenborough (b) Sir William Blake
(c) Stephen Jake (d) Robert Blake

143. Amendment to which of the following labour codes was approved by the Union Cabinet?
(a) Occupational safety and health
(b) Social security
(c) Industrial relations
(d) All the above

144. The Pradhan Mantri Matsya Sampada Yojana aims at
(a) Sustainable development of fisheries
(b) Education of girl child
(c) Agricultural reforms
(d) Promote computer literacy

145. Which state has recently planned to convert stubble into fuel?
(a) Rajasthan (b) Punjab
(c) Madhya Pradesh (d) Haryana

146. Who has won the Best Screenplay Award at Venice International Film Festival?
(a) Chaitanya Tamhane (b) Christopher Nolan
(c) Steven Spielberg (d) James Cameron

147. Which of the following is credited with the implementation of NREGA?
(a) Lalu Prasad Yadav
(b) Rahul Gandhi
(c) Raghuvansh Prasad Singh
(d) Nitish Kumar

148. Subhash Kamath has been elected chairman of which of the following organizations?
(a) Advertising Standards Council of India
(b) Bar Council of India
(c) Creative Think Media
(d) None of the above

149. Who has won 2020 US Open title?
(a) Serena Willams (b) Venus Williams
(c) Naomi Osaka (d) Victoria Azarenka

150. Who has been appointed as CEO of Citigroup?
(a) Jamie Dimon (b) Brian Moynihan
(c) Vikram Pandit (d) Jane Fraser

Hints & Solutions

ANSWER KEY																			
1	(d)	**16**	(a)	**31**	(d)	**46**	(a)	**61**	(b)	**76**	(b)	**91**	(c)	**106**	(a)	**121**	(b)	**136**	(c)
2	(b)	**17**	(b)	**32**	(?)	**47**	(c)	**62**	(d)	**77**	(b)	**92**	(c)	**107**	(b)	**122**	(c)	**137**	(c)
3	(c)	**18**	(c)	**33**	(c)	**48**	(d)	**63**	(d)	**78**	(a)	**93**	(a)	**108**	(d)	**123**	(b)	**138**	(a)
4	(b)	**19**	(d)	**34**	(d)	**49**	(a)	**64**	(d)	**79**	(d)	**94**	(b)	**109**	(d)	**124**	(a)	**139**	(c)
5	(c)	**20**	(a)	**35**	(b)	**50**	(c)	**65**	(b)	**80**	(c)	**95**	(d)	**110**	(d)	**125**	(d)	**140**	(b)
6	(c)	**21**	(b)	**36**	(d)	**51**	(a)	**66**	(a)	**81**	(d)	**96**	(c)	**111**	(b)	**126**	(b)	**141**	(b)
7	(a)	**22**	(b)	**37**	(a)	**52**	(b)	**67**	(d)	**82**	(c)	**97**	(b)	**112**	(d)	**127**	(d)	**142**	(a)
8	(d)	**23**	(d)	**38**	(c)	**53**	(a)	**68**	(c)	**83**	(d)	**98**	(d)	**113**	(a)	**128**	(c)	**143**	(d)
9	(c)	**24**	(a)	**39**	(d)	**54**	(b)	**69**	(b)	**84**	(b)	**99**	(c)	**114**	(a)	**129**	(b)	**144**	(a)
10	(c)	**25**	(a)	**40**	(b)	**55**	(d)	**70**	(d)	**85**	(d)	**100**	(a)	**115**	(c)	**130**	(d)	**145**	(b)
11	(d)	**26**	(c)	**41**	(a)	**56**	(d)	**71**	(a)	**86**	(c)	**101**	(a)	**116**	(c)	**131**	(d)	**146**	(a)
12	(b)	**27**	(b)	**42**	(c)	**57**	(b)	**72**	(c)	**87**	(d)	**102**	(c)	**117**	(a)	**132**	(b)	**147**	(c)
13	(a)	**28**	(a)	**43**	(d)	**58**	(d)	**73**	(d)	**88**	(a)	**103**	(a)	**118**	(d)	**133**	(d)	**148**	(a)
14	(b)	**29**	(c)	**44**	(c)	**59**	(a)	**74**	(b)	**89**	(b)	**104**	(a)	**119**	(c)	**134**	(d)	**149**	(c)
15	(c)	**30**	(d)	**45**	(d)	**60**	(d)	**75**	(d)	**90**	(d)	**105**	(d)	**120**	(a)	**135**	(b)	**150**	(d)