CBSE & NTSE

CLASS-IX

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Published by :

Resonance Eduventures Limited

Address : Plot No. A-51 [A], IPIA, Near Resonance CG Tower,
Behind City Mall, Jhalawar Road, Kota (Rajasthan)-324005
Contact. No.:+91-0744-6635569, 8824078330,
E-mail : pccp@resonance.ac.in
Website : www.pccp.resonance.ac.in

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Second Edition 2018

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CIRCULAR MOTION

A. CIRCULAR MOTION

(a) Definition :

The motion of a body moving around a fixed point in a circular path is known as circular motion.

Uniform Circular motion : If the body covers equal distances along the circumference of the circle in equal intervals of time, the motion is said to be a uniform circular motion. A uniform circular motion is a motion in which speed remains constant but direction of velocity changes.

Eg: Examples of uniform circular motion are:

(i) Motion of moon around the earth.

(ii) Motion of satellite around its planet.

(b) Circular motion is known as accelerated motion :

(i) Explanation : Consider a boy running along a regular hexagonal track (path) as shown in figure. As the boy runs along the side of the hexagon at a uniform speed, he has to take a turn at each corner changing direction but keeping the speed same. In one round he has to take six turns at regular intervals. If the same boy runs along the side of a regular octagonal track with same uniform speed, he will have to take eight turns in one round at regular intervals but the interval will become smaller.

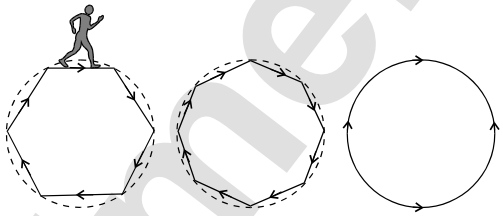

Fig. 1

By increasing the number of sides of the regular polygon, we find that number of turns per round becomes more and the interval between two turns become still shorter. A circle is a limiting case of a polygon with an infinite number of sides. On the circular track, the turning becomes a continuous process without any gap in between. The boy running along the sides of such a track will be performing a circular motion. Hence, circular motion is the motion of a body along the sides of a polygon of infinite number of sides with uniform speed, the direction changing continuously, it means the body moves with changing velocity in a circular path thus the uniform circular motion is known as accelerated motion.

(ii) Diffrence between uniform linear and uniform circular motion

Uniform linear motion	Uniform circular motion
1. The direction of motion does not changes.	**1.** The direction of motion changes continuously.
2. The motion is non accelerated.	**2.** The motion is accelerated.

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(iii) Radian : It is the unit of plane angle.

(I) Definition : One radian is defined as the angle subtended at the centre of the circle by an arc equal in length to its radius.

Eg. In figure , the arc AB of the circle has length ℓ and subtends an angle θ at the centre **C**.
If $\angle ACB = \theta$ radians.

Then, $\theta = \frac{\ell}{r}$ radians.

[For $\ell = r$, $\theta = 1$ radian]
Angle subtended by the circumference at the centre,

$\theta = \frac{2\pi r}{r} = 2\pi$ radians {or $2\pi^c$}

[^{c}] is symbol for radian, just as (^{o}) is symbol for degree.

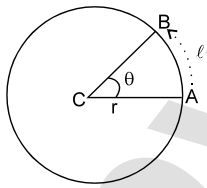

Fig. 2

(II) Relation between radian and degree :

For complete circle at centre $2\pi^c = 360^o$

or $1^c = \left|\frac{360}{2\pi}\right| = 57.3^o$

(c) Variables of circular motion :

(i) Angular Position : To decide the angular position of a point in space we need to specify (i) origin and (ii) reference line. The angle made by the position vector w.r.t. origin, with the reference line is called angular position. Clearly angular position depends on the choice of the origin as well as the reference line. Circular motion is a two dimensional motion or motion in a plane.

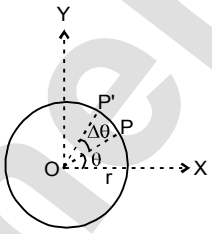

Fig. 3

Suppose a particle P is moving in a circle of radius r and centre O.
The angular position of the particle P at a given instant may be described by the angle θ between OP and OX. This angle θ is called the angular position of the particle.

(ii) Angular Displacement (θ) :

Definition : Angle through which the position vector of the moving particle rotates in a given time interval is called its **angular displacement**. Angular displacement depends on origin, but it does not depends on the reference line. As the particle moves on above circle its angular position θ changes. Suppose the point rotates through an angle $\Delta\theta$ in time Δt, then $\Delta\theta$ is angular displacement.

NOTE :

- Angular displacement is a dimensionless quantity. Its SI unit is radian, some other units are degree and revolution

$$2\pi \text{ rad} = 360° = 1 \text{ rev}$$

- Infinitesimally small angular displacement is a vector quantity, but finite angular displacement is a scalar, because while the addition of the Infinitesimally small angular displacements is commutative, addition of finite angular displacement is not.

$d\vec{\theta}_1 + d\vec{\theta}_2 = d\vec{\theta}_2 + d\vec{\theta}_1$ but $\theta_1 + \theta_2 \neq \theta_2 + \theta_1$

- Direction of small angular displacement is decided by right hand thumb rule. When the fingers are directed along the motion of the point then thumb will represents the direction of angular displacement.

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(iii) Angular Velocity (ω) : The angular displacement per unit time is called the angular velocity. It is represented by the symbol ω (omega).

$$\omega_{av} = \frac{\text{Angular displacement}}{\text{Total time taken}} \qquad \omega_{av} = \frac{\theta_2 - \theta_1}{t_2 - t_1} = \frac{\Delta\theta}{\Delta t}$$

where θ_1 and θ_2 are angular position of the particle at time t_1 and t_2. Since angular displacement is a scalar, average angular velocity is also a scalar.

NOTE :

- Its S.I. unit is rad/s.
- For a rigid body, as all points will rotate through same angle in same time, angular velocity is a characteristic of the body as a whole, e.g., angular velocity of all points of earth about earth's axis is (2π/24) rad/hr.
- If a body makes 'N' rotations in 't' seconds then average angular velocity in radian per second will be

$$\omega_{av} = \frac{2\pi N}{t}$$

- If T is the period and 'f' is the frequency of uniform circular motion. then

$$\omega_{av} = \frac{2\pi}{T} = 2\pi f$$

- Direction of angular velocity is along the axis of rotation and decided by right hand thumb rule.

(iv) Angular Acceleration (α) : The rate of the change of angular velocity is called angular acceleration. Let ω_1 and ω_2 be the instantaneous angular speeds at times t_1 and t_2 respectively, then the average angular acceleration α_{av} is defined as

$$\vec{\alpha}_{av} = \frac{\vec{\omega}_2 - \vec{\omega}_1}{t_2 - t_1} = \frac{\Delta\vec{\omega}}{\Delta t}$$

NOTE :

- Both average and instantaneous angular acceleration are axial vectors with dimension $[T^{-2}]$ and unit rad/s^2.
- Direction of angular acceleration is along the axis of rotation and decided by right hand thumb rule.

If $\alpha = 0$, circular motion is said to be uniform.

(d) Relation between linear and angular quantities :

(i) Relation between angular displacement and linear displacement :

$\because$ angle = $\frac{\text{arc}}{\text{radius}}$

$\theta = \frac{x}{r} \Rightarrow x = r\theta$ ..... (i)

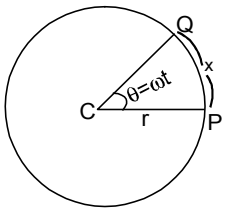


Fig. 4

(ii) Relation between angular velocity and linear velocity :

From (i) $x = r\theta$

$\frac{x}{t} = r\frac{\theta}{t} \Rightarrow v = r\omega$ ..... (ii)

(iii) Relation between angular velocity and linear velocity :

From (ii) $v = r\omega$

$\frac{v}{t} = r\frac{\omega}{t} \Rightarrow a = r\alpha$ ..... (iii)

Solved Examples

Illustration 1. A fly wheel making 120 revolutions/minute. Find the angular speed of the wheel :

Sol. $\because$ 120 revolution/ minute = 2 rev/s

Angular speed = angle in one revolution × number of revolution/s

$= 2\pi \times 2 = 4\pi$ rad/s

Illustration 2. A stone tied to the end of a string 80 cm is whirled in a horizontal circle with a constant speed. If the stone makes 14 revolutions in 25 sec., what is the magnitude of the angular speed. $\left(\text{use } \pi = \frac{22}{7}\right)$

Sol. angular speed = angle × number of rev./s

$\omega = 2\pi \times \frac{14}{25} = 3.52$ rad/s

Illustration 3. Earth revolves around the Sun in 365 days. Calculate its angular speed.

Sol. T = 365 days = 365 × 24 × 60 × 60 s

So, $\omega = \frac{2\pi}{T} = \frac{2\pi}{365 \times 24 \times 60 \times 60} = 1.99 \times 10^{-7}$ rad/s

Illustration 4. Is the angular velocity of rotation of hour hand of a watch greater or smaller than the angular velocity of Earth's rotation about its own axis ?

Sol. Hour hand completes one rotation in 12 hours while Earth completes one rotation in 24 hours. So, angular velocity of hour hand is double the angular velocity of Earth. $\left(\omega = \frac{2\pi}{T}\right)$.

Illustration 5. A particle is moving with constant speed in a circular path. Find the ratio of average velocity to its instantaneous velocity when the particle describes an angle $\theta = \frac{\pi}{2}$

Sol. Time taken to describe angle θ, $t = \frac{\theta}{\omega} = \frac{\theta R}{v} = \frac{\pi R}{2v}$

Average velocity = $\frac{\text{Total displacement}}{\text{Total time}}$

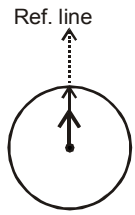
$= \frac{\sqrt{2}R}{\pi R/2v} = \frac{2\sqrt{2}}{\pi}v$

Instantaneous velocity = v

The ratio of average velocity to its instantaneous velocity = $\frac{2\sqrt{2}}{\pi}$ **Ans.**

Illustration 6. Find the time period of meeting of minute hand and second hand of a clock.

Sol.



$\omega_{min} = \frac{2\pi}{60}$ rad/min. , $\omega_{sec} = \frac{2\pi}{1}$ rad/min

$\theta_{sec} - \theta_{min} = 2\pi$ (for second and minute hand to meet again)

$(\omega_{sec} - \omega_{min})\, t = 2\pi$

$2\pi(1 - 1/60)\, t = 2\pi$

$\Rightarrow \quad t = \frac{60}{59}$ min.

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Check Your Progress

Q.1_ What is the direction of the linear velocity of a particle in uniform circular motion?

Q.2_ What is the direction of the centripetal force?

Q.3_ What is the angular velocity of the hour needle in a clock?

Q.4_ Find the relation between angular velocity and linear velocity.

Q.5_ Give an example of a body moving with a uniform speed having acceleration.

Q.6_ Two particles of equal mass are revolving in circular orbits of radii r_1 and r_2 with the same period. Show that $v_1 : v_2 = r_1 : r_2$.

Q.7_ Two bodies in circular paths of radii 1 : 3 take same time to complete their circles.Find the ratio of their linear speeds (Ans. 1 : 3)

Q.8_ In a circular path of radius 3m, a mass of 8kg moves with a constant speed of 20 ms^{-1}. Find the angular speed in radian/sec. (Ans 20/3 rad/sec)

Q.9_ The wheel of a cycle of radius 25cm is moving with a speed 20ms^{-1}. Calculate the angular velocity of the wheel (Ans 28 rad / s)

Q.10_ An air craft completes a horizontal loop of radius 2 km with a uniform speed of 600 kmh^{-1}. Find the angular velocity of the air craft.. (Ans 1/12 rad / s)

Board Level Exercise

TYPE (I) : VERY SHORT ANSWER TYPE QUESTIONS : [01 MARK EACH]

1. Give relation between linear and angular acceleration.

2. Why circular motion is accelerated motion ?

TYPE (II) : SHORT ANSWER TYPE QUESTIONS : [02 MARKS EACH]

3. Two bodies in circular paths of radii 1 : 2 take same time to complete their circles. Find the The ratio of their linear speeds is :

4. Write down the units of angular displacement, angular velocity and angular acceleration.

TYPE (III) : LONG ANSWER TYPE QUESTIONS: [03 MARK EACH]

5. Derive the relation between
(a) linear displacement and angular displacement
(b) linear velocity and angular velocity

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Exercise-1

✍ **Marked Questions can be used as Revision Questions.**

SUBJECTIVE QUESTIONS

SUBJECTIVE EASY, ONLY LEARNING VALUE PROBLEMS

SECTION (A) : CIRCULAR MOTION

A-1 Define Circular motion

A-2 State the meaning of uniform ciruclar motion

A-3 The wheel of a cycle of radius 50 cm is moving with a speed 14 ms^{-1}. Calculate the angular velocity of the wheel.

A-4 Define angular speed write its S.I. unit.

✍**A-5** An air craft completes a horizontal loop of radius 1 km with a uniform speed of 900 kmh^{-1}. Find the angular velocity of the air craft.

A-6 An artificial satellite takes 90 minutes to complete its revolution around the earth. Calculate the angular velocity of the satellite.

A-7 Name a physical quantity that (i) varies (ii) remains same in a circular motion.

A-8 Define the time period and find the relation between v and ω.

OBJECTIVE QUESTIONS

SINGLE CHOICE OBJECTIVE, STRAIGHT CONCEPT/FORMULA ORIENTED

SECTION (A) : CIRCULAR MOTION

A-1. 1^C is equal to :
(A) 57.3º (B) 573º (C) 180º (D) 360º

A-2. The angular velocity in (rad/hr) of the earth's rotation about its axis will be
(A) 12/ π (B) π/12 (C) 48 / π (D) π / 24

A-3. Angular velocity of minute hand of a watch is
(A) π/3600 rad/s (B) π /1800 rad/s (C) π / 7200 rad/s (D) π / 900 rad/s

✍**A-4.** Suppose a boy is enjoying a ride on a merry-go round which is moving with a constant speed of 10 ms^{-1}. It implies that the boy is
(A) at rest (B) moving with no acceleration
(C) in accelerated motion (D) moving with uniform velocity

A-5. A wheel is of diameter 1m. If it makes 30 revolutions/sec., then the linear speed (in m/s) of a point on its circumference is
(A) 30 π (B) π (C) 60 π (D) π / 2

A-6. Uniform circular motion is an example of :
(A) Constant acceleration (B) Variable acceleration
(C) A and B both (D) None of these

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A-7. Rate of change of angular velocity refer to :
(A) angular speed (B) angular displacement
(C) angular acceleration (D) None of these

A-8. The ratio of angular speed of hour's hand and second's hand of a clock is
(A) 1 : 1 (B) 1 : 60 (C) 1 : 720 (D) 1 : 3600

A-9. The angular velocity (in rad/s) of a fly wheel making 120 revolutions/minute is
(A) 2π (B) 8π (C) π (D) 4π

A-10. Unit of angular velocity is :
(A) rad (B) m/s (C) rad/s^2 (D) rad/s

A-11. Two bodies in circular paths of radii 1 : 2 take same time to complete their circles. The ratio of their linear speeds is :
(A) 1 : 2 (B) 2 : 1 (C) 1 : 3 (D) 3 : 1

A-12. In a circular path of radius 1m, a mass of 2kg moves with a constant speed of 10 ms^{-1}. The angular speed in radian/sec. is :
(A) 5 (B) 10 (C) 15 (D) 20

A-13. The relation among v, ω and r is :
(A) $\omega = \frac{v}{r}$ (B) $v = \frac{\omega}{r}$ (C) $\omega = \frac{r}{v}$ (D) None of these

A-14. A body moving along circular path may have :
(A) a constant speed (B) a constant velocity
(C) no tangential velocity (D) no radial acceleration

A-15. A particle revolves in a circular path. The acceleration of the particle is :
(A) along the tangent (B) zero
(C) along the radius (D) None of these

A-16. The earth's radius is 6400 km. It makes one rotation about its own axis in 24 hrs. The centripetal acceleration of a point on its equator is nearly.
(A) 340 cm/s^2 (B) 34 cm/s^2 (C) 3.4 cm/s^2 (D) 0.34 cm/s^2

A-17. The motion of a point on the rim of a wheel rotating about an axis fixed in a wall is :
(A) Circular (B) Linear
(C) Linear and circular (D) Vibratory

A-18. Examples of uniform circular motion are :
(A) motion of moon around the earth
(B) motion of satellite around a planet
(C) a runner running on a circular track with constant speed
(D) all of them

A-19. When a body moves along a semicircle, total angle subtended by it at centre of circle is :
(A) $\frac{\pi}{2}$ (B) 2π (C) π (D) none of these

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Exercise-2

Marked Questions can be used as Revision Questions.

OBJECTIVE QUESTIONS

1. A motor car is travelling at 20 m/s on a circular road of radius 100m. It is increasing its speed at the rate of 3 m/s^2. Acceleration of motor car is :
(A) 3 m/sec^2 (B) 5 m/sec^2 (C) 8 m/sec^2 (D) None of these

2. Two particles of equal masses are revolving in circular paths of radii r_1 and r_2 respectively with the same speed. The ratio of their centripetal forces is

(A) $\frac{r_2}{r_1}$ (B) $\sqrt{\frac{r_2}{r_1}}$ (C) $\left(\frac{r_1}{r_2}\right)^2$ (D) $\left(\frac{r_2}{r_1}\right)^2$

3. Two bodies of mass 10 kg and 5 kg moving in concentric orbits of radii R and r such that their periods are the same. Then the ratio between their centripetal acceleration is
(A) R/r (B) r/R (C) R^2/r^2 (D) r^2/R^2

4. The ratio of angular speeds of minute hand and hour hand of a watch is
(A) 1 : 12 (B) 6 : 1 (C) 12 : 1 (D) 1 : 6

5. A 500 kg car takes a round turn of radius 50 m with a velocity of 36 km/hr. The centripetal force is
(A) 250 N (B) 750 N (C) 1000 N (D) 1200 N

6. The direction of centripetal acceleration of an object moving in a circular path is
(A) directed away from the centre of the circle
(B) directed towards the centre of the circle
(C) directed upward in the plane of the circle
(D) none of the these.

7. The acceleration of an object moving with speed u in a circle of radius r is
(A) $\upsilon^2 r$ (B) r/υ^2 (C) υ^2/r (D) υ^2/r^2

Exercise-3

Marked Questions can be used as Revision Questions.

NTSE PROBLEMS (PREVIOUS YEARS)

1. A person takes time t to go once around a circular path of diameter 2R. The speed (ν) of this person would be: **(Raj./ NTSE Stage-I/2015)**

(A) $\frac{t}{2\pi R}$ (B) $\frac{2\pi R}{t}$ (C) $\frac{\pi R^2}{t}$ (D) $2\pi R.t$

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Answers

BOARD LEVEL EXERCISE

TYPE (II) : SHORT ANSWER TYPE QUESTIONS :

3. 1 : 2

EXERCISE - 1
SUBJECTIVE QUESTIONS
SUBJCTIVE EASY, ONLY LEARNING VALUE PROBLEMS

SECTION (A) : CIRCULAR MOTION

A-3 28 rad/s **A-5** 0.25 rad/s **A-6** $\frac{\pi}{2700}$ **rad/s**

OBJECTIVE QUESTIONS
SINGLE CHOICE OBJECTIVE, STRAIGHT CONCEPT/FORMULA ORIENTED

SECTION (A) : CIRCULAR MOTION

A-1	(A)	**A-2**	(B)	**A-3**	(B)	**A-4**	(C)	**A-5**	(A)	**A-6**	(B)
A-7	(C)	**A-8**	(C)	**A-9**	(D)	**A-10**	(D)	**A-11**	(A)	**A-12**	(B)
A-13	(A)	**A-14**	(A)	**A-15**	(C)	**A-16**	(C)	**A-17**	(A)	**A-18**	(D)
A-19	(C)										

EXERCISE - 2
OBJECTIVE QUESTIONS
SINGLE CHOICE OBJECTIVE, STRAIGHT CONCEPT/FORMULA ORIENTED

Ques.	1	2	3	4	5	6	7
Ans.	B	A	A	C	C	B	C

EXERCISE - 3
NTSE PROBLEMS (PREVIOUS YEARS)

Ques.	1
Ans.	B

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MATTER IN OUR SURROUNDING

INTRODUCTION

There are a large number of things around us which we see and feel. For example, we can see a book in front of us. A book occupies some space. The space occupied by the book is called its volume. If we pick up the book, we can also feel its weight. So, we conclude that the book has some mass. We cannot see the air around us, yet if we fill a balloon with air and then weigh it carefully, we will find that not only does air occupy space (bounded by the balloon), but it also has mass.

Things like a book and air are examples of matter. Other examples of matter are wood, cloth, paper, ice, steel, water, oil etc. Further, that matter offers resistance is borne out by the fact that we cannot displace an object from one place to another without applying some force. We have to apply force to pick up a stone from the ground. Thus , matter can be defined as follows -

Anything that occupies space, has mass and offers resistance is called **matter.**

A. PHYSICAL NATURE OF MATTER

(a) Matter is Made up of Particles :

(i) Everything around us is made up of many tiny pieces or particles.

(ii) Particles which make up the matter are constantly moving.

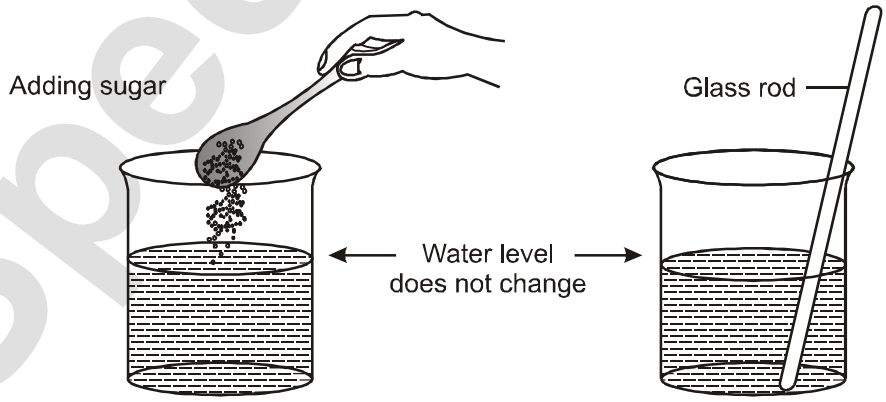
(iii) Particles which make up matter are atoms or molecules.

Evidences for the presence of particles in matter : Most of the evidences for the existence of particles in matter and their motion come from the experiments on diffusion and Brownian motion.

Evidence - 1

Dissolving a solid in a liquid : Take a beaker. Fill half of it with water. Mark the level of water in the beaker. Add some sugar to the water and dissolve it with the help of a glass rod. You will see that the sugar has disappeared, but there is no change in the level of water.

Conclusion : This can be explained by assuming that matter is not continuous, rather it is made up of particles. Sugar contains a large number of separate particles. These particles when dissolved in water occupy the vacant spaces between the particles of water. That is why, the water level in the beaker did not rise. Had sugar been continuous, like a block of wood, the water level in the beaker would have risen.



When a solid dissolves in a liquid, the volume of the liquid does not change

Experiment to show that matter is made of particles

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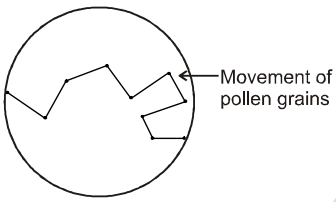
Evidence - 2

Movement of pollen grains in water : The best evidence for the existence and movement of particles in liquids was given by **Robert Brown** in 1827. Robert Brown suspended extremely small pollen grains in water. On looking through the microscope, it was found that the pollen grains were moving rapidly throughout water in a very irregular way (or zig-zag way).

Conclusion : Water is made up of tiny particles which are moving very fast (the water molecules themselves are invisible under the microscope because they are very, very small). **The pollen grains move on the surface of water because they are constantly being hit by the fast moving particles of water.** So, though the water particles (or water molecules) are too small to be seen, but their effect on the pollen grains can be seen clearly. The random motion of visible particles (pollen grains) caused by the much smaller invisible particles of water is an example of Brownian motion (after the name of the scientist Robert Brown who first observed this phenomenon.)



Brownian motion : Zig-zag motion (in a very irregular way) of particles is known as brownian motion. Brownian motion can also be observed in gases. Sometimes, when a beam of light enters in a room, we can see tiny dust particles suspended in air which are moving rapidly in a very random way. This is an example of Brownian motion in gases. The tiny dust particles move here and there because they are constantly hit by the fast moving particles of air. The existence of Brownian motion gives two conclusions.

• Matter is made up of tiny particles.

• Particles of matter are constantly moving.

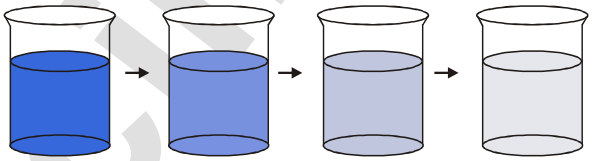
❖ **Note :**
Brownian motion increases on increasing the temperature.

(b) Characteristics of Particles of Matter :

The important characteristics of particles of matter are the following :

(i) The particles of matter are very, very small.

Experiment : Potassium permanganate is a purple coloured solid substance and water is a liquid. We will take 2-3 crystals of potassium permanganate and dissolve them in 100 ml of water. Now we will take out 10 ml of this solution and put into another 90 ml of clear water. We will keep diluting the solution like this 5 to 8 times.

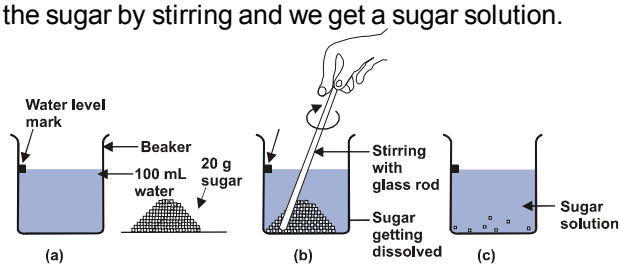


Just a few crystals of potassium permanganate can colour a huge volume of water

Conclusion : This experiment shows that just a few crystals of potassium permanganate can colour a large volume of water. It means a crystal of $KMnO_4$ is made up of millions of tiny particles. They keep dividing themselves into smaller and smaller particles.

(ii) The particles of matter have spaces between them :

Experiment : We take about 100 ml of water in a beaker and mark the level of water. We will also take 20 g of sugar. Now we will dissolve the sugar by stirring and we get a sugar solution.



When we dissolve sugar in water, there is no change in the volume of water

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Conclusion : The level of sugar solution in the beaker is at the same mark where water level was initially in the beaker.

It shows that particles of sugar go into the spaces between various molecules of water due to which there is no change in the volume. Thus, from this experiment it can be concluded that, the molecules in water are not tightly packed, they have spaces between them.

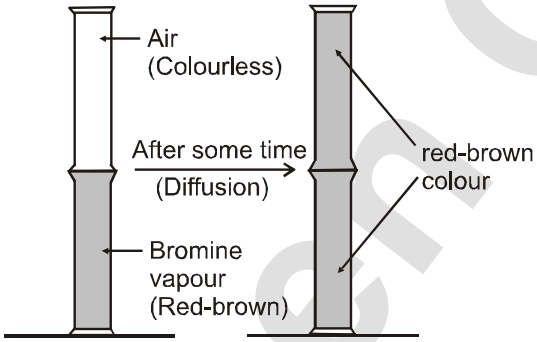
(iii) The particles of matter are constantly moving : This property can be explained by diffusion.

Diffusion : "Intermixing of particles of two different types of matter on their own is called diffusion." It is the phenomenon in which the movement of molecules or particles occur from their higher concentration towards their lower concentration.

e.g. : When a perfume bottle is opened in one corner of a room, its fragrance spreads in the whole room quickly. This happens because the particles of perfume move rapidly in all directions and mix with the moving particles of air in the room.

Experiment : We take a gas jar full of bromine vapours and invert another gas jar containinig air over it, then after some time, the red-brown vapours of bromine spread out into the upper gas jar containing air.

Conclusion : In this way, the upper gas jar which contains colourless air in it, also turns red-brown. The mixing is due to the diffusion of bromine vapours (or bromine gas) into air.



Diffusion of bromine vapour into air

❖ **Note :**
The particles of matter possess kinetic energy and so are constantly moving. As the temperature rises, particles move faster.

(iv) Particles of matter attract each other : There are some forces of attraction between the particles of matter which bind them together.

(I) Cohesive Force : The force of attraction between the particles of same substances is called cohesive force.

(II) Adhesive Force : The force of attraction between the particles of different substances is called adhesive force.

e.g. : If we take a piece of chalk, a cube of ice and an iron nail and beat them with a hammer, chalk will easily break into smaller pieces, but more force will be required to break a cube of ice and iron nail will not break.

Reason : The reason for this is, that the force of attraction is quite weak in between the chalk particles, but force of attraction in between the particles of ice cube is a bit stronger, while force of attraction in between the particles of iron is very-very strong.

RIGID AND FLUID

(i) Rigid : Rigid means unbending or inflexible. A solid is a rigid form of matter so that it maintains its shape when subjected to outside force.

(ii) Fluids : Fluids are the substances which have tendency to flow. A liquid is a fluid form of matter which occupies the space of the container. Liquids have a well defined surface. A gas is a fluid form of matter which fills the whole container in which it is kept.

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❖ **Note :**
Liquids and gases are known as fluids.

(c) Classification of Matter

On the basis of physical states, all matter can be classified into three groups:-
(i) Solids (ii) Liquids (iii) Gases

(i) Solids :

A solid is that state of matter which has definite shape, mass and volume.
e.g. : Ice, wood, coal, iron etc.

Properties :

(I) Solids have a definite mass and definite volume.

(II) Solids have a definite shape.

(III) Solids have negligible compressibility.

(IV) Solids have high densities.

(V) The intermolecular forces in solids are very strong.
(VI) The dimensions of solid do not increase in large proportion on heating or on cooling.

(VII) Solids diffuse into one another very slowly.

(ii) Liquids :

A liquid is a state of matter which has definite mass and volume but no definite shape.
e.g. : Water, alcohol, milk, mercury etc.

Properties :

(I) Liquids have a definite mass and volume.

(II) Liquids do not have a definite shape.

(III) Liquids are slightly more compressible than that of solids.

(IV) Density of liquids is lesser than that of solids.

(V) The force of attraction between the molecules of liquids is less than that of solids.

(VI) Liquids expand far more than solids on heating.

(VII) The particles of two different liquids can diffuse in one another easily to form homogeneous mixture.

(iii) Gases :

A gas is a state of matter, which has definite mass, but no definite shape and no definite volume.
e.g. : O_2, N_2, H_2 etc.

Properties :

(I) A gas contained in a vessel has a definite mass.

(II) Gases do not have definite shape and volume.

(III) Gases are highly compressible because intermolecular spaces between them are very-very large as compared to solids and liquids.

(IV) Density of gases is extremely small as compared to solids and liquids.

(V) Intermolecular forces are negligible.

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(VI) Gases expand to large extent when heated.

(VII) Gases diffuse in one another rapidly to form homogeneous mixture.

COMPARISON OF THE CHARACTERISTICS OF THREE STATES OF MATTER

Property	Solid state	Liquid state	Gaseous state
Interparticle spaces	Very small spaces	Comparatively large spaces than solids	Very large spaces
Interparticle forces	Very strong	Weak	Very weak
Nature	Very hard and rigid	Fluid	Highly fluid
Compressibility	Negligible	Very small	Highly compressible.
Shape and volume	Definite shape and volume	Indefinite shape, but definite volume	Indefinite shape as well as volume
Density	High	Less than solid state	Very low density
Kinetic energy	Low	Comparatively high than solids	Very high
Diffusion	Negligible	Slow	Very fast

Gases are Highly Compressible therefore :

(1) LPG (Liquefied Petroleum Gas) is used in our home for cooking.

(2) Oxygen cylinders supplied to hospitals contain liquid oxygen.

(3) These days C.N.G. (Compressed Natural Gas) is used as fuel in vehicles.

❖ **Note :**
Gaseous particles move randomly at high speed and hit each other and also walls of the container, so exert pressure.

Plasma

This state consists of super energetic and super excited particles. These particles are in the form of ionised gases.
For eg: Neon sign bulb and fluorescent tube
Neon sign bulb – Neon gas
Fluorescent tube – Helium gas
When electrical energy flows through gas, it gets ionised and hence plasma is created.
Plasma glows with a special colour depending on nature of gas. Sun and the stars glow because of the presence of plasma.

Bose - Einstein condensate (B.E.C.)

The B.E.C. is formed by cooling a gas of extremely low density, about one-hundred-thousandth the density of normal air, to super low temperature

Solved Examples

Example.1_ What is the difference between fluidity and viscosity ?
Solution. Fluidity means tendency to flow but viscosity refers to resistance to flow.

Example.2_ Give reasons why the rate of diffusion of liquid in another liquid is greater than rate of diffusion of a solid in a liquid ?
Solution. The kinetic energy of the particles of liquid is greater than the kinetic energy of the particle of solid.

Check Your Progress

1._ What are the general characteristics of particle of matter ?
2._ Name two processes which provide the best evidence for the motion of particles of matter ?
3._ Write one common characteristic between solid and liquid ?
4._ Why do gases have neither a fixed shape nor a fixed volume ?

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5. A gas exerts pressure on the walls of the containers. How it is possible ?

B. INTERCONVERSION OF STATES OF MATTER

The phenomenon of change of matter from one state to another state and back to original state, by altering the conditions of temperature and pressure, is called interconversion of states of matter.

The various states of matter can be interchanged into one another by altering the conditions of -
(a) Temperature (b) Pressure.

(a) Altering the Temperature of Matter :

(i) Interconversion of solid into liquid and vice versa : Solids can be converted into liquids by heating them. Similarly liquids can be cooled to form solids.

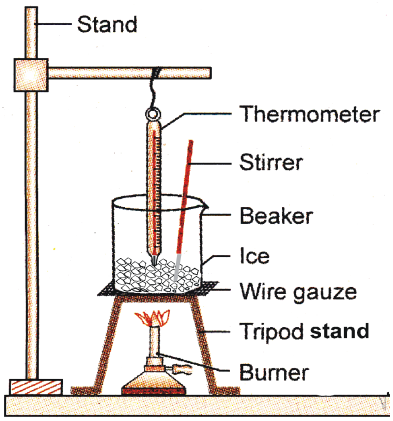
e.g. : Ice at 0^0C changes into water at 0^0C, when heat energy is supplied to it. The water at 0^0C changes into ice at 0^0C on freezing.

Activity -
To study the change of state from ice to water.

Materials required -
A 100 cc beaker, a thermometer (Celsius), a glass stirrer, a wire gauze, a tripod stand, a Bunsen burner, an iron stand, ice cubes.

Method -
Half fill the beaker with ice cubes and place it over a wire gauze and tripod stand. Suspend a Celsius thermometer from the iron stand, such that its bulb is touching the water level. Place a glass stirrer in the ice.

Record the temperature of ice. You will find it is 0^0 C (273 K). Now heat the beaker on a low bunsen flame and continuously stir the contents of beaker. Record the temperature five to six times, till all the ice melts. You will observe that temperature throughout remains 0^0C (273 K), till all the ice melts.



Change of state from ice to water

(I) Melting or Fusion: The process due to which a solid changes into liquid state by **absorbing heat energy** is called melting or fusion.

(II) Freezing or Solidification: The process due to which a liquid changes into solid state by **giving out heat energy** is called freezing or solidification.

(III) Melting Point: The constant temperature at which a solid changes into liquid state by absorbing heat energy at 1 atm pressure is called its melting point.

(IV) Freezing Point: The constant temperature at which a liquid changes into solid state by giving out heat energy at 1 atm pressure is called freezing point.

❖ **Note :**
The numerical value of freezing point and melting point is same.

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Melting point of ice = Freezing point of water = 0ºC (273.16 K).

Explanation: On increasing the temperature of solids, the kinetic energy (K.E.) of particles increases. Due to increase in K.E., the particles start vibrating with greater speed. The energy supplied by heat overcomes the force of attraction between the particles. Then, the particles leave their fixed positions and start moving freely and thus solid melts.

Latent Heat of Fusion : The amount of heat energy that is required to change 1 kg of solid into liquid at atmospheric pressure and at its melting point is known as the latent heat of fusion. (In Greek Latent means Hidden) Latent heat of fusion of ice = 3.34×10^5 J/kg.

❖ **Note :**
Particles of water at 0^0C (273 K) have more energy as compared to particles in ice at the same temperature.

(ii) Interconversion of liquid into gaseous state and vice versa: Liquids can be converted into gases by heating them. Similarly, gases can be converted into liquids by cooling them.

e.g. : Water at 1 atm pressure changes into vapours (steam) at 100^0C by absorbing heat. Steam at 100^0C changes into water by giving out energy.

Activity -

To study the change of state from water to steam.

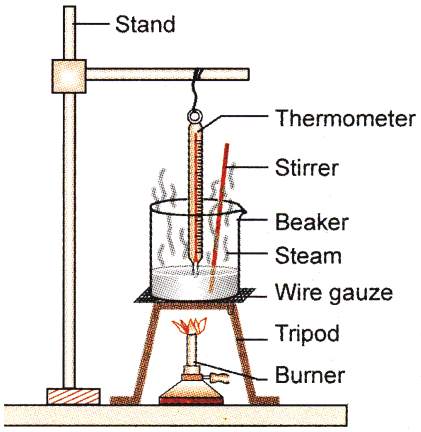
Materials required -

A 100 cc beaker, a thermometer (Celsius), a glass stirrer, a wire gauze, a tripod stand, a Bunsen burner, an iron stand, tap water.

Method -

Half fill the beaker with water and place it over a wire gauze and tripod stand. Suspend a Celsius thermometer from the iron stand, such that its bulb is touching the water level. Place a glass stirrer in the water.
Record the temperature of water. Heat the beaker on a low Bunsen flame and continuously stir the water with glass stirrer. Go on recording the temperature till water starts boiling. Allow the water to boil for few minutes and record its temperature.

You will notice that temperature of water rises till it starts boiling. The temperature of boiling water is 100^0C (373 K). If we continue heating the water it changes into steam, but the temperature remains constant, i.e., 100^0C (373 K).



Change of state from water to steam

(I) Boiling or Vaporisation: The process due to which a liquid changes into gaseous state by absorbing heat energy is called boiling.

(II) Condensation or Liquefaction: The process due to which a gas changes into liquid state by giving out heat energy is called condensation.

(III) Boiling Point: The constant temperature at which a liquid rapidly changes into gaseous state by absorbing heat energy at atmospheric pressure is called boiling point.

(IV) Condensation Point:- The constant temperature at which a gas changes into liquid state by giving out heat energy at atmospheric pressure is called condensation point.

❖ **Note :**
The numerical value of condensation point and boiling point is same.
Condensation point of water vapour = Boiling point of water = 100ºC (373.16 K).

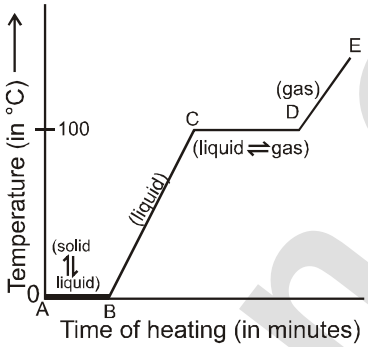
Explanation : When heat is supplied to water, particles start moving faster. At a certain temperature, a point is reached when the particles have enough energy to break the forces of attraction between the particles. At this temperature the liquid starts changing into gas.

Latent heat of vaporisation: The amount of heat which is required to convert 1 kg of the liquid (at its boiling point) to vapour without any change in temperature. Latent heat of vaporisation of water = 22.5×10^5 J/kg.

❖ **Note :**
Particles in steam, that is water vapour at 373 K have more energy than water at the same temperature. Because steam has absorbed extra energy in the form of latent heat of vaporisation.

TEMPERATURE TIME GRAPH

We can show the change of temperature with time in the form of a temperature-time graph drawn by using the readings obtained in the above experiment. Such a temperature-time graph is shown in figure.



Temperature Time Graph

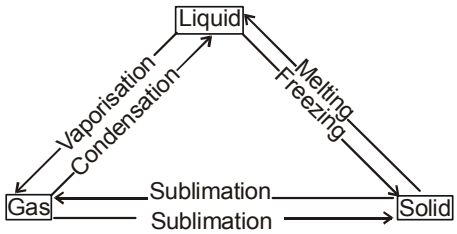
We can understand the above graph by taking an example of water.In this graph at point A, we have all ice. As we heat it, the ice starts melting to form water but the temperature of ice and water mixture does not rise. It remains constant at 0°C during the melting of ice. At point B, all the ice has melted to form water. Thus, we have only water at point B. Now, on heating beyond point B, the temperature of water (formed from ice) starts rising as shown by the sloping line BC in the graph. When the temperature of water reaches its boiling point i.e; 100°C, water starts converting into steam. But during the process of boiling, temperature does not rise and thus constant temperature is observed (line CD). At point D all the water has boiled to form steam. Thus, we have only steam at point D. Now on heating beyond point D, the temperature of steam rises as shown by the sloping line DE.

(iii) Direct interconversion of solid into gaseous state and vice versa: The changing of solid directly into vapours on heating and of vapours directly into solid on cooling is known as sublimation.

I. The solid which undergoes sublimation to form vapour is called 'sublime'.

II. The solid obtained by cooling the vapours of a solid is called 'sublimate'.

e.g. : Ammonium Chloride (NH_4Cl), iodine, camphor, naphthalene (moth balls) and anthracene.



Interconversion of states of matter

Specific Heat

The specific heat of a substance is the amount of heat which is required to raise the temperature of a unit mass of the substance by 1º C. Now, if we measure the heat in "joules" and mass in "kilograms", then the definition of specific heat becomes. **The specific heat of a substance is the amount of heat in joules required to raise**

Specimen Copy

the temperature of 1 kilogram of the substance by 1ºC.

The specific heat of a substance is usually represented by the symbol C (Sometimes, however, the specific heat of a substance is also represented by the letter 'S'). The specific heat of a substance varies slightly with temperature. The change in the specific heat of a substance with temperature is due to the changes which occur in the structure and organization of the molecules in a substance with change in temperature.

Units of Specific Heat

The unit of specific heat depends on the units in which "heat" and "mass" are measured. Now, the S.I. unit of heat is "joule" and that of mass is "kilogram", so, the S.I. unit of specific heat is "joules per kilogram per degree celcius", which is written in short form as :J/kg°C or J kg^{-1} $°C^{-1}$.

(b) Altering the Pressure of Matter :

The difference in various states of matter is due to the different intermolecular spaces between their particles. So when a gas is compressed the intermolecular space between its particles decreases and ultimately it will be converted into liquid.

Pressure and temperature determine the state of a substance. So, high pressure and low temperature can liquefy gases.

e.g. : Carbon dioxide (CO_2) is a gas under normal conditions of temperature and pressure. It can be liquefied by compressing it to a pressure 70 times more than atmospheric pressure.

Solid CO_2 is known as **'Dry ice'.** Solid CO_2 is extremely cold and used to 'deep freeze' food and to keep ice-cream cold.

Unit of pressure :

Atmosphere (atm) is a unit for measuring pressure exerted by a gas.

The S.I unit of pressure is Pascal (Pa.)

1 atm = 1.01×10^5 Pa.

❖ **Note :**

When pressure is lowered the boiling point of liquid is lowered. This helps in rapid change of liquid into gas.

Solved Examples

Example.1_ Why is ice at 273 K more effective in cooling than water at the same temperature.

Solution. Ice (solid water) has extra energy in the form of latent heat of fusion (3.35×10^5 J/kg) as compared to water. Due to absorption of energy the temperature of surroundings gets lowered or cooling is caused. Since water is already present in a liquid state so it does not absorb energy from the surroundings. Thus, ice at 273 K causes more cooling than water at the same temperature.

Example.2_ What produces more severe burns, boiling water or steam ?

Solution. When water (liquid form) at 373 K is converted into steam at 373 K, it absorbs energy equal to latent heat of vaporisation (22.6×10^5J/kg) from surroundings. Thus, steam (vapour form of water) at 373 K (100°C) have more energy then water at the same temperature and hence, steam produces more severe burns than boiling water.

Check Your Progress

1._ At what temperature, do solid ice and liquid water co-exist together.

2._ What do you understand by the term latent heat.

3._ The freezing point of a substance is the same as the melting point. Justify this statement by a simple example. Is the freezing point of sea water is same as that of rain water ?

4._ Name the temperature at which liquid changes into a gas ?

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5._ Write the name of two substances which shows sublimation.

C. EVAPORATION

The phenomenon of change of a liquid into vapours at any temperature below its boiling point is called evaporation.

Water changes into vapours below 100^0C. The particles of matter are always moving and are never at rest. At a given temperature in any gas, liquid or solid, there are particles with different K.E.
In case of liquids, a small fraction of particles at the surface, having higher K.E., is able to break the forces of attraction of other particles and gets converted into vapour.

❖ **Note :**
The atmospheric pressure at sea level is 1 atm.

(a) Factors Affecting Evaporation:

(i) Temperature: With the increase in temperature the rate of evaporation increases.
Rate of evaporation α T

Reason : On increasing temperature more number of particles get enough K.E. to go into the vapour state.

(ii) Surface Area : Rate of evaporation α Surface area
Since evaporation is a surface phenomena, if the surface area is increased, the rate of evaporation increases. So, while putting clothes for drying up we spread them out.

(iii) Humidity of Air : Rate of evaporation $\alpha \frac{1}{\text{Humidity}}$

Humidity is the amount of water vapour present in air. When humidity of air is low, the rate of evaporation is high and water evaporates more readily. When humidity of air is high, the rate of evaporation is low and water evaporates very slowly.

(iv) Wind Speed : Rate of evaporation α Wind speed
With the increase in wind speed, the particles of water vapour move away with the wind. So the amount of water vapour decreases in the surroundings.

(v) Nature of substance : Substances with high boiling points will evaporate slowly, while substances with low boiling points will evaporate quickly.

(b) Differences between Evaporation and Boiling :

Evaporation	Boiling
It is a surface phenomenon.	It is a bulk phenomenon.
It occurs at all temperatures below B.P.	It occurs at B.P. only.
The rate of evaporation depends upon the surface area of the liquid, humidity temperature & wind speed	The rate of boiling does not depend upon the surface area, wind speed, and humidity.

(c) Cooling Caused by Evaporation :

The cooling caused by evaporation is based on the fact that when a liquid evaporates, it draws (or takes) the **latent heat of vaporisation** from 'anything' which it touches.
For example :

(i) We Wear Cotton Clothes in Summer :

During summer, we perspire more because of the mechanism of our body which keeps us cool. During evaporation, the particles at the surface of liquid gain energy from the surroundings or body surface. The heat energy equal to latent heat of vaporisation, is absorbed from the body, leaving the body cool. Cotton, being a good absorber of

Specimen Copy

water helps in absorbing the sweat.

(ii) Pouring the acetone on our palm : If we pour some acetone or ether or nail polish remover on our palm then we feel cool because the energy needed for evaporation is taken from our palm. Hence, our palm feels cooling.

(iii) Sprinkling of water on the open ground after a hot sunny day : The sprinkling of water of the open ground or roof after a hot sunny day causes the cooling of the surface of roof because the water evaporates by absorbing heat from the ground and the surrounding air. In this way the ground or roof become cool and we feel comfort.

(d) Water droplets on the outer surface of a glass containing ice cold water : If we take some ice cold water in a glass then we will observe water droplets on the outer surface of glass.
Reason : The water vapour present in air on coming in contact with glass of cold water, loses energy. So water vapour gets converted to liquid state, which we see as water droplets.

Solved Examples

Example.1_ Out of water and petrol which is a more volatile ?
Solution. The petrol is more volatile than water because the force of attraction between the particles of petrol is lesser than water.

Example.2_ Why do we feel cold after taking a hot bath ?
Solution. The hot water takes heat from the body and evaporates. Thus, the body loses heat and we feel cold.

Check Your Progress

1._ Does the evaporation of liquid occur only at a fixed temperature ?

2._ What is the difference between evaporation and boiling.

3._ Why should wet clothes be spread while drying ?

4._ Why do we wear cotton clothes in summer ?

5._ Why water droplets appear in a glass containing ice cold water ?

Board Level Exercise

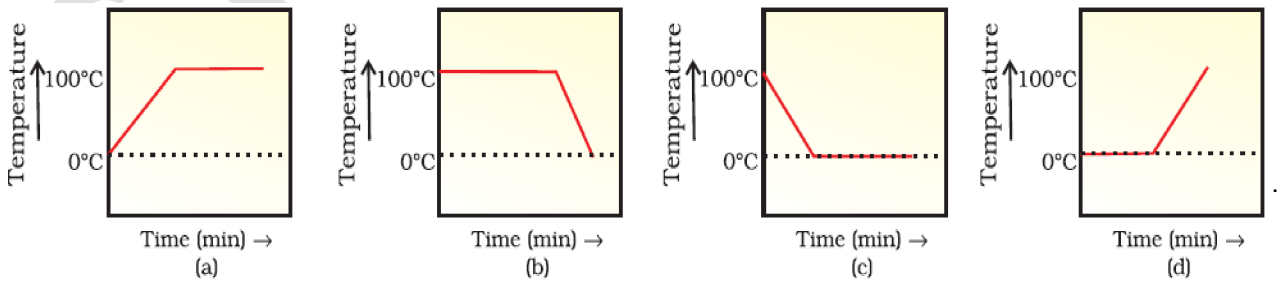
TYPE (I) : VERY SHORT ANSWER TYPE QUESTIONS : **[01 MARK EACH]**

1._ 'Osmosis is a special kind of diffusion'. Comment.

2._ A sample of water under study was found to boil at 102°C at normal temperature and pressure. Is the water pure? Will this water freeze at 0°C? Comment.

TYPE (II) : SHORT ANSWER TYPE QUESTIONS : **[02 MARKS EACH]**

3._ A student heats a beaker containing ice and water. He measures the temperature of the content of the beaker as a function of time. Which of the following Fig. would correctly represent the result? Justify your choice



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4._ It is a hot summer day, Priyanshi and Ali are wearing cotton and nylon clothes respectively. Who do you think would be more comfortable and why?

TYPE (III) : LONG ANSWER TYPE QUESTIONS: [04 MARK EACH]

5._ Water as ice has a cooling effect, whereas water as steam may cause severe burns. Explain these observations.

6._ (a) Conversion of solid to vapour is called sublimation. Name the term used to denote the conversion of vapour to solid.

(b) Conversion of solid state to liquid state is called fusion; what is meant by latent heat of fusion?

TYPE (IV): VERY LONG ANSWER TYPE QUESTIONS [05 MARK EACH]

7._ Comment on the following statements:

(a) Evaporation produces cooling.

(b) Rate of evaporation of an aqueous solution decreases with increase in humidity.

(c) Sponge though compressible is a solid.

8._ You are provided with a mixture of naphthalene and ammonium chloride by your teacher. Suggest an activity to separate them with well labelled diagram.

Exercise-1

Marked Questions can be used as Revision Questions.

SUBJECTIVE QUESTIONS

SUBJECTIVE EASY, ONLY LEARNING VALUE PROBLEMS

SECTION (A) : PHYSICAL NATURE OF MATTER

A-1. Why do gases diffuse very fast ?

A-2. Arrange the following substances in the increasing order of interparticle forces.
Water, common salt, nitrogen.

A-3. A certain substance 'A' can be compressed to very less extent, but takes up the shape of any container in which it is placed. What will be its physical state ?

A-4. Solids are generally very heavy while gases are light. Explain.

A-5. Define diffusion ? Give one example each of diffusion of (i) a solid into a liquid, (ii) a liquid into another liquid, (iii) a gas into a liquid and (iv) a gas into another gas

SECTION (B) : INTERCONVERSION OF STATES OF MATTER

B-1. The melting point of a substance is just below the room temperature. Predict its physical state.

B-2. How the two temperature scales (Celsius) °C and (Fahrenheit) °F are related with each other.

B-3. When a solid melts, its temperature remains the same, so where does the heat energy go ?

B-4. Discuss the significance of the boiling point of a liquid.

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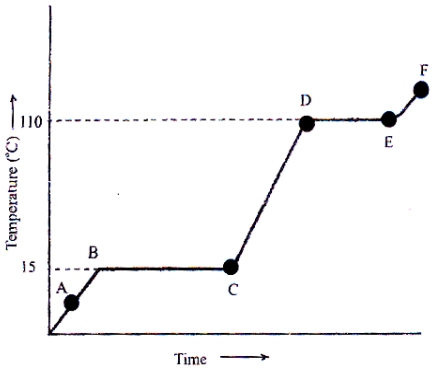
B-5. (a) The graph shows the heating curve for a pure substance. The temperature rises with time as the substance is heated:
(b) What is the physical state of the substance at the points A,B,C,D, E and F ?
(c) What is the melting point of the substance ? What is its boiling point ?
(d) What happens to the temperature during change of the state ?
(e) The substance is not water. How can you judge from the graph ?



SECTION (C) : EVAPORATION

C-1. Sometimes for performing minor surgery surgeon uses ether,why?

C-2. Explain the factors affecting the rate of evaporation.

C-3. What is the purpose of sipping coffee from a saucer instead of sipping from a glass or cup ?

C-4. How is water kept in an earthen pot (matka) become cool during summer ?

C-5. Why a desert cooler is more effective in summer ?

OBJECTIVE QUESTIONS

SINGLE CHOICE OBJECTIVE, STRAIGHT CONCEPT/FORMULA ORIENTED

SECTION (A) : PHYSICAL NATURE OF MATTER

A-1. The quantity of matter present in an object is called its -
(A) weight (B) volume (C*) mass (D) density

A-2. Which of the following is/are rigid(s) ?
(A*) Solids (B) Liquids (C) Gases (D) Both (B) and (C)

A-3. Which of the following statements is/are correct ?
(A) Intermolecular forces of attraction in solids are maximum.
(B) Intermolecular forces of attraction in gases are minimum.
(C) Intermolecular spaces in solids are minimum.
(D*) All of the above

A-4. What happens to the volume of the aqueous solution when small amount of sugar is dissolved in it ?
(A) Volume increases (B) Volume decreases
(C) Volume first increases then decreases. (D*) No change in volume.

A-5. Which of the following is not correct for gases ?
(A) Gases have definite mass. (B) Gases have definite shape.
(C) Gases have definite volume. (D*) Both (B) and (C)

A-6. Which of the following is not an example of matter ?
(A) Air (B*) Feeling of cold (C) Dust (D None of these

Specimen Copy

A-7. Which of the following statements is/are correct ?
(A) Interparticle spaces are maximum in the gaseous state of a substance .
(B) Particles which constitute gas follow a zig-zag path.
(C) Solid state is the most compact state of substance.
(D*) All are correct

A-8. Which out of the following does not make sense ?
(A) Solids have fixed shape and fixed volume.
(B*) Liquids can be compressed easily, but not gases.
(C) The particles of solids have negligible kinetic energy.
(D) Property of diffusion is maximum in the gaseous state.

A-9. Which of the following is/are application(s) of high compressibility of gases ?
(A) L.P.G. is used as fuel in homes for cooking food .
(B) Oxygen cylinders are supplied to hospitals.
(C) C.N.G. is used as fuel in vehicles.
(D*) All of these

A-10. Which of the following statements does not go with the liquid state ?
(A) Particles are loosely packed in the liquid state.
(B*) Fluidity is the maximum in the liquid state.
(C) Liquids can be compressed.
(D) Liquids take up the shape of that container in which these are placed.

SECTION (B) : INTERCONVERSION OF STATES OF MATTER

B-1. On changing which of the following, the states of matter will change ?
(A) Temperature (B) Pressure (C*) (A) & (B) both (D) None of these

B-2. Melting & freezing point of water -
(A*) are same. (B) have large difference between them.
(C) have close difference between them. (D) None of these

B-3. The boiling point of alcohol is 78^0C. What will be the temperature in Kelvin scale ?
(A) 373 K (B*) 351 K (C) 375 K (D) 78 K

B-4. Latent heat of vaporisation of water is -
(A) 2.25×10^2 J/kg (B*) 22.5×10^5 J/kg (C) 3.34×10^5 J/kg (D) 33.4×10^2 J/kg

B-5. S.I. unit of temperature is -
(A*) Kelvin (B) Celsius (C) Both (D) None

B-6. In sublimation process -
(A) solid changes into liquid. (B) liquid changes into gas.
(C*) solid changes directly into gas. (D) None of these

B-7. When a liquid starts boiling, the further heat energy which is supplied -
(A) is lost to the surrounding as such.
(B) increases the temperature of the liquid.
(C) increases the kinetic energy of the liquid.
(D*) is absorbed as latent heat of vaporisation by the liquid.

B-8._ Which of these choices will not change the state of matter?
(A) Temperature (B*) Crushing a crystal (C) Pressure (D) Electricity

Specimen Copy

B-9. Which of the following will respond to sublimation ?
(A) Common salt (B) Sugar (C*) Camphor (D) Potassium nitrate

B-10._ Identify the true statement among the following:
(A*) Gases are highly compressible and diffuse very easily.
(B) Gases are highly compressible and possess strong attraction force.
(C) Solid molecules are closely packed and highly compressible
(D) Solid molecules are loosely packed and possess strong forces.

SECTION (C) : EVAPORATION

C-1. During evaporation of liquid -
(A*) the temperature of the liquid falls.
(B) the temperature of the liquid rises.
(C) the temperature of the liquid remains unchanged.
(D) all statements are wrong.

C-2. As temperature increases rate of evaporation -
(A*) increases. (B) decreases.
(C) first increases, then decreases. (D) remains same.

C-3. On a humid day rate of evaporation -
(A) is more. (B*) is less.
(C) initially more, later on less. (D) remains same.

C-4. During evaporation, particles of a liquid change into vapours only -
(A*) from the surface. (B) from the bulk.
(C) from both surface and bulk. (D) neither from surface nor from bulk.

C-5. Rate of evaporation depends upon -
(A) temperature (B) surface area (C) humidity (D*) All of these

C-6. In which phenomenon water changes into water vapour below its boiling point ?
(A*) Evaporation (B) Condensation
(C) Boiling (D) No such phenomena exists

C-7._ During summer water kept in earthen pot becomes cool because of the phenomena -
(A) Diffusion (B) Transpiration (C) Osmosis (D*) Evaporation

C-8._ Dogs stretch out their tongues generally in summer because
(A*) Evaporation leads cooling (B) Of condensation of water vapour
(C) Of freezing of saliva (D) Their body temperature are high

C-9._ Rate of evaporation of water
(A) Is more in coastal areas than in non coastal areas
(B*) Is more in non coastal areas than in coastal areas
(C) Is the same in both coastal and non coastal areas
(D) Cannot be predicted

C-10._ Which of the following factors do not affect the rate of evaporation -
(A*) Depth of liquid (B) Humidity of surrounding air
(C) Temperature of liquid (D) Surface of liquid

Specimen Copy

Exercise-2

✍ **Marked Questions can be used as Revision Questions.**

OBJECTIVE QUESTIONS

1._ In which of the following substances, intermolecular force of attraction is the maximum?
(A*) iron bar (B) water (C) air (D) nitrogen

2._✍ Water sticks to glass due to
(A*) Adhesive force between water and glass (B) Cohesive force between water and glass
(C) Cohesive force between water molecules (D) Cohesive force between glass molecules

3._ Identify the wrong statement among the following
(A) Molecules of solid posses only vibratory motion
(B) Solid are incompressible
(C*) Solid have only one free surface
(D) Gases are highly diffusible

4. A liquid disturbed by stirring comes to rest after sometime due to its property of -
(A) Compressibility (B) Diffusion (C*) Viscosity (D) All of these

5.✍ When common salt is added is ice -
(A*) its melting point decreases.
(B) its melting point increases.
(C) its melting point does not change from 0ºC
(D) ice becomes harder.

6. Which of the following statements is false ?
(A) Melting and freezing point of a substance are the same.
(B*) Evaporation of liquid takes place only at its boiling point.
(C) Pure water has no taste
(D) Water allows sunlight to pass through it.

7.✍ The water boils when :
(A*) Saturated vapour pressure of water becomes equal to the atmospheric pressure
(B) Boiling point of water becomes more than atmospheric pressure
(C) Saturated vapour pressure of water is less than atmospheric pressure
(D) Vapour pressure of water becomes more than atmospheric pressure

8. The temperature remain same during melting, while all the ice changes into water due to the :
(A*) latent heat of fusion. (B) latent heat of vapourisation.
(C) latent heat of evaporation. (D) latent heat of sublimation.

9. Fusion is the process of conversion of -
(A) liquid into gas. (B) solid into gas. (C*) solid into liquid. (D) liquid into solid.

10.✍ A thermometer is inserted into a beaker filled with ice at 0ºC. The beaker is heated slowly. The temperature does not rise for some time. This is because -
(A) ice is very cold
(B*) heat was used for changing ice at 0ºC to water at 0ºC
(C) the density of water is more than ice
(D) the density of water is less than the ice

Specimen Copy

11. What sublimate will be obtained when a mixture of sand, sulphur, common salt and iodine is sublimed ?
(A) Sand (B*) Iodine (C) Sulphur (D) Common salt

12. Purity of organic liquid can be checked by its characteristic -
(A*) boiling point (B) volume (C) solubility in water (D) solubility in alcohol

13. Sublimation is involved in
(A) Incense stick and odonil (B) Camphor and incense stick
(C) Perfume and odonil (D*) Naphthalene balls and camphor

14. At higher altitude :
(A) B.P. of a liquid increases (B) Melting point of a substance increases
(C*) B.P. of a liquid decreases (D) None of these.

15. Which of the following conditions is most favourable for converting a gas into liquid ?
(A*) High pressure, low temperature (B) Low pressure, low temperature
(C) Low pressure, high temperature (D) High pressure, high temperature

16. Which of the following statements regarding melting point and freezing point of a substance is true ?
(A) Melting point of a substance is more than its freezing point.
(B) Melting point of a substance is less than its freezing point.
(C*) Melting point and freezing point of a substance are same numerically.
(D) None of these.

Exercise-3

Marked Questions can be used as Revision Questions.

NTSE PROBLEMS (PREVIOUS YEARS)

1. Boiling point of water is – **[Raj. NTSE Stage-I/13]**
(A) 273K (B) 0K (C*) 373K (D) 100K

2. By which property are gases and liquids different from solid ? **[Raj. NTSE STAGE-I/14]**
(A) Volume (B) Mass (C) Conductivity (D*) Fluidity

3. Ice is floating on water in a beaker when ice completely melts then level of water in beaker : **[Delhi_NTSE Stage-I/15]**
(A) Increases (B) Decreases
(C*) remains the same (D) First increases decreases

4. The boiling point of a gas is –80°C. This temperature is equivalent to: **[Raj._NTSE Stage-I/15]**
(A) –193 K (B*) 193 K (C) 353 K (D) – 353 K

5. When the solid melts, its temperature : **[Haryana_NTSE Stage-I/15]**
(A) increases (B) decreases
(C*) remain constant (D) first increases then decrease

6. In which state of a substance, it has the shape ? **[Gujarat NTSE Stage-I/17]**
(A) Liquid (B) Liquid & Gas (C) Gas (D*) Solid

Specimen Copy

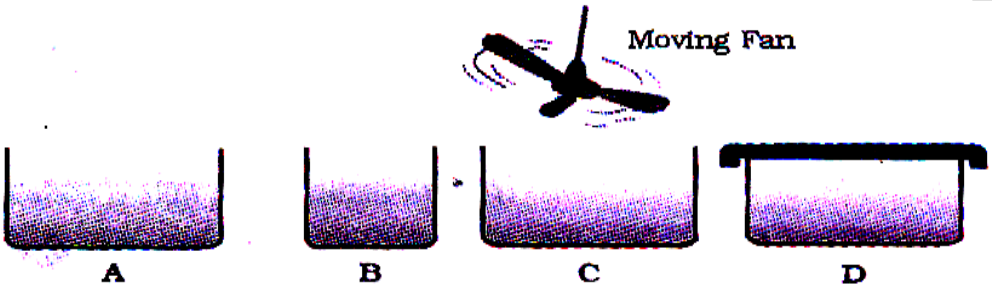
7. The physical state of water at 298 K temperature is : **[Delhi NTSE Stage-I/17]**
(A) Gaseous (B) Solid (C*) Liquid (D) Plasma

VALUE BASED / PRACTICAL BASED QUESTIONS

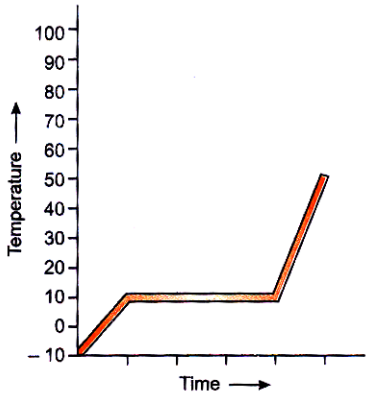
MARKED QUESTIONS MAY HAVE FOR REVISION QUESTIONS.

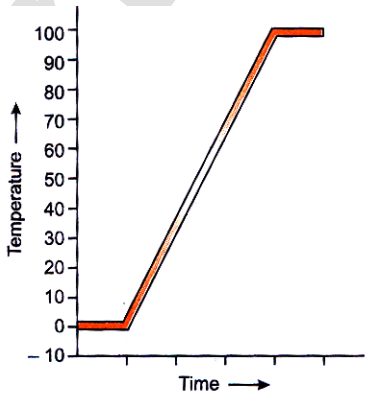
This Section is not meant for classroom discussion. It is being given to promote self-study and self testing amongst the Resonance students.

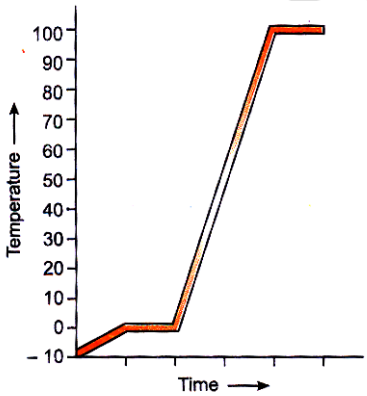
1. Look at Fig. and suggest in which of the vessel A, B, C or D the rate of evaporation will be the highest ?

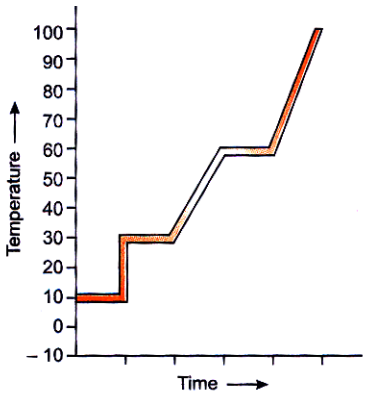


2. Ice at –10°C is heated slowly until the water formed starts boiling. The temperature time plot that will explain the changes correctly is represented as :

(i)


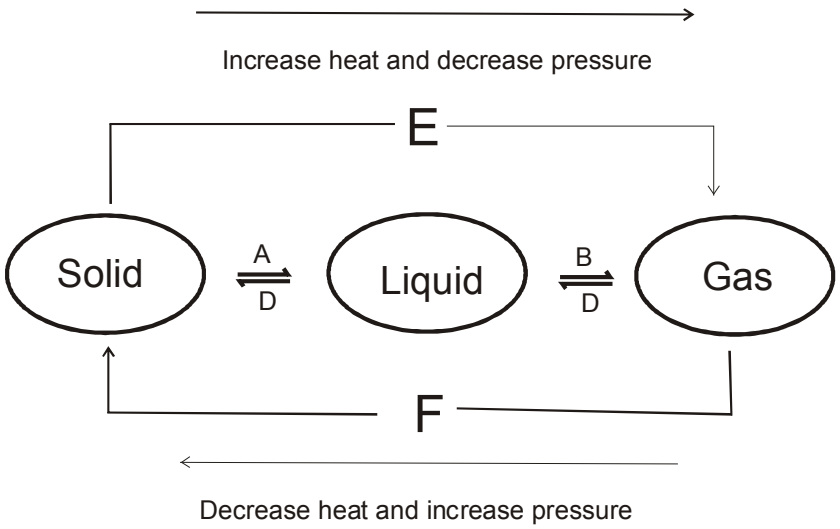
(ii)


(iii)


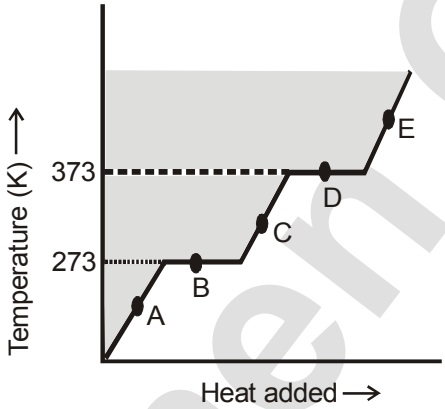
(iv)


(A) (i) and (iii) are correct (B) Both (ii) and (iv) are correct
(C*) only (iii) is correct (D) only (iv) is correct

3. Name A, B, C, D, E and F in the following diagram showing change in their state :



4. The heating curve of a pure substance at one atmosphere pressure is shown in the following figure.



(a) What is the physical state of the substance at points A, B, C, D and E.

(b) What is the melting point of the substance ?

(c) What the boiling point of the substance ?

(d) What happens to the temperature when the substance is changing its state ?

(e) Can the given substance be ice at point A ?

5. Give two reasons why the rate of diffusion of liquid in another liquid is greater than the rate of diffusion of a solid in a liquid ?

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Answers

EXERCISE - 1
SUBJECTIVE QUESTIONS

SUBJCTIVE EASY, ONLY LEARNING VALUE PROBLEMS

B-1 Liquid **B-2** $F - 32 = \frac{9}{5}C$

B-5 a) At point A : The substance is in the solid state
At point B : The substance has started melting and it exist in solid and liquid states along the curve BC.
At point C : The substance is in the liquid state
At point D : The substance has started boiling and it exists in liquid and gas state along the curve DE
At point E : The substance is in the gaseous state and maintains it along EF and onwards.
(b) The melting point of the substance is 15°C
(c) The boiling point is 110°C.

C-1 Wet air

C-5 Hot and dry air passes through the wet pads of cooler and takes up water vapour (due to evaporation) with it and thereby the air coming out loses its temperature and feels cold.

OBJECTIVE QUESTIONS

SINGLE CHOICE OBJECTIVE, STRAIGHT CONCEPT/FORMULA ORIENTED

SECTION (A) : PHYSICAL NATURE OF MATTER

A-1 (C) **A-2** (A) **A-3** (D) **A-4** (D) **A-5** (D) **A-6** (B) **A-7** (D)
A-8 (B) **A-9** (D) **A-10** (B)

SECTION (B) : INTERCONVERSION OF STATES OF MATTER

B-1 (C) **B-2** (A) **B-3** (B) **B-4** (B) **B-5** (A) **B-6** (C)
B-7 (D) **B-8** (B) **B-9** (C) **B-10** (A)

SECTION (C) : EVAPORATION

C-1 (A) **C-2** (A) **C-3** (B) **C-4** (A) **C-5** (D) **C-6** (A)
C-7 (D) **C-8** (A) **C-9** (B) **C-10** (A)

EXERCISE - 2
OBJECTIVE QUESTIONS

SINGLE CHOICE OBJECTIVE, STRAIGHT CONCEPT/FORMULA ORIENTED

Ques	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Ans	A	A	C	C	A	B	A	A	C	B	B	A	D	C	A	C

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EXERCISE - 3
NTSE PROBLEMS (PREVIOUS YEARS)

Ques	1	2	3	4	5	6	7
Ans	C	D	C	B	C	D	C

PRACTICAL BASED QUESTIONS

1. C **2.** C

3. A = fusion or melting, B = Evaporation, C = Condensation
D = Solidification or Freezing, E = Sublimation, F = Frosting

4. (a) At point A, the substance is in the solid state; at point B, it exists both in the solid as well as in the liquid state. At point C, the substance exists as a liquid ; at point D, it exists both as a liquid as well as a gas while at point E, it exists only as a gas.
(b) The m.p. of the substance is 273 K.
(c) The b.p. of the substance is 373 K.
(d) During the phase, from solid to liquid or from liquid to gas, the temperature remains constant.
(e) From melting point and boiling point, the substance appears to be water.

5. The following reason
(i) The kinetic energy of the particles of liquid is greater than the kinetic energy of the particles of solid.
(ii) The interparticle space is greater in liquid than the interparticle space of solids.

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NUMBER SYSTEM

A. INTRODUCTION TO NUMBER SYSTEM & RATIONAL NUMBERS

(a) Classification of Numbers

(i) Natural numbers : Counting numbers are known as **natural numbers**.
N = { 1, 2, 3, 4, ... }.

(ii) Whole numbers : All natural numbers together with 0 form the collection of all **whole numbers**.
W = { 0, 1, 2, 3, 4, ... }.

(iii) Integers : All whole numbers and negative of natural numbers form the collection of all **integers**.
I or **Z** = { ..., – 3, – 2, – 1, 0, 1, 2, 3, ... }.

(iv) Rational numbers : The numbers which can be expressed in the form of $\frac{p}{q}$, where **p** and **q** are integers and $q \neq 0$.

For example : $\frac{2}{3}$, $-\frac{37}{15}$.

❖ All natural numbers, whole numbers and integers are rational.

(v) Real numbers : Numbers which can represent actual physical quantities in a meaningful way are known as **real numbers**. They can be represented on the number line.

❖ Real numbers include all rational and irrational numbers.

(vi) Prime numbers : Prime numbers are natural numbers greater than 1 and each of which is divisible by 1 and itself only. For example : 2, 3, 5, 7, 11, 13, 17, 19, 23, ... etc.

(vii) Composite numbers : All natural numbers greater than 1 which are not prime numbers.

❖ 1 is neither prime nor composite number.

(viii) Co-prime Numbers : If the H.C.F. of the given numbers (not necessarily prime) is 1 then they are known as **co-prime numbers**. For example : 4, 9 are co-prime as H.C.F. of (4, 9) = 1.

❖ Any two consecutive numbers will always be co-prime.

(ix) Even Numbers : Integers divisible by 2
E = { ..., – 2, 0, 2, ... }.
(x) Odd Numbers : Integers not divisible by 2
E = { ..., – 3, –1, 1, 3, ... }.

(b) Rational number in decimal form

(i) Terminating Decimal :

Let **x** be a rational number whose decimal expansion terminates. Then, **x** can be expressed in the form $\frac{p}{q}$, where **p** and **q** are co-prime, and prime factorization of **q** is of the form $\mathbf{2^m \times 5^n}$, where **m**, **n** are non-negative integers. In such finite decimal number of digit occurs after decimal.

For example : $\frac{1}{2}$ = 0.5, $\frac{11}{16}$ = 0.6875, $\frac{3}{20}$ = 0.15 etc.

(ii) Non-Terminating and Repeating (Recurring Decimal) :

Let x = $\frac{p}{q}$ be a rational number, such that the prime factorization of **q** is not of the form $2^m \times 5^n$, where **m, n** are non - negative integers. Then, **x** has a decimal expansion which is non - terminating repeating. In this a set of digits or a digit is repeated continuously.

For example : $\frac{2}{3} = 0.6666..... = 0.\overline{6}$ and $\frac{5}{11} = 0.454545..... = 0.\overline{45}$

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(c) Representation of rational number on a real number line

❖ **Representing terminating Decimals on Number line :**

The process of visualization of number on the number line through a magnifying glass is known as **successive magnification.**

Sometimes, we are unable to check the numbers like 3.765 and $4.\overline{26}$ on the number line. We seek the help of magnifying glass by dividing the part into subparts and subparts into again equal subparts to ensure the accuracy of the given number.

❖ Method to Find Such Numbers on the Number Line

1. Choose the two consecutive integral numbers in which the given number lies.

2. Choose the two consecutive decimal points in which the given decimal part lies by dividing the two given decimal parts into required equal parts.

3. Visualize the required number through magnifying glass.

(d) Conversion of recuring decimal into fraction

(i) Long Method :

Step 1 : Take the mixed recurring decimal and let it be equal to **x.**

Step 2 : Count the number of nonrecurring digits after the decimal point. Let it be **n**.

Step 3 : Multiply both sides of equation by $\mathbf{10^n}$ so that only the repeating decimal is on the right hand side of the decimal point.

Step 4 : Multiply both sides of equation obtained in step 3 by $\mathbf{10^m}$ where **m** is the number of repeating digits in the decimal part.

Step 5 : Subtract the equation in **step 3** from equation obtained in **step 4**.

Step 6 : Divide both sides of the resulting equation by the coefficient of **x**.

Step 7 : Write the rational number thus obtained in the simplest $\frac{p}{q}$ form.

(ii) Direct Method :

Step1 : To obtain numerator subtract the number formed by non-repeating digits from the complete number without decimal. (Consider repeated digits only once.)

Step2 : To obtain denominator take number of nines = Number of repeating digits & after that put number of zeros = number of non-repeating digits.

(e) Finding Rational Numbers Between Two Integral Number :

Method - I

Let a & b are two given rational numbers such that a < b.

If n rational numbers are inserted between a & b.

Then, multiply numerator and denominator of a and b by $\frac{n+1}{n+1}$.

$a = a \times \frac{n+1}{n+1}$ and $b = b \times \frac{n+1}{n+1}$.

Then, as we increase the value of numerator we get rational numbers between a & b.

Method - II

Let a & b are two given rational numbers such that a < b then, a < b

$\Rightarrow$ a + a < b + a [adding a both sides]

$\Rightarrow$ 2a < a + b $\Rightarrow$ $a < \frac{a+b}{2}$

Again, a < b

Specimen Copy

$\Rightarrow$ a + b < b + b. [adding b both sides]

$\Rightarrow$ a +b < 2b $\Rightarrow$ $\frac{a+b}{2} < b$.

$\therefore$ $a < \frac{a+b}{2} < b$. i.e. $\frac{a+b}{2}$ lies between a and b.

Hence 1st rational number between a and b is $\frac{a+b}{2}$.

For next rational number

$$\frac{a+\frac{a+b}{2}}{2} = \frac{\frac{2a+a+b}{2}}{2} = \frac{3a+b}{4}$$

$\therefore$ $a < \frac{3a+b}{4} < \frac{a+b}{2} < b.$

next $$\frac{\frac{a+b}{2}+b}{2} = \frac{a+b+2b}{2\times 2} = \frac{a+3b}{4}$$

$\therefore$ $a < \frac{3a+b}{4} < \frac{a+b}{2} < \frac{a+3b}{4} < b$ and continues like this.

Solved Examples

Example.1

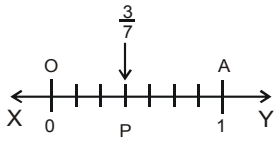
Is (39, 93) a coprime ?

Sol. HCF of (39, 93) is 3.
$\therefore$ (39, 93) is not coprime.

Example.2

Represent $\frac{3}{7}$ on a real number line.

Sol. **(i)** Draw a line XY which extends endlessly in both the directions.
(ii) Take a point O on it and let it represent O (zero).
(iii) Taking the fixed length, called unit length, mark off OA = 1 unit, as shown in figure below
(iv) Divide OA into 7 equal parts. OP represents $\frac{3}{7}$ of a unit.



Example.3

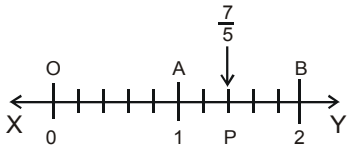
Represent $\frac{7}{5}$ on a real number line.

Sol. $\frac{7}{5} = 1\frac{2}{5}$

(i) Draw a line XY which extends endlessly in both the directions.
(ii) Take a point O on it and let it represent 0 (zero).
(iii) Taking the fixed length, called unit length, mark off OA = 1 unit and OB = 2 unit.

Specimen Copy

(iv) Divide OA and AB into 5 equal parts. OP represents the rational number $\frac{7}{5}$.



Example.4

Represent $-\frac{13}{4}$ on a real number line.

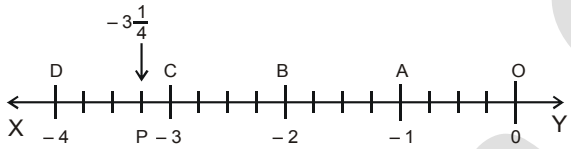
Sol. $-\frac{13}{4} = -3\frac{1}{4}$

(i) Draw a line XY which extends endlessly in both the directions.

(ii) Take a point O on it and let it represent 0 (zero).

(iii) Taking the fixed length, called unit length, mark off OA = 1 unit and OB = 2 unit and OC = 3 unit on the left side of O.

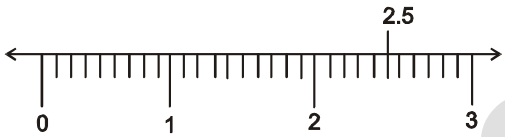
(iv) Divide OA , AB, BC and CD into 4 equal parts. OP represents the rational number $-\frac{13}{4}$ of a unit.



Example.5

Represent 2.5 on a real number line.

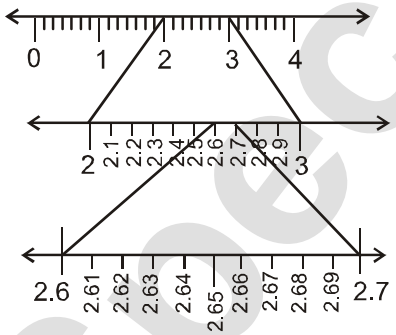
Sol.



Example.6

Represent 2.65 on a real number line by process of magnification.

Sol.



Example.7

Visualize the representation of $5.3\overline{7}$ on the number line upto 5 decimal places.

Sol.

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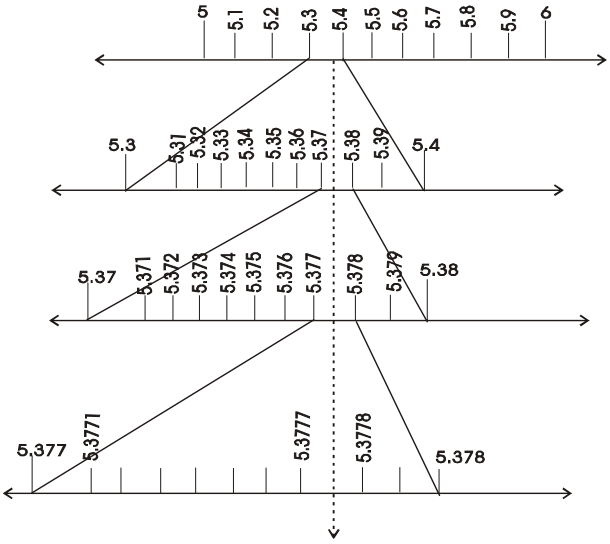

Example.8

Express $0.\overline{6}$ to $\frac{p}{q}$ form.

Sol. Let $x = 0.\overline{6}$

i.e. $x = 0.6666.....$ ...(i)

Multiply both sides of eq.(i) by 10.

$10x = 6.666.....$ ...(ii)

Subtract eq.(i) from eq.(ii)

$$\begin{array}{l} 10x = \quad 6.666.... \\ \underline{-x = -0.666....} \\ \quad 9x = 6 \end{array}$$

$\Rightarrow \quad x = \frac{6}{9} \quad \Rightarrow \quad x = \frac{2}{3}$.

Example.9

Express $0.\overline{47}$ to $\frac{p}{q}$ form.

Sol. Let $x = 0.\overline{47}$

i.e. $x = 0.474747.....$ ...(i)

Multiply both sides of eq.(i) by 100.

$100x = 47.474747.....$ ...(ii)

Subtract eq.(i) from eq.(ii)

$$\begin{array}{l} 100x = \ 47.474747.... \\ \underline{-x = -0.474747....} \\ \quad 99x = 47 \end{array}$$

$\Rightarrow x = \frac{47}{99}$.

Example.10

Express $0.12\overline{3}$ to $\frac{p}{q}$ form.

Sol. Let $x = 0.12\overline{3}$

i.e. $x = 0.12333.....$ ...(i)

Multiply both sides of eq.(i) by 100.

Specimen Copy

100x = 12.333..... ...(ii)
Multiply both sides of eq.(ii) by 10
1000x = 123.333..... ...(iii)
Subtract eq.(ii) from eq.(iii)
1000 x = 123.333....
– 100 x = –12.333....

900 x = 111.000

$\Rightarrow$ x = $\frac{111}{900}$ $\Rightarrow$ x = $\frac{3\times 37}{900} = \frac{37}{300}$.

Example.11

Express the following to $\frac{p}{q}$ form using direct method :

(i) $0.\overline{45}$ **(ii)** $0.7\overline{37}$ **(iii)** $0.46\overline{573}$

Sol. **(i)** $0.\overline{45} = \frac{45-0}{99} = \frac{45}{99} = \frac{5}{11}$.

(ii) $0.7\overline{37} = \frac{737-7}{990} = \frac{730}{990} = \frac{73}{99}$.

(iii) $0.46\overline{573} = \frac{46573-46}{99900} = \frac{46527}{99900}$.

Example.12

Find 4 rational numbers between 2 and 3.

Sol. **Steps :**

(i) Multiplying 2 and 3 in N^r and D^r with (4+1).

(ii) 2 = $\frac{2\times(4+1)}{(4+1)} = \frac{10}{5}$ & $\frac{3\times(4+1)}{(4+1)} = \frac{15}{5}$

(iii) So, the four required numbers are $\frac{11}{5}, \frac{12}{5}, \frac{13}{5}, \frac{14}{5}$.

Example.13

Find 3 rational numbers between $\frac{1}{3}$ & $\frac{1}{2}$.

Sol. $\frac{\frac{1}{3}+\frac{1}{2}}{2} = \frac{\frac{2+3}{6}}{2} = \frac{5}{12}$

$\therefore$ $\frac{1}{3}, \frac{5}{12}, \frac{1}{2}$

$\frac{\frac{1}{3}+\frac{5}{12}}{2} = \frac{\frac{4+5}{12}}{2} = \frac{9}{24}$

$\therefore$ $\frac{1}{3}, \frac{9}{24}, \frac{5}{12}, \frac{1}{2}$

Specimen Copy

$$\frac{\frac{5}{12}+\frac{1}{2}}{2} = \frac{\frac{5}{12}+\frac{6}{12}}{2} = \frac{11}{24}$$

$\therefore \quad \frac{1}{3}, \frac{9}{24}, \frac{5}{12}, \frac{11}{24}, \frac{1}{2}.$

Check Your Progress

1. Represent the number $\frac{3}{5}$ on the number line.

2. Find a fraction between $\frac{3}{8}$ and $\frac{2}{5}$.

Ans. $\frac{31}{80}$

3. Insert 5 rational numbers between 3 and 4.

Ans. $\frac{19}{6}, \frac{20}{6}, \frac{21}{6}, \frac{22}{6}, \frac{23}{6}$

4. Which of the following fractions yield a recurring decimal ?

$\frac{5}{3}; \frac{7}{16}; \frac{9}{14}; \frac{5}{7}; \frac{12}{5}; \frac{6}{11}$

Ans. $\frac{5}{3}, \frac{9}{14}, \frac{5}{7}, \frac{6}{11}$

5. Represent 1. 129129129..... as a fraction.

Ans. $x = \frac{1128}{999}$

B. IRRATIONAL NUMBERS

All real number which are not rational are called irrational numbers. These are non-recurring as well as non-terminating type of decimal numbers.

i.e. $\sqrt{2}$, $\sqrt[3]{4}$, $2+\sqrt{3}$, $\sqrt{2+\sqrt{3}}$, $\sqrt[4]{\sqrt[7]{3}}$, π, etc..

(a) Proof of irrationality of numbers

To prove the irrationality of a given number, process is done by contradiction method. In logic, proof by contradiction is a form of proof, and more specifically a form of indirect proof, that establishes the truth or validity of a proposition. It starts by assuming that the opposite proposition is true, and then shows that such an assumption lead to a contradiction.

(b) Insertion of irrational numbers between two real numbers

Let a and b are two given real numbers, then irrational number between a and b is $\sqrt{a \times b}$. Provide $a \times b$ is

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not a perfect square.

(c) Irrational Number on a Number Line

Irrational Number in Decimal Form :

$\sqrt{2}$ = 1.414213..... i.e. it is non-recurring as well as non-terminating.

$\sqrt{3}$ = 1.732050807..... i.e. it is non-recurring as well as non-terminating.

Properties of Irrational Number :

(i) Negative of an irrational number is an irrational number. **e.g.** $-\sqrt{3}, -\sqrt[4]{5}$ are irrational.

(ii) Sum and difference of a rational and an irrational number is always an irrational number.

(iii) Sum, product and difference of two irrational numbers is either rational or irrational number.

(iv) Product of a rational number with an irrational number is either rational or irrational.

(d) Geometrical representation of real numbers

To represent any real number $\sqrt{x}$ on number line we follow the following steps :

STEP I : Obtain the positive real number **x** (say).

STEP II : Draw a line and mark a point A on it.

STEP III : Mark a point B on the line such that AB = x units.

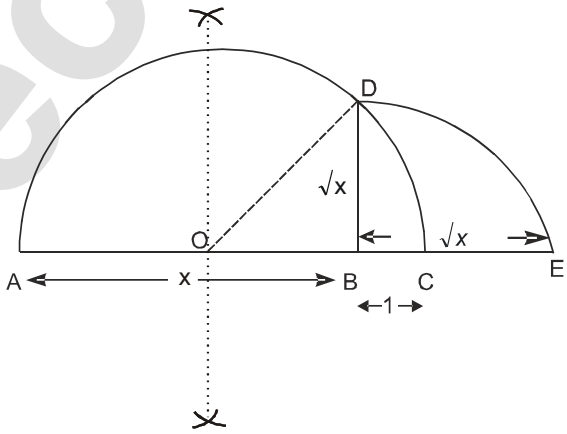
STEP IV : From point B mark a distance of 1 unit and mark the new point as C. Such that ABC is a straight line.

STEP V : Find the mid-point of AC by drawing the perpendicular bisector of line segment AC and mark the point as O.

STEP VI : Draw a semi circle with centre O and radius OC.

STEP VII : Draw a line perpendicular to AC passing through B and intersecting the semi circle at D. Length BD is equal to $\sqrt{x}$.

STEP VIII : Taking B as centre and BD as radius, draw an arc cutting OC produced at E. Distance BE represents $\sqrt{x}$.



EXPLANATION :
We have,
AB = x units and BC = 1 unit.

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$\therefore$ AC = (x + 1) units

$\Rightarrow$ OA = OC = $\frac{x+1}{2}$ units

$\Rightarrow$ OD = $\frac{x+1}{2}$ units [$\because$ OA = OC = OD]

Now, OB = AB – OA

$= x - \frac{x+1}{2} = \frac{x-1}{2}$

Using Pythagoras Theorem in ΔOBD, we have

$OD^2 = OB^2 + BD^2 \Rightarrow BD^2 = OD^2 - OB^2$

$\Rightarrow BD^2 = \left(\frac{x+1}{2}\right)^2 - \left(\frac{x-1}{2}\right)^2 \Rightarrow BD = \sqrt{\frac{(x^2+2x+1)-(x^2-2x+1)}{4}}$

$\Rightarrow BD = \sqrt{\frac{4x}{4}} \Rightarrow BD = \sqrt{x}$

This shows that $\sqrt{x}$ exists for all real numbers x > 0.

Solved Examples

Example. 14

Prove that $\sqrt{2}$ is an irrational number.

Sol. Let assume on the contrary that $\sqrt{2}$ is a rational number.

Then, there exists positive integer a and b such that $\sqrt{2} = \frac{a}{b}$ where, a and b are coprime i.e. their HCF is1.

$\Rightarrow (\sqrt{2})^2 = \left(\frac{a}{b}\right)^2 \Rightarrow 2 = \frac{a^2}{b^2}$

$\Rightarrow a^2 = 2b^2 \Rightarrow a^2$ is a multiple of 2

$\Rightarrow$ a is a multiple of 2 ...(i)

a = 2c for some integer c.

$\Rightarrow a^2 = 4c^2 \Rightarrow 2b^2 = 4c^2$

$\Rightarrow b^2 = 2c^2 \Rightarrow b^2$ is a multiple of 2

$\Rightarrow$ b is a multiple of 2 ....(ii)

From (i) and (ii), a and b have at least 2 as a common factor. But this contradicts the fact that a and b are co-prime. This means that $\sqrt{2}$ is an irrational number.

Example.15

Prove that $3 - \sqrt{5}$ is an irrational number.

Sol. Let assume that on the contrary that $3 - \sqrt{5}$ is rational.

Then, there exist co-prime positive integers a and b such that,

$3 - \sqrt{5} = \frac{a}{b} \Rightarrow 3 - \frac{a}{b} = \sqrt{5}$

$\Rightarrow \frac{3b-a}{b} = \sqrt{5} \Rightarrow \sqrt{5}$ is rational [$\because$ a, b are integer $\therefore \frac{3b-a}{b}$ is a rational number]

This contradicts the fact that $\sqrt{5}$ is an irrational number.

Hence, $3 - \sqrt{5}$ is an irrational number.

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Example.16

Insert an irrational number between 2 and 3.

Sol. $\sqrt{2\times 3}=\sqrt{6}$

Example.17

Find two irrational number between 2 and 2.5.

Sol. **1st Method :** $\sqrt{2\times 2.5}=\sqrt{5}$.

Since, there is no rational number whose square is 5. So, $\sqrt{5}$ is an irrational number.

Also, $\sqrt{2\times\sqrt{5}}$ is an irrational number.

2nd Method : 2.101001000100001..... is between 2 and 5 and it is non-recurring as well as non-terminating.
Also, 2.201001000100001 ..... and so on.

Example.18

Plot $\sqrt{2}, \sqrt{3}, \sqrt{5}$ on a number line.

Sol. Let X'OX be a horizontal line, taken as the x - axis and let O be the origin. Let O represents 0 (zero).
Take OA = 1 unit and draw AB $\perp$ OA such that AB = 1 unit.
Join OB. Then,

OB = $\sqrt{OA^2+AB^2}$ = $\sqrt{1^2+1^2}$ = $\sqrt{2}$ units.

With O as centre and OB as radius, draw an arc, meeting OY at P.

Then, OP = OB = $\sqrt{2}$ units.

Thus the point P represents $\sqrt{2}$ on the real line.

Now draw BC $\perp$ OB such that BC = 1 unit.
Join OC. Then,

OC = $\sqrt{OB^2+BC^2}$ = $\sqrt{\left(\sqrt{2}\right)^2+1^2}$ = $\sqrt{3}$ units.

With O as centre and OC as radius, draw an arc, meeting OY at Q.

Then, OQ = OC = $\sqrt{3}$ units.

Thus the point Q represents $\sqrt{3}$ on the real line.

Now draw CD $\perp$ OC such that CD = 1 unit.
Join OD. Then,

OD = $\sqrt{OC^2+CD^2}$ = $\sqrt{\left(\sqrt{3}\right)^2+1^2}$ = $\sqrt{4}$ = 2 units.

Now draw DE $\perp$ OD such that DE = 1 unit.
Join OE. Then,

OE = $\sqrt{OD^2+DE^2}$ = $\sqrt{(2)^2+1^2}$ = $\sqrt{5}$ units.

With O as centre and OE as radius, draw an arc, meeting OY at R.

Then, OR = OE = $\sqrt{5}$ units.

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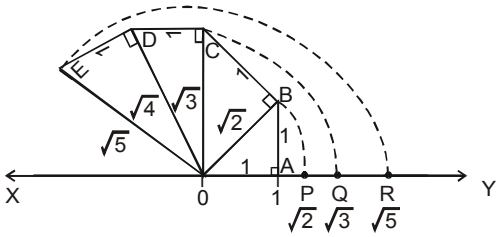


❖ **Another Method for :**

(i) Plot $\sqrt{2}, \sqrt{3}$

Draw a number line and mark a point O, representing zero, on it. Suppose a point A represents 1. Then OA = 1. Now draw a right triangle OAB such that AB = OA = 1.
By pythagoras theorem,

OB = $\sqrt{OA^2 + AB^2}$ = $\sqrt{1^2 + 1^2}$ = $\sqrt{2}$ units.

Now, draw an arc with centre O and radius OB. It cuts the number line at C.

Then, OC = OB = $\sqrt{2}$ units.

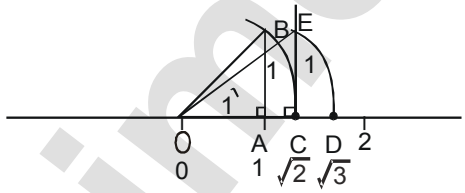
Thus the point C represents $\sqrt{2}$ on the real line.

Now, draw a right triangle OEC such that CE = AB = 1 unit.
Again by pythagoras theorem,

OE = $\sqrt{OC^2 + CE^2}$ = $\sqrt{(\sqrt{2})^2 + 1^2}$ = $\sqrt{3}$ units.

Now, draw an arc with centre O and radius OE. It cuts the number line at D.

Then, OD = OE = $\sqrt{3}$ units.



Check Your Progress

1. Which of the following numbers are not rational?
1.256; 0.45454545…; 0.05005000500005 …; 5.51551555151…; 2.012340123401234…;

Ans. 0.05005000500005 …; 5.51551555151…;

2. Find two irrational numbers between $\sqrt{5}$ and $\sqrt{6}$.

Ans. $\sqrt{5.1}$, $\sqrt{5.2}$

3. Prove that $\sqrt{3}$ is irrational number.

4. Represent $\sqrt{6}$ on the number line.

5. Represent $\sqrt{7.3}$ on the number line.

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(C) SURDS AND THEIR APPLICATION

(a) Surds

An irrational number of the form $\sqrt[n]{a}$ is given a special name **Surd**, where **'a'** is called **radicand** and it should always be a rational number. Also the symbol $\sqrt[n]{\ }$ is called the **radical sign** and the index **n** is called **order** of the surd. $\sqrt[n]{a}$ is read as **'nth root of a'** and can also be written as $a^{\frac{1}{n}}$.

(b) Law of Surds

(i) $\left(\sqrt[n]{a}\right)^n = \sqrt[n]{a^n} = a$

(ii) $\sqrt[n]{a} \times \sqrt[n]{b} = \sqrt[n]{ab}$

(iii) $\sqrt[n]{a} \div \sqrt[n]{b} = \sqrt[n]{\frac{a}{b}}$

(iv) $\sqrt[n]{\sqrt[m]{a}} = \sqrt[nm]{a} = \sqrt[m]{\sqrt[n]{a}}$

(v) $\sqrt[n]{a} = \sqrt[n\times p]{a^p}$ or $\sqrt[n]{a^m} = \sqrt[n\times p]{a^{m\times p}}$

(c) Operation on Surds

(i) Addition and Subtraction of Surds :

Addition and subtraction of surds are possible only when order and radicand are same i.e. only for like surds. The addition of surds follow the following rules. Summation of same degree surds is distributive.

$$a\sqrt[n]{p} + b\sqrt[n]{p} = (a+b)\sqrt[n]{p}$$

The subtraction of surds follow the following rules. Subtraction of same degree surds is distributive.

$$a\sqrt[n]{p} - b\sqrt[n]{p} = (a-b)\sqrt[n]{p}$$

(ii) Multiplication and Division of Surds :

For multiplication and division we have to check the order if it is not same then first we make the order of surd same by using LCM of indices.Then we follow the follwing rule

$$a\sqrt[n]{p} \times b\sqrt[n]{q} = (a\times b)\sqrt[n]{p\times q}$$

$$\frac{a\sqrt[n]{p}}{b\sqrt[n]{q}} = \left(\frac{a}{b}\right)\sqrt[n]{\left(\frac{p}{q}\right)}$$

(iii) Comparison of Surds :

It is clear that if x > y > 0 and n > 1 is a positive integer then $\sqrt[n]{x} > \sqrt[n]{y}$.

(d) Rationalization of Surds

Rationalizing factor : Product of two surds is a rational number then each of them is called the **rationalizing factor (R.F.)** of the other. The process of converting a surd to a rational number by using an appropriate multiplier is known as **rationalization.**

When the denominator of an expression contains a term with a square root (or a number with radical sign),

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the process of converting it to an equivalent expression whose denominator is a rational number is called **rationalizing** the **denominator**.

❖ Rationalizing factor of $a^{\frac{1}{n}}$ is $a^{1-\frac{1}{n}}$ where a is a real number.

Solved Examples

Example.19

$\sqrt{75}-\sqrt{45}+\sqrt{50}-\sqrt{32}$

Sol. $\sqrt{75}-\sqrt{45}+\sqrt{50}-\sqrt{32}$

$= 5\sqrt{3}-3\sqrt{5}+5\sqrt{2}-4\sqrt{2}$

$= 5\sqrt{3}-3\sqrt{5}+\sqrt{2}$.

Example.20

Simplify : $5\sqrt[3]{250}+7\sqrt[3]{16}-14\sqrt[3]{54}$

Sol. $5\sqrt[3]{250}+7\sqrt[3]{16}-14\sqrt[3]{54} = 5\sqrt[3]{125\times 2}+7\sqrt[3]{8\times 2}-14\sqrt[3]{27\times 2}$

$= 5\times 5\sqrt[3]{2}+7\times 2\sqrt[3]{2}-14\times 3\times\sqrt[3]{2} = (25+14-42)\sqrt[3]{2} = -3\sqrt[3]{2}$.

Example.21

Simplify : $\sqrt[3]{2}\times\sqrt[4]{3}$.

Sol. $\sqrt[3]{2}\times\sqrt[4]{3}$

$= \sqrt[12]{2^4}\times\sqrt[12]{3^3}$ [order should be made same]

$= \sqrt[12]{2^4\times 3^3} = \sqrt[12]{16\times 27} = \sqrt[12]{432}$.

Example.22

Simplify : $\sqrt{8a^5b}\times\sqrt[3]{4a^2b^2}$.

Sol. $\sqrt{8a^5b}\times\sqrt[3]{4a^2b^2} = \sqrt[6]{8^3a^{15}b^3}\times\sqrt[6]{4^2a^4b^4}$

$= \sqrt[6]{2^{13}a^{19}b^7} = 2^2a^3b\sqrt[6]{2ab} = 4a^3b\sqrt[6]{2ab}$.

Example.23

Divide : $\sqrt{24}\div\sqrt[3]{200}$.

Sol. $\sqrt{24}\div\sqrt[3]{200} = \dfrac{\sqrt{24}}{\sqrt[3]{200}} = \dfrac{\sqrt[6]{(24)^3}}{\sqrt[6]{(200)^2}} = \sqrt[6]{\dfrac{216}{625}}$.

Example.24

Which is greater :

(i) $\sqrt[3]{6}$ and $\sqrt[5]{8}$ **(ii)** $\sqrt{\dfrac{1}{2}}$ and $\sqrt[3]{\dfrac{1}{3}}$

Sol. **(i)** $\sqrt[3]{6}$ and $\sqrt[5]{8}$

L.C.M. of 3 and 5 is 15.

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$\sqrt[3]{6} = \sqrt[3\times5]{6^5} = \sqrt[15]{7776}$

$\sqrt[5]{8} = \sqrt[3\times5]{8^3} = \sqrt[15]{512}$

$\therefore \quad \sqrt[15]{7776} > \sqrt[15]{512} \Rightarrow \quad \sqrt[3]{6} > \sqrt[5]{8}$

(ii) $\sqrt{\frac{1}{2}}$ and $\sqrt[3]{\frac{1}{3}}$

L.C.M. of 2 and 3 is 6.

$\sqrt[6]{\left(\frac{1}{2}\right)^3}$ and $\sqrt[6]{\left(\frac{1}{3}\right)^2}$

$\sqrt[6]{\frac{1}{8}}$ and $\sqrt[6]{\frac{1}{9}}$ $\quad \left[\text{As } 8 < 9 \therefore \frac{1}{8} > \frac{1}{9}\right]$

So, $\sqrt[6]{\frac{1}{8}} > \sqrt[6]{\frac{1}{9}} \quad \Rightarrow \quad \sqrt{\frac{1}{2}} > \sqrt[3]{\frac{1}{3}}$.

Example.25

Arrange $\sqrt{2}$, $\sqrt[3]{3}$ and $\sqrt[4]{5}$ in ascending order.

Sol. $\sqrt{2}$, $\sqrt[3]{3}$ and $\sqrt[4]{5}$

L.C.M. of 2, 3, 4 is 12.

$\therefore \quad \sqrt{2} = \sqrt[2\times6]{2^6} = \sqrt[12]{64}$

$\sqrt[3]{3} = \sqrt[3\times4]{3^4} = \sqrt[12]{81}$

$\sqrt[4]{5} = \sqrt[4\times3]{5^3} = \sqrt[12]{125}$

As, $64 < 81 < 125$.

$\therefore \quad \sqrt[12]{64} < \sqrt[12]{81} < \sqrt[12]{125} \quad \Rightarrow \quad \sqrt{2} < \sqrt[3]{3} < \sqrt[4]{5}$.

Example.26

Rationalize the denominator $\frac{1}{\sqrt{162}}$.

Sol. $\frac{1}{\sqrt{162}} = \frac{1}{\sqrt{81\times2}}$

$= \frac{1}{9\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{2}}{18}$.

❖ Rationalising factor of $a + b\sqrt{c}$ is $a - b\sqrt{c}$ where a,b,c are rational numbers.

Example.27

Rationalize the denominator $\frac{1}{7+5\sqrt{3}}$.

Sol. $\frac{1}{7+5\sqrt{3}} = \frac{1}{7+5\sqrt{3}} \times \frac{7-5\sqrt{3}}{7-5\sqrt{3}}$

$= \frac{7-5\sqrt{3}}{49-75} = \frac{7-5\sqrt{3}}{-26} = \frac{5\sqrt{3}-7}{26}$.

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Example.28

Rationalize the denominator of $\frac{a^2}{\sqrt{a^2+b^2}+b}$.

Sol. $\frac{a^2}{\sqrt{a^2+b^2}+b} \times \frac{\sqrt{a^2+b^2}-b}{\sqrt{a^2+b^2}-b} = \frac{a^2\left(\sqrt{a^2+b^2}-b\right)}{\left(\sqrt{a^2+b^2}\right)^2-(b)^2}$

$= \frac{a^2\left(\sqrt{a^2+b^2}-b\right)}{a^2+b^2-b^2} = \left(\sqrt{a^2+b^2}-b\right)$.

Example.29

If $\frac{3+2\sqrt{2}}{3-\sqrt{2}} = a+b\sqrt{2}$, where a and b are rationals in reduced form then, find the values of a and b.

Sol. LHS $\frac{3+2\sqrt{2}}{3-\sqrt{2}} = \frac{(3+2\sqrt{2})(3+\sqrt{2})}{(3-\sqrt{2})(3+\sqrt{2})}$

$= \frac{9+3\sqrt{2}+6\sqrt{2}+4}{9-2}$

$= \frac{13+9\sqrt{2}}{7} = \frac{13}{7}+\frac{9}{7}\sqrt{2}$

$\because \quad \frac{13}{7}+\frac{9}{7}\sqrt{2} = a+b\sqrt{2}$

Equating the rational and irrational parts

We get $a=\frac{13}{7}$, $b=\frac{9}{7}$.

Example.30

If $x=\frac{1}{2+\sqrt{3}}$, find the value of $x^3 - x^2 - 11x + 3$.

Sol. As, $x=\frac{1}{2+\sqrt{3}} = 2-\sqrt{3} \quad \Rightarrow \quad x - 2 = -\sqrt{3}$

$\Rightarrow \quad (x-2)^2 = \left(-\sqrt{3}\right)^2$ [By squaring both sides]

$\Rightarrow \quad x^2 + 4 - 4x = 3 \quad \Rightarrow \quad x^2 - 4x + 1 = 0$

Now, $x^3 - x^2 - 11x + 3 = x(x^2 - 4x + 1) + 3(x^2 - 4x + 1)$

$= x(0) + 3(0) = 0 + 0 = 0.$

Example.31

If $x = 3 - \sqrt{8}$, find the value of $x^3 + \frac{1}{x^3}$.

Sol. $x = 3 - \sqrt{8}$

$\therefore \quad \frac{1}{x} = \frac{1}{3-\sqrt{8}} \quad \Rightarrow \quad \frac{1}{x} = 3+\sqrt{8}$

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Now, $x+\frac{1}{x}=3-\sqrt{8}+3+\sqrt{8}=6$

$\Rightarrow \quad x^3+\frac{1}{x^3}=\left(x+\frac{1}{x}\right)^3-3x\frac{1}{x}\left(x+\frac{1}{x}\right) \quad \Rightarrow \quad x^3+\frac{1}{x^3}=(6)^3-3(6)$

$\Rightarrow \quad x^3+\frac{1}{x^3}=216-18 \quad \Rightarrow \quad x^3+\frac{1}{x^3}=198.$

Example.32

If $\sqrt{5}$ = 2.236 and $\sqrt{2}$ = 1.414, then evaluate : $\frac{3}{\sqrt{5}+\sqrt{2}}+\frac{4}{\sqrt{5}-\sqrt{2}}$

Sol. $\frac{3}{\sqrt{5}+\sqrt{2}}+\frac{4}{\sqrt{5}-\sqrt{2}}$

$=\frac{3\left(\sqrt{5}-\sqrt{2}\right)+4\left(\sqrt{5}+\sqrt{2}\right)}{\left(\sqrt{5}-\sqrt{2}\right)\left(\sqrt{5}+\sqrt{2}\right)}$

$=\frac{3\sqrt{5}-3\sqrt{2}+4\sqrt{5}+4\sqrt{2}}{5-2}$

$=\frac{7\sqrt{5}+\sqrt{2}}{5-2}$

$=\frac{7\sqrt{5}+\sqrt{2}}{3}$

$=\frac{7\times 2.236+1.414}{3}$

$=\frac{15.652+1.414}{3}$

$=\frac{17.066}{3}$ = 5.689 (approximately)

Check Your Progress

1. What is the simplest form of $\sqrt{200}-\sqrt{50}$?

Ans. $5\sqrt{2}$

2. Rationalise the denominator of $\frac{5}{\sqrt{10}+\sqrt{5}}$.

Ans. $\sqrt{10}-\sqrt{5}$

3. If x = $\sqrt{2}$ – 1 what is the value of x – 1/x ?

Ans. – 2

4. Simplify $(\sqrt{5}+1)^2+(\sqrt{5}-1)^2$.

Ans. 12

Specimen Copy

5. If x = $\frac{\sqrt{5}-2}{\sqrt{5}+2}$, find the value of $x+\frac{1}{x}$.

Ans. 18

D. EXPONENTS

(a) Exponents of Real Numbers

(i) Positive Integral Power :

For any real number **a** and a natural number **'n'** we define $\mathbf{a^n}$ as :
$a^n = a \times a \times a \times$ .....$\times$ a (n times)

$\mathbf{a^n}$ is called the $\mathbf{n^{th}}$ power of **a**. The real number **'a'** is called the **base** and **'n'** is called the **exponent** of the $\mathbf{n^{th}}$ power of **a**.
e.g. $2^3 = 2 \times 2 \times 2 = 8$

NOTE :
For any non –zero real number 'a' we define $a^0 = 1$.

e.g.: Thus, $3^o = 1$, 5° , $\left(\frac{3}{4}\right)^0 = 1$ and so on.

(ii) Negative Integral Power :

For any non–zero real number **'a'** and positive integer **'n'** we define $\mathbf{a^{-n} = \frac{1}{a^n}}$.

Thus we have defined $\mathbf{a^n}$ for all integral values of **n**, positive, zero or negative. $\mathbf{a^n}$ is called the $\mathbf{n^{th}}$ power of **a**.

(iii) Rational Exponents of a Real number

Principal of $\mathbf{n^{th}}$ Root of a Positive Real Numbers :

If **'a'** is a positive real number and **'n'** is a **positive integer**, then the principal $\mathbf{n^{th}}$ **root** of **a** is the unique positive real number **x** such that $\mathbf{x^n = a}$.

The principal n^{th} root of a positive real number a is denoted by $\mathbf{a^{1/n}}$ or $\sqrt[n]{a}$.

❖ **REMARK :**
If **'a'** is negative real number and **'n'** is an **even positive** integer, then the principal $\mathbf{n^{th}}$ root of **a** is not defined, because an even power of a real number is always positive. Therefore $(-9)^{1/2}$ is a meaningless quantity, if we confine ourselves to the set of real number, only.

(b) Law of Rational Exponents

The following laws hold the rational exponents

(i) $a^m \times a^n = a^{m+n}$

(ii) $a^m \div a^n = a^{m-n}$

(iii) $(a^m)^n = a^{mn}$

(iv) $a^{-n} = \frac{1}{a^n}$

(v) $a^{m/n} = (a^m)^{1/n} = (a^{1/n})^m$ i.e. $a^{m/n} = \sqrt[n]{a^m} = \left(\sqrt[n]{a}\right)^m$

(vi) $(ab)^m = a^m b^m$

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(vii) $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$ **(viii)** $a^{bn} = a^{b+b+b.....n\ times}$

where a, b are positive real numbers and m, n are rational numbers.

Solved Examples

Example.33

Evaluate each of the following :

(i) $5^8 \div 5^3$ **(ii)** $\left(\frac{3}{4}\right)^{-3}$

Sol. Using the laws of indices, we have :

(i) $5^8 \div 5^3 = \frac{5^8}{5^3} = 5^{8-3} = 5^5 = 3125$. $[\because a^m \div a^n = a^{m-n}]$

(ii) $\left(\frac{3}{4}\right)^{-3} = \frac{1}{\left(\frac{3}{4}\right)^3} = \frac{1}{\frac{3^3}{4^3}} = \frac{1}{\frac{27}{64}} = \frac{64}{27}$ $[\because a^{-n} = \frac{1}{a^n}]$

Example.34

Evaluate each of the following :

(i) $\left(\frac{1}{2}\right)^5 \times \left(\frac{-2}{3}\right)^4 \times \left(\frac{3}{5}\right)^{-1}$ **(ii)** $\left(\frac{2}{3}\right)^3 \times \left(\frac{2}{5}\right)^{-3} \times \left(\frac{3}{5}\right)^2$

Sol. **(i)** We have,

$$\left(\frac{1}{2}\right)^5 \times \left(\frac{-2}{3}\right)^4 \times \left(\frac{3}{5}\right)^{-1} = \left(\frac{1}{2}\right)^5 \times \left(\frac{-2}{3}\right)^4 \times \left(\frac{1}{\frac{3}{5}}\right) = \frac{1^5}{2^5} \times \frac{(-2)^4}{3^4} \times \frac{5}{3}$$

$$= \frac{1 \times 16 \times 5}{32 \times 81 \times 3} = \frac{5}{2 \times 81 \times 3} = \frac{5}{486}.$$

(ii) We have,

$$\left(\frac{2}{3}\right)^3 \times \left(\frac{2}{5}\right)^{-3} \times \left(\frac{3}{5}\right)^2 = \frac{2^3}{3^3} \times \frac{1}{(2/5)^3} \times \frac{3^2}{5^2}$$

$$= \frac{2^3 \times 5^3 \times 3^2}{3^3 \times 2^3 \times 5^2} = \frac{5}{3}.$$

Example.35

Simplify :

(i) $\frac{(25)^{3/2} \times (243)^{3/5}}{(16)^{5/4} \times (8)^{4/3}}$ **(ii)** $\frac{16 \times 2^{n+1} - 4 \times 2^n}{16 \times 2^{n+2} - 2 \times 2^{n+2}}$

Sol. We have,

(i) $$\frac{(25)^{3/2} \times (243)^{3/5}}{(16)^{5/4} \times (8)^{4/3}} = \frac{\left(5^2\right)^{3/2} \times \left(3^5\right)^{3/5}}{\left(2^4\right)^{5/4} \times \left(2^3\right)^{4/3}} = \frac{5^{2\times3/2} \times 3^{5\times3/5}}{2^{4\times5/4} \times 2^{3\times4/3}} = \frac{5^3 \times 3^3}{2^5 \times 2^4} = \frac{125 \times 27}{32 \times 16} = \frac{3375}{512}.$$

(ii) $$\frac{16 \times 2^{n+1} - 4 \times 2^n}{16 \times 2^{n+2} - 2 \times 2^{n+2}} = \frac{32 \times 2^n - 4 \times 2^n}{64 \times 2^n - 8 \times 2^n} = \frac{2^n(32-4)}{2^n(64-8)} = \frac{1}{2}$$

Example.36

Specimen Copy

Simplify $\left(\frac{81}{16}\right)^{-3/4} \times \left[\left(\frac{25}{9}\right)^{-3/2} \div \left(\frac{5}{2}\right)^{-3}\right]$.

Sol. We have,

$$\left(\frac{81}{16}\right)^{-3/4} \times \left[\left(\frac{25}{9}\right)^{-3/2} \div \left(\frac{5}{2}\right)^{-3}\right] = \left(\frac{3^4}{2^4}\right)^{-3/4} \times \left[\left(\frac{5^2}{3^2}\right)^{-3/2} \div \left(\frac{5}{2}\right)^{-3}\right]$$

$$= \left[\left(\frac{3}{2}\right)^4\right]^{-3/4} \times \left[\left(\frac{5}{3}\right)^2\right]^{-3/2} \div \left[\left(\frac{5}{2}\right)^{-3}\right] = \left(\frac{3}{2}\right)^{4\times-3/4} \times \left[\left(\frac{5}{3}\right)^{2\times-3/2} \div \left(\frac{5}{2}\right)^{-3}\right]$$

$$= \left(\frac{3}{2}\right)^{-3} \times \left[\left(\frac{5}{3}\right)^{-3} \div \left(\frac{5}{2}\right)^{-3}\right] = \left(\frac{2}{3}\right)^3 \times \left[\left(\frac{3}{5}\right)^3 \div \left(\frac{2}{5}\right)^3\right] = \frac{2^3}{3^3} \times \left[\frac{3^3}{5^3} \div \frac{2^3}{5^3}\right]$$

$$= \frac{2^3}{3^3} \times \left[\frac{3^3}{5^3} \times \frac{5^3}{2^3}\right] = 1.$$

Example.37

Prove that : $\frac{x^{-1}}{x^{-1}+y^{-1}} + \frac{x^{-1}}{x^{-1}-y^{-1}} = \frac{2y^2}{y^2-x^2}$.

Sol. $$\frac{x^{-1}}{x^{-1}+y^{-1}} + \frac{x^{-1}}{x^{-1}-y^{-1}} = \frac{\frac{1}{x}}{\frac{1}{x}+\frac{1}{y}} + \frac{\frac{1}{x}}{\frac{1}{x}-\frac{1}{y}} = \frac{\frac{1}{x}}{\frac{y+x}{xy}} + \frac{\frac{1}{x}}{\frac{y-x}{xy}}$$

$$= \frac{xy}{x(y+x)} + \frac{xy}{x(y-x)} = \frac{xy(y-x)+xy(y+x)}{x(y^2-x^2)}$$

$$= \frac{y(y-x)+y(y+x)}{y^2-x^2} = \frac{y^2-xy+y^2+xy}{y^2-x^2} = \frac{2y^2}{y^2-x^2}.$$

Example.38

Find the value of x : $\left(\frac{3}{5}\right)^x \left(\frac{5}{3}\right)^{2x} = \frac{125}{27}$.

Sol. $$\left(\frac{3}{5}\right)^x \left(\frac{5}{3}\right)^{2x} = \frac{125}{27}$$

$$\left(\frac{5}{3}\right)^{-x} \left(\frac{5}{3}\right)^{2x} = \frac{125}{27}$$

$$\left(\frac{5}{3}\right)^{2x-x} = \frac{125}{27}$$

Specimen Copy

$$\left(\frac{5}{3}\right)^x = \left(\frac{5}{3}\right)^3$$

Because the base is same, so comparing the powers x = 3.

Example.39

If $25^{x-1} = 5^{2x-1} - 100$, find the value of x.

Sol. We have,

$\Rightarrow 25^{x-1} = 5^{2x-1} - 100$

$\Rightarrow \left(5^2\right)^{x-1} = 5^{2x-1} - 100$

$\Rightarrow 5^{2x-2} - 5^{2x-1} = -100$

$\Rightarrow 5^{2x-2} - 5^{2x-2}.5^1 = -100$

$\Rightarrow 5^{2x-2}(1-5) = -100$

$\Rightarrow 5^{2x-2}(-4) = -100$

$\Rightarrow 5^{2x-2} = 25$

$\Rightarrow 5^{2x-2} = 5^2$

$\Rightarrow 2x - 2 = 2$

$\Rightarrow 2x = 4$

$\Rightarrow x = 2.$

Example.40

Assuming that x is a positive real number and a, b, c are rational numbers, show that :

$$\left(\frac{x^b}{x^c}\right)^a\left(\frac{x^c}{x^a}\right)^b\left(\frac{x^a}{x^b}\right)^c = 1$$

Sol. $\left(\frac{x^b}{x^c}\right)^a.\left(\frac{x^c}{x^a}\right)^b.\left(\frac{x^a}{x^b}\right)^c$

$= \left(x^{b-c}\right)^a.\left(x^{c-a}\right)^b.\left(x^{a-b}\right)^c = x^{ab-ac}.x^{bc-ba}.x^{ac-bc}$

$= x^{ab-ac+bc-ba+ac-bc} = x^0 = 1.$

Check Your Progress

1. Find the value of the following:

(i) $81^{1/4}$ **(ii)** $64^{1/3}$ **(iii)** $32^{3/5}$ **(iv)** $27^{2/3}$

Ans. **(i) 3** **(ii) 4** **(iii) 8** **(iv) 9**

2. Simplify the following:

(i) $3^{1/3} . 3^{2/5}$ **(ii)** $\left(\frac{4}{9}\right)^{1/2}$ **(iii)** $2^{2/3}.3^{2/3}$ **(iv)** $\left(2^{1/3}\right)^3$

Ans. **(i)** $3^{11/15}$ **(ii) 2/3** **(iii)** $6^{2/3}$ **(iv) 2**

Specimen Copy

3. Simplified value of $2^n \times 4^n \times 8^{1-n}$

Ans. **8**

4. Find x, if $8^x = 16$

Ans. **4/3**

5. Find x,y,z if $15^3 x 12^2 x 16^4 = 2^x x 3^y x 5^z$

Ans. x = 20, y = 5, z = 3

Board Level Exercise

TOPIC NAME : NUMBER SYSTEM (DIRECTLY QUESTION FROM EXAMPLER)

TYPE (I) : VERY SHORT ANSWER TYPE QUESTIONS : **[01 MARK EACH]**

1. Find the product of any two irrational numbers.

Ans. Rational or Irrational

2. Find a rational number between $\sqrt{2}$ & $\sqrt{3}$.

Ans. 1.5

3. Find the value of 1.999... in the form $\frac{p}{q}$, where p and q are integers and $q \neq 0$.

Ans. 2

4. Find the number obtained on rationalising the denominator of $\frac{1}{\sqrt{7}-2}$.

Ans. $\frac{\sqrt{7}+2}{3}$

5. After rationalising the denominator of $\frac{7}{3\sqrt{3}-2\sqrt{2}}$, what will be the denominator

Ans. $\frac{7(3\sqrt{3}+2\sqrt{2})}{19}$

6. Find the value of $\frac{\sqrt{32}+\sqrt{48}}{\sqrt{8}+\sqrt{12}}$.

Ans. 2

7. Simplify $\sqrt[4]{\sqrt[3]{2^2}}$.

Ans. $2^{\frac{1}{6}}$

Specimen Copy

8. Simplify $\sqrt[4]{(81)^{-2}}$.

Ans. $\frac{1}{9}$

TYPE (II) : SHORT ANSWER TYPE QUESTIONS : **[02 MARKS EACH]**

9. If $\sqrt{2}$ = 1.4142, then find the value of $\sqrt{\frac{\sqrt{2}-1}{\sqrt{2}+1}}$.

Ans. 0.4142

10. Find the product $\sqrt[3]{2}.\sqrt[4]{2}.\sqrt[12]{32}$.

Ans. 2

11. Find the value of $(256)^{0.16} \times (256)^{0.09}$.

Ans. 4

12. State whether the following statements are true or false? Justify your answer.

(i) $\frac{\sqrt{2}}{3}$ is a rational number.

(ii) There are infinitely many integers between any two integers.

(iii) Number of rational numbers between 15 and 18 is finite.

(iv) There are numbers which cannot be written in the form $\frac{p}{q}$, $q \neq 0$, p, q both are integers.

(v) The square of an irrational number is always rational.

(vi) $\frac{\sqrt{12}}{\sqrt{3}}$ is not a rational number as $\sqrt{12}$ and $\sqrt{3}$ are not integers.

(vii) $\frac{\sqrt{15}}{\sqrt{3}}$ is written in the form $\frac{p}{q}$, $q \neq 0$ and so it is a rational number.

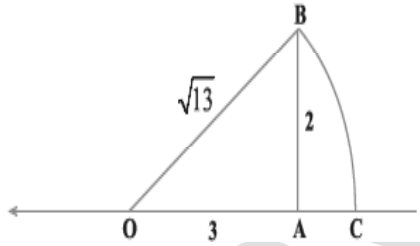
Ans. (i) False (ii) False (iii) False (iv) False
(v) False (vi) False (vii) False

13. Locate $\sqrt{13}$ on the number line.

Sol. We write 13 as the sum of the squares of two natural numbers :
$13 = 9 + 4 = 3^2 + 2^2$

Specimen Copy

On the number line, take OA = 3 units. Draw BA = 2 units,



perpendicular to OA. Join OB (see Fig.1.1).

By Pythagoras theorem, OB = $\sqrt{13}$

Using a compass with centre O

and radius OB, draw an arc which intersects the number line at the point C. Then, C corresponds to $\sqrt{13}$.

Remark : We can also take OA = 2 units and AB = 3 units.

14. Express $0.12\overline{3}$ in the form $\frac{p}{q}$, where p and q are integers and $q \neq 0$.

Ans. $\frac{37}{300}$

Sol. Let $x = 0.12\overline{3}$

so, $10x = 1.2\overline{3}$

or $10x - x = 1.2\overline{3} - 0.12\overline{3} = 1.2333 ... - 0.12333 ...$

or $9x = 1.11$

or $x = \frac{1.11}{9} = \frac{111}{900}$

Therefore, $0.12\overline{3} = \frac{111}{900} = \frac{37}{300}$

15. Find the value of a in the following :

$$\frac{6}{3\sqrt{2}-2\sqrt{3}} = 3\sqrt{2} - a\sqrt{3}$$

Ans. a = – 2

Sol. $\frac{6}{3\sqrt{2}-2\sqrt{3}} = \frac{6}{3\sqrt{2}-2\sqrt{3}} \times \frac{3\sqrt{2}+2\sqrt{3}}{3\sqrt{2}+2\sqrt{3}}$

Specimen Copy

$$= \frac{6\left(3\sqrt{2}+2\sqrt{3}\right)}{\left(3\sqrt{2}\right)^2-\left(2\sqrt{3}\right)^2} = \frac{6\left(3\sqrt{2}+2\sqrt{3}\right)}{18-12} = \frac{6\left(3\sqrt{2}+2\sqrt{3}\right)}{6}$$

$= 3\sqrt{2}+2\sqrt{3}$

Therefore, $3\sqrt{2}+2\sqrt{3} = 3\sqrt{2}-a\sqrt{3}$

or $a = -2$

16. Simplify : $\left[5\left(8^{\frac{1}{3}}+27^{\frac{1}{3}}\right)^3\right]^{\frac{1}{4}}$

Ans. 5

Sol. $\left[5\left(8^{\frac{1}{3}}+27^{\frac{1}{3}}\right)^3\right]^{\frac{1}{4}} = \left[5\left((2^3)^{\frac{1}{3}}+(3^3)^{\frac{1}{3}}\right)^3\right]^{\frac{1}{4}}$

$= \left[5(2+3)^3\right]^{\frac{1}{4}} = \left[5(5)^3\right]^{\frac{1}{4}} = \left[5^4\right]^{\frac{1}{4}} = 5$

17. Represent the following numbers on the number line :

$7, 7.2, \frac{-3}{2}, \frac{-12}{5}$

TYPE (III) : LONG ANSWER TYPE QUESTIONS : **[03 MARK EACH]**

18. Find three rational numbers between

(i) – 1 and – 2 (ii) 0.1 and 0.11 (iii) $\frac{5}{7}$ and $\frac{6}{7}$ (iv) $\frac{1}{4}$ and $\frac{1}{5}$

19. Insert a rational number and an irrational number between the following :

(i) 2 and 3 (ii) $\frac{1}{3}$ and $\frac{1}{2}$ (iii) $\frac{-2}{5}$ and $\frac{1}{2}$ (iv) $\sqrt{2}$ and $\sqrt{3}$

(v) 0.0001 and 0.001

20. Locate $\sqrt{5}, \sqrt{10}$ and $\sqrt{17}$ on the number line.

21. Represent geometrically the following numbers on the number line :

(i) $\sqrt{4.5}$ **(ii)** $\sqrt{2.3}$

22. Simplify the following :

(i) $\sqrt{45}-3\sqrt{20}+4\sqrt{5}$ **(ii)** $\frac{\sqrt{24}}{8}+\frac{\sqrt{54}}{9}$

(iii) $\sqrt[4]{12}\times\sqrt[7]{6}$ **(iv)** $4\sqrt{28}\div 3\sqrt{7}\div\sqrt[3]{7}$

(v) $3\sqrt{3}+2\sqrt{27}+\frac{7}{\sqrt{3}}$ **(vi)** $\left(\sqrt{3}-\sqrt{2}\right)^2$

Specimen Copy

(vii) $\sqrt[4]{81}-8\sqrt[3]{216}+15\sqrt[5]{32}+\sqrt{225}$ **(viii)** $\frac{3}{\sqrt{8}}+\frac{1}{\sqrt{2}}$

(ix) $\frac{2\sqrt{3}}{3}-\frac{\sqrt{3}}{6}$

Ans. **(i)** $\sqrt{5}$ **(i)** $\frac{7\sqrt{6}}{12}$ **(iii)** $\sqrt[28]{2^{18}.3^{11}}$ **(iv)** $\frac{8}{3\sqrt[3]{7}}$

(v) $\frac{34}{\sqrt{3}}$ **(vi)** $5-2\sqrt{6}$ **(vii)** 0 **(viii)** $\frac{5\sqrt{2}}{4}$

(ix) $\frac{\sqrt{3}}{2}$

23. Rationalise the denominator of the following :

(i) $\frac{2}{3\sqrt{3}}$ **(ii)** $\frac{\sqrt{40}}{\sqrt{3}}$ **(iii)** $\frac{3+\sqrt{2}}{4\sqrt{2}}$ **(iv)** $\frac{16}{\sqrt{41}-5}$

(v) $\frac{2+\sqrt{3}}{2-\sqrt{3}}$ **(vi)** $\frac{\sqrt{6}}{2+\sqrt{3}}$ **(vii)** $\frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}}$ **(viii)** $\frac{3\sqrt{5}+\sqrt{3}}{\sqrt{5}-\sqrt{3}}$

(ix) $\frac{4\sqrt{3}+5\sqrt{2}}{\sqrt{48}+\sqrt{18}}$

Ans. **(i)** $\frac{2\sqrt{3}}{9}$ **(ii)** $\frac{2\sqrt{30}}{3}$ **(iii)** $\frac{3\sqrt{2}+2}{8}$ **(iv)** $\sqrt{41}+5$

(v) $7+4\sqrt{3}$ **(vi)** $3\sqrt{2}-2\sqrt{3}$ **(vii)** $5+2\sqrt{6}$ **(viii)** $9+2\sqrt{15}$

(ix) $\frac{9+4\sqrt{6}}{15}$

24. Find the values of a and b in each of the following :

(i) $\frac{5+2\sqrt{3}}{7+4\sqrt{3}} = a-6\sqrt{3}$ **(ii)** $\frac{3-\sqrt{5}}{3+2\sqrt{5}} = a\sqrt{5}-\frac{19}{11}$

(iii) $\frac{\sqrt{2}+\sqrt{3}}{3\sqrt{2}-2\sqrt{3}} = 2-b\sqrt{6}$ **(iv)** $\frac{7+\sqrt{5}}{7-\sqrt{5}}-\frac{7-\sqrt{5}}{7+\sqrt{5}} = a+\frac{7}{11}\sqrt{5}b$

Ans. **(i)** a = 11 **(ii)** $a=\frac{9}{11}$ **(iii)** $\frac{-5}{6}$ **(iv)** a = 0 , b = 1

25. If $a = 2+\sqrt{3}$, then find the value of $a-\frac{1}{a}$.

Ans. $2\sqrt{3}$

26. If $a = 5+2\sqrt{6}$ and $b = \frac{1}{a}$, then what will be the value of $a^2 + b^2$?

Ans. 98

Specimen Copy

Sol. $a = 5 + 2\sqrt{6}$

$$b = \frac{1}{a} = \frac{1}{5+2\sqrt{6}} \times \frac{5-2\sqrt{6}}{5-2\sqrt{6}} = \frac{5-2\sqrt{6}}{5^2-\left(2\sqrt{6}\right)^2} = \frac{5-2\sqrt{6}}{25-24} = 5 - 2\sqrt{6}$$

Therefore, $a^2 + b^2 = (a + b)^2 - 2ab$

Here, $a + b = (5 + 2\sqrt{6}) + (5 - 2\sqrt{6}) = 10$

$ab = (5 + 2\sqrt{6})(5 - 2\sqrt{6}) = 5^2 - (2\sqrt{6})^2 = 25 - 24 = 1$

Therefore, $a^2 + b^2 = 10^2 - 2 \times 1 = 100 - 2 = 98$

27. If $\sqrt{2} = 1.414$, $\sqrt{3} = 1.732$, then find the value of $\frac{4}{3\sqrt{3}-2\sqrt{2}} + \frac{3}{3\sqrt{3}+2\sqrt{2}}$.

Ans. 2.063

TYPE (IV): VERY LONG ANSWER TYPE QUESTIONS **[04 MARK EACH]**

28. Rationalise the denominator in each of the following and hence evaluate by taking $\sqrt{2} = 1.414$, $\sqrt{3} = 1.732$ and $\sqrt{5} = 2.236$, upto three places of decimal.

(i) $\frac{4}{\sqrt{3}}$ **(ii)** $\frac{6}{\sqrt{6}}$ **(iii)** $\frac{\sqrt{10}-\sqrt{5}}{2}$ **(iv)** $\frac{\sqrt{2}}{2+\sqrt{2}}$

(v) $\frac{1}{\sqrt{3}+\sqrt{2}}$

Ans. **(i)** 2.309 **(ii)** 2.449 **(iii)** 0.463 **(iv)** 0.414
(v) 0.318

29. Simplify :

(i) $\left(1^3+2^3+3^3\right)^{\frac{1}{2}}$ **(ii)** $\left(\frac{3}{5}\right)^4\left(\frac{8}{5}\right)^{-12}\left(\frac{32}{5}\right)^6$ **(iii)** $\left(\frac{1}{27}\right)^{\frac{-2}{3}}$

(iv) $\left[\left((625)^{-\frac{1}{2}}\right)^{-\frac{1}{4}}\right]^2$ **(v)** $\frac{9^{\frac{1}{3}} \times 27^{-\frac{1}{2}}}{3^{\frac{1}{6}} \times 3^{-\frac{2}{3}}}$ **(vi)** $64^{-\frac{1}{3}}\left[64^{\frac{1}{3}} - 64^{\frac{2}{3}}\right]$

(vii) $\frac{8^{\frac{1}{3}} \times 16^{\frac{1}{3}}}{32^{-\frac{1}{3}}}$

Ans. **(i)** 6 **(ii)** $\frac{2025}{64}$ **(iii)** 9

Specimen Copy

(iv) 5 **(v)** $3^{\frac{-1}{3}}$ **(vi)** – 3

(vii) 16

30. If a = $\frac{3+\sqrt{5}}{2}$, then find the value of $a^2 + \frac{1}{a^2}$.

Ans. 7

31. If x = $\frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}}$ and y = $\frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}}$, then find the value of $x^2 + y^2$.

Ans. 98

32. Express $0.6 + 0.\overline{7} + 0.4\overline{7}$ in the form $\frac{p}{q}$, where p and q are integers and $q \neq 0$.

Ans. $\frac{167}{90}$

33. Simplify : $\frac{7\sqrt{3}}{\sqrt{10}+\sqrt{3}} - \frac{2\sqrt{5}}{\sqrt{6}+\sqrt{5}} - \frac{3\sqrt{2}}{\sqrt{15}+3\sqrt{2}}$.

Ans. 1

34. Find the value of $\frac{4}{(216)^{-\frac{2}{3}}} + \frac{1}{(256)^{-\frac{3}{4}}} + \frac{2}{(243)^{-\frac{1}{5}}}$.

Ans. 214

Exercise-1

Marked Questions can be used as Revision Questions.

SUBJECTIVE QUESTIONS

Subjective Easy, only learning value problems

Section (A) : Introduction to number system & rational numbers

A.1 Express $\frac{2}{11}$ in decimal form.

Ans. 0.1818

Specimen Copy

Sol.

$$\begin{array}{r|l} & 0.1818 \\ 11 & \overline{)20} \\ & 11 \\ & 90 \\ & 88 \\ & 20 \\ & 11 \\ & 90 \\ & 88 \\ & 2 \end{array}$$

A.2 Give three rational numbers between – 2 and – 1.

Ans. $-\frac{7}{4}, -\frac{3}{2}, -\frac{5}{4}$

Sol. Three rational numbers between – 2 and – 1.

$-2 \times \frac{4}{4} = -\frac{8}{4}$ and $-1 \times \frac{4}{4} = -\frac{4}{4}$

Three rational numbers between them are

$$-\frac{7}{4}, -\frac{6}{4}, -\frac{5}{4}$$

or $$-\frac{7}{4}, -\frac{3}{2}, -\frac{5}{4}.$$

A.3 Find five rational numbers between $\frac{3}{5}$ and $\frac{4}{5}$.

Ans. $\frac{19}{30}, \frac{2}{3}, \frac{7}{10}, \frac{11}{15}, \frac{23}{30}$

Sol. Five rational number between $\frac{3}{5}$ and $\frac{4}{5}$

$$\frac{3}{5} = \frac{3}{5} \times \frac{6}{6} = \frac{18}{30}$$

$$\frac{4}{5} = \frac{4}{5} \times \frac{6}{6} = \frac{24}{30}$$

So, five rational number between $\frac{3}{5}$ and $\frac{4}{5}$ is

$$\frac{19}{30}, \frac{20}{30}, \frac{21}{30}, \frac{22}{30} \text{ and } \frac{23}{30}.$$

or, $$\frac{19}{30}, \frac{2}{3}, \frac{7}{10}, \frac{11}{15}, \frac{23}{30}.$$

A.4 Express the following in the form of p/q.

(i) $0.\overline{37}$ (ii) $43.\overline{54}$ (iii) $5.3\overline{245}$ (iv) $4.62\overline{1}$

Ans. **(i)** $\frac{37}{99}$ **(ii)** 4311.0 **(iii)** $\frac{53192}{9990}$ **(iv)** $\frac{4159}{900}$

Sol. (i) $0.\overline{37}$

Let $x = 0.\overline{37}$ ....(i)

Specimen Copy

$100x = 37.\overline{37}$ .....(ii)

Subtract equation (i) from (ii)

$100x - x = 37$

$99x = 37$

So, $x = \frac{37}{99}$.

Thus, $0.\overline{37} = \frac{37}{99}$.

(ii) $43.\overline{54}$

Let, $x = 43.\overline{54}$ .....(i)

Multiply equation (i) with 100

$100x = 4354.\overline{54}$ .....(ii)

Subtract equation (i) from equation (ii)

$99x = 4354.\overline{54} - 43.\overline{54}$

$= 4311.0$

So, rational representation of x is $\frac{4311}{99}$.

(iii) $5.3\overline{245}$

Let $x = 5.3\overline{245}$ ..... (i)

Multiply equation (i) with 10

$10x = 53.\overline{245}$ ..... (ii)

Multiply equation (i) with 1000

$10000x = 53245.\overline{245}$ ..... (iii)

Subtract equation (ii) from equation (iii)

So, $9990x = 53192$

$\therefore x = \frac{53192}{9990}$.

(iv) $4.62\overline{1}$

Let, $x = 4.62\overline{1}$ ..... (i)

Multiply equation (i) by 100

$100x = 462.\overline{1}$ ..... (ii)

Multiply equation (ii) by 10

$1000x = 4621.\overline{1}$ ..... (iii) Subtract equation (ii) from equation (iii)

$1000x - 100x = 4159$

or $900x = 4159$

$x = \frac{4159}{900}$.

Thus, $4.62\overline{1} = \frac{4159}{900}$.

Section (B) : Irrational numbers

Specimen Copy

B.1 Write three irrational number between $\sqrt{3}$ and $\sqrt{5}$

Ans. 1.801001....,1.901001.....,2.01001.....

Sol. Three irrational number between $\sqrt{3}$ and $\sqrt{5}$ are 1.801001....,1.901001.....,2.01001.....

B.2 Find three different irrational numbers between $\frac{5}{7}$ and $\frac{9}{11}$.

Ans. 0.7507500750007.....,0.7670767007670007..... , and 0.808008000800008.....

Sol. $\frac{5}{7}$ and $\frac{9}{11}$

$\frac{5}{7}$ = 0.7142857.....

$\frac{9}{11}$ = 0.818181.....

So, three different irrational numbers are
0.7507500750007.....,0.7670767007670007..... , and 0.808008000800008.....

B.3 Give one example where the product of two different irrational number is rational.

Ans. $(3 + \sqrt{2})(3 - \sqrt{2})$

Sol. Let first number be $(3 + \sqrt{2})$

Let second number be $(3 - \sqrt{2})$

so their product is

$(3 + \sqrt{2})(3 - \sqrt{2}) = 9 - 4 = 5$

B.4 Prove that $7+\sqrt{3}$ is an irrational number.

Sol. Let $7+\sqrt{3}$ be a rational number in form p/q where $q \neq 0$ & p & q are integers

$7+\sqrt{3} = \frac{p}{q}$

$\sqrt{3} = \frac{p}{q} - 7$

$\sqrt{3} = \frac{p-7q}{q}$

$\because \frac{p-7q}{q}$ is rational no. & $\sqrt{3}$ is an irrational no.

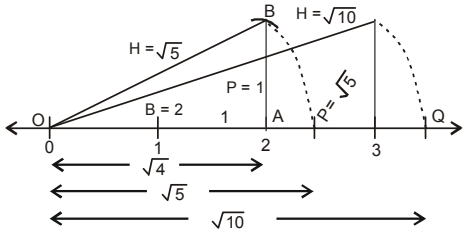
Hence, our assumption is wrong.

Therefore, $7+\sqrt{3}$ is an irrational number.

B.5 Represent $\sqrt{4}, \sqrt{5}, \sqrt{10}$ on the real number line.

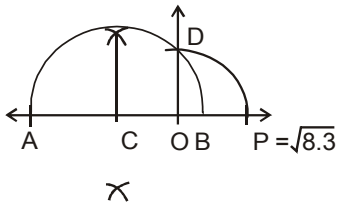
Sol. Representation of $\sqrt{4}, \sqrt{5}$ & $\sqrt{10}$ on real number line

Specimen Copy



B.6 Represent $\sqrt{8.3}$ on the number line.

Sol. Let AO = 8.3 cm and OB = 1 cm, then AB = 8.3 + 1 = 9.3 cm



$$OC = BC - OB = \frac{AB}{2} - OB$$

$$OC = \frac{9.3}{2} - 1 = \frac{7.3}{2}$$

$$OD = BC = \frac{AB}{2} = \frac{9.3}{2}$$

In right angled ΔCOD

$P^2 = H^2 - B^2$ (pyth. Th.)

$OD^2 = CD^2 - OC^2$

$$= \left(\frac{9.3}{2}\right)^2 - \left(\frac{7.3}{2}\right)^2$$

$$= \frac{1}{4}(9.3 + 7.3)(9.3 - 7.3)$$

$$= \frac{1}{4}(16.6)(2) = \frac{33.2}{4} = 8.3$$

$OD = \sqrt{8.3} = OP.$

So, OP represent $\sqrt{8.3}$.

Section (C) : Surds and their application

C.1 Multiply $3\sqrt{28}$ by $2\sqrt{7}$

Ans. 84

Sol. $3\sqrt{28}$ by $2\sqrt{7}$

$3\sqrt{28} \times 2\sqrt{7}$

$\Rightarrow 3\sqrt{7 \times 2 \times 2} \times 2\sqrt{7}$

$3 \times 2\sqrt{7} \times 2\sqrt{7} = 84$

Specimen Copy

C.2 Find the value of $2\sqrt{5}+3\sqrt{5}$.

Ans. $5\sqrt{5}$

Sol. $2\sqrt{5} + 3\sqrt{5}$

$= 5\sqrt{5}$

C.3 What is the square root of the number 0.04 in fraction form?

Ans. $\frac{1}{5}$

Sol. N = 0.04
Taking square root of above

$\sqrt{N} = \sqrt{0.04}$
= 0.2

In fraction from $\frac{0.2}{10} = \frac{2}{10} \Rightarrow \frac{1}{5}$.

C.4 Simplify the expression $\frac{3}{\sqrt{48}-\sqrt{75}}$.

Ans. $\frac{3}{4\sqrt{3}-5\sqrt{3}}$

Sol. $\frac{3}{\sqrt{48}-\sqrt{75}}$

$\frac{3}{\sqrt{2\times2\times2\times2\times3}-\sqrt{5\times3\times5}} = \frac{3}{2\times2\sqrt{3}-5\sqrt{3}}$

$= \frac{3}{4\sqrt{3}-5\sqrt{3}}$

C.5 Find the value of $\frac{6}{\sqrt{5}-\sqrt{3}}$, if being given that $\sqrt{3}$ = 1.732 and $\sqrt{5}$ =2.236.

Ans. 11.904.

Sol. $\frac{6}{\sqrt{5}-\sqrt{3}}$

$= \frac{6}{\sqrt{5}-\sqrt{3}} \times \frac{\sqrt{5}+\sqrt{3}}{\sqrt{5}+\sqrt{3}}$

$= \frac{6\left(\sqrt{5}+\sqrt{3}\right)}{2}$

Specimen Copy

$= 3\,(2.236 + 1.732)$
$= 3 \times 3.968$
$= 11.904.$

C.6 Multiply $\sqrt{27a^3b^2c^4} \times \sqrt[3]{128a^7b^9c^2} \times \sqrt[6]{729ab^{12}c^2}$.

Ans. $36\,a^4\,b^6\,c^3\sqrt[6]{108}$

Sol. $\sqrt{27a^3b^2c^4} \times \sqrt[3]{128a^7b^9c^2} \times \sqrt[6]{729ab^{12}c^2}$

$= (27a^3b^2c^4)^{1/2} \times (128a^7b^9c^2)^{1/3} \times (729\,ab^{12}c^2)^{1/6}$

$= (3^3a^3b^2c^4)^{1/2} \times (2^7a^7b^9c^2)^{1/3} \times (3^6ab^{12}c^2)^{1/6}$

$= (3^9a^9b^6c^{12})^{1/6} \times (2^{14}a^{14}b^{18}c^4)^{1/6} \times (3^6ab^{12}c^2)^{1/6}$

$= (2^{14}3^{15}a^{24}b^{36}c^{18})^{1/6}$

$= 2^2\,3^2\,a^4\,b^6\,c^3\sqrt[6]{2^2 \times 3^3}$

$= 36\,a^4\,b^6\,c^3\sqrt[6]{108}$

C.7 Simplify :

(i) $\dfrac{3\sqrt{2}}{\sqrt{6}-\sqrt{3}} - \dfrac{4\sqrt{3}}{\sqrt{6}-\sqrt{2}} + \dfrac{2\sqrt{3}}{\sqrt{6}+2}$

(ii) $\dfrac{7\sqrt{3}-5\sqrt{2}}{\sqrt{48}+\sqrt{18}}$

Ans. **(i)** 0 **(ii)** $\dfrac{114-41\sqrt{6}}{30}$

Sol. (i) $\dfrac{3\sqrt{2}}{\sqrt{6}-\sqrt{3}} - \dfrac{4\sqrt{3}}{\sqrt{6}-\sqrt{2}} + \dfrac{2\sqrt{3}}{\sqrt{6}+2}$

Let $x = \dfrac{3\sqrt{2}}{\sqrt{6}-\sqrt{3}}$, $y = \dfrac{4\sqrt{3}}{\sqrt{6}-\sqrt{2}}$, $z = \dfrac{2\sqrt{3}}{\sqrt{6}+2}$

$x = \dfrac{3\sqrt{2}}{\sqrt{6}-\sqrt{3}} \times \dfrac{\sqrt{6}+\sqrt{3}}{\sqrt{6}+\sqrt{3}}$

$= \dfrac{6\sqrt{3}+3\sqrt{6}}{6-3}$

$= 2\sqrt{3} + \sqrt{6}$

$y = \dfrac{4\sqrt{3}}{\sqrt{6}-\sqrt{2}} \times \dfrac{\sqrt{6}+\sqrt{2}}{\sqrt{6}+\sqrt{2}}$

$= \dfrac{4 \times 3\sqrt{2}+4\sqrt{6}}{4} = 3\sqrt{2}+\sqrt{6}$

$z = \dfrac{2\sqrt{3}}{\sqrt{6}+2} \times \dfrac{\sqrt{6}-2}{\sqrt{6}-2}$

$= \dfrac{2\sqrt{3}\left(\sqrt{6}-2\right)}{6-4}$

$= \sqrt{3}\left(\sqrt{6}-2\right)$

$= 3\sqrt{2} - 2\sqrt{3}$

So, $x - y + z$

Specimen Copy

$= 2\sqrt{3} + \sqrt{6} - 3\sqrt{2} - \sqrt{6} + 3\sqrt{2} - 2\sqrt{3}$

$= 0.$

(ii) $\dfrac{7\sqrt{3}-5\sqrt{2}}{\sqrt{48}+\sqrt{18}}$

$= \dfrac{7\sqrt{3}-5\sqrt{2}}{\sqrt{16\times 3}+\sqrt{9\times 2}}$

$= \dfrac{7\sqrt{3}-5\sqrt{2}}{4\sqrt{3}+3\sqrt{2}}$

$= \dfrac{7\sqrt{3}-5\sqrt{2}}{4\sqrt{3}+3\sqrt{2}} \times \dfrac{4\sqrt{3}-3\sqrt{2}}{4\sqrt{3}-3\sqrt{2}}$

$= \dfrac{28\times 3-21\sqrt{6}-20\sqrt{6}+30}{48-18}$

$= \dfrac{114-41\sqrt{6}}{30}.$

C.8 Find the value of a and b :

(i) $\dfrac{\sqrt{11}-\sqrt{7}}{\sqrt{11}+\sqrt{7}} = a - b\sqrt{77}$ **(ii)** $\dfrac{3+\sqrt{6}}{\sqrt{3}+\sqrt{2}} = a + b\sqrt{3}$

Ans. **(i)** $a = \dfrac{9}{2}$ & $b = \dfrac{1}{2}$. **(ii)** a = 0 and b = 1.

Sol. (i) $\dfrac{\sqrt{11}-\sqrt{7}}{\sqrt{11}+\sqrt{7}} = a - b\sqrt{77}$

$\dfrac{\sqrt{11}-\sqrt{7}}{\sqrt{11}+\sqrt{7}} \times \dfrac{\sqrt{11}-\sqrt{7}}{\sqrt{11}-\sqrt{7}} = a - b\sqrt{77}$

$\dfrac{\left(\sqrt{11}-\sqrt{7}\right)^2}{11-7} = a - b\sqrt{77}$

$\dfrac{11+7-2\sqrt{77}}{4} = a - b\sqrt{77}$

$\dfrac{18-2\sqrt{77}}{4} = a - b\sqrt{77}$

$\dfrac{9-\sqrt{77}}{2} = a - b\sqrt{77}$

$\dfrac{9}{2} - \dfrac{1}{2}\sqrt{77} = a - b\sqrt{77}$

Comparing rational and irrational part

$\therefore a = \dfrac{9}{2}$ & $b = \dfrac{1}{2}$.

(ii) $\dfrac{3+\sqrt{6}}{\sqrt{3}+\sqrt{2}} = a + b\sqrt{3}$

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$$\frac{3+\sqrt{6}}{\sqrt{3}+\sqrt{2}} \times \frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}-\sqrt{2}} = a + b\sqrt{3}$$

$$\frac{3\sqrt{3}-3\sqrt{2}+3\sqrt{2}-2\sqrt{3}}{1} = a + b\sqrt{3}$$

$$3\sqrt{3} - 2\sqrt{3} = a + b\sqrt{3}$$

$$\sqrt{3} = a + b\sqrt{3}$$

Comparing rational and irrational part

a = 0 and b = 1.

C.9 If $x = \frac{\sqrt{3}+1}{2}$, find the value of $4x^3 + 2x^2 - 8x + 7$.

Ans. **10**

Sol. $\frac{\sqrt{3}+1}{2} = x$

$\sqrt{3} + 1 = 2x$

$2x - 1 = \sqrt{3}$

Squaring both sides we have,

$4x^2 - 4x + 1 = 3$

$4x^2 - 4x - 2 = 0$

$2x^2 - 2x - 1 = 0$

$$\begin{array}{r|l} & 2x + 3 \\ \hline 2x^2 - 2x - 1 & 4x^3 + 2x^2 - 8x + 7 \\ & \underline{-4x^3 \mp 4x^2 \mp 2x} \\ & 6x^2 - 6x + 7 \\ & \underline{6x^2 - 6x - 3} \\ & -\quad + \quad + \\ & 10 \end{array}$$

So, $4x^3 + 2x^2 - 8x + 7 = (2x^2 - 2x - 1)(2x + 3) + 10$

$4x^3 + 2x^2 - 8x + 7 = (0)(2x + 3) + 10$

$4x^3 + 2x^2 - 8x + 7 = 10.$

C.10 Prove that :

$$\frac{1}{3-\sqrt{8}} - \frac{1}{\sqrt{8}-\sqrt{7}} + \frac{1}{\sqrt{7}-\sqrt{6}} - \frac{1}{\sqrt{6}-\sqrt{5}} + \frac{1}{\sqrt{5}-2} = 5$$

Sol. $\frac{1}{3-\sqrt{8}} = \frac{1}{3-\sqrt{8}} \times \frac{3+\sqrt{8}}{3+\sqrt{8}}$

$= \frac{3+\sqrt{8}}{9-8}$

$= 3+\sqrt{8}$.

$\frac{1}{\sqrt{8}-\sqrt{7}} = \frac{1}{\sqrt{8}-\sqrt{7}} \times \frac{\sqrt{8}+\sqrt{7}}{\sqrt{8}+\sqrt{7}}$

$= \frac{\sqrt{8}+\sqrt{7}}{8-7}$

Specimen Copy

$= \sqrt{8} + \sqrt{7}$.

$$\frac{1}{\sqrt{7}-\sqrt{6}} = \frac{1}{\sqrt{7}-\sqrt{6}} \times \frac{\sqrt{7}+\sqrt{6}}{\sqrt{7}+\sqrt{6}}$$

$$= \frac{\sqrt{7}+\sqrt{6}}{7-6}$$

$= \sqrt{7} + \sqrt{6}$.

$$\frac{1}{\sqrt{6}-\sqrt{5}} = \frac{1}{\sqrt{6}-\sqrt{5}} \times \frac{\sqrt{6}+\sqrt{5}}{\sqrt{6}+\sqrt{5}}$$

$$= \frac{\sqrt{6}+\sqrt{5}}{6-5}$$

$= \sqrt{6} + \sqrt{5}$.

$$\frac{1}{\sqrt{5}-2} = \frac{1}{\sqrt{5}-2} \times \frac{\sqrt{5}+2}{\sqrt{5}+2}$$

$$= \frac{\sqrt{5}+2}{5-4}$$

$= \sqrt{5} + 2$.

So, $\frac{1}{3-\sqrt{8}} - \frac{1}{\sqrt{8}-\sqrt{7}} + \frac{1}{\sqrt{7}-\sqrt{6}} - \frac{1}{\sqrt{6}-\sqrt{5}} + \frac{1}{\sqrt{5}-2}$

$= 3 + \sqrt{8} - \sqrt{8} - \sqrt{7} + \sqrt{7} + \sqrt{6} - \sqrt{6} - \sqrt{5} + \sqrt{5} + 2$

$= 5$.

RHS **Hence Proved** .

C.11 Arrange the following surds in ascending order of magnitude : $\sqrt[3]{2}, \sqrt[6]{3}, \sqrt[9]{4}$.

Ans. $\sqrt[9]{4} < \sqrt[6]{3} < \sqrt[3]{2}$

Sol. $\sqrt[3]{2}, \sqrt[6]{3}, \sqrt[9]{4}$

$= (2)^{1/3}, (3)^{1/6}, (4)^{1/9}$

$= \left((2)^{18/3}\right)^{1/18}, \left[(3)^{18/6}\right]^{1/18}, \left[(4)^{18/9}\right]^{1/18}$

$= (64)^{1/18}, (27)^{1/18}, (16)^{1/18}$

So, $\sqrt[9]{4} < \sqrt[6]{3} < \sqrt[3]{2}$.

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C.12 If x = 2 + $\sqrt{3}$, find the value of $x^3 + \frac{1}{x^3}$.

Ans. 52

Sol. x = 2 + $\sqrt{3}$

$$\frac{1}{x} = \frac{1}{2+\sqrt{3}}$$

$$\frac{1}{x} = \frac{1}{2+\sqrt{3}} \times \frac{2-\sqrt{3}}{2-\sqrt{3}}$$

$$\frac{1}{x} = \frac{2-\sqrt{3}}{4-3}$$

$$\frac{1}{x} = 2 - \sqrt{3}$$

So, $x + \frac{1}{x} = 2 + \sqrt{3} + 2 - \sqrt{3} = 4.$

$$x^3 + \frac{1}{x^3} = \left(x + \frac{1}{x}\right)^3 - 3\left(x + \frac{1}{x}\right)$$

$= (4)^3 - 3(4)$
$= 64 - 12$
$= 52.$

Section (D) : Exponents

D.1 Find the value of x : $5^{x-2} \times 3^{2x-3} = 135$.

Ans. 3

Sol. $5^{x-2} \times 3^{2x-3} = 135$
$5^{x-2} \times 3^{2x-3} = 5^1 \times (3)^3$
Compare LHS and RHS power
$x - 2 = 1$
$\Rightarrow x = 3$
or $2x - 3 = 3$
$\Rightarrow x = 3$
So, x = 3.

D.2 Evaluate : $\frac{3^{-3} \times 6^2 \times \sqrt{98}}{5^2 \times \sqrt[3]{1/25} \times (15)^{-4/3} \times 3^{1/3}}$.

Ans. $28\sqrt{2}$

Sol. $\frac{3^{-3} \times 6^2 \times \sqrt{98}}{5^2 \times \sqrt[3]{1/25} \times (15)^{-4/3} \times 3^{1/3}}$

$$= \frac{3^{-3} \times 3^2 \times 2^2 \times 7 \times \sqrt{2}}{5^2 \times 5^{-2/3} \times (3)^{-4/3} \times (5)^{-4/3} \times 3^{1/3}}$$

Specimen Copy

$$= \frac{3^{-1} \times 2^{5/2} \times 7}{3^{-1} \times 5^{-2+2}}$$

$= 7 \times 2^{5/2}$

$= 28\sqrt{2}$.

D.3 Simplify : $\frac{1}{1+x^{b-a}+x^{c-a}} + \frac{1}{1+x^{a-b}+x^{c-b}} + \frac{1}{1+x^{a-c}+x^{b-c}}$.

Ans. 1

Sol. $\frac{1}{1+x^{b-a}+x^{c-a}} + \frac{1}{1+x^{a-b}+x^{c-b}} + \frac{1}{1+x^{a-c}+x^{b-c}}$

$$= \frac{1}{1+\frac{x^b}{x^a}+\frac{x^c}{x^a}} + \frac{1}{1+\frac{x^a}{x^b}+\frac{x^c}{x^b}} + \frac{1}{1+\frac{x^a}{x^c}+\frac{x^b}{x^c}}$$

$$= \frac{x^a}{x^a+x^b+x^c} + \frac{x^b}{x^a+x^b+x^c} + \frac{x^c}{x^a+x^b+x^c}$$

$$= \frac{x^a+x^b+x^c}{x^a+x^b+x^c} = 1.$$

D.4 If $\frac{9^n \times 3^2 \times \left[3^{-n/2}\right]^{-2} - (27)^n}{3^{3m} \times 2^3} = \frac{1}{27}$, then prove that m – n = 1.

Sol. $\frac{9^n \times 3^2 \times \left[3^{-n/2}\right]^{-2} - (27)^n}{3^{3m} \times 2^3} = \frac{1}{27}$

$$\frac{3^{2n} \times 3^2 \times 3^{-\frac{n}{2}\times -2} - 3^{3n}}{3^{3m} \times 2^3} = \frac{1}{27}$$

$$\frac{3^{2n+2+n} - 3^{3n}}{3^{3m} \times 2^3} = \frac{1}{27}$$

$$\frac{3^{3n+2} - 3^{3n}}{3^{3m} \times 2^3} = \frac{1}{27}$$

$$\frac{3^{3n}\left(3^2-1\right)}{3^{3m}\left(2^3\right)} = \frac{1}{27}$$

$$\frac{3^{3n}(8)}{3^{3m}(8)} = \frac{1}{27}$$

$27 \times 3^{3n} = 3^{3m}$

$3^3 \times 3^{3n} = 3^{3m}$

$3^{3n+3} = 3^{3m}$

Specimen Copy

$3n + 3 = 3m$
$3 = 3m - 3n$
$3 \times 1 = 3(m - n)$
$m - n = 1$ **Hence proved.**

D.5 If $a^x = b^y = c^z$ and $b^2 = ac$, then prove that $\frac{1}{x} + \frac{1}{z} = \frac{2}{y}$.

Sol. $a^x = b^y = c^z$ and $b^2 = ac$
$a^x = b^y = c^z = k$
So, $a = k^{1/x}$
$b = k^{1/y}$
and $c = k^{1/z}$
Now, $b^2 = ac$
$(k^{1/y})^2 = k^{1/x} \times k^{1/z}$
$k^{2/y} = k^{1/x + 1/z}$
$\frac{2}{y} = \frac{1}{x} + \frac{1}{z}$. **Hence proved**

OBJECTIVE QUESTIONS

Single Choice Objective, straight concept/formula oriented

Section (A) : Introduction to number system & rational numbers

A.1 The decimal representation of $\frac{27}{400}$ is :
(A*) Terminating
(B) Non terminating recurring
(C) Non terminating non recurring
(D) None of these

Sol. $\frac{27}{400} = \frac{27}{2^4 \times 5^2} = \frac{27}{2^m \times 5^n}$
Denominator is of the form of $2^m \times 5^n$ so, it has terminating decimal expansion.

A.2 $2.2\overline{34}$ is :
(A) Non-terminating only
(B) Non-repeating only
(C*) Non-terminating and repeating
(D) Non-terminating and non-repeating

Sol. $2.2\overline{34}$ Non terminating & repeating.

A.3 How many rational numbers exist between any two distinct rational numbers?
(A) 2 (B) 3 (C) 11 (D*) Infinite

Sol. We can find out infinite rational number between any two distinct rational numbers.

A.4 The rational form of $2.74\overline{35}$ is :
(A) $\frac{27161}{9999}$ (B) $\frac{27}{99}$ (C*) $\frac{27161}{9900}$ (D) $\frac{27161}{9000}$

Sol. Let $x = 2.74\overline{35}$

$$\begin{aligned} 10000x &= 27435.\overline{35} \\ 100x &= 274.\overline{35} \\ \hline 9900x &= 27161.0 \end{aligned}$$

Specimen Copy

$x = \frac{27161}{9900}$.

Section (B) : Irrational numbers

B.1 Which of the following number is irrational ?

(A) $\sqrt{16} - 4$ (B) $(3 - \sqrt{3})(3 + \sqrt{3})$ (C*) $\sqrt{5} + 3$ (D) $-\sqrt{25}$

Sol. $\sqrt{16} - 4 = 4 - 4 = 0$ which is rational

$(3 - \sqrt{3})(3 + \sqrt{3}) = 9 - 3 = 6$ which is rational

$\sqrt{5} + 3$ which is irrational

$-\sqrt{25} = -5$ which is rational

B.2 The decimal expansion of $\sqrt{2}$ is :

(A) Finite decimal (B) 1.4121
(C) Non-terminating recurring (D*) Non - terminating non recurring

Sol. $\sqrt{2}$ is irrational number and irrational number having non - terminating non recurring decimal form.

B.3 The product of a non -zero rational number with an irrational number is :

(A*) Irrational number (B) Rational number (C) Whole number (D) Natural number

Sol. The product of a non -zero rational number with an irrational number always give a irrational no.

B.4 The number $\frac{3-\sqrt{3}}{3+\sqrt{3}}$ is :

(A) rational (B*) irrational (C) both (D) can't say

Sol. $\frac{3-\sqrt{3}}{3+\sqrt{3}}$

$\Rightarrow \frac{3-\sqrt{3}}{3+\sqrt{3}} \times \frac{3-\sqrt{3}}{3-\sqrt{3}} = \frac{12-6\sqrt{3}}{6} = 2-\sqrt{3}$

So, $2 - \sqrt{3}$ is an irrational number.

B.5 Every point on a number line represents :

(A) A natural number (B*) A real number (C) A rational number (D) A irrational number

Sol. (B) a real number.

B.6 A rational number lying between $\sqrt{2}$ and $\sqrt{3}$ is :

(A) $\frac{\sqrt{2}+\sqrt{3}}{2}$ (B) $\sqrt{6}$ (C*) 1.6 (D) 1.9

Sol. $\sqrt{2} \cong 1.414$

$\sqrt{3} \cong 1.7312$

1.6 lies between $\sqrt{2}$ & $\sqrt{3}$

Section (C) : Surds and their application

C.1 If $\sqrt{3} = 1.732$ and $\sqrt{2} = 1.414$, the value of $\frac{1}{\sqrt{3}-\sqrt{2}}$ is :

Specimen Copy

(A) 0.318 (B*) 3.146 (C) $\frac{1}{3.146}$ (D) $\sqrt{1.732}-\sqrt{1.414}$

Sol. $\frac{1}{\sqrt{3}-\sqrt{2}} \times \frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}+\sqrt{2}} = \sqrt{3} + \sqrt{2} = 1.732 + 1.414 = 3.146$

C.2 If x = 2 + $\sqrt{3}$, then $\left(x+\frac{1}{x}\right)$ equals to :

(A) $-2\sqrt{3}$ (B) 2 (C*) 4 (D) $4-2\sqrt{3}$

Sol. x = 2 + $\sqrt{3}$

$\frac{1}{x} = \frac{1}{2+\sqrt{3}} \times \frac{2-\sqrt{3}}{2-\sqrt{3}} = \frac{2-\sqrt{3}}{4-3} = 2-\sqrt{3}$

$\left(x+\frac{1}{x}\right) = 2 + \sqrt{3} + 2 - \sqrt{3} = 4$

C.3 The exponential form of $\sqrt{\sqrt{2}\sqrt{3}}$ is :

(A) $6^{1/2}$ (B) $6^{1/3}$ (C*) $6^{1/4}$ (D) 6

Sol. $\sqrt{\sqrt{2}\times\sqrt{3}} = \sqrt{\sqrt{6}}$

$= ((6)^{1/2})^{1/2}$

$= 6^{1/4}$

C.4 The simplest rationalisation factor of $\sqrt{50}$ is :

(A) $5\sqrt{2}$ (B*) $\sqrt{2}$ (C) 50 (D) $\sqrt{50}$

Sol. $\sqrt{50} = \sqrt{2}$, so $\sqrt{2}$ is simplest R.F.

C.5 If $x = 3+\sqrt{8}$ and $y = 3-\sqrt{8}$ then $\frac{1}{x^2}+\frac{1}{y^2}$ =

(A) – 34 (B*) 34 (C) $12\sqrt{8}$ (D) $-12\sqrt{8}$

Sol. $x = 3+\sqrt{8}$,

$\frac{1}{x} = \frac{1}{3+\sqrt{8}}$

$= \frac{1}{3+\sqrt{8}} \times \frac{3-\sqrt{8}}{3-\sqrt{8}} = \frac{3-\sqrt{8}}{9-8}$

$= 3-\sqrt{8}$.

y = $3-\sqrt{8}$,

Specimen Copy

$$\frac{1}{y} = \frac{1}{3-\sqrt{8}}$$

$$= \frac{1}{3-\sqrt{8}} \times \frac{3+\sqrt{8}}{3+\sqrt{8}} = \frac{3+\sqrt{8}}{9-8}$$

$$= 3+\sqrt{8}$$

So,

$$\frac{1}{x^2}+\frac{1}{y^2} = \left(3-\sqrt{8}\right)^2 + \left(3+\sqrt{8}\right)^2$$

$$= 9 + 8 - 6\sqrt{8} + 9 + 8 + 6\sqrt{8}$$

$$= 34.$$

C.6 If $\frac{3+\sqrt{7}}{3-\sqrt{7}} = a+b\sqrt{7}$ then (a, b) =

(A) (8, – 3) (B) (– 8, – 3) (C) (– 8, 3) (D*) (8, 3)

Sol. $\frac{3+\sqrt{7}}{3-\sqrt{7}} = \frac{3+\sqrt{7}}{3-\sqrt{7}} \times \frac{3+\sqrt{7}}{3+\sqrt{7}} = \frac{\left(3+\sqrt{7}\right)^2}{3^2-\left(\sqrt{7}\right)^2}$

$$= \frac{9+7+6\sqrt{7}}{9-7} = \frac{16+6\sqrt{7}}{2} = 8 + 3\sqrt{7}$$

Now $a + b\sqrt{7} = 8 + 3\sqrt{7}$

$\therefore$ a = 8

and $b\sqrt{7} = 3\sqrt{7}$

b = 3

$\therefore$ (a,b) = (8, 3).

C.7 Which one is greatest in the following :

(A) $\sqrt{2}$ (B) $\sqrt[3]{3}$ (C*) $\sqrt[3]{4}$ (D) $\sqrt[3]{2}$

Sol. $\sqrt{2}$, $\sqrt[3]{3}$, $\sqrt[3]{4}$, $\sqrt[3]{2}$

$= (2)^{1/2}, (3)^{1/3}, (4)^{1/3}, (2)^{1/3}$

$$= \left((2)^{\frac{1}{2}\times 6}\right)^{1/6}, \left((3)^{\frac{1}{3}\times 6}\right)^{1/6}, \left((4)^{\frac{1}{3}\times 6}\right)^{1/6}, \left((2)^{\frac{1}{3}\times 6}\right)^{1/6}$$

$$= \left(2^3\right)^{\frac{1}{6}}, \left((3)^2\right)^{\frac{1}{6}}, \left((4)^2\right)^{\frac{1}{6}}, \left(2^2\right)^{\frac{1}{6}}$$

$$= (8)^{\frac{1}{6}}, (9)^{\frac{1}{6}}, (16)^{\frac{1}{6}}, (4)^{\frac{1}{6}}$$

So $(16)^{\frac{1}{6}}$ is greatest or $\sqrt[3]{4}$ is greatest.

C.8 The value of $\sqrt[5]{(32)^{-3}}$ is :

(A*) 1/8 (B) 1/16 (C) 1/32 (D) None of these

Sol. $\sqrt[5]{(32)^{-3}} = \left(\left(2^5\right)^{-3}\right)^{\frac{1}{5}}$

Specimen Copy

$= \left(2^{-3}\right)^{5\times\frac{1}{5}} = 2^{-3} = \frac{1}{2^3} = \frac{1}{8}$.

C.9 If $x = \frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}}$ and $y = \frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}}$ the value of $x^2 + xy + y^2$ is :

(A*) 99 (B) 100 (C) 1 (D) 0

Sol. $x = \frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}}$

$= \frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}} \times \frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}-\sqrt{2}} = 5-2\sqrt{6}$

$\therefore x^2 = (5 - 2\sqrt{6})^2 = 49 - 20\sqrt{6}$

$y = \frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}}$

$= \frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}} \times \frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}+\sqrt{2}} = 5+2\sqrt{6}$

$\therefore y^2 = (5 + 2\sqrt{6})^2 = 49 + 20\sqrt{6}$

& $xy = \frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}} \times \frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}} = 1$

$\therefore x^2 + xy + y^2 = 49 - 20\sqrt{6} + 1 + 49 + 20\sqrt{6} = 99.$

C.10 Simplify : $\frac{2}{\sqrt{5}+\sqrt{3}} + \frac{1}{\sqrt{3}+\sqrt{2}} - \frac{3}{\sqrt{5}+\sqrt{2}}$.

(A) 1 (B*) 0 (C) 10 (D) 100

Sol. $\frac{2}{\sqrt{5}+\sqrt{3}} = \frac{2}{\sqrt{5}+\sqrt{3}} \times \frac{\sqrt{5}-\sqrt{3}}{\sqrt{5}-\sqrt{3}}$

$= \frac{2(\sqrt{5}-\sqrt{3})}{\left(\sqrt{5}\right)^2 - \left(\sqrt{3}\right)^2}$

$= \frac{2\left(\sqrt{5}-\sqrt{3}\right)}{2} = \sqrt{5}-\sqrt{3}$

$\frac{1}{\sqrt{3}+\sqrt{2}} = \frac{1}{\sqrt{3}+\sqrt{2}} \times \frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}-\sqrt{2}}$

$= \frac{\sqrt{3}-\sqrt{2}}{(3-2)}$

$= \sqrt{3}-\sqrt{2}$.

$\frac{3}{\sqrt{5}+\sqrt{2}} = \frac{3}{\sqrt{5}+\sqrt{2}} \times \frac{\sqrt{5}-\sqrt{2}}{\sqrt{5}-\sqrt{2}}$

$= \frac{3\left(\sqrt{5}-\sqrt{2}\right)}{(5-2)}$

Specimen Copy

$$= \frac{3\left(\sqrt{5}-\sqrt{2}\right)}{3} = \sqrt{5}-\sqrt{2}$$

So, $\frac{2}{\sqrt{5}+\sqrt{3}} + \frac{1}{\sqrt{3}+\sqrt{2}} - \frac{3}{\sqrt{5}+\sqrt{2}}$

$= \sqrt{5}-\sqrt{3}+\sqrt{3}-\sqrt{2}-\sqrt{5}+\sqrt{2}$

$= 0.$

C.11 Which of the following is smallest :

(A) $\sqrt[4]{5}$ (B*) $\sqrt[5]{4}$ (C) $\sqrt{4}$ (D) $\sqrt{3}$

Sol. $(5)^{1/4}\ (4)^{1/5}\ (4)^{1/2}$, $(3)^{1/2}$

$= \left(5^{\frac{1}{4}\times 20}\right)^{1/20} \left(4^{\frac{1}{5}\times 20}\right)^{1/20}, \left(4^{\frac{1}{2}\times 20}\right)^{1/20}, \left(3^{\frac{1}{2}\times 20}\right)^{1/20}$

$= (5^5)^{1/20}, (4^4)^{1/20}, (4^{10})^{1/20}, (3^{10})^{1/20}$

Easily $(4^4)^{20}$ is smallest.

$\therefore (4)^{1/5}$ or $\sqrt[5]{4}$ is smallest.

C.12 The product of $\sqrt{3}$ and $\sqrt[3]{5}$ is :

(A) $\sqrt[6]{375}$ (B*) $\sqrt[6]{675}$ (C) $\sqrt[6]{575}$ (D) $\sqrt[6]{475}$

Sol. $(3)^{1/2}\times(5)^{1/3}$

$= \left(3^{\frac{1}{2}\times 6}\right)^{\frac{1}{6}} \times \left(5^{\frac{1}{3}\times 6}\right)^{\frac{1}{6}} = (3^3)^{1/6} \times (5^2)^{1/6} = (27)^{1/6} \times (25)^{1/6} = \sqrt[6]{675}$

C.13 The value of $\sqrt{20}\times\sqrt{5}$ is :

(A*) 10 (B) $2\sqrt{5}$ (C) $20\sqrt{5}$ (D) $4\sqrt{5}$

Sol. $\sqrt{20}\times\sqrt{5} = \sqrt{20\times 5} = \sqrt{100} = 10$

C.14 $\sqrt[3]{\frac{54}{250}}$ equals :

(A) $\frac{9}{25}$ (B*) $\frac{3}{5}$ (C) $\frac{27}{125}$ (D) $\frac{\sqrt[3]{2}}{5}$

Sol. $\sqrt[3]{\frac{54}{250}} = \sqrt[3]{\frac{27}{125}} = \frac{3}{5}$

Section (D) : Exponents

D.1 The value of x, if $5^{x-3}\,.\,3^{2x-8} = 225$, is :

(A) 1 (B) 2 (C) 3 (D*) 5

Sol. $5^{x-3}\,.\,3^{2x-8} = 225$

$5^{x-3}\,.\,3^{2x-8} = 25\times 9$

$5^{x-3}\,.\,3^{2x-8} = 5^2\times 3^2$

$\therefore x - 3 = 2$ or $2x - 8 = 2$

$\therefore x = 5.$

Specimen Copy

D-2. $\dfrac{3^{5x} \times (81)^2 \times 6561}{3^{2x}} = 3^7$, then

(A) x = – 2 (B*) x = – 3 (C) x = – 1 (D) x = 0

D-3. $3^n \times 9^n \times 27^{1-n} =$

(A) 9 (B*) 27 (C) 3 (D) $\dfrac{1}{3}$

D-4. $(3^{-1} + 5^{-1} + 2^{-1})^{-1} =$

(A) $\dfrac{29}{30}$ (B) $\dfrac{31}{29}$ (C*) $\dfrac{31}{30}$ (D) None

D-5. If $2^x = 4^y = 8^z$, then find x : y : z.

(A) 1 : 2 : 3 (B) 3 : 2 : 1 (C) 2 : 3 : 1 (D*) 6 : 3 : 2

Exercise-2

✍ Marked Questions can be used as Revision Questions.

MERGE FOR NTSE SHEET EXERCISE - 1

OBJECTIVE QUESTIONS

1. The digit at the 100th place in the decimal representation of $\dfrac{6}{7}$, is :

(A*) 1 (B) 2 (C) 4 (D) 5

Sol. $\dfrac{6}{7} = 0.\overline{857142}$

six digit are repeated

$$\begin{array}{r} 16 \\ 6\overline{)100} \\ 96 \\ \hline \times 4 \end{array}$$

$\therefore$ 100 digit will be the 4th digit of $0.\overline{857142}$

i.e. 1.

2. xy is a number that is divided by ab where xy < ab and gives a result 0.xyxyxy... then ab equals :

(A) 11 (B) 33 (C*) 99 (D) 66

Sol. $\dfrac{xy}{ab}$ = xyxyxyxy.....

$\Rightarrow$ ab = 99.

3. When the repeating decimal 0.45454545..... is written in simplest fractional form, the sum of the numerator and denominator is :

(A) 5 (B) 11 (C) 55 (D*) 16

Sol. Let N = 0.45454545.....

$= \dfrac{45}{99} = \dfrac{5}{11}$

Sum of numerator & denominator = 5 + 11 = 16.

Specimen Copy

4. If $\sqrt{9-(n-2)^2}$ is a real number, then the number of integral values of n is :

(A) 3 (B) 5 (C*) 7 (D) Infinitely many

Sol. $\sqrt{9-(n-2)^2}$

For n = 5, 4, 3, 2, 1, 0, – 1

$\sqrt{9-(n-2)^2}$ is a real number

So, number of integral values of n is 7.

5. If x is a positive integer less than 100, then the number of x which make $\sqrt{1+2+3+4+x}$ an integer is:

(A) 6 (B*) 7 (C) 8 (D) 9

Sol. $\sqrt{1+2+3+4+x} = \sqrt{10+x}$

x which make $\sqrt{10+x}$ an integer is 6, 15, 26, 39, 54, 71 and 90.

So, number of positive integers = 7.

6. If $\dfrac{\sqrt{954+\sqrt{\sqrt{484}+\sqrt{704+\sqrt{625}}}}}{0.00155} = \dfrac{\sqrt{0.0004}}{(0.009)^2.x}$. Then approximate value of x is

(A) 123.456 (B*) 0.01234 (C) 12.34 (D) 12345.67

Sol. $\dfrac{\sqrt{954+\sqrt{\sqrt{484}+\sqrt{704+\sqrt{625}}}}}{0.00155} = \dfrac{\sqrt{.0004}}{(.009)^2.\ x}$

$\Rightarrow x = \dfrac{\sqrt{4.10^{-4}}}{(9.10^{-3})^2} \cdot \dfrac{155.10^{-5}}{\sqrt{961}} = \dfrac{310}{81} \cdot \dfrac{10^{-1}}{\sqrt{961}}$

= 0.01234.

7. If n is a perfect square, then the next perfect square greater than n is :

(A) $n^2 + 1$ (B) $n^2 + n$ (C*) $n + 2\sqrt{n} + 1$ (D) $2n + 1$

Sol. Next perfect square greater than n is $n + 2\sqrt{n} + 1$.

As, $n = a^2$ is a perfect square

Therefore, $n + 2\sqrt{n} + 1 = a^2 + 2\sqrt{a^2} + 1$

$= a^2 + 2a + 1 = (a + 1)^2$.

8. If $x+\sqrt{x+\sqrt{x+\sqrt{x+.....}}} = 2$ then x equals

(A*) $2-\sqrt{2}$ (B) $2+\sqrt{2}$ (C) $2\pm\sqrt{2}$ (D) $2-\sqrt{3}$

Sol. $x+\sqrt{x+\sqrt{x+\sqrt{x+.....}}} = 2$

$x+\sqrt{2} = 2$

$x = 2-\sqrt{2}$

9. The four digit number 2652 is such that any two consecutive digits from it make a multiple of 13. Another number N has this same property, is 100 digits long, and begins in a 9. The last digit of N, is

(A) 2 (B) 3 (C) 6 (D*) 9

Sol. 913913 ..... (100 digit)

we see that 913 is repeated.

913 comes 33 times so the last digit (100th digit) will be 9.

10. The expression

Specimen Copy

$$\left(\frac{1}{2}+\frac{1}{3}+.....+\frac{1}{2008}\right)\left(1+\frac{1}{2}+\frac{1}{3}+.....+\frac{1}{2007}\right)-\left(1+\frac{1}{2}+\frac{1}{3}+.....+\frac{1}{2008}\right)\left(\frac{1}{2}+\frac{1}{3}+.....+\frac{1}{2007}\right)$$

simplifies to :

(A) 0 (B) $\frac{1}{2007}$ (C*) $\frac{1}{2008}$ (D) $\frac{2}{2007}$

Sol. $\left(\frac{1}{2}+\frac{1}{3}+.....+\frac{1}{2008}\right)\left(1+\frac{1}{2}+\frac{1}{3}+.....+\frac{1}{2007}\right)$

$-\left(1+\frac{1}{2}+\frac{1}{3}+.....+\frac{1}{2008}\right)\left(\frac{1}{2}+\frac{1}{3}+.....+\frac{1}{2007}\right)$

Let $\left(\frac{1}{2}+\frac{1}{3}+.....+\frac{1}{2007}\right)=x$

and $\left(1+\frac{1}{2}+\frac{1}{3}+.....+\frac{1}{2007}\right)=y$

So,

$$y-x=\left(1+\frac{1}{2}+\frac{1}{3}+.....+\frac{1}{2007}-\frac{1}{2}-\frac{1}{3}.....-\frac{1}{2007}\right)=1$$

So, $\left(x+\frac{1}{2008}\right)y-\left(y+\frac{1}{2008}\right)\times x$

$$=xy+\frac{y}{2008}-xy-\frac{x}{2008}$$

$$=\frac{y-x}{2008} \qquad =\frac{1}{2008}.$$

11. If $\dfrac{1}{\dfrac{1}{\dfrac{1}{x}+\dfrac{1}{2}}+\dfrac{1}{\dfrac{1}{x}+\dfrac{1}{2}}}+\dfrac{1}{\dfrac{1}{\dfrac{1}{x}+\dfrac{1}{2}}+\dfrac{1}{\dfrac{1}{x}+\dfrac{1}{2}}}=\dfrac{x}{36}$, then x is equal to :

(A*) 70 (B) 72 (C) 36 (D) 68

Sol. $$\frac{1}{\dfrac{1}{\dfrac{1}{x}+\dfrac{1}{2}}+\dfrac{1}{\dfrac{1}{x}+\dfrac{1}{2}}}+\dfrac{1}{\dfrac{1}{\dfrac{1}{x}+\dfrac{1}{2}}+\dfrac{1}{\dfrac{1}{x}+\dfrac{1}{2}}}=\frac{x}{36}$$

$$\frac{1}{\dfrac{1}{\dfrac{2+x}{2x}}+\dfrac{1}{\dfrac{2+x}{2x}}}+\dfrac{1}{\dfrac{1}{\dfrac{2+x}{2x}}+\dfrac{1}{\dfrac{2+x}{2x}}}$$

Specimen Copy

$$= \frac{1}{\dfrac{1}{\dfrac{2x}{2+x}+\dfrac{2x}{2+x}}+\dfrac{1}{\dfrac{2x}{2+x}+\dfrac{2x}{2+x}}}$$

$$= \frac{1}{\dfrac{2+x}{4x}+\dfrac{2+x}{4x}} = \frac{4x}{4+2x} = \frac{x}{36}$$

$4 \times 36 = 4 + 2x$

$144 = 4 + 2x$; $x = \frac{140}{2} = 70.$

12. The value of $\left(1-\frac{1}{3}\right)^2 \left(1-\frac{1}{4}\right)^2 \left(1-\frac{1}{5}\right)^2 \ldots\ldots \left(1-\frac{1}{n}\right)^2$ is equal to :

(A) $\left(\frac{1}{n}\right)^2$ (B*) $\left(\frac{2}{n}\right)^2$ (C) $\left(\frac{3}{n}\right)^2$ (D) $\left(\frac{4}{n}\right)^2$

Sol. $\left(\frac{2}{3}\right)^2 \left(\frac{3}{4}\right)^2 \left(\frac{4}{5}\right)^2 \ldots \left(\frac{4-1}{n}\right)^2 = \frac{2^2}{n^2} = \left(\frac{2}{n}\right)^2$

13. If $x = (7 + 4\sqrt{3})$, then the value of $\sqrt{x} + \frac{1}{\sqrt{x}}$ is :

(A) 8 (B) 6 (C) 5 (D*) 4

Sol. Given $x = 7 + 4\sqrt{3} = (2 + \sqrt{3})^2$

$\therefore \quad \sqrt{x} = 2 + \sqrt{3}$

and $x + 1 = 8 + 4\sqrt{3} = 4(2 + \sqrt{3})$.

Now, $\sqrt{x} + \frac{1}{\sqrt{x}} = \frac{x+1}{\sqrt{x}} = \frac{4(2+\sqrt{3})}{2+\sqrt{3}} = 4.$

14. If $x = \frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}}$ and $y = \frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}}$ the value of $x^2 + xy + y^2$ is :

(A*) 99 (B) 100 (C) 1 (D) 0

Sol. $x = \frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}} = \frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}} \times \frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}-\sqrt{2}} = 5-2\sqrt{6}$

$\therefore x^2 = (5 - 2\sqrt{6})^2 = 49 - 20\sqrt{6}$

$y = \frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}} = \frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}} \times \frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}+\sqrt{2}} = 5+2\sqrt{6}$

$\therefore y^2 = (5 + 2\sqrt{6})^2 = 49 + 20\sqrt{6}$

& $xy = \frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}} \times \frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}} = 1$

$\therefore x^2 + xy + y^2 = 49 - 20\sqrt{6} + 1 + 49 + 20\sqrt{6} = 99.$

15. The value of the expression $\sqrt{\frac{1}{\sqrt{2}+1}+\frac{1}{\sqrt{3}+\sqrt{2}}+\frac{1}{\sqrt{4}+\sqrt{3}}+\ldots\ldots}$ upto 99 terms is equal to

Specimen Copy

(A) 9 (B*) 3 (C) 1 (D) 0

Sol. $\sqrt{\frac{1}{\sqrt{2}+1}+\frac{1}{\sqrt{3}+\sqrt{2}}+\frac{1}{\sqrt{4}+\sqrt{3}}+.....\text{upto 99 terms}}$

$=\sqrt{\sqrt{2}-1+\sqrt{3}-\sqrt{2}+\sqrt{4}-\sqrt{3}+.....\sqrt{100}-\sqrt{99}}$

$=\sqrt{-1+10}=\sqrt{9}=3.$

16. The simplest rationalising factor of $\sqrt[4]{48}$ is :

(A) $\sqrt[4]{9}$ (B*) $\sqrt[4]{27}$ (C) $\sqrt[3]{9}$ (D) None of these

Sol. R. F . of $\sqrt[4]{48}$ or $2\sqrt[4]{3}$ = $\sqrt[4]{27}$.

17. Let r and s be integer. The $\frac{6^{r+s}\times 12^{r-s}}{8^r\times 9^{r+2s}}$ is an integer if :

(A) $r + s \le 0$ (B*) $s \le 0$ (C) $r \le 0$ (D) $r \ge s$

Sol. $\frac{6^{r+s}\times 12^{r-s}}{8^r\times 9^{r+2s}}$

$=\frac{2^{r+s}\times 3^{r+s}\times 2^{2r-2s}\times 3^{r-s}}{2^{3r}\times 3^{2r+4s}}$

$= 2^{r+s+2r-2s-3r}\times 3^{r+s+r-s-2r-4s}$

$= 2^{-s}\times 3^{-4s}$

This should be an integer only when $s \le 0$.

18. If $2^a > 4^c$ and $3^b > 9^a$ and a, b, c all positive, then :

(A*) c < a < b (B) b < c < a (C) c < b < a (D) a < b < c

Sol. $2^a > 4^c$ $3^b > 9^a$

$2^a > 2^{2c}$ $3^b > 3^{2a}$

$a > 2c$ $b > 2a$

$\Rightarrow a > c$ - (i) $\Rightarrow b > a$ - (ii)

from (1) & (2), we have

c < a < b.

19. If $2^{2008} - 2^{2007} - 2^{2006} + 2^{2005} = k \cdot 2^{2005}$ then the value of k is equal to :

(A) 2 (B*) 3 (C) 4 (D) 5

Sol. Given : $2^{2008} - 2^{2007} - 2^{2006} + 2^{2005} = k \cdot 2^{2005}$

$\Rightarrow 2^3\times 2^{2005} - 2^2\times 2^{2005} - 2.2^{2005} + 2^{2005} = k\times 2^{2005}$

$\Rightarrow (2^3 - 2^2 - 2 + 1)\times 2^{2005} = k\times 2^{2005}$

$\Rightarrow k = 3.$

20. If $2^x = 3^y = 6^{-z}$, then $\left(\frac{1}{x}+\frac{1}{y}+\frac{1}{z}\right)$ is equal to :

(A*) 0 (B) 1 (C) $\frac{3}{2}$ (D) $-\frac{1}{2}$

Sol. $2^x = 3^y = 6^{-z}\sin\ \frac{1}{x}+\frac{1}{y}+\frac{1}{z}$

Let $2^x = 3^y = 6^{-z} = k$

$2 = k^{1/x}$ $6^{-z} = k$

Specimen Copy

$3 = k^{1/y}$

$k^{1/x} \times k^{1/y} = k^{-1/z}$

$k^{1/x + 1/y} = k^{-\frac{1}{z}}$

$\frac{1}{x} + \frac{1}{y} = -\frac{1}{z}$

so $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = 0$

21. If $4^x - 4^{x-1} = 24$, then the value of $(2x)^x$ equals :

(A) $5\sqrt{5}$ (B) $\sqrt{5}$ (C*) $25\sqrt{5}$ (D) 25

Sol. $4^x - 4^{x-1} = 24$

$\Rightarrow \quad 4^x [1 - \frac{1}{4}] = 24$

$\Rightarrow \quad 4^x \times \frac{3}{4} = 24$

$\Rightarrow \quad 4^x = 32$

$\Rightarrow \quad 2^{2x} = 2^5$

$\Rightarrow \quad 2x = 5$

So, $(2x)^x = 5^{2.5} = 25\sqrt{5}$.

22. $2^{73} - 2^{72} - 2^{71}$ is the same as :

(A) 2^{69} (B) 2^{70} (C*) 2^{71} (D) 2^{72}

Sol. $2^{71}(2^2 - 2 - 1) = 2^{71}(4 - 3) = 2^{71}$.

23. If x = – 0.5 then which one of the following has the smallest value :

(A) $2^{\frac{1}{x}}$ (B*) $\frac{1}{x}$ (C) 2^x (D) $\frac{1}{\sqrt{-x}}$

Sol. $x = -0.5 = -\frac{1}{2}$

(A) $2^{\frac{1}{x}} = 2^{-2} = \frac{1}{4} = 0.25$

(B) $\frac{1}{x} = -2$

Specimen Copy

(C) $2^x = 2^{-\frac{1}{2}} = \frac{1}{\sqrt{2}}$

(D) $\frac{1}{\sqrt{-x}} = \sqrt{2}$

So, option (B) has the smallest value.

Exercise-3

Marked Questions can be used as Revision Questions.
*** Marked Questions may have more than one correct option.**

NTSE PROBLEMS (PREVIOUS YEARS)

*** Marked Questions may have more than one correct option.**

1. If $2^x = 4^y = 8^z$ and $\frac{1}{2x} + \frac{1}{4y} + \frac{1}{6z} = \frac{24}{7}$, then the value of z is - **(Rajasthan NTSE Stage-1 2005)**

(A) $\frac{7}{16}$ (B) $\frac{7}{32}$ (C*) $\frac{7}{48}$ (D) $\frac{7}{64}$

Sol. $2^x = 4^y = 8^z$

$2^x = 2^{2y} = 2^{3z}$

$\therefore x = 2y, 2y = 3z$

$$\frac{1}{2x} + \frac{1}{4y} + \frac{1}{6z} = \frac{24}{7}$$

$$\Rightarrow \frac{1}{4y} + \frac{1}{4y} + \frac{1}{6z} = \frac{24}{7}$$

$$\Rightarrow \frac{1}{2y} + \frac{1}{6z} = \frac{24}{7}$$

$$\Rightarrow \frac{1}{3z} + \frac{1}{6z} = \frac{24}{7}$$

$$\Rightarrow z = \frac{3 \times 7}{6 \times 24}$$

$$z = \frac{7}{48}$$

2. If $\left(\frac{a}{b}\right)^{x-1} = \left(\frac{b}{a}\right)^{x-3}$ then the value of x is - **(Rajasthan NTSE Stage-1 2005)**

(A) 1 (B*) 2 (C) 3 (D) 4

Sol. $\left(\frac{a}{b}\right)^{x-1} = \left(\frac{a}{b}\right)^{-x+3}$

so, $x - 1 = -x + 3$

$\Rightarrow x + x = 1 + 3$

$\Rightarrow 2x + 4$

$x = 2$

Specimen Copy

3. If $a^x = b$, $b^y = c$ and $c^z = a$, then value of xyz is **(Rajasthan NTSE Stage-1 2007)**

(A*) 1 (B) 0 (C) –1 (D) a + b + c.

Sol. $a^x = b$, $b^y = c$, $c^z = a$

$\Rightarrow (a^x)^y = c$

$\Rightarrow a^{xy} = c$

$\Rightarrow (a^{xy})^z = a$

$a^{xyz} = a^1$

xyz = 1

4. An equivalent expression of $\frac{5}{\sqrt{3}-\sqrt{5}}$ after rationlizing the denominator is

(Rajasthan NTSE Stage-1 2013)

(A) $\left(\frac{5}{2}\right)(\sqrt{3}+\sqrt{5})$ (B*) $\left(-\frac{5}{2}\right)(\sqrt{3}+\sqrt{5})$ (C) $\left(\frac{5}{2}\right)(\sqrt{3}-\sqrt{5})$ (D) $\left(-\frac{5}{2}\right)(\sqrt{3}-\sqrt{5})$

Sol. $\frac{5}{\sqrt{3}-\sqrt{5}}$

$= \frac{5}{\sqrt{3}-\sqrt{5}} \times \frac{\sqrt{3}+\sqrt{5}}{\sqrt{3}+\sqrt{5}}$

$= \frac{5(\sqrt{3}+\sqrt{5})}{3-5} = -\frac{5}{2}(\sqrt{3}+\sqrt{5})$

5. Value of $\frac{2^{100}}{2}$ is : **(Rajasthan NTSE Stage-1 2013)**

(A) 1 (B) 50^{100} (C) 2^{50} (D*) 2^{99}

Sol. $\frac{2^{100}}{2} = \mathbf{2^{100-1} = 2^{99}}$

6. If $x^{p^q} = (x^p)^q$, then p = **(Haryana NTSE Stage-1 2013)**

(A) $q^{\frac{1}{q}}$ (B) 1 (C) q^q (D*) $q^{\frac{1}{q-1}}$

Sol. $x^{p^q} = \left(x^p\right)^q$

so

$x^{p^q} = x^{pq}$

$p^q = pq$

$p^q - pq = 0$

$p(p^{q-1} - q) = 0$

so p = 0 or $p^{q-1} - q = 0$

so

$p = q^{\frac{1}{q-1}}$

7. If $a^x = b$, $b^y = c$ and $c^z = a$, then the value of $x^2y^2z^2$ is .....

[Madhya Pradesh NTSE Stage-1 2013]

(A) $a^2b^2c^2$ (B) 1 (C) 4 (D) $\frac{1}{a^2b^2c^2}$

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Sol. $a^x = b$, $b^y = c$, $c^z = a$

$\Rightarrow b^y = c$

$\Rightarrow (a^x)^y = c$

$a^{xy} = c$

if $c^z = a$

$\Rightarrow (a^{xy})^z = a$

$a^{xyz} = a^1$

$xyz = 1$

$x^2y^2z^2 = 1$

8. H.C.F. (28, 35, 91) = ... **[Gujarat NTSE Stage-1 2013]**

(A) 1 (B) 5 (C) 7 (D) 14

9. Which of the following time expressions is right for the fraction $\frac{1}{4}$? **[Gujarat NTSE Stage-1 2014]**

(A) 15 minute (B) 30 minute (C) 45 minute (D) 10 minute

Sol. 15 Minutes

10. Which real number lies between 2 and 2.5 **(Chandigarh NTSE Stage-1 2014)**

(A) $\sqrt{11}$ (B) $\sqrt{8}$ (C) $\sqrt[3]{7}$ (D) $\sqrt[3]{9}$

Sol. $2 = \sqrt[3]{8}$

$2.5 = \sqrt[3]{15.625}$

so the correct option is (D) $\sqrt[3]{9}$

11. Of the following four numbers the largest is : **(Harayana NTSE Stage-1 2014)**

(A) 3^{210} (B) 7^{140} (C) $(17)^{105}$ (D) $(31)^{84}$

Sol. (i) $3^{210} < 4^{210}$

$3^{210} < 2^{420}$

(ii) $7^{140} < 8^{140}$

$7^{140} < 2^{420}$

(iii) $(17)^{105} > 16^{105}$

$(17)^{105} > 2^{420}$

(iv) $(31)^{84} < (32)^{84}$

$(31)^{84} < 2^{420}$

$\therefore$ so $(17)^{105}$ is largest

12. The rationalizing factor of $\sqrt[n]{\frac{a}{b}}$ is **(Karnataka NTSE Stage-1 2014)**

(A) $ab\sqrt[n]{\frac{a}{b}}$ (B) $\sqrt[n]{\frac{a}{b}}$ (C) $\sqrt[n]{\frac{a^{n-1}}{b^{n-1}}}$ (D) $\sqrt[n]{\frac{a^{n+1}}{b^{n+1}}}$

Sol. R.F. of $\sqrt[n]{\frac{a}{b}}$ is $\left(\frac{a}{b}\right)^{1-1/n}$

as, $\left(\frac{a}{b}\right)^{1/n} \cdot \left(\frac{a}{b}\right)^{1-1/n} = \left(\frac{a}{b}\right)$

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So, $\left(\frac{a}{b}\right)^{1-1/n} = \left(\frac{a}{b}\right)^{\frac{n-1}{n}}$

$= \left[\left(\frac{a}{b}\right)^{n-1}\right]^{1/n}$

$= \sqrt[n]{\left(\frac{a}{b}\right)^{n-1}}$

13. In a number is divided by 6, the remainder is 3 then what will be the remainder when the square of the same number is divided by 6 again — **[Uttar Pradesh NTSE Stage-1 2014]**

(A) 0 (B) 1 (C) 2 (D) 3

14. If x = (3 + $\sqrt{8}$) , then $\left(x^2 + \frac{1}{x^2}\right)$ will be- **[Uttar Pradesh NTSE Stage-1 2014]**

(A) 38 (B) 36 (C) 34 (D) 30

15. If $\left(\frac{a}{b}\right)^{x-1} = \left(\frac{b}{a}\right)^{x-3}$ then the value of x will be- **[Uttar Pradesh NTSE Stage-1 2014]**

(A) –1 (B) 1 (C) 2 (D) 3

16. The simplest rationalizing factor of $\sqrt[3]{72}$ is **[Madhya Pradesh NTSE Stage-1 2014]**

(A) $2^{\frac{1}{3}}$ (B) $3^{\frac{1}{3}}$ (C) $3^{\frac{1}{2}}$ (D) $2^{\frac{1}{2}}$

Sol. $\sqrt[3]{72}$

$= \sqrt[3]{2^3 \times 3^2}$

$\sqrt[3]{72} = 2\sqrt[3]{3^2}$

$= 2 \times 3^{2/3}$

rationalisation factor = $3^{1/3}$

17. The value of $\left(\frac{x^b}{x^c}\right)^{\frac{1}{bc}} \cdot \left(\frac{x^c}{x^a}\right)^{\frac{1}{ca}} \cdot \left(\frac{x^a}{x^b}\right)^{\frac{1}{ab}}$ on simplifying is : **(Rajasthan NTSE Stage-1 2015)**

(A) x (B) 1/x (C) 1 (D) – 1

Sol. $\left(x^{b-c}\right)^{\frac{1}{bc}} \left(x^{c-a}\right)^{\frac{1}{ca}} \left(x^{a-b}\right)^{\frac{1}{ab}}$

$= x^{\frac{a(b-c)+b(c-a)+c(a-b)}{abc}}$

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$= x^{\frac{0}{abc}} = x^{\circ} = 1$

18. If $x = 2 + \sqrt{3}$ and $xy = 1$ then $\frac{x}{\sqrt{2}+\sqrt{x}} + \frac{y}{\sqrt{2}-\sqrt{y}}$ = ... **(Bihar NTSE Stage-1 2015)**

(A*) $\sqrt{2}$ (B) $\sqrt{3}$ (C) 1 (D) None of these

19. Simple form of $\frac{\sqrt{5}-2}{\sqrt{5}+2} + \frac{\sqrt{5}+2}{\sqrt{5}-2}$ is ..... **[Madhya Pradesh NTSE Stage-1 2015]**

(A) $9 + \sqrt{5}$ (B) 18 (C) $18 + \sqrt{5}$ (D) 9

Sol. $\frac{\sqrt{5}-2}{\sqrt{5}+2} + \frac{\sqrt{5}+2}{\sqrt{5}-2}$

$\frac{5+4-4\sqrt{5}+5+4+4\sqrt{5}}{5-4} = 18$

20. If the L.C.M. of two numbers is 2520 and H.C.F. is 12.Its one number is 504, then the other number will be ..... **[Madhya Pradesh NTSE Stage-1 2015]**

(A) 50 (B) 65 (C) 40 (D) 60

Sol Let two number are N_1 N_2

$N_1 \times N_2 = LCM (N_1 \times N_2) \times HCF (N_1, N_2)$

$504 \times N_2 = 2520 \times 12$

$N_2 = \frac{2520 \times 12}{504} = 60$

$N_2 = 60$

21. Which number is the inverse of the opposite of $-\frac{5}{8}$? **[Gujarat NTSE Stage-1 2015]**

(A) $\frac{5}{8}8$ (B*) $1\frac{3}{5}$ (C) $2\frac{2}{5}$ (D) $-\frac{8}{5}$

22. If $x = \sqrt[4]{16} + \sqrt[4]{625}$ than what is x = ? **[Gujarat NTSE Stage-1 2015]**

(A*) 7 (B) 29 (C) 12 (D) 5

23. The simplified value of $\frac{1}{\sqrt{2}+\sqrt{3}-\sqrt{5}} + \frac{1}{\sqrt{2}-\sqrt{3}-\sqrt{5}}$ is **[Delhi NTSE Stage-1 2015]**

(A) 1 (B) 0 (C) $\sqrt{2}$ (D) $\frac{1}{\sqrt{2}}$

24. Raj wanted to type the first 200 natural numbers, how many times does he have to press the keys **[Delhi NTSE Stage-1 2015]**

(A) 489 (B) 492 (C) 400 (D) 365

25. Which is the greatest among $\sqrt[6]{100}$, $\sqrt[3]{12}$ and $\sqrt{3}$ **[Delhi NTSE Stage-1 2015]**

(A) $\sqrt{3}$ (B) $\sqrt[6]{100}$ (C) $\sqrt[3]{12}$ (D) cannot be determined

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26. Among the numbers 2^{250}, 3^{200}, 4^{150} and 5^{100}, the greatest is **(West Bengal NTSE Stage-1 2016)**

(A) 2^{250} (B) 3^{200} (C) 4^{150} (D) 5^{100}

Sol. 2^{250} 3^{200} 4^{150} 5^{100}

$= (2^5)^{50}$ $(3^4)^{50}$ $(4^3)^{50}$ $(5^2)^{50}$

$= (32)^{50}$ $(81)^{50}$ $(64)^{50}$ $(25)^{50}$

27. The simplified value of $\frac{1}{\sqrt{2}+\sqrt{3}-\sqrt{5}} + \frac{1}{\sqrt{2}-\sqrt{3}-\sqrt{5}}$ is **(Delhi NTSE Stage-1 2016)**

(A) 1 (B) 0 (C) $\sqrt{2}$ (D) $\frac{1}{\sqrt{2}}$

Sol. $\frac{1}{\sqrt{2}+\sqrt{3}-\sqrt{5}} + \frac{1}{\sqrt{2}-\sqrt{3}-\sqrt{5}}$

$\Rightarrow \frac{1}{\left(\sqrt{2}-\sqrt{5}\right)+\sqrt{3})} + \frac{1}{\left(\sqrt{2}-\sqrt{5}\right)-\sqrt{3})}$

Let $a = \sqrt{2}-\sqrt{5}$ $b = \sqrt{3}$

$(a + b)(a - b) = a^2 - b^2$

$\Rightarrow \frac{\sqrt{2}-\sqrt{5}-\sqrt{3}+\sqrt{2}-\sqrt{5}+\sqrt{3}}{\left(\sqrt{2}-\sqrt{5}\right)^2-\left(\sqrt{3}\right)^2} = \frac{2\left(\sqrt{2}-\sqrt{5}\right)}{2+5-2\sqrt{10}-3} = \frac{2\left(\sqrt{2}-\sqrt{5}\right)}{2\left(2-\sqrt{10}\right)} = \frac{\left(\sqrt{2}-\sqrt{5}\right)}{\sqrt{2}\left(2-\sqrt{5}\right)} = \frac{1}{\sqrt{2}}$

28. $\sqrt[3]{1-\frac{127}{343}}$ is equal to **(Bihar NTSE Stage-1 2016)**

(A) $\frac{5}{9}$ (B*) $1-\frac{1}{7}$ (C) $\frac{4}{7}$ (D) $1-\frac{2}{7}$

29. What is the value of $2.\overline{6} - 1.\overline{9}$? **(Bihar NTSE Stage-1 2016)**

(A*) $0.\overline{6}$ (B) $0.\overline{9}$ (C) $0.\overline{7}$ (D) 0.7

30. An equivalent expression of $\frac{5}{7+4\sqrt{5}}$ after rationalizing the denominator is

[Gujarat NTSE Stage-1 2016]

(A) $\frac{20\sqrt{5}-35}{31}$ (B) $\frac{20\sqrt{5}-35}{129}$ (C) $\frac{35-20\sqrt{5}}{31}$ (D) $\frac{35-20\sqrt{5}}{121}$

Sol. **(A)** $\frac{5}{7+4\sqrt{5}} \times \frac{7-4\sqrt{5}}{7-4\sqrt{5}} = \frac{35-20\sqrt{5}}{49-80}$

$= \frac{35-20\sqrt{5}}{-31} = \frac{20\sqrt{5}-35}{31}$

31. Four positive integers sum to 125. If the first of these numbers is increased by 4, the second is decreased by 4. the third is multiplied by 4 and the fourth is divided by 4 we find four equal numbers then four original integers are **[Delhi NTSE Stage-1 2016]**

(A) 16, 24, 5, 80 (B) 8, 22, 38, 57 (C) 7, 19, 46, 53 (D) 12, 28, 40, 45

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32. If $a=\sqrt{6}+\sqrt{5};\ b=\sqrt{6}-\sqrt{5}$, the find the value of $2a^2-5ab+2b^2$ **[Maharashtra NTSE Stage-1 2016]**

(A) 36 (B) 37 (C) 39 (D) 41

Sol. (3)

$2a^2-5ab+2b^2$

$=2\left(11+2\sqrt{30}\right)-5(1)+2\left(11-2\sqrt{30}\right)=39$

33. $\sqrt{m^4n^4}\times\sqrt[6]{m^2n^2}\times\sqrt[3]{m^2n^2}=(mn)^k$, then find the value of k. **[Maharashtra NTSE Stage-1 2017]**

(A) 6 (B) 3 (C) 2 (D) 1

Sol. (B)

$\sqrt{m^4n^4}\times\sqrt[6]{m^2n^2}\times\sqrt[3]{m^2n^2}=(mn)^k$

$m^2n^2\times(mn)^{\frac{1}{3}}\times(mn)^{\frac{2}{3}}=(mn)^k$

$(mn)^{2+\frac{1}{3}+\frac{2}{3}}=(mn)^k$

$(mn)^3=(mn)^k$

$k=3$

<u>VALUE BASED / PRACTICAL BASED QUESTIONS</u>

MARKED QUESTIONS MAY HAVE FOR REVISION QUESTIONS.

This Section is not meant for classroom discussion. It is being given to promote self-study and self testing amongst the Resonance students.

VALUE BASED QUESTIONS

1. In a school, 5 out of every 7 children participated in 'SAVE WILDLIFE' campaign organised by the school authorities.

(i) What fraction of the students participated in the campaign?

(ii) Find what kind of decimal expansion it has?

(iii) What value do the participating students possess ?

Sol. (i) fraction of students partipated in compaign are $=\frac{5}{7}$

(ii) $\frac{5}{7}$ = 0.714285714285.....

so it is non terminating repeating decimal

(iii) caring, social, helpful and environmenal concern.

2. While discussing rationalizing factor, teacher asked the students to find reciprocal of $\sqrt{6}+\sqrt{5}$.

Deepanshi answered $\sqrt{6}-\sqrt{5}$

(i) Is she correct? Justify your answer.

(ii) Which values are depicted in this question ?

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Sol. $\sqrt{6} + \sqrt{5}$

reciprocal of $\sqrt{6} + \sqrt{5} = \frac{1}{\sqrt{6}+\sqrt{5}} \times \frac{\sqrt{6}-\sqrt{5}}{\sqrt{6}-\sqrt{5}}$

$= \frac{\sqrt{6}-\sqrt{5}}{(\sqrt{6})^2-(\sqrt{5})^2} = \frac{\sqrt{6}-\sqrt{5}}{1}$

(i) yes, depanshi is in correct
(ii) knowledge and curiosity.

Answers

EXERCISE - 1

EXERCISE - 2

EXERCISE - 3

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FUNDAMENTAL UNIT OF LIFE

A. CELL

A cell may be defined as the smallest unit of structure and functions of living organisims. The word cell is derived from latin word **"cellula"** meaning small room.Smallest 'unit of structure' means, the smallest structures by the union of which the body of an organism is constructed.Study of structure and composition of cell is called as "Cytology". Cell was first observed by "Robert Hooke" in a dead cork slice in the year 1665. He described about this in his book "Micrographia". First living cell was discovered by A.V. Leeuwenhoek. Protoplasm was discovered by "Felix Dujardin" and named as sarcode. The term protoplasm was coined by Purkinje in 1839 **ultrastructure** (fine structure) of cell and various cell organelles in 1940s.

Check Your Progress

Q.1 Who discovered cell and how ?

Q.2 Why the cell called the structural & functional unit of life ?

B. CELL THEORY

Two biologists, "Schleiden and Schwann" gave the "Cell theory" which was later on expanded by "Rudolf Virchow". Cell theory states that –

(i) All plants and animals are composed of cells.

(ii) Cell is the basic unit of life.

(iii) All cells arise from pre-existing cells. Viruses are the exceptions of cell theory.

Check Your Progress

Q.1 Who proposed cell theory ?

Q.2 Who expended cell theory and why ?

C. TYPES OF CELL

(a) On the basis of type of organization, cells are of two types :

(i) Prokaryotic cells **(ii) Eukaryotic cells**

(i) Prokaryotic cells : These are primitive and incomplete cells.They have less developed nucleus without nuclear membrane and nucleolus.e.g. Bacteria.

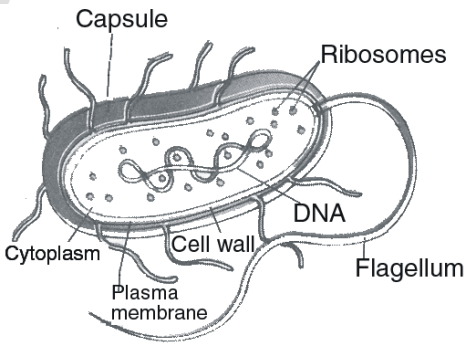

Fig.1.1 : Bacteria

(ii) Eukaryotic cells : These are well developed cells. They have advanced nucleus with nuclear membrane

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(b) On the basis differentiation :

(i) Undifferentiated : These are unspecialized cells which by mitotic divisions give rise to new cells for the formation and maintenance of tissues.

(ii) Differentiated : These are specialized cells formed from the unspecialized cells by change in structure and function during development and growth of an organism.

(iii) Dedifferentiated : These are specialized cells reverted to a more generalized (embryonic), actively dividing state. Dedifferentiation often occurs for regeneration.

Check Your Progress

Q.1 What is the difference between undifferentiated and differentiated cell ?
Q.2 What is nucleoid ?
Q.3 Define plasmid.

D. CELL SHAPE

Cells are of various shapes and sizes. Their shape is according to the function.Generally cells are spherical but they may be elongated (e.g.,nerve cell), branched (e.g.,pigmented cells), discoidal (e.g.,RBC), spindle shaped (e.g.,muscle cell) etc.

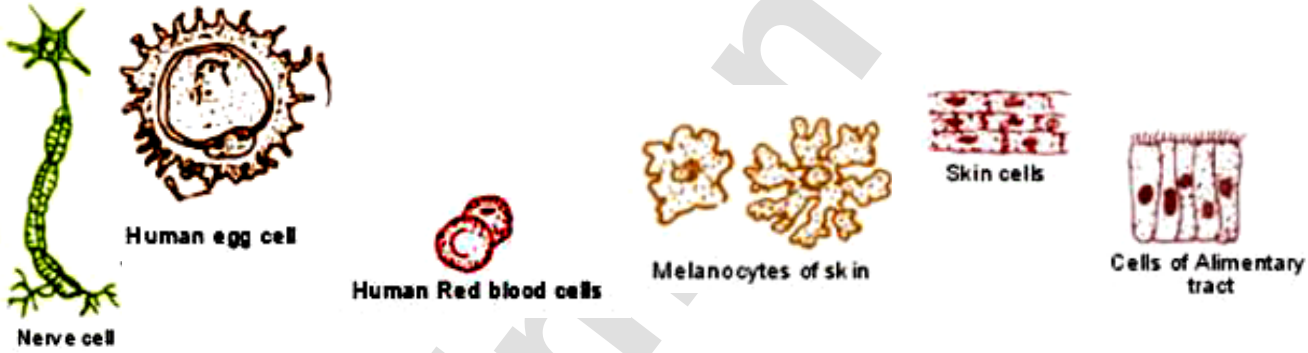

Fig.1.2 : Cells of Various Shapes

Check Your Progress

Q.1 Cell shape differentiate according to their fuction explain.

E. CELL SIZE

Size of cell is variable depending upon the type of organism. Some are microscopic while some are visible with naked eyes. Their size may vary from 0.2 μm to 18 cm.

- Size of a typical cell in a multicellular organism ranges from **20-30 μm.**
- The largest cell is ostrich egg (18 cm. in diametre with shell & 15 cm. in diametre without shell)
- The longest cell: in animal is nerve cell. (upto 1m. or more) in plants longest cell is hemp fibre

KNOWLEDGE BOOSTER

➡ The longest living cell in the body are brain cell which can live an entire life time.

Smallest cells so far known are PPLOs (pleura pneumonia like organism).e.g. Mycoplasma (0.1 μm in dia).

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SMALLER THE CELL MORE ACTIVE IT IS

The smaller cells have more surface area per unit volume. It ensures more diffusion of
(i) Nutrients into the cells.
(ii) Respiratory gases i.e. O_2 into the cells and CO_2 outof the cells.
(iii) Waste products out of the cells.

Check Your Progress

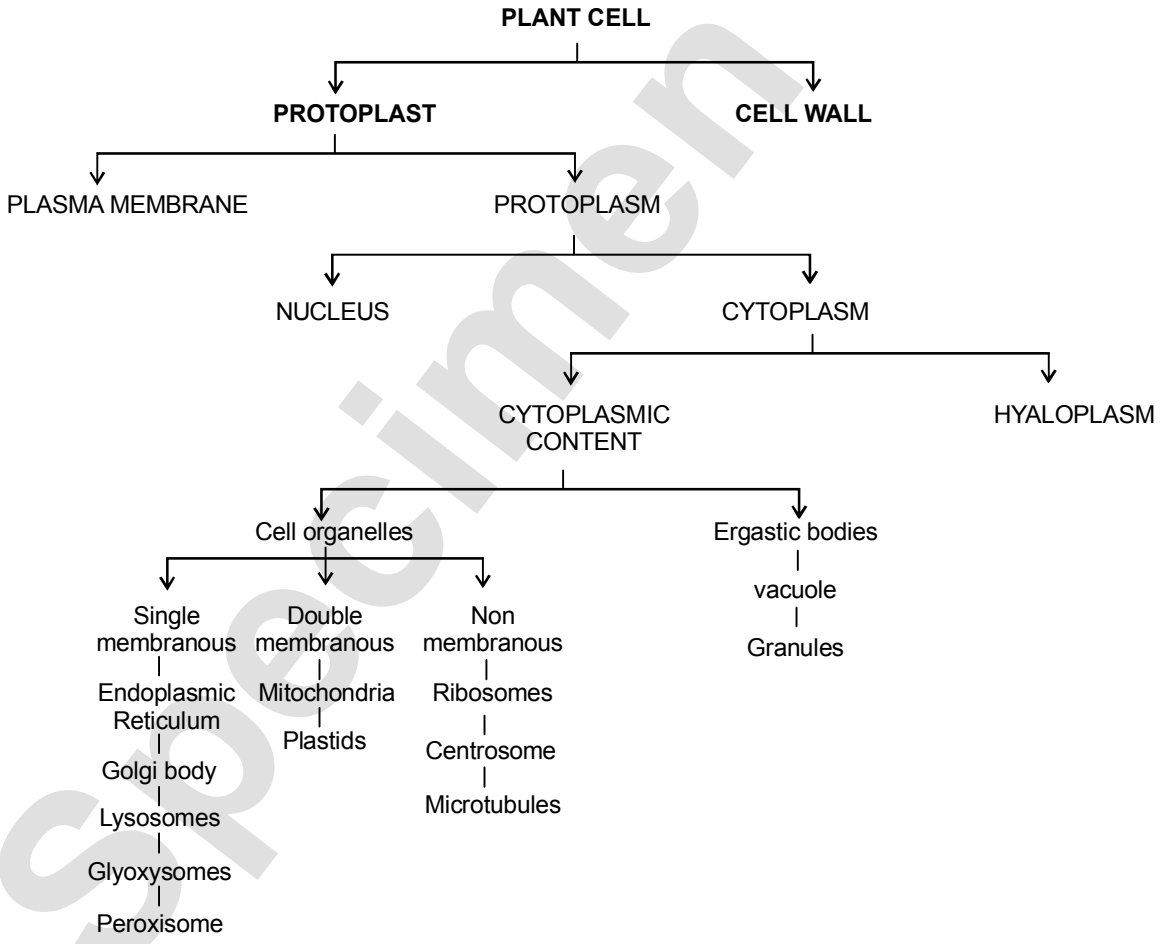
Q.1 Which is the longest cell ?

Q.2 Give name of smallest cell.

F. COMPONENTS OF A CELL

There is an occurrence of division of labour within a cell as they all got certain specific components called "Cell organelles" each of them performs a specific function.

- The three basic components of all the cells are
  (a) Cell coat **(b)** Nucleus **(c)** Cytoplasm



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(a) Cell coat :

(i) Cell wall :

- It is the outermost covering of the plant cells.
- It is absent in animal cells.
- Cell wall is rigid, strong, thick, porous and dead structure.It is made up of cellulose and hemicellulose. Cell walls of two adjacent cells are joined by a layer called middle lamellae. It is made up of calcium and magnesium pectate.

KNOWLEDGE BOOSTER

➨ Fibres of cotton, jute and coconut which are of great economic value are the cell walls of dead cells.

NATURE	LOCATION
Lignin or cellulose	Plant tissues (most of them)
Suberin	Cork tissues of some plants
Muclilage or chitin	Fungi
Silica	Plant protistans (diatoms)
Peptidoglycan	Bacteria

♦ **Functions of cell wall :**

- It provides and maintains the shape of a cell.
- It provides strength and plant bears stress and strain because of cell wall
- It is permeable and allows entry of molecules of different sizes.

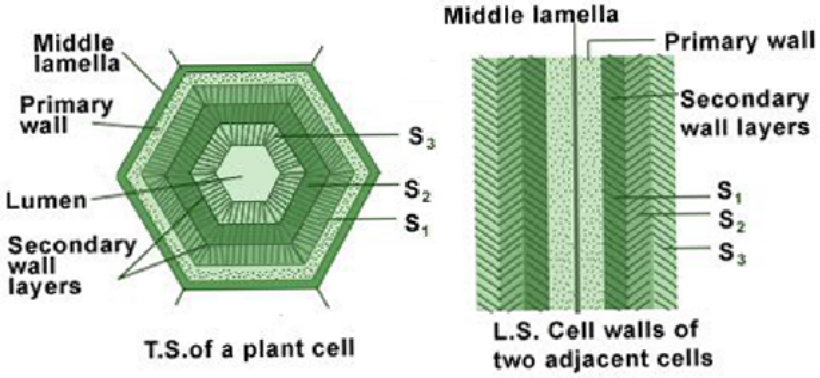

Fig.1.3 : Cell Wall

(ii) Cell membrane

♦ Cell membrane is also called as Plasma Membrane or Plasmalemma.

♦ Plasma membrane name was given by Nageli.

♦ It is found in both plant as well as animal cells.

♦ It is the outer most covering of a cell in case of animals & lies below the cell wall in case of plants.

♦ It is made up of proteins and lipids where proteins are sandwiched between bilayer of lipids. Viruses lack any membrane & hence do not show characteristics of life untill they enter a living body and use its machinery to multiply

♦ **Singer and Nicholson** gave the fluid mosaic model of plasma membrane. According to him it consists of a protein layer sandwiched between two layers of lipids. It is in quasifluid state. It is 75 Å thick.

♦ It is flexible and can be folded, broken & reunited.

♦ Plasma membrane is selectively permeable in nature. It allows or permits the entry and exit of some selective materials only.

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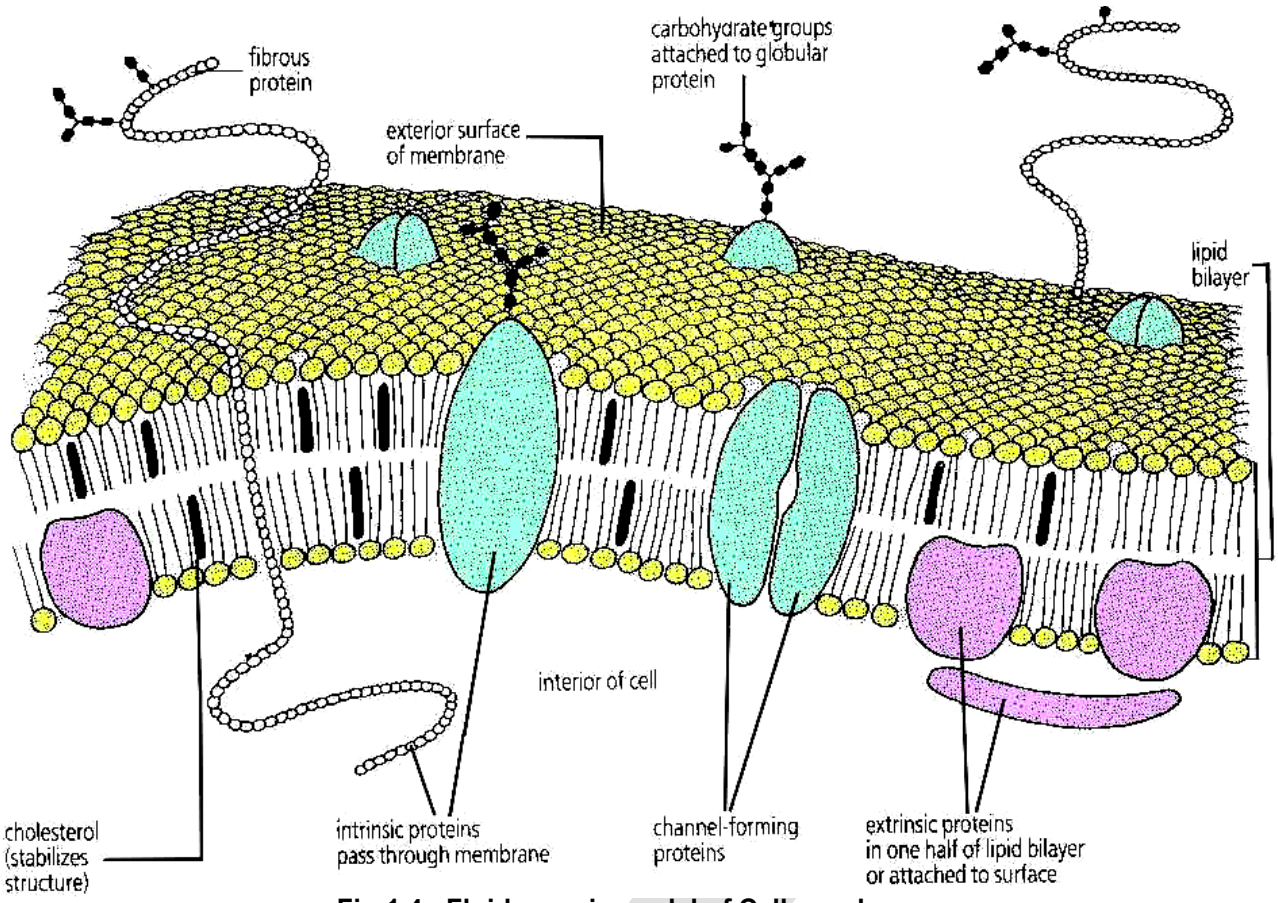

Fig.1.4 : Fluid mosaic model of Cell membrane

- **Functions of Plasma membrane** :

- It provides and maintains the shape of cell.
- It provides mechanical support for the protection of internal structures of a cell.
- It allows only useful substances to enter into the cells.
- It provides specificity to the cells.
- It is the limiting boundary of each cell which separates the cytoplasm from its surroundings.

(I) Transportation of molecules across the plasma membrane : This can be done by following ways :

(1) Diffusion : Movement of molecules or ions from higher concentration to lower concentration is called as diffusion.e.g.,CO_2 & O_2 move across the membrane.

(2) Osmosis : The movement of solvent or water from lower concentration of solution to higher concentration of solution through a semipermeable membrane is called as osmosis. Osmosis can also be called as "diffusion of solvents".

DIFFERENCES BETWEEN DIFFUSION AND OSMOSIS

S.no.	Diffusion	Osmosis
1.	Diffusion can occur in any medium	It occurs only in liquid medium
2.	The diffusing molecules may be solids, liquids or gases	It involves movement of solvent molecules only
3.	Semipermeable membrane is not required	Semipermeable membrane is required
4.	It is dependent upon the free energy of the molecules of diffusing substance only ; presence of other substance in the system is of no importance	Though it is the diffusion of solvent molecules only, yet influenced by the presence of other substances (solutes) in the system.

Specimen

- **Endosmosis :** Movement of solvent into the cell is called as Endosmosis.
- **Exosmosis :** Movement of solvent outside the cell is called as Exosmosis.
- Both diffusion & osmosis do not require energy so called as passive transport.

(3) **Mediated Transport :** Some molecules are moved across the membrane by special proteins called **transport proteins** or **permeases.** Permeases form a small passageway through the membrane, enabling the solute molecule to cross the phospholipid bilayer. Permeases are usually quite specific, recognising and transporting only a limited group of chemical substances or perhaps even a single substance.

(4) **In Facilitated transport/diffusion –** The permease assists a molecule to diffuse through the membrane that it cannot otherwise penetrate.

(II) Types of solutions on the basis of concentration :

(1) **Isotonic solution:** When the concentration of the solution outside the cell is equal to the concentration of cytoplasm of the cell it is called as isotonic solution.

(2) **Hypertonic solution:** When the concentration of the solution outside the cell is more than that inside the cell. Due to this cell looses water and becomes plasmolysed.

(3) **Hypotonic solution:** When the concentration of the solution outside the cell is lesser than that of cytoplasm of cell. Due to this cell swells up and bursts.

KNOWLEDGE BOOSTER

- Shrinking of protoplasm
  In plant cell → **Plasmolysis**
  In animal cell → **Crenation**
- The process of taking in a bulk of materials from external environment into the cell is known as Endocytosis. It is of two type –
  Phagocytosis (cell eating) and **Pinocytosis** (cell drinking).
- Phagocytosis + Pinocytosis → **Endocytosis**

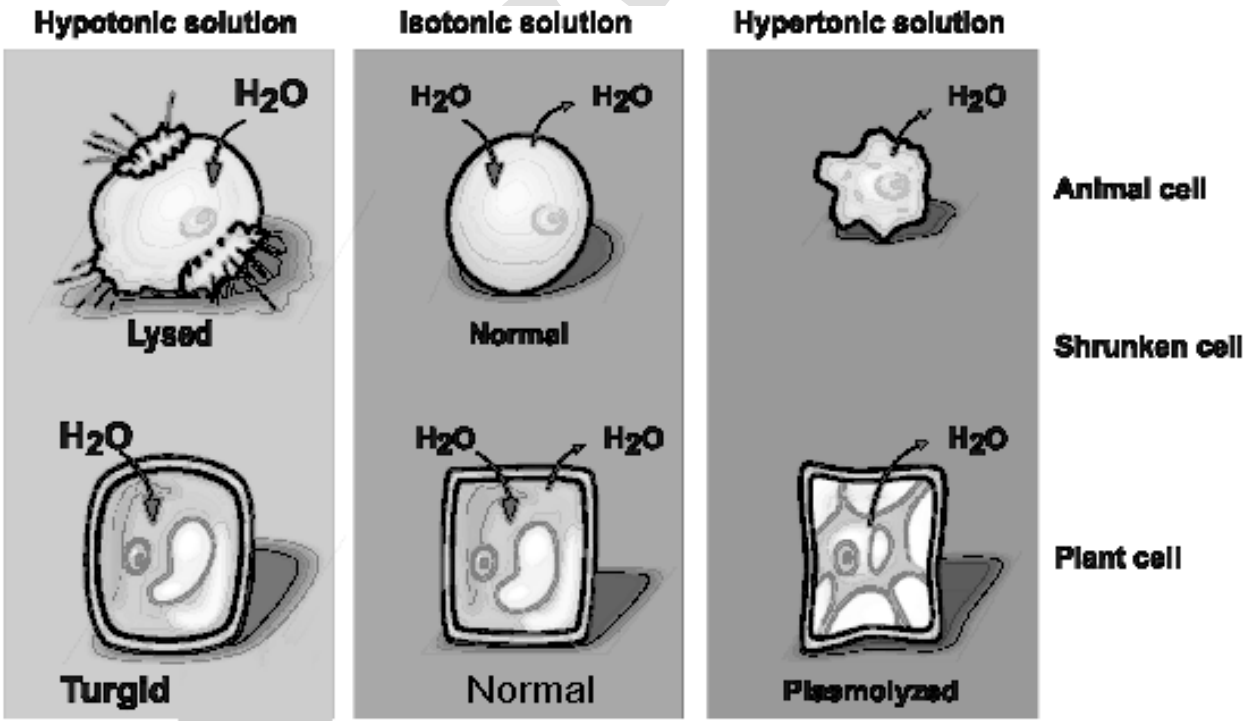

Fig.1.5 : Movement of water in a cell in different types of solution

(b) Nucleus :

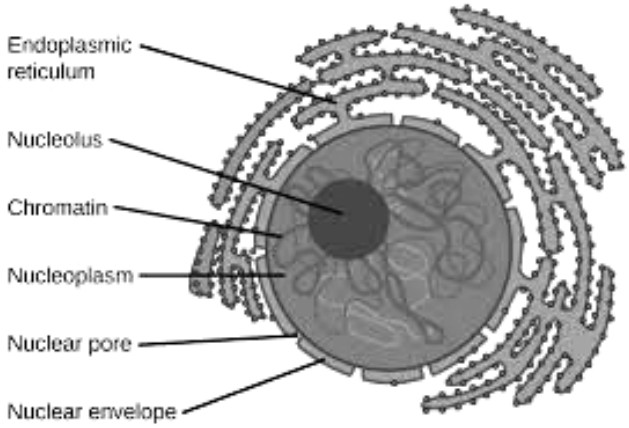

Fig.1.6 : Nucleus

- Nucleus-Headquarter of the cell.
- Discovered by – Robert Brown (1831).
- "Nucleus is double membrane bound dense protoplasmic body, which controls all cellular metabolism and encloses the genetic information of cell".
- Nucleus is consider as controller or director of cell.
- **Structure :** It is made up of following four contents.

(i) Nuclear membrane / Nuclear envelope / Karyotheca.
(ii) Nuclear sap / Nucleoplasm / Karyolymph.
(iii) Nucleolus.
(iv) Chromatin threads.

(i) Nuclear envelope : Nucleus is surrounded by two membranes, that separates nucleoplasm from cytoplasm.The nuclear membrane has minute pores. These are called nucleo-pores.

(ii) Nucleoplasm : The part of protoplasm which is enclosed by nuclear membrane is called nucleoplasm.It contains chromatin threads and nucleolus.

(iii) Nucleolus : Discovered by Fontana. Usually one nucleolus is present in each nucleus but sometimes more than one nucleoli are present. It is a store house of RNA.

(iv) Chromatin threads : A darkly stained network of long fine threads called chromatin threads. Chromatin threads are intermingled with one another forming a network.

KNOWLEDGE BOOSTER

- Nucleopore takes part in exchange of different substances between nucleoplasm and cytoplasm.
- Chromosomes are chemically made up of DNA and histone proteins. DNA carries all genetic information which is passed on to next generation.The functional segment of DNA is called genes.

- **Functions of nucleus :** The nucleus performs following functions :

- It controls all the metabolic activities of the cell.
- It brings about growth of the cell by directing the synthesis of structural proteins.
- It takes part in the formation of ribosomes.
- It regulates cell cycle.
- It contains genetic information and is concerned with the transmission of hereditary traits from one generation to another.

Specimen Copy

COMPARATIVE STUDY OF PLANT & ANIMAL CELL			
S.NO.	**CHARACTERS**	**ANIMAL CELL**	**PLANT CELL**
1.	Cell wall	Absent	Present
2.	Plasma membrane	Only cell membrane	Present
3.	Microtubules /Microfilaments	Present	Present
4.	Lysosomes	Lysosomes occur in cytoplasm	Lysosomes usually not evident
5.	Nucleus	Present	Present
6.	Shape	Round (irregular shape)	Rectangular (fixed shape)
7.	Chloroplast	Animal cell don't have chloroplasts	Plant cell have chloroplasts because they make their own food
8.	Cytoplasm	Present	Present
9.	Endoplasmic Reticulum	Present	Present
10.	Ribosomes	Present	Present
11.	Mitochondria	Present	Present
12.	Vacuole	One or more small vacuoles (much smaller than point cells).	One, large central vacuole taking up 90% of cell volume.
13.	Centrioles	Present in all animal cells	Only present in lower plant forms.
14.	Golgi Apparatus	Present	Present

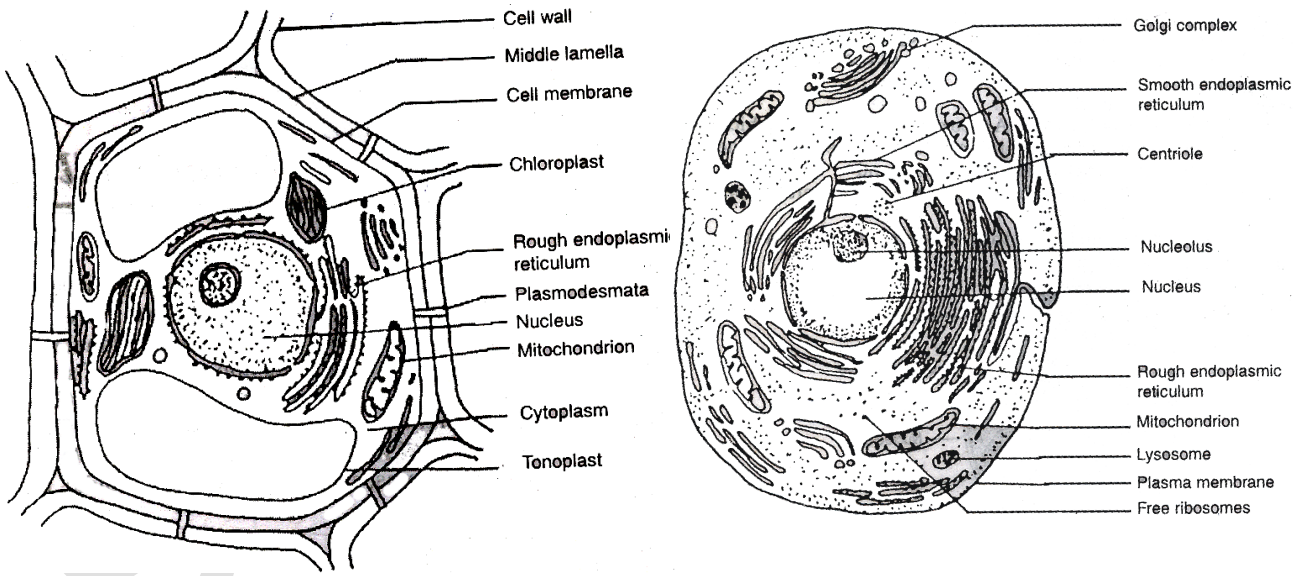

Fig.1.7 : Plant Cell & Animal Cell

DIFFERENCES BETWEEN PROKARYOTIC AND EUKARYOTIC CELL			
S.NO	CHARACTERS	PROKARYOTIC CELLS	EUKARYOTIC CELLS
1.	Nuclear body	Incipient nucleus, No nuclear membrane Nucleolus absent.	True nucleus, Nuclear membrane present Nucleolus present.
2.	Mitosis	No mitosis	Mitosis found
3.	DNA arrangement	Single closed loop, (histones absent)	Multiple chromosomes, (histones present in chromosome)
4.	Respiratory system	In plasma membrane, (mitochondria absent)	In mitochondria
5.	Photosynthetic apparatus	In internal membranes, (chloroplasts absent)	In chloroplasts

(C) Cytoplasm :

- Cytoplasm was discovered by Kolliker in 1862.
- It is the site of both biosynthetic and catabolic pathways.
- It can be divided into two parts :

(i) **Cytosol :** Aqueous soluble part contains various fibrous proteins forming cytoskeleton.

(ii) **Cytoplasmic Inclusion :** In the cell cytoplasm, there are present numerous living and non-living structures, collectively called cytoplasmic inclusions.

(I) The living cytoplasmic inclusions are called cell organelles or protoplasmic inclusions or organoids and

(II) The non-living structures are called Deutoplasmic or ergastic bodies.

- **Role of Cytoplasm :**

- Participates in intracellular distribution of nutrients, metabolites and enzymes.
- Helps in exchange of materials between cell organelle.
- Acts as a site of chemical reactions like glycolysis (step of respiration), synthesis of fatty acids.

(d) Cell Organelles :

- These are living sub-cellular structures of the cytoplasm and are also called protoplasmic bodies or organoids. These include -

(i) **Double membranous :** Plastid and Mitochondria.

(ii) **Single membranous :** Endoplasmic reticulum, Golgi apparatus, Lysosomes, peroxisomes, Glyoxysomes etc.

(iii) **Non-membranous :** Ribosomes etc.

(i) **Double Membranous cell organelles**

(I) **Plastid**

- Plants and some protists have several types of double membrane bound organelles called plastids, which harvest solar energy, manufacture nutrient molecules and store materials.
- Plastid term was coined by E.Haeckel.
- Plastids generally contain pigments and may synthesize & accumulate various substances.
- Depending upon the type of pigment present in them they are of following three types.

Specimen Copy

S.NO.	LEUCOPLAST	CHROMOPLAST	CHLOROPLAST
1.	Non Pigmented White in colour	Coloured pigments All colours except green Phaeoplast – Brown Rhodoplast – Red	Green pigment chlorophyll is found in them.
2.	Generally found in underground parts Important for food storage. **e.g.** Aleuroplast (Protein). Elaioplast (Oil), Amyloplast (Starch)	Found in flowers, Fruits, Leaves etc.	Found in aerial parts of plant which are green in colour

KNOWLEDGE BOOSTER

➡ During ripening of fruits, the colour changes from green to yellow or reddish because of the degeneration of chlorophyll and the masked carotene pigments take over.

(1) Chloroplast :

- It is a double membranous discoidal structure, found only in plant cells.
- Chloroplast was discovered by A.V. Leeuwenhoek and named by Schimper.
- Besides being discoidal or rhombic in plant cells they occur in variable shapes like in algae they can be 'U' shaped , spiral , coiled, ribbon shaped etc.
- Each chloroplast consists of two parts.
- **Grana :** It constitutes the lamellar system. These are found layered on top of each other, these stacks are called as **Grana.**
- Each granum of the chloroplast is formed by superimposed closed compartments called **Thylakoids.**

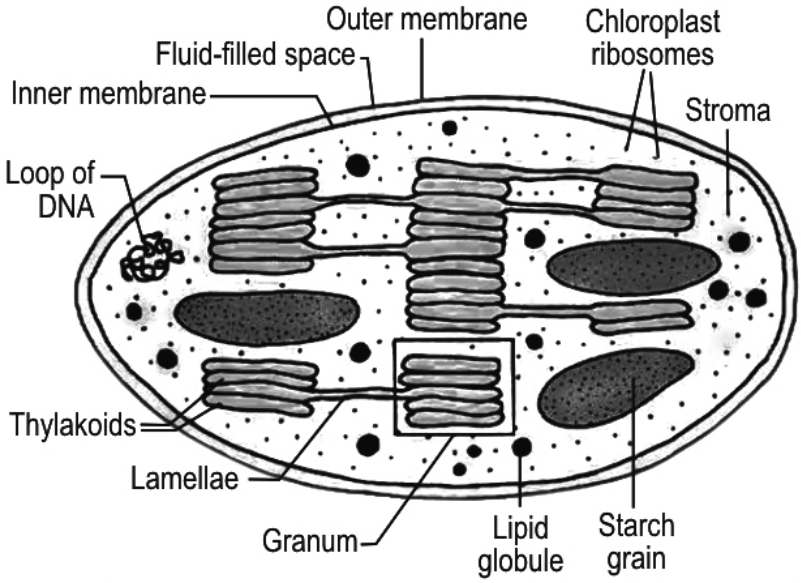

Fig.1.7 : Internal structure of Chloroplast

- In each thylakoid Quantasomes are present which are called as Photosynthetic units.
- Each quantasome possesses 230 chlorophyll molecules.
- **Functions :** Grana are the sites of light reaction of photosynthesis as they contain photosynthetic pigment chlorophyll.
- **Stroma:** It is a granular transparent substance also called as matrix.
- Grana are embedded in it. Besides grana they also contain lipid droplets, starch grains, ribosomes etc.
- **Function :** This is the site of dark reaction of photosynthesis.

(ii) Mitochondra :

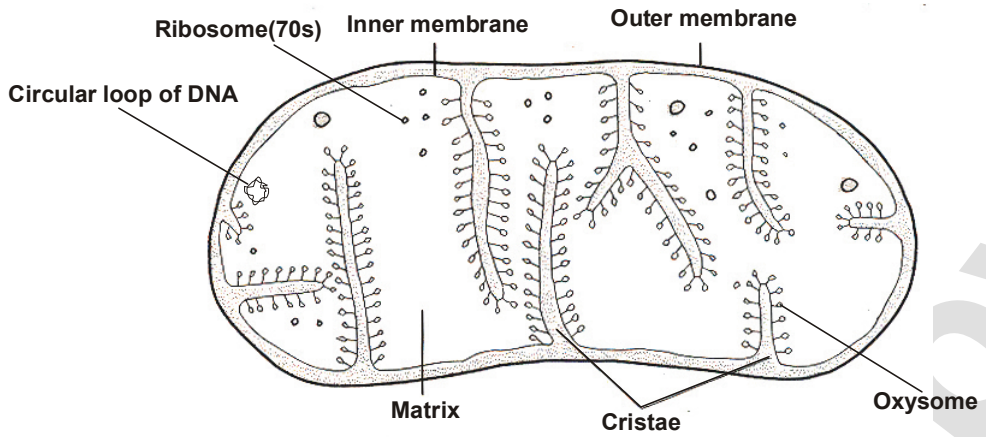

Fig.1.7 : Mitochondria

- It was first seen by Kolliker in insect cells and named by Benda.
- It is a rod shaped structure found in cytoplasm of all eukaryotic cells except mammalian RBC's.
- These are also absent in prokaryotes.
- Maximum mitochondria are found in metabolically active cells.
- It is also called as **"Power House of the Cell" or the "Storage Battery".**
- It is double membranous structure where outer membrane has specific proteins while inner membrane is folded inside to form chambers called Cristae."Cristae" are the infoldings of inner mitochondrial membrane that possess enzymes for respiratory cycles like Kreb Cycle. ATP synthesizing units are called **Oxysomes or F_0 – F_1 Particles.**
- Space between inner and outer mitochondrial membranes is called as perimitochondrial space. The fluid **present in mitochondria is called as matrix.**
- **Functions :**
- Its main function is to produce and store the energy in the form of ATP.
- It is the site of Kreb's cycle of respiration, as it contains enzymes for Kreb cycle.
- Oxysome contains enzymes for ATP production.

KNOWLEDGE BOOSTER
➨ Plastids and mitochondria are semi autonomous cell organelle as they are having ribosome DNA and enzyme which are useful in protein synthesis.

(ii) Single membranous cell organelles :

(I) Endoplasmic reticulum :

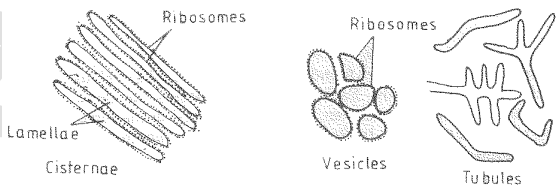

Fig.1.8 : Endoplasmic Reticulum

- It is the network of membranes present in the cytoplasm.
- It was discovered by Porter, Claude and Fullan.
- These are present in all cells except prokaryotes and mammalian erythrocytes.
- They are made up of three components :
- **Cisternae :**
- These are long, flattened, parallely arranged, unbranched tubules.
- These form successive layers of nucleus.
- These are found in cells which are active in protein synthesis and are 40 – 50 μm in diameter.

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- **Vesicles :** These are rounded or spherical, They are found in synthetically active cells.
- **Tubules :** These are small, smooth walled and have tubular spaces. These are found in non secretory as well as steroid synthesizing cells.

Endoplasmic reticulum of striated muscles are called as sarcoplasmic reticulum.

(1) Smooth endoplasmic reticulum **(B)** Rough endoplasmic reticulum

DIFFERENCES BETWEEN SMOOTH AND ROUGH ENDOPLASMIC RETICULUM			
S.NO.	**CHARACTER**	**SER**	**RER**
1.	Components	Made of tubules mainly.	Made of cisternae & vesicles.
2.	Ribosomes	Absent	Present
3.	Position	Mainly present near cell membranes	Mainly present near the nucleus
4.	Functions	Helps in steroid, lipids & polysaccharide synthesis.	Helps in protein synthesis.
		Helps in membrane biogenesis.	
5.	Occurrence	Mainly found in lipid forming cells like adipocytes (Fat cells)	Mainly found in protein forming cells like Nissl's granules of nerve cells.

Functions

- ER increases the surface area of the cytoplasm for various metabolic activities of the cell.
- It gives internal support to the colloidal matrix i.e. cytoplasm.
- It functions as an intracellular transport system for various substances.
- Materials synthesized can be stored in different parts of ER.
- Protein synthesis occurs on the surface of rough ER by ribosomes. These proteins are either used within the cell or exported outside the cell.
- Synthesis of lipids in collaboration with Golgi complex occurs on the surface of the smooth ER. Smooth ER helps in the synthesis of sex hormones like testosterone in the testis and estrogens in ovary.

(II) Golgi Apparatus :

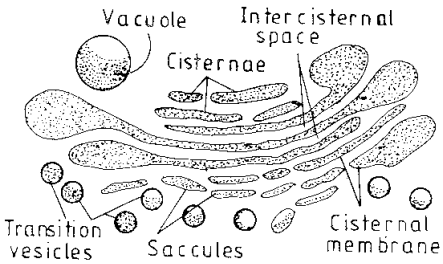

Fig.1.9 : Golgi apparatus

- Discovered by Camillo Golgi (1998) in nerve cell of owl
- **Position :** It is located near the nucleus.
- Golgi bodies are pleomorphic structures, because component of golgi body are different in structure & shape in different cells.
- It contains a pile of flattened sacs named cisternae along with small vesicles and tubules.

Functions :

- It is involved in cell secretion and acts as storage,modification and condensation or packaging membrane.
- It forms the acrosome of sperm.
- It forms lysosomes.
- Synthesis of cell wall material
- Formation of plasmalemma

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- Cell plate formation(phragmoplast) during plant cell division formation.

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- In plants golgi body is called as Dictyosomes.
- It is absent in prokaryotes, mammalian RBC's and sieve cells.
- Acrosome is a bag like structure filled with lytic enzymes which dissolve egg membrane at the time of fertilization.

(III) Lysosomes : (Discovery : Christian de Duve) (Lyso = digestive, soma = body)

- It is a small vesicle or sac like structure scattered in the cytoplasm.They do not have a definite shape or size.
- It contains 40 type of enzymes which are called as hydrolases
- They occur in animal cells and a few plant cells.
- Lysosomes exhibit polymorphism i.e. they occur in different forms.

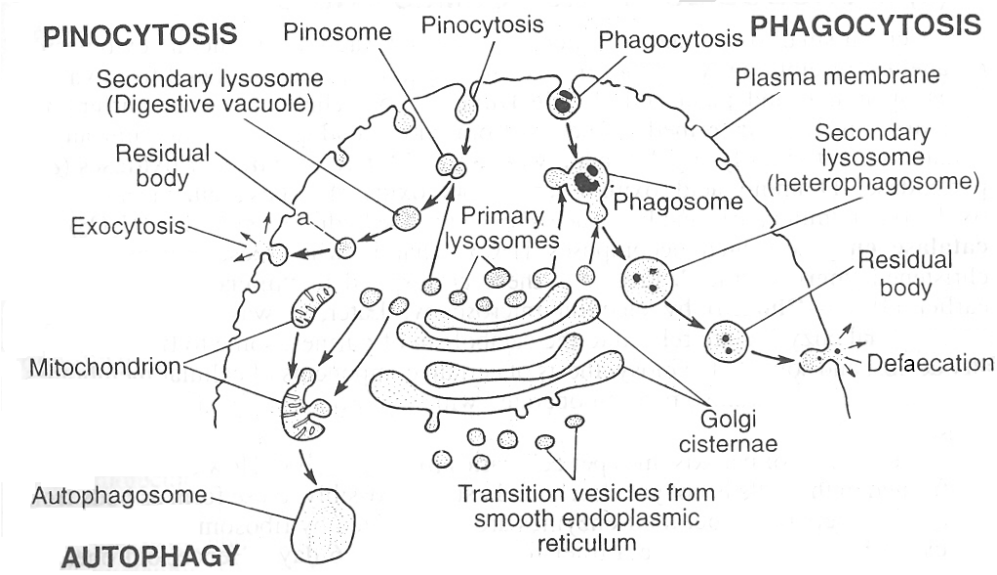

Fig.1.10 : Polymorphism in Lysosome

- **Functions :**
- Their main function is phagy = digestion(intra cellular digestion)
- They are kind of waste disposal system.
- They help in digesting foreign materials and worn out cells.
- During disturbances in cellular metabolism i.e. in case of cell damage lysosomes burst and their enzymes are released into the cytoplasm and they digest their own cell so they are also called as **"Suicidal Bags".**

(IV) Peroxisomes :

- The term 'peroxisome' was first used by de Duve and also called as uricosomes.
- Peroxisomes are ovoid or granular structures, limited by a single unit membrane and have a diameter of 0.5 to 1.0 μm.

(iii) NON-MEMBRANOUS CELL ORGANELLES

(I) Ribosomes

Chemically a ribosome is made of proteins and RNA.

- First reported by Claude and named by G.Palade.
- They are small granular structures visible only under electro microscope.
- They are usually attached on the outer surface of endoplasmic reticulum as well as freely in the cytoplasm.
- They are the only organelles which are present in all types of cells.
- They help in protein synthesis and are known as "protein factories"
- Each ribosomes consists of two unequal subunits, larger dome shaped and small ovoid.
- The size of ribosome is determined by sedimentation coefficient in the centrifuge.
- The cytoplasmic ribosomes of eukaryotes are 80S and in prokaryotes and cell organelles like mitochondria and chloroplast ,it is 70S type. The two sub units of 80S ribosomes are 60S and 40S while 70S type ribosomes have 50S and 30S subunits.

70S Ribosome 80S Ribosome

Fig.1.11 : (a) Prokaryotic ribosome & (b) Eukaryotic ribosome

(II) Centrosomes : It is found in animal cells whereas absent in plant cells with a very few exceptions. It is present near the nucleus.It is differentiated into a clear, homogeneous mass of cytoplasm called **centrosphere** and one or a pair of microtubular **centrioles.**

- **Functions of centrosome**

- The centrosome is concered with
- The process of cell division.
- The formation of basal bodies of cilia and flagella.

(III) Microtubules : These are very fine microscopic tube-like structures which may be present independently or as parts of some organelles such as centrioles, basal bodies, cilia, flagella etc.

- **Fuctions of Microtubules :**

- The microtubular structures provide strength and
- They also help in bringing about various movements inside the cell.

(iv) ERGASTIC BODIES : It include non-living structures.

(I) Vacuole :

- Vacuoles are non-living structures of cytoplasm.
- These are membrane bounded regions in the cytoplasm containing water and other substances.
- They are bounded by a single membrane called **Tonoplast.**
- In animal cells vacuoles are smaller in size and numerous while in plant cells a single large vacuole is found which occupies about 90% of the volume of cell.
- **Functions :**

- It helps in maintaining osmotic pressure in a cell.
- It stores toxic metabolic products of plant cell.
- It contains various coloured pigments like anthocyanins.

(II) Granules : These are also non-living cytoplasmic inclusions. These are small particles, crystals or droplets.

- **Function :**

- Starch grains, fat droplets help in the storage of food in cells.

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Check Your Progress

Q.1 Can you name the two organelles we have studied that contain their own genetic material ?

Q.2 If the organisation of a cell is destroyed due to some physical or chemical influence. What will happen ?

Q.3 Why are lysosomes known as suicide bags ?

Q.4 Where are proteins synthesised inside the cell ?

G. MICROSCOPE

It is an instrument which is used to study those objects that cannot be seen with the naked eye or with the help of a hand lens. A microscope has more than one lens. The 1st compound microscope was built by F. Janssen and Zacharias Janssen (1590).

(a) Structure of Microscope :

The microscope used in schools is called **compound microscope.** a compound microscope has following parts :

(i) **Base :** It is the basal,metallic,horse- shoe shapedstructure. It bears the whole weight of microscope.

(ii) **Handle :** It is the curved part to hold the microscope.It is also called as arm

(iii) **Stage :** It is a strong metallic,rectangular,horizontal plate fixed to the handle.

(iv) **Stage Clips :** Two clips are attached to stage used for holding the slide in position.

(v) **Condenser :** Below the stage is present a condenser for concentrating the light rays.

(vi) **Body tube :** it is wide, hollow tube attached to the upper part of the arm. To this tube lenses are attached

(vii) **Adjustment Screw :**

(I) Coarse adjustment : it is bigger sized screw used to move the body tube up and down.

(II) Fine adjustment : It is a smaller sized screw for fine focussing.

(viii) **Reflecting Mirror :** It is meant for reflecting the light rays,so that light passes through the object which is to be seen.

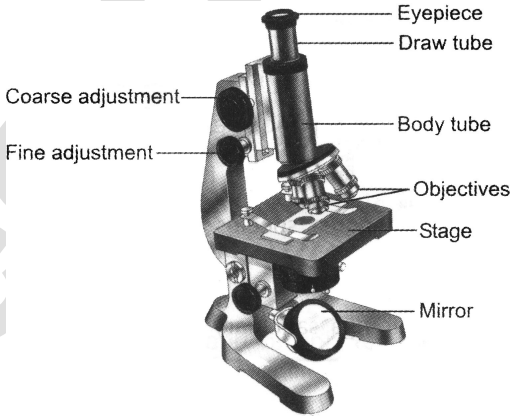

Fig.1.12 : Microscope

- **Knoll and Ruska (1932)** of Germany designed the electron microscope which was employed to study the.

(b) Preparation of microscopic slide :

- The object to be viewed under microscope is called the **specimen**. A thin sheet of glass called a **microscopic slide** is used to hold a small sample of the specimen. A second much thinner glass sheet is placed over the sample, called as **coverslip.**

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(i) Take a clean glass slide.

(ii) With a dropper, put a drop of water in the middle of the slide.

(iii) Gently put the object to be observed in the drop of water on the slide with the help of a brush.

(iv) Objects, if transparent, are first stained with a proper chemical.

(v) Hold the coverslip over the object in such a manner that it touches the edge of the drop of water. Gently lower the coverslip onto the water.

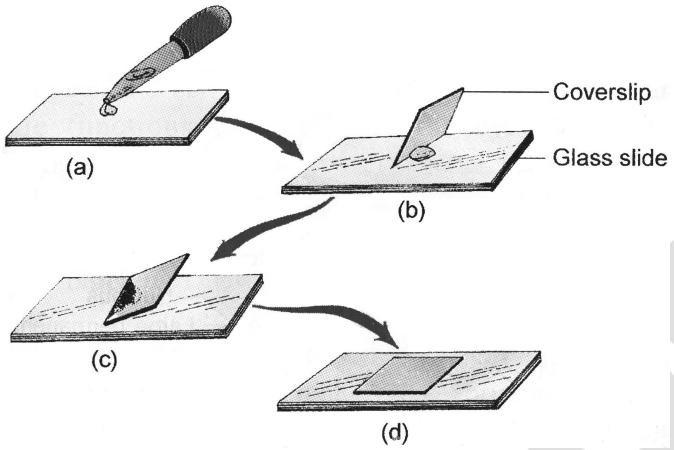

Fig.1.13 : Slide Preparation

(vi) Dry the extra water that may come out from under the coverslip with the help of a blotting paper. Take care that the slide thus prepared is clean and dry.

Check Your Progress

Q.1 What is the use of stage clip in microscope ?

Q.2 Write down the function of fine adjuster ?

- Activity
- To observe the plant cells (e.g., onion peel cell / Rheo leaf Cell) under a microscope.
- **Materials required :** Onion, glass slide, coverslip, stain, microscope.

WHY DO WE STAIN CELLS
➡ Staining is done to bring nucleus into prominence

- **Procedure :** Cut a slice of an onion and peel off its skin. Take out the thin membrane present between the two fleshy layers. Place it on a clean glass slide. Put a drop of water on it and place coverslip over it. Observe the slide under a microscope. Prepare another slide of onion peel stained with safranine. Observe it also under a microscope.

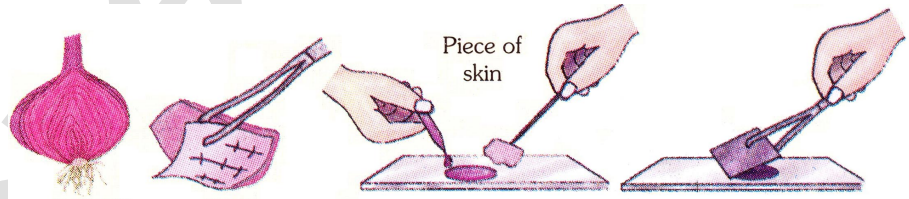

Fig.1.14 : Making a slide of an onion peel

- **Observations :** It is observed that :
- A number of cells lie side–by–side.
- Each cell has a distinct wall. This is called the cell wall.
- At the centre of each cell, there is a nucleus.
- Some large empty spaces exist within the cell. These are vacuoles.

Specimen Copy

Board Level Exercise

TOPIC NAME : FUNDAMENTAL UNIT OF LIFE

TYPE (I) : VERY SHORT ANSWER TYPE QUESTIONS : [01 MARK EACH]

1. Why are lysosomes known as 'suicide-bags' of a cell ?
2. Do you agree that "A cell is a building unit of an organism". If yes, explain why ?
3. Why does the skin of your finger shrink when you wash clothes for a long time ?
4. Why is endocytosis found in animals only ?
5. A person takes concentrated solution of salt, after sometime, he starts vomiting. What is the phenomenon responsible for such situation ? Explain.

TYPE (II) : SHORT ANSWER TYPE QUESTIONS : [02 MARKS EACH]

6. Write the name of different plant parts in which chromoplast, chloroplast and leucoplast are present.
7. How is a bacterial cell different from an onion peel cell ?
8. How do substances like carbon dioxide (CO_2) and water (H_2O) move in and out of the cell ?
9. How does amoeba obtain its food ?
10. Name the two organelles in a plant cell that contain their own genetic material and ribosomes.

TYPE (III) : LONG ANSWER TYPE QUESTIONS [04 MARK EACH]

11. Why do plant cells possess large sized vacuole ?
12. How are chromatin, chromatid and chromosomes related to each other ?
13. What are the consequences of the following conditions ?
    (a) A cell containing higher water concentration than the surrounding medium
    (b) A cell having low water concentration than the surrounding medium.
    (c) A cell having equal water concentration to its surrounding medium

TYPE (IV) : VERY LONG ANSWER TYPE QUESTIONS [05 MARK EACH]

14. Draw a neat labelled diagram of an animal cell.
15. Draw a well labelled diagram of an eukaryotic nucleus. How is it different from nucleoid ?
16. Differentiate between rough and smooth endoplasmic reticulum. How is endoplasmic reticulum important for membrane biogenesis ?

Exercise-1

Marked Questions can be used as Revision Questions.

SUBJECTIVE QUESTIONS

Subjective Easy, only learning value problems

SECTION (A) : CELL

A-1 Write down the definition of cell.
A-2 Who wrote micrographia.

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SECTION (B) : CELL THEORY

B-1 Define omnis cellula e cellulae

B-2 Who gave the cell theory ? What does it state ? Which organism is an exception of cell theory ?

SECTION (C) : TYPES OF CELL

C-1 Define prokaryotic cell.

C-2 Give one example of dedifferentiated cell.

SECTION (D) : CELL SHAPE

D-1 Give one-one example of spindle shape cell,discoidal and branched cell.

SECTION (E) : CELL SIZE

E-1 Write down the name of largest plant cell.

E-2 Write down the name of smallest cell of human body.

SECTION (F) : COMPONENTS OF A CELL

F-1 Define protoplast.

F-2 What is the composition of protoplasm ?

F-3 Who gave the fluid mosaic model of plasma membrane ?

F-4 What is osmosis ?

F-5 Which cell organelle is called as the head quarter of cell ?

F-6 What is the difference between diffusion and osmosis ?

F-7 Why plasma membrane is called as selectively permeable membrane ?

F-8 Draw a neat and labelled diagram of nucleus. State it's main functions.

F-9 State any two functions of golgi body.

F-10 Describe the types of endoplasmic reticulum and draw necessary figure. Give it's main functions also.

F-11 Which organelle controls osmotic pressure in a cell ?

F-12 State any two functions of golgi body.

F-13 State the main functions of lysosomes ?

SECTION (G) : MICROSCOPE

G-14 Write down name of the all parts of microscope.

G-15 How can prepare microscopic slide explain.

OBJECTIVE QUESTIONS

SINGLE CHOICE OBJECTIVE, STRAIGHT CONCEPT/FORMULA ORIENTED

SECTION (A) : CELL

A-1 The first person to observe a cell under microscope was –
(A) M. Schleiden (B) T. Schwann (C) Robert Hooke (D) A.V. Leeuwenhoek

A-2 The word cell was coined by –
(A) Robert hooke (B) Weismann (C) Cuvier (D) Darwin

A-3 What is protoplasm :
(A) Nucleoplasm-cytoplasm (B) Cytosole only
(C) Nucleoplasm+cytoplasm (D) Trophoplasm of cell

A-4 What is cytology ?
(A) Study of cytoplasm (B) Study of structure and composition of cell
(C) Study of animal cell only (D) Study of plant cell only

A-5 Protoplasm was coined by
(A) Robert hooke (B) Felix dujardin (C) Robert brown (D) none of these

Specimen Copy

SECTION (B) : CELL THEORY

B-1 Cell theory was propounded by –
(A) Morgan (B) Haldane
(C) Schleiden and Schwann (D) Robert Hooke

B-2 Cells are autonomous because :
(A) They synthesize components of living protoplasm from nonliving materials.
(B) They are able to grow
(C) Spindle
(D) Bean shape

SECTION (E) : CELL SIZE

E-1 Smallest cells so far known are –
(A) bacteria (B) blue green algae (C) PPLOs (D) human egg

E-2 Which of the following is the longest cell of animal kingdom ?
(A) Bacteria (B) Nerve cell (C) Virus (D) Muscle cell

E-3 Which one of the following is the smallest in size ?
(A) Bacteria (B) Mitochondrion (C) Mammalian cell (D) Virus

SECTION (F) : COMPONENTS OF A CELL

F-1 Aleuroplst stores -
(A) Protein (B) Carbohydrate (C) Fat (D) All

F-2 Which organell know as 'storage battery' -
(A) ER (B) Mitochondria (C) Plastid (D) Golgi body

F-3 Which orgenell plays a Crucial role in detoxification of drug and Poisonous -
(A) SER (B) RER (C) Golgi body (D) None

F-4 Which organell provide endoskeleton to cell -
(A) Lysosome (B) Mitochondria (C) ER (D) Plastid

F-5 Fragmoplast formation occur by
(A) Golgi body (B) Glyoxisome (C) Peroxisome (D) All of the above

SECTION (G) : MICROSCOPE

G-1 Which part of the folloiwng used in slide adjustment.
(A) Coarse adjustment (B) Fine adjustment (C) Base (D) both (A) & (B)

G-2 Who was build first compound microscope -
(A) Jansen and Janssen (B) Robert hook (C) Robert bron (D) None of these

Exercise-2

Marked Questions can be used as Revision Questions.

OBJECTIVE QUESTIONS

1. Which one is present in bacteria ?
(A) Nucleus (B) Golgi apparatus (C) Mitochondria (D) Ribosomes

2. Grapes were put in a concentrated sugar solution. On examination after 12 hours, the grapes were shrunken. This is because,
(A) Grapes become sweeter (B) Water evaporates from the solution
(C) Sugar induces disintegration of grapes (D) Loss of water from grapes by osmosis

3. Osmosis takes place between two solutions separated by a semipermeable membrane because.
(A) Water molecules move from the more dilute solution to the less dilute solution
(B) Solute molecules move from the less dilute solution to the more dilute solution
(C) Water molecules move from the less dilute solution to the more dilute solution
(D) Solute molecules move from the more dilute solution to the less dilute solution

Specimen Copy

4. Plasmolysis is not observed in boiled plant tissue because :
(A) The cell wall becomes impermeable to water (B) The cell membrane disintegrates
(C) The cell wall disintegrates (D) The cell membrane becomes impermeable to water

5. When a cell is fully turgid , which one of the following will be zero ?
(A) turgor pressure (B) wall pressure (C) suction pressure (D) osmotic pressure

6. Mammalian liver cells will swell when kept in
(A) hypertonic solution (B) hypotonic solutions (C) isotonic solution (D) isothermal solutions

7. Mitochondrial matrix contains :
(A) Enzymes (B) DNA and RNA (C) Ribosomes (D) All of the above

8. Mitochondria are semi autonomous due to :
(A) Presence of functional naked DNA (B) Presence of ribosomes
(C) Synthesize its own Protein (D) All of the above

9. Chromoplasts are formed from chloroplast during :
(A) Ripening of tomato (B) Ripening of chilli (C) Development of carrot (D) Both A and B

10. Endoplasmic Reticulum is absent in :
(A) Animal cells (B) Prokaryotes (C) Plant cells (D) Protista and fungi

11. Which one of the following provides mechanical support to cell ?
(A) Ribosomes (B) Golgi bodies (C) Lysosomes (D) Endoplasmic reticulum

12. Ribosomes develop from :
(A) Nucleus (B) Nucleolus (C) Endoplasmic reticulum (D) Mitochondria

13. Proteins are synthesized on,
(A) Cytoskeleton (B) Mitochondria (C) Ribosomes (D) Golgi apparatus

14. If the analogy of a city is applied to a eukaryotic cell then which of the following statements is correct ?
(A) Nucleus as a library and ribosome as a slaughter house
(B) Nucleus as a police station and mitochondria as powerhouse
(C) Mitochondria as powerhouse and Golgi as a cargo sorting facility
(D) Mitochondria as powerhouse and nucleus as slaughter house

15. If you fractionate all the organelles from the cytoplasm of a plant cell. In which one of the following sets of fractions will you find nucleic acids ?
(A) nucleus, mitochondria, chloroplast, cytoplasm
(B) nucleus, mitochondria, chloroplast, glyoxysome
(C) nucleus, chloroplast , cytoplasm and peroxisome
(D) nucleus, mitochondria, chloroplast, Golgi bodies

16. Microtubules are present in :
(A) Bacteria (B) Viruses (C) Eukaryotes (D) Mycoplasma

17. The following structure is NOT found in plant cells
(A) vacuole (B) nucleus (C) centriole (D) vitamin D

Exercise-3

Marked Questions can be used as Revision Questions.

NTSE PROBLEMS (PREVIOUS YEARS)

1. Cell organelle which differentiates plant cell from animal cell is –
(Raj/NTSE/Stage-1/Cell/13)
(A) Cell Membrane (B) Plastids (C) Nucleolus (D) Vacuoles

2. Example of cell organelle which do not have a unit membrane is
(Raj/NTSE/Stage-1/Cell/07)
(A) Mitochondria (B) Lysosome (C) Ribosome (D) Plastid

Specimen Copy

3. Chromosome reaches the equator during which stage of cell division ?
(Raj/NTSE/Stage-1/Cell/07)
(A) Prophase (B) Metaphase (C) Anaphase (D) Telophase

4. Decreasing order of size is :
(Raj/NTSE/Stage-1/Cell/06)
(A) DNA, t RNA, m RNA (B) m RNA, DNA, t RNA
(C) t RNA, DNA, m RNA (D) DNA, m RNA, t RNA

5. Sequence of cell cycle is :
(Raj/NTSE/Stage-1/Cell /07)
(A) G_I, G_{II} S (B) S, G_I ,G_{II} (C) G_I, S, G_{II} (D) G_I , G_{II} ,G_{III}

6. Mitosis
(Delhi/NTSE/Stage-1/Cell/2013)
(A) leads to recombinant daughter cells
(B) is a reduction division
(C) leads to formation of parental type of daughter cells
(D) occurs in gametes

7. Mitochondria and chloroplasts are similar because
(Delhi/NTSE/Stage-1/Cell/2013)
(A) Both have nuclei (B) Both have 80s ribosomes
(C) Both have DNA (D) Both have signle membrane envelope

8. Nucleus of the cell was discovered by
(Rajasthan/NTSE/Stage-1/Cell/2018)
(A) Robert Hooke (B) Leeuwenhoek (C) Robert Brown (D) Virchow

9. Turgidity of cell is maintained by
(Rajasthan/NTSE/Stage-1/Cell/2018)
(A) Vacuole (B) Lysosome (C) Plastid (D) Golgi body

10. Power house of cell is known as :`
(MP/NTSE/Stage-1/Cell/2017)
(A) Golgi bodies (B) Mitochondria (C) Ribosome (D) Lysosome

11. DNA (De-oxyribonucleic acid) is not present in one of the following
(Jharkhand/NTSE/Stage-1/Cell/2017)
(A) Chloroplast (B) Nucleus
(C) Mitochondria (D) TMV (Tobacco Mosaic Virus)

12. Blood cell without nucleus are
(UP/NTSE/Stage-1/Cell/2017)
(A) Red blood corpuscles (B) White blood corpuscles
(C) Blood platelets (D) None of these

13. Which is the largest cell in human body ?
(Gujrat/NTSE/Stage-1/Cell/2017)
(A) Liver cell (B) Nerve cell (C) Muscle cell (D) Kidney cell

14. Who has given the word 'cell' ?
(Gujrat/NTSE/Stage-1/Cell/2017)
(A) Robert Hook (B) Robert Brown (C) Watson and crick (D) Flamming

15. Which part of the cell is also termed as 'suicide bags of the cell'?
(Chandigarh/NTSE/Stage-1/Cell/2017)
(A) Ribosomes (B) Golgi bodies (C) Lysosomes (D) Mitochondria

Specimen Copy

16. Match the words in column / with those which are most appropriate in column II
(Hariyana/NTSE/Stage-1/Cell/2017)

Column I	**Column II**
(A) Karyokinesis	(1) Meiocytes
(B) Cytokinesis	(2) Plant cell
(C) Meiosis	(3) Nuclear division
(D) Cell plate	(4) Cytoplasmic division

(A) A=1, B=2, C=3, D=4 (B) A=2, B=1, C=4, D=3
(C) A=3, B=4, C=1, D=2 (D) A=4, B=3, C=2, D=1

Answers

EXERCISE - 1

SECTION (A) : CELL

A-1 C A-2 A A-3 C A-4 B A-5 B

SECTION (B) : CELL THEORY

B-1 C B-2 D

SECTION (C) : TYPES OF CELL

C-1 C C-2 D C-3 C

SECTION (D) : CELL SHAPE

D-1 B D-2 A

SECTION (E) : CELL SIZE

E-1 C **E-2** B **E-3** D

SECTION (F) : COMPONENTS OF A CELL

F-1 A **F-2** B **F-3** A **F-4** C **F-5** A

SECTION (G) : MICROSCOPE

G-1 D **G-2** A

EXERCISE - 2

OBJECTIVE QUESTION

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
A.	D	D	A	B	D	B	D	D	D	B	D	B	C	C	A	C	C

EXERCISE - 3

OBJECTIVE QUESTION

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A.	B	C	C	D	C	C	C	C	A	B	D	A	B	A	C	C

Specimen Copy

THE FRENCH REVOLUTION

INTRODUCTION

Today the Ideas of Equality , Liberty and fraternity are common and in this chapter we are going to read about the French revolution which brought these ideas into implementation for the first time in world history.

French revolution is considered as the most important landmark in human history. The revolution occurred in 1789 and swept away the existing political institutions, overthrew the French Monarchy and aimed at establishing an Egalitarian society and responsible government. The revolution began with the siege of Bastille on July 14, 1789 and continued until the rise of Napoleon Bonaparte to power.

1.1 FRENCH SOCIETY DURING THE LATE EIGHTEENTH CENTURY

The term 'Old Regime' is usually used to describe the society and institutions of France before 1789. French society before 1789 was divided into three estates; hence, it was called a society of estates. The estates constituted as follows:

Fig. – The Spider and the Fly. An anonymous etching.

(i) The First Estate - The First Estate consisted of the clergy. The clergy were exempted from paying taxes to the king.

(ii) The Second Estate - The Second Estate consisted of nobility. The nobility was also exempted from taxes. The nobles further enjoyed feudal privileges. These included feudal dues, which they extracted from the peasants.

(iii) The Third Estate - The Third Estate consisted of big businessmen, merchants, court officials, lawyers, peasants and artisan, landless labour, servants, etc. The Third Estate comprised both rich and poor persons.

(a) Causes of the French Revolution :

Political Causes :

(i) The political structure of the French state was highly unpopular with the people who were burdened with heavy taxes and insecure conditions of life and property.

(ii) Divine rights of the Kings, despotism and tyranny of the French monarchs topped by the extravagance and inefficiency of the Bourbon Kings.

(iii) Louis XV indulged in a life of ease and pleasure, was not interested in administrative reforms or the welfare of the people.

(iv) Louis XVI though good natured was completely under the influence of incompetent and corrupt ministers and a domineering queen, Marie Antoinette.

(v) Absence of any representative body to voice the needs of the people. Local bodies called 'Parliament' were courts of justice rather than voices of people.

Specimen Copy

Social Forces:

(i) The unfair division of French society and its feudal nature were also responsible for the revolution.

(ii) The first two estates enjoyed all the privileges and benefits in the society. The third estate was fraught with inequalities and discriminations. Most of the burden of taxation was borne by the least privileged and most impoverished third estate.

(iii) Middle class was most receptive to new ideas and values as they were educated and had a broader outlook, denied the whole ideas, rights and privileged existence where the main qualification is that of birth and instead favoured the criterion of merit.

Economic Unrest :

(i) In the 18th century the condition of common man had become pathetic, problem of subsistence due to failure of crops, increase in the prices of food grains

(ii) In the second half of the 18th century the French economy had started expanding. But its financial impact was uneven, hardest hit were the Third Estate

(iii) Between 1689 and 1783 France fought several long and exhausting wars which proved to be disastrous both in terms of French Manpower and finances, not only led to mounting debts but interest on these debts also multiplied.

(iv) To meet its mounting costs the government increased taxes. Peasantry was the hardest hit who owned the minimum land and paid the maximum taxes.

(v) Taxes were **Taille** the direct land tax, salt tax known as **Gabelle**, feudal dues or payments were taken by nobility and taxes known as **Tithe** was taken by the Church.

A growing middle class envisages an end to Privileges :

(i) The French Revolution drew its strength from the ideas of philosophers and thinkers of the time, groups of intellectuals classified by scholars according to their thinking.

(ii) Physiocrates, Philosophers and some others were grouped as liberals depending on their ideologies.

(iii) Greatest thinkers were Francois Marie, Arouet de Voltaire, Jean Jacques Rousseau, Charles Louis Montesquieu, John Locke and Denis Diderot to name a few.

(iv) Through their teachings and writings they stirred the people to action , revolutionized the minds of the people and prepared them for the great changes ahead.

DO YOU KNOW?

Livre- Unit of currency in france before 1794.

Clergy- Group of persons invested with special functions in the church

Tithe- A tax levied by the church,1/10th of the agricultural produce.

Taille-A direct tax to be paid to the stata.

Subsistence Crisis-An extreme situation where the basic means of livelihood are endangered

Contributions of the thinkers :

(i) Charles Montesquieu - A noblemen by birth, he became a lawyer and a judge. He preferred constitutional monarchy in France, he popularized the theory of separation of powers within the government between the legislative, the executive and the judiciary in his book *"The Spirit of the Laws"*.

(ii) Francis Aronet Voltaire - He was another outstanding philosopher of the revolution. He wanted the people to think about their material life on earth and forget about heaven. He condemned the Church which supported the privileged class and ignored the poor.

Sample Copy

(iii) Jean Jacques Rousseau - He is regarded as the architect of the French Revolution. In the famous book " The Social Contract", he proved that the government was the result of a social contract between the people on one hand and ruler on the other. So if the ruler didn't fulfill the contract, the people had the right to withdraw their loyalty to him and bring down the tyranny of the ruler by revolting against him.

(iv) John Locke - He was a great political thinker. He wrote "Two Treatises of Government" in which he sought to refute the doctrine of the divine and absolute right of monarch.

1.2 THE OUT BREAK OF THE REVOLUTION

On 5 May 1789, Louis XVI called together an assembly of the Estates General to pass proposals for new taxes. The Estates General was a political body. The three estates sent their representatives to this body. Each of the three estates had one vote each. The first estate and the second estate had sent 300 representatives each. They were seated in rows facing each other on two sides. The third estate had sent 600 representatives. They required standing at the back. Peasants, artisans and women were denied entry to the assembly. New taxes could be proposed only after the Estates General gave its approval to the king's proposal.

Since the first estate and the second estate were exempted from paying taxes, it was a foregone conclusion that the king's proposals on new taxes would get the approval of the Estates General.

(a) The Tennis Court Oath :

Voting in the Estates General in the past had been conducted according to the principle that each estate had one vote. Members of the third Estate demanded that voting now be conducted by the assembly as a whole, where each member would have one vote. When the King rejected this proposal, members of the third Estate walked out of the assembly in protest.

The representatives of the third Estate on June 20, 1789 assembled in the hall of an indoor tennis court in the grounds of Versailles. They declared themselves a National Assembly and swore not to disperse till they had drafted a constitution for France that would limit the powers of the monarch. While the National assembly was busy at Versailles the rest of France seethed with turmoil, on 14 July the agitated crowd stormed and destroyed the Bastille.

DO YOU KNOW

Chateau (pl. Chateaux)- Castle or stately residence belonging to a king or a nobleman

Manor- An estate consisting of the lords lands and his mansion.

(b) 'Storming of the Bastille' :

On the morning of July 14, 1789 the city of Paris was in a state of alarm. A severe winter had meant a bad harvest; the price of bread rose. Bakers exploited the situation and hoarded supplies. Crowds of angry women stormed into the shops.

The army was ordered by the king to move into the city. It was rumored that the army would be ordered to open fire upon the citizens. Thousands of persons gathered and decided to form a people's militia. They broke into a number of government buildings in search of arms. Bastille was a dreaded fortress-prison. It was hated by all because it stood for the despotic power of the king. Protestors stormed into the Bastille in search of arms. The commander of Bastille was killed; the prisoners were released. The fortress was demolished. Louis XVI finally accorded recognition to the National Assembly and accepted the principle that his powers would from now on be checked by a constitution. On the Night of 4 August 1789, the Assembly passed a decree abolishing the feudal system of obligations and taxes.

(c) France becomes a Constitutional Monarchy :

(i) The National Assembly completed the drafting of the constitution in 1791. Power was now separated and assigned to different institutions-the legislature, executive and judiciary making France a constitutionally monarchy.

(ii) The Constitution of 1791 vested the power to make laws in the National Assembly, which was indirectly elected.

(iii) The Constitution began with a Declaration of the Rights of Man and Citizen. Rights such as the Right of life, freedom of speech, freedom of opinion, equality before law were established as 'natural and inalienable' rights.

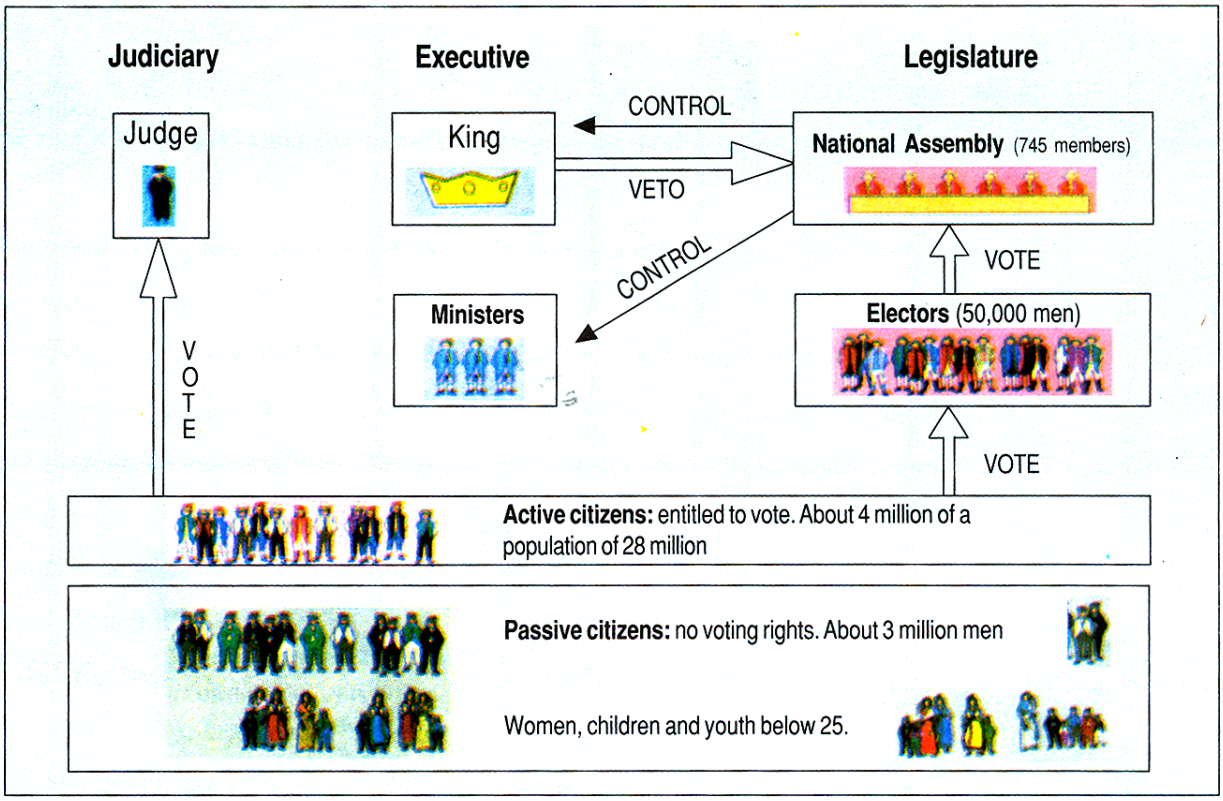

Fig. – The Political sytstem under the Constitution of 1791.

The Declaration of Rights of Man and Citizen :

(i) Men are born and remain free and equal in rights.

(ii) The aim of every political association is the preservation of the natural and inalienable rights of man; these are liberty, property, security and resistance to oppression.

(iii) The source of all sovereignty resides in the nation; no group or individual may exercise authority that does not come from the people.

(iv) Liberty consists of the power, to do whatever is not injurious to others.

(v) The law has the right to forbid only those actions that are injurious to society.

(vi) Law is the expression of the general will. All citizens have the right to participate in its formation, personally or through their representatives. All citizens are equal before it.

(vii) No man be accused, arrested or detained, except in cases determined by the law.

(viii) Every citizen may speak, write and print freely; he must take responsibility for the abuse of such liberty in cases determined by the law.

(ix) For the maintenance of the public force and for the expenses of administration a common tax is indispensable; it must be assessed equally on all citizens in proportion to their means.

(x) Since property is a sacred and inviolable right, no one may be deprived of it, unless a legally established public necessity requires it. In that case a just compensation must be given in advance

Le–Barbier painted the declaration of the rights of man and citizens in 1790. Majority of people at that time could not read and write, so he used many symbols to convey the content of the declaration of rights.

Fig. – The Declaration of the Rights of Man and Citizen, painted by the artist Le Barbier in 1790. The figure on the right represents France. The figure on the left symbolises the law.

(i) Figure on the right represented France and figure on the left symbolized the law

(ii) **The broken chain –** Stands for the act of becoming free.

(iii) **The bundle of rods –** It implies that strength lies in unity as one rod can be easily broken but not an entire bundle.

(iv) **The eye within a triangle radiating light –** Eye stand for knowledge, the rays of sun will drive away the clouds of ignorance

(v) **Sceptre –** It is a symbol of royal power.

(vi) **Snake** biting its tail to form a ring, a symbol of eternity.

(vii) **Red cap –** Cap worn by a slave upon becoming free.

(viii) **Blue, White, Red –** These are National colours of France.

(ix) **Winged woman –** Personification of the law.

(x) **The law tablet –** the law is same for all.

1.3 FRANCE ABOLISHES MONARCHY AND BECOMES A REPUBLIC

(i) Although Louis XVI had signed the Constitution, he entered into secret negotiations with the king of Prussia.

(ii) The National Assembly voted in April 1792 to declare war against Prussia and Austria. People saw this as a war of the people against kings and aristocracies all over Europe.

(iii) The revolutionary wars brought losses and economic difficulties to the people. Political clubs became an important rallying point for people who wished to discuss government policies and plan their own forms of action. The most successful of these clubs was that of the **Jacobins**, which got its name from the former convent of St. Jacob in Paris.

(iv) In the summer of 1792 the Jacobins planned an insurrection of a large number of Parisians who were angered by the short supplies and high prices of food. On the morning of August 10 they stormed the Palace of the Tuileries and held the king himself as hostage for several hours.

(v) Elections were held. The newly elected assembly was called the Convention. On 21 September 1792 it abolished the monarchy and declared France a Republic.

(vi) Louis XVI was sentenced to death by a court on the charges of treason. On 21 January 1793 he was executed publicly at the Place de la Concorde.

DO YOU KNOW?

Convent- Building belonging to a community devoted to a religious life.

(a) The Reign of Terror :

The period in between 1793-94 is referred as the "Reign of Terror".

(i) During this period Robespierre, who was the head of the government of France followed a policy of severe control and punishment.

(ii) Ex-nobles and clergy, even members of his own party who did not agree with his methods were arrested, imprisoned and then guillotined.

(iii) France witnessed the guillotine of thousands of nobles and innocent men who supported monarchy.

(iv) Robespierre issued laws placing a maximum ceiling on prices. Churches were shut down.

(v) Finally Robespierre was guillotined in July 1794.

Specimen Copy

(b) A Directory Rules France :

The reign of terror ended in 1794. The Jacobin government fell, and a new constitution was prepared by an elected convention providing for a republican form a government with a legislature and an executive body called the Directory. Directory was an executive made up of five members. Directors often clashed with the legislative councils, who then sought to dismiss them. The political instability of the Directory paved the way for the rise of a military dictator, Napoleon Bonaparte.

1.4 DID WOMAN HAVE A REVOLUTION

(i) Most women of the third estate had to work for a living, did not have a access to education or job training. Working women had also to care for their families, their wages were lower than those of men.

(ii) In order to discuss and voice their interests woman started their own political clubs and newspapers. About sixty women's clubs came up in different French cities. One of their main demand was that women enjoy the same political rights as men.

(iii) In the early years the revolutionary government did introduce laws that helped to improve the lives of women, creation of state schools, schooling made compulsory for all girls, could be no longer forced to get into marriage against their will, Divorce could be applied for by both women and men. Women could now train for jobs, could become artists or run small businesses.

(iv) During the Reign of Terror, the new government issued laws ordering closure of women's clubs and banning their political activities.

(v) The fight for the vote was carried out through an international suffrage movement during the late nineteenth and early twentieth centuries. It was finally in 1946 that women in France won the right to vote.

(a) The Abolition of Slavery :

(i) Slavery was rampant in the European colonies of the Caribbean and the Americans. The slaves were mostly used on sugar, coffee, indigo and tobacco plantations. Their demand was because of their availability and low costs

(ii) In a debate in the Constituent Assembly in October 1790, to safeguard commercial interests of planters' two parties holding opposite views emerged. The group that safeguarded planters' interests but pledged to maintain order in the colonies came up around the Massaic Club founded in August 1789 and their adversaries were the Society of the Friends of the Blacks founded in 1783. The outcome of the debate was that it served the purpose of drawing attention to the condition of slaves and sowed seeds of future political divisions.

(iii) On February 4,1794 the Convention (National Assembly) ended slavery in the French Colonies. Napoleon Bonaparte revoked the decree in 1802; slavery was finally abolished from the French colonies in 1848.

DO YOU KNOW?

Treason- Betrayal of one's country or government.

Negros- A term used for the indigenous people of Africa south of the Sahara. It is a derogatory term and no longer used in common language.

1.5 THE LEGACY OF THE FRENCH REVOLUTION

The French Revolution produced great effects not only in France but also on the whole of Europe.

(a) Effects on France :

The French Revolution put on end to the arbitrary rule in France and paved the way for the establishment of a republic there. The special privileges of the high order were abolished and lead to the regeneration of France on the basis of social equality. The declaration of the rights of man granted freedom and individual liberty to all without any distinction of class or creed. Many reforms were introduced in the administration. The higher and important posts in the state were opened to talented people. All were granted religious freedom. The Napoleonic code introduced a uniform system of law for France and made it quite clear and simple.

Specimen copy

(b) Effects on Europe :

(i) Equality – The French Revolution had a great influence on Europe. Equality was one of the main principles of French Revolution. It implied the equality of all before law and abolition of privileges enjoyed by the upper order in the society. It established social, economic and political equality in the European countries.

(ii) Liberty – Revolutionary idea of liberty was hailed all over Europe. It implied social, political and religious freedom. The declaration of rights of man made people understand the importance of personal liberty and rights.

(iii) Sovereignty – The French revolution emphasized the fact that sovereignty recites in the general public and law should be based on the will of the people. It infused the spirit of nationalism and patriotism in the people.

(c) Global Impact :

(i) The French Revolution had a global impact which was felt equally in India.

(ii) The UN charter of Human Rights also embodies the principles of the Revolution as laid down in the Declaration of Rights of Man and Citizens.

1.6 THE RISE AND FALL OF NAPOLEON

In 1804, Napoleon Bonaparte crowned himself Emperor of France. He set out to conquer neighboring European countries, dispossessing dynasties and creating kingdoms where he placed members of his family. Napoleon saw his role as a moderniser of Europe. He introduced many laws such as the protection of private property and a uniform system of weights and measures provided by the decimal system. Initially, many saw Napoleon as a liberator who would bring freedom for the people. But soon the Napoleonic armies came to be viewed everywhere as an invading force. He was finally defeated at Waterloo in 1815.

Some Important Dates :

1774 - Louis XVI becomes king of France, faces empty treasury and growing discontent within society of the Old Regime.

1789 - Convection of Estates General, Third Estate forms National Assembly, the Bastille is stormed, and peasant revolts in the countryside.

1791- A constitution is framed to limit the powers of the king and to guarantee basic rights to all human beings.

1792-93 France becomes a republic, the king is beheaded. Overthrow of the Jacobin republic, a Directory rules France.

1804- Napoleon becomes emperor of France, annexes large parts of Europe. 1815- Napoleon defeated at Waterloo

Exercise-1

FREE RESPONSE TYPE

VERY SHORT ANSWER TYPE

1. How was The French society organized during the Old Regime ?

2. What do you mean by 'subsistence crisis' ? Why did it occur frequently during the old Regime in France ?

3. What was the composition of the Estates General of May 5, 1789 ?

4. What was the main aim of the National Assembly ?

5. Mention two activities of French Assembly which hastened the Revolution

6. Why did Louis XVI want to raise taxes ? Why was he opposed ?

7. What was the National Anthem of France ? Who composed it ?

8. What is a Guillotine ? Who invented it ?

9. State any two laws passed by Napoleon.

10. Identify Napoleon, telling the part played by him in the French Revolution.

SHORT ANSWER TYPE

11. What was 'Bastille' ? What do you understand by 'Storming of the Bastille' ?

12. What was the Tennis Court Oath ?

13. Explain how the new political system worked ?

14. Who were Jacobins ? What role did they play in emergence of republic in France ?

15. What was Directory ? What were its consequences ?

16. What role did the philosophers play in bringing about the French Revolution ?

17. Why is the Declaration of the Rights of man citizen regarded as a revolutionary document ?

18. Give an estimate of Napoleon Bonaparte as the First Consul.

19. What was the impact of the French Revolution on the world ?

20. Which groups of French society benefited from the Revolution ? Which groups were forced to relinquish power? Which sections of society would have been disappointed with the outcome of the Revolution?

21. Explain the term 'Third Estate' ?

LONG ANSWER TYPE

22. What was the impact of French Revolution on France ?

23. Write short notes on
(i) French slave trade (ii) Reign of Terror (iii) Fall of Napoleon.

24. What was the importance of slavery to France ?

25. Discuss the impact of abolition of censorship in France.

26. How did the teachings of Rousseau lay the foundations of democracy ?

27. List the accomplishments of the National Assembly of France from 1789 to 1791.

28. How did France become a constitutional monarchy ?

29. Discuss the role of women in the revolutionary movement in France. When did women gain political equality in France ?

30. Give an estimate of the work of the National Assembly?

Specimen Copy

FILL IN THE BLANKS

1. On _____ the members of the third estate assembled in an indoor tennis court in the grounds of Versailles.
2. The National Assembly completed the drafting of the constitution in _____ .
3. Between 1793-1794 _____ ruled over the country of France.
4. _____ are the National colours of France.
5. In 1804 _____ crowned himself emperor of France.

TRUE / FALSE

1. The most successful of the clubs was that of the Jacobins Club.
2. John Locke wrote 'The Social Contract'.
3. On the Night of 4 August 1789, the Assembly passed a decree abolishing the feudal system of obligations and taxes.
4. The third estate consisted of nobles, landlords and dukes.
5. About 3 million men, women, children and youth below comprised of passive citizens.

MATCH THE COLUMN

1.

Column 'A'	**Column 'B'**
(a) Two treatises of Government	(i) Jean Jacquis Rousseau
(b) Social contract	(ii) Abbe Sieyes
(c) The spirit of the laws	(iii) John Locke
(d) What is the Third Estate	(iv) Montesquieu

(A) a-ii, b-i, c-iv, d-iii (B) a-iii, b-i, c-ii, d-iii (C) a-i, b-iv, c-ii, d-iii (D) a-iii, b-i, c-iv, d-ii

2.

Column 'A'	**Column 'B'**
(a) 5 May 1789	(i) Meeting of Estates General
(b) 20 June 1789	(ii) Tennis Court Oath
(c) 14 July 1789	(iii) Attack on Bastille
(d) 4 August 1789	(iv) Abolition of feudal system of obligations and taxes by the National Assembly

(A) a-i, b-ii, c-iii, d-iv (B) a-iii, b-iv, c-ii, d-i (C) a-iv, b-iii, c-ii, d-i (D) a-i, b-iii, c-ii, d-i

Exercise-2

FIXED RESPONSE TYPE

1. Olympe de Gouges was
(A) A poetess (B) A sportswoman (C) A female political leader (D) A school teacher

2. The demand of the Third Estate regarding their voting right was
(A) One man-One vote (B) one man-Two vote (C) One man-Three vote (D) One man-Four vote

3. The professions of the people of the Third estate were
(A) Lawyers and administrative officers (B) potters
(C) Butchers (D) writers

4. A Republic can be defined as
(A) Elected government (B) Hereditary monarchy
(C) Presidential government (D) Constitutional monarchy

Specimen Copy

5. At the time of the French Revolution the meaning of the term 'Third Estate' was
(A) Privileged class society (B) Underprivileged class society
(C) Nobles of the court (D) Aristocracy

6. The term used to describe the societies and institutions of France before 1789 is
(A) Old Regime (B) La Society (C) Manorial regime (D) Kings estate

7. The event which shaped the making of the modern world was
(A) The French Revolution (B) The revolution in Russia
(C) The Rise and end of Nazism (D) The Independence of Greece

8. The ideas promoted by the French revolution were mainly those of
(A) Liberty and equality (B) Taxes and dues
(C) Constitutional monarchy (D) Independent government

9. The year that Napoleon was defeated in Waterloo was
(A) 1804 (B) 1810 (C) 1815 (D) 1821

10. Louis XVI called an assembly of the Estates to pass proposals for new taxes in the year
(A) 1780 (B) 1784 (C) 1789 (D) 1774

11. The population of France rose from about 23 million to 28 million in the year
(A) 1715-1789 (B) 1725-1774 (C) 1774-1775 (D) 1770-1789

12. The tax which was directly paid to the state by the Third Estate was
(A) Clergy (B) Tithe (C) Taille (D) Livres

13. Louis XVI become the king of France in the year
(A) 1774 (B) 1789 (C) 1753 (D) 1719

14. Political symbols like broken chains, the Sceptre and bundles of rods were used during the French Revolution because French peasants were
(A) socially adaptable. (B) politically inclined. (C) educated. (D) illiterate.

15. The group that was described as 'passive citizen' by the Constitution of 1791 in France was
(A) Landed clergy. (B) Political philosophers
(C) Tax paying peasants. (D) women and peasants.

16. 'Negroes' is a term used for the indigenous people of
(A) Africa. (B) America (C) Australia. (D) Cuba.

17. The book The Spirit of the Laws is written by
(A) Lenin (B) Karl Marx (C) E.H.Carr (D) Montesquieu

18. "Negroes" are a community of people who are the
(A) Indigenous people of America (B) Indigenous people of Africa
(C) Indigenous people of England (D) Indigenous people of Sri Lanka

19. The Document that proclaimed freedom of Speech and Expression as a Natural Right was
(A) Declaration of Rights of man and citizen. (B) Declaration of Women's rights.
(C) Declaration of Legal Rights. (D) Declaration of Constitution.

20. In the 1790's Martinique, Guadeloupe and San Domingo are names of places in the Caribbean, which were
(A) French plantations. (B) French colonies. (C) French capitals. (D) French states.

21. The initial purpose of the pledging of the 'Tennis Court Oath' by the French peasantry was to
(A) declare itself a National Assembly. (B) declare France as a Monarchy.
(C) influence the King. (D) decide on a representative.

22. Hearing about the storming of Bastille, peasants in villages attacked the
(A) farm houses. (B) churches. (C) chateaux. (D) institutes.

Specimen Copy

23. The war against Prussia and Austria in April 1792 was viewed as a war against the
(A) kings and aristocracies. (B) forced occupation.
(C) peasants revolt. (D) military dictatorship.

24. A gap existed between the rich and the poor during the Old Regime because
(A) rich were many in number. (B) poor migrated.
(C) of natural calamities. (D) of reduction in wages.

25. After the execution of Robespierre a new constitution was introduced in France by the name of
(A) Assembly. (B) Directory. (C) Reichstag. (D) Convention.

26. On August 10 1792, King Louis VI was held hostage at the
(A) Bastille Prison. (B) Palace of the Tuileries.
(C) Palace of Versailles. (D) Place de la Concorde.

27. A Revolutionary woman journalist executed during the 'Reign of Terror' was
(A) Chaumette. (B) Marie Antoinette. (C) Bourdeaux. (D) Camille Desmoulins.

28. Olympe de Gouges wrote a "Declaration of the Rights of Woman and Citizen" and addressed to the
(A) king. (B) people. (C) peasants. (D) queen.

29. The Convention abolished the monarchy and declared France a republic on
(A) 21 September 1790 (B) 21 September 1791. (C) 21 September 1792. (D) 21 September 1793.

30. The tax that the Church extracted from the peasants was known as
(A) Gabelle. (B) Tallage. (C) Taille. (D) Tithes.

Exercise-3

NTSE PREVIOUS YEARS' QUESTIONS

1. When did the French Revolution take place? **[Chandigrah_NTSE_Stage-1_2013]**
(A) 1789 (B) 1786 (C) 1795 (D) 1781

2. The club which was most successful constituted by the men and women of France, after the Constitution of 1791 was **[Rajasthan_NTSE_Stage-1_2014]**
(A) Liberty club (B) Zollverein (C) Jacobin club (D) Equality club

3. The great Indians who were influenced by the thoughts of French Revolution were **[Rajasthan_NTSE_Stage-1_2014]**
(A) Haider Ali & Tipu Sultan (B) Tipu Sultan & Raja Rammohan Roy
(C) Lala Lajpat Rai & Tilak (D) Bahadur Shah Jafar & Laxmibai

4. The institution like Indian Parliament that was established after the French Revolution in France was **[Rajasthan_NTSE_Stage-1_2014]**
(A) Duma (B) Zollverein (C) House of Lords (D) National Assembly

5. "Without Rousseau, the French Revolution would not have taken place", proclaimed by : **[Maharashtra_NTSE Stage-1_ 2014]**
(A) Napoleon Bonaparte (B) Mirabo (C) Robespierre (D) Callone

6. Which tax on salt was to be paid by the French people? **[Maharashtra_NTSE Stage-1_ 2014]**
(A) Crown tax (B) Tally (C) Wainstam (D) Gabble

7. The club which was most successful constituted by the men and women of France, after the Constitutionof 1791 was **[Rajasthan_NTSE Stage-1_ 2013]**
(A) Liberty club (B) Zollverein (C) Jacobin club (D) Equality club

8. The writer of 'The Social Contract' is **(Rajasthan/NTSE Stage I/2015)**
(A) Rousseau (B) Montesquieu (C) Tilak (D) Mirabeau.

Specimen Copy

9. Napoleon Bonaparte was defeated at Waterloo in **(Rajasthan/NTSE Stage I/2015)**
(A) 1915 (B) 1825 (C) 1815 (D) 1819

10. Suffrage Movement was started for : **(Delhi/NTSE Stage I/2014)**
(A) The Right to Vote for Women (B) Right to Education
(C) Food for Poors (D) Peasant's Right

11. Jacobin Club was the most powerfull political organization in : **(Delhi/NTSE Stage I/2014)**
(A) Germany (B) Russia (C) France (D) Britain

12. Tithe is **[Rajasthan_NTSE_Stage-1_2016]**
(A) religious tax (B) implied tax (C) taille tax (D) feudal tax.

13. Match the table I with table II and select the correct response from the options given thereafter : **[Haryana_NTSE_Stage-1_2015]**

Table-I	**Table-II**
a. Louis XVI became the king of France	i. 1792-93
b. Convocation of Estate General	ii. 1804
c. France became a republic, the king was beheaded	iii. 1774
d. Napoleon became emperor of France	iv. 1789

(A) a-i, b-ii, c-iii, d-iv (B) a-ii, b-iv, c-i, d-iii (C) a-iii, b-iv, c-i, d-ii (D) a-iv, b-iii, c-ii, d-i

14. Match the table I with table II and select the correct response from the options given thereafter : **[Haryana_NTSE_Stage-1_2015]**

Table-I	**Table-II**
a. Montesquieu	i. Social contract
b. Rousseau	ii. Mein Kampf
c. Karl Marx	iii. Das Capital
d. Adolf Hitler	iv. The spirit of Laws

(A) a-iv, b-i, c-iii, d-ii (B) a-ii, b-i, c-v, d-iii (C) a-i, b-iv, c-iii, d-ii (D) a-ii, b-iii, c-i, d-iv

15. Who introduced the reign of terror ? **[Andhra Pradesh_NTSE_Stage-1_2015]**
(A) Mirabeau (B) Napoleon Bonaparte (C) John Locke (D) Maximillien Robespirre

16. Who wrote 'The Spirit of Laws'? **[West Bengal_NTSE_Stage-1_2016]**
(A) Adam Smith (B) Rousseau (C) Montesquieu (D) Voltaire.

17. What was Bastile ? **[Chattisgarh_NTSE_Stage-1_2015]**
(A) Fortres of france (B) Biggest gym of france
(C) Biggest theatre of france (D) Biggest garden of france.

18. Which among the following is not correctly matched in relation to the symbols of the French Revolution? **[Rajasthan_NTSE_Stage-1_2017]**

(Attribute)	(Significance)
(A) Broken Chains	- Being freed
(B) Breast plate with eagle	- Willingness to make peace
(C) Sceptre	- Symbol of royal power
(D) The winged woman	- Personification of the law.

19. Match List-I with List-II correctly and choose the correct code from the following: **[Rajasthan_NTSE_Stage-1_2017]**

List-I	**List-II**
(a) Napleon defeated at Waterloo	(i) 1929
(b) Formation of the Hindustan Socialist Republican Army	(ii) 1919
(c) Formation of Comintern	(iii) 1928
(d) Lahore Congress	(iv) 1815

Code :

	a	b	c	d
(A)	iii	ii	iv	I
(B)	iv	iii	ii	i
(C)	i	iv	ii	iii
(D)	ii	iv	i	iii

Specimen Copy

20. Find out the correct explanation **[Rajasthan_NTSE_Stage-1_2017]**
(A) Livre: Unit of currency in France, discontinued in 1794
(B) Clergy: Building belonging to a community devoted to a religious life
(C) Tithe: Tax to be paid directly to the state
(D) Taille : A tax levied-by the church.

21. The writer of 'Declaration of the Right of women and citizen is **[Delhi_NTSE_Stage-1_2018]**
(A) Olympe de Gouges (B) Camille Desmoulins (C) Napolean Bonapart (D) Henry Mayhew

22. Tax levied by the church comprising th agriculture produce was **[Delhi_NTSE_Stage-1_2018]**
(A) Livre (B) Taille (C) Tithe (D) Suffrage

23. Match List-I with List-II correctly and choose the correct code from the following : **[Rajasthan_NTSE_Stage-1_2018]**

List-I	List-II
(a) Meeting of the Estates General	(i) 20th June, 1789
(b) Bastille was destroyed on	(ii) 4th August, 1789
(c) Abolishment of feudal system in France	(iii) 14th July, 1789
(d) Swore of Tennis Court	(iv) 5th May, 1789.

Code:

	a	b	c	d
(A)	i	ii	iii	iv
(B)	iv	iii	ii	i
(C)	iv	i	ii	iii
(D)	i	iv	iii	ii.

Answers

EXERCISE # 1

Fill in the blanks.

1. 20 June 1789 2. 1791 3. Robespierre 4. Blue, White, Red
5. Napeleon Bonaparte

True and False.

1. True 2. False 3. True 4. False 5. True

Match the following :

1. (D) a-iii, b-i, c-iv, d-ii 2. (A) a-i, b-ii, c-iii, d-iv

EXERCISE # 2

Ques	1	2	3	4	5	6	7	8	9	10
Ans.	C	A	A	C	B	A	A	A	C	C
Ques	11	12	13	14	15	16	17	18	19	20
Ans.	A	C	A	D	D	A	D	B	A	B
Ques	21	22	23	24	25	26	27	28	29	30
Ans.	A	C	A	D	B	B	D	D	C	D

EXERCISE # 3

Ques	1	2	3	4	5	6	7	8	9	10
Ans.	A	C	B	D	A	D	C	A	C	A
Ques	11	12	13	14	15	16	17	18	19	20
Ans.	C	A	C	A	D	C	A	B	B	A
Ques	21	22	23							
Ans.	A	B	B							

Specimen Copy

TENSE

Eng. G. - 1

DEFINITION

It is any form of the verb which may be used to show (i) the time of an action and (ii) the state of action or an event. The tense of a verb shows the time when an action takes place.
There can be no sentence without a verb.

(a) There are three main tenses in English :

The Present Tense	———	(i) Mr. Sharma teaches us English.
The Past Tense	———	(ii) Mr. Sharma taught us English.
The Future Tense	———	(iii) Mr. Sharma will teach us English.

The three main tenses are subdivided into four heads. They are

(a) Indefinite or Simple (b) Continuous (c) Perfect (d) Perfect Continuous.

(b) Tense at a Glance :

Tense at a Glance				
Tense	**Indefinite/Simple**	**Continuous**	**Perfect**	**Perfect Continuous**
Present	writes	am writing is writing are writing	has written have written	has been writing have been writing
Past	wrote	was writing were writing	had written	had been writing
Future	shall write will write	shall be writing will be writing	shall have written will have written	shall have been writing will have been writing

(c) Examine the following sentences :

(i) I write a letter.
(ii) I am writing a letter.
(iii) I have written a letter.
(iv) I have been writing a letter.

The verbs in all these four sentences refer to the Present Time and are therefore said to be in the Present Tense.

- **In sentence (i) :** the verb 'write' simply expresses the action done in the present time, without indicating the state of action. It does not tell us anything about the completeness or incompleteness of the action. Hence the verb is said to be in the ***Simple Present Tense* or *Present Indefinite Tense*.**
- **In sentence (ii) :** the verb 'am writing' is still going on or continuing. Hence the verb is said to be in the ***Present Continuous Tense*.**
- **In sentence (iii) :** the verb 'have written' shows that the action is completed, finished or perfect. Hence the verb is said to be in the ***Present Perfect Tense*.**
- **In sentence (iv) :** the verb 'have been writing' shows that the action is going on continuously up to the present time. Hence the verb is said to be in the ***Present Perfect Continuous Tense*.**

(d) Similarly the Past Tense and the Future Tense have four forms:

- **Simple Past Tense or Past Indefinite Tense** (i) I wrote a letter.
- **Past Continuous Tense** (ii) I was writing a letter.
- **Past Perfect Tense** (iii) I had written a letter.
- **Past Perfect Continuous Tense** (iv) I had been writing a letter.

And

- **Simple Future or Future Indefinite Tense** (i) I shall write a letter.
- **Future Continuous Tense** (ii) I shall be writing a letter.
- **Future Perfect Tense** (iii) I shall have written a letter.
- **Future Perfect Continuous Tense** (iv) I shall have been writing a letter.

Specimen Copy

PRESENT TENSE

We use the Present Simple Tense to describe

(i) Things that are always true i.e. universal fact. **Eg.** The Sun rises in the East.
(ii) Situations that exist now and will go on indefinitely. **Eg.** Teachers teach the students.
(iii) Habits or things that happen regularly. **Eg.** We go to school everyday.

(a) Present Simple (Indefinite) Tense :

(i) In the Simple Present (Indefinite) Tense, *the first form of the verb* is used.
Eg. (i) I respect my elders.
(ii) You drive the car very carelessly.
(iii) Children love their parents.

(ii) ***'s' or 'es'*** is added to *the first form of the verb* when the *subject* is in *the third person* and of *singular number*.
Eg. (i) My brother goes to school.
(ii) An eagle flies high up in the sky.
(iii) A child loves to play with others' toy.

Note :

I. Add ***'es'*** to the *first form of the verb*, if it ends in **'ch', 'sh', 'o', 'ss' or 'x'**
Eg. marches, pushes, does, passes, fixes.

II. If a verb ends in **'y'** and *is preceded with a consonant*, change **'y'** into **'i'** and add **'es'**
Eg. worry – worries, fly – flies, try – tries.
If there is a vowel before 'y', add only 's' to the first form of the verb.
Eg. obey – obeys, enjoy – enjoys, pray – prays.

III. To all other verbs just add 's'.
Eg. talk – talks, sleep – sleeps, fight – fights.

Affirmative Form :

- I / we/ you/ they/ plurals + 1st form of the verb.
- He/ she/ it / singular + 1st form of the verb + s / es
  Eg. The students go to school.
  My brother goes to office.

Interrogative Form :

- Do / Does + Subject + 1st form of the verb + ———— ?

  OR

  Question word + Do / Does + subject + 1st form of verb + ————?

  Eg. (i) Do you know English ?
  (ii) Does she cook tasty food?
  (iii) When do you go to school?

Note : Only first form of the verb is used with 'do' or 'does'

Negative Form :

- Subject + do not / does not + 1st form of the verb + ————
  Eg. My students do not want to fail.
  He does not get time to play.

Interrogative Negative :

- Do not / Does not + subject + 1st form of the verb + ————?
  Eg. Don't you want to succeed in life?
  Doesn't she disturb you always?

(b) Present Continuous Tense :

The present continuous tense describes -

(i) An action that is happening (now) at the time of speaking.
Eg. We are learning English grammar.

(ii) To describe an action going on over a period of time, including the present, but may not be going on at the time of speaking.
Eg. (Nowadays) My friend is working in American Institute.

Specimen Copy

Affirmative Form :

- Subject + is / am / are + present participle + ————.

  Eg. The teacher is teaching his students.
  I am teaching my students.
  The students are listening to the teacher.

Interrogative Form :

- Is / am/ are + subject + 1st form of the verb + ———?

  Eg. Is the teacher teaching his students ?
  Am I teaching my students?
  Are the students listening to the teacher ?

Negative Form:

- Subject + is / am / are + not + present participle + ————.

  Eg. He is not giving the answers to my questions.
  I am not teaching today.
  Students are not asking their difficulties.

(c) Present Perfect Tense :

The present perfect tense refers to an action or a process that has been completed in the present.

Affirmative Form **:**

- Subject + has / have + past participle + ———.

  Eg. He has done his homework.
  You have solved all the examples.
  She has finished her work.

Interrogative Form :

- Has / have + Subject + past participle + ———?

  Eg. Has he done his homework?
  Have you solved all the examples?
  Has she finished her work?

Negative Form :

- Subject + has / have + not + past participle + —————.

  Eg. He has not done his homework.
  You have not solved all the examples.
  She has not finished her work.

(d) Present Perfect Continuous Tense :

This tense is used to describe an action that began in the past, is still continuing and may extend into the future. **'Since'** and **'for'** are used with the Present Perfect Continuous Tense.
'Since' is used with a **'point of time'**. It denotes some definite point of time in the past till now.
e.g. since evening, since Sunday, since 2007, etc.
'For' is used with a period of time. It denotes a 'length of time' till now.
e.g. for several weeks, for seven days, for many years etc.

Affirmative Form :

- Subject + has / have + been + present participle + ———— + since/ for

  Eg. I have been living in Kota since 2005.
  The child has been crying for one hour.

Interrogative Form:

- Has / have + Subject + been + present participle + ————— + since /for?

  Eg. Have I been living in Kota since 2005 ?
  Has the child been crying for one hour ?

Negative Form:

- Subject + has / have + not been + present participle + ———— + since/ for

  Eg. I have not been living in Kota since 2005.
  The child has not been crying for one hour.

Specimen Copy

PAST TENSE

The past tense refers to actions and events that happened in the past or in an earlier time.

(a) Simple Past (Indefinite) Tense :

Affirmative Form :

- Subject + Second form of the verb + ———-

  Eg. The boy threw his bat in anger.
  Bangladesh won the cricket match against India.
  Charles met with an accident while coming back from work.

Interrogative Form :

- Did + subject + 1st form of the verb + ————?

  Eg. Did the boy throw his bat in anger?
  Did Bangladesh win the cricket match against India ?
  Did Charles meet with an accident while coming back from work ?

Negative Form :

- Subject + did + not + 1st form of the verb + ————.

  Eg. The boy did not throw his bat in anger.
  Bangladesh did not win the cricket match against India.
  Charles did not meet with an accident while coming back from work.

(b) Past Continuous Tense :

Affirmative Form :

- Subject + was / were + present participle + ————.

  Eg. My brother was going to the temple.
  The students were preparing for their exams.

Interrogative Form :

- Was / were + subject + present participle+ ————?

  Eg. Was my brother going to the temple?
  Were the students preparing for their exams?

Negative Form :

- Subject + was /were + not + present participle + ———.

  Eg. My brother was not going to the temple.
  The students were not preparing for their exams.

(c) Past Perfect Tense :

Affirmative Form :

- Subject + had + past participle + ————.

  Eg. I had completed my work when my father came.
  The train had left before she reached the station.

Interrogative Form :

- Had + Subject + past participle + ————?

  Eg. Had I completed my work when my father came.?
  Had the train left before she reached the station?

Negative Form:

- Subject + had + not + past participle + ————.

  Eg. I had not completed my work when my father came.
  The train had not left before she reached the station.

Specimen Copy

(d) Past Perfect Continuous Tense :

Affirmative Form :

- Subject + had + been + present participle + ————. + since / for .

  Eg. They had been waiting for us for one hour.
  The airplane had been flying around the airport due to bad weather since morning.

Interrogative Form :

- Had + Subject + been + present participle + ————.+ since / for?

  Eg. Had they been waiting for us for one hour?.
  Had the airplane been flying around the airport due to bad weather since morning.?

Negative Form :

- Subject + had + not + been + present participle + ————. + since / for

  Eg. They had not been waiting for us for one hour.
  The airplane had not been flying around the airport due to bad weather since morning.

THE FUTURE TENSE

(a) Simple Future (Indefinite) Tense

Affirmative Form:

- Subject + shall / will + 1st form of the verb + ————.

  Eg. We shall succeed in life.
  You will go to college regularly.
  The boys will win the football match.

'Shall' is used with first person and **'Will'** is used with the second and the third person to show simple future.

Interrogative Form :

- Shall / will + Subject + 1st form of the verb + ————?

  Eg. Shall we succeed in life?
  Will you go to college regularly?
  Will the boys win the football match?

Negative Form :

- Subject + shall / will + not + 1st form of the verb + ————.

  Eg. We shall not succeed in life.
  You will not go to college regularly.
  The boys will not win the football match.

(b) Future Continuous Tense

Affirmative Form :

- Subject + shall / will + be + present participle + ————.

  Eg. They will be playing in the evening.
  I shall be going to Mumbai during Diwali vacation.

Interrogative Form :

- Shall / will + subject + be +present participle + ————?

  Eg. Will they be playing in the evening?
  Shall I be going to Mumbai during Diwali vacation?

Negative Form :

- Subject + shall / will + not + be + present participle + ————.

  Eg. They will not be playing in the evening.
  I shall not be going to Mumbai during Diwali vacation.

(c) Future Perfect Tense

Affirmative Form :

- Subject + shall / will + have + past participle + ————.

  Eg. I shall have gone to Mumbai by November.
  The teachers will have showed the slides to the students.

Interrogative Form :

- Subject + shall / will + have + past participle + ————?

  Eg. Shall I have gone to Mumbai by November ?
  Will the teachers have showed the slides to the students ?

Specimen Copy

Negative Form :

- Subject + shall / will + not + have + past participle + ————.

  Eg. I shall not have gone to Mumbai by November.
  The teachers will not have showed the slides to the students.

(d) Future Perfect ContinuousTense

Affirmative Form :

- Subject + shall / will + have + been + present participle + ———— + since /for.

  Eg. The mountaineers will have been climbing the mountain since early morning.
  We shall have been playing for 3 hours.

Interrogative Form :

- Shall / will + Subject + have + been + present participle+———— +since /for + —— ?

  Eg. Will the mountaineers have been climbing the mountain since early morning ?
  Shall we have been playing for 3 hours ?

Negative Form :

- Subject + shall / will + not + have + been + present participle + ing + ———— + since /for.

  Eg. The mountaineers will not have been climbing the mountain since early morning.
  We shall not have been playing for 3 hours.

Exercise-1

Direction (1 to 10): Fill in the blanks with the correct form of verbs.

1. Bipin _____ to market.
(A) go (B) going (C) Is go (D) is going

2. Farmers _____ in the field.
(A) are working (B) works (C) working (D) is working

3. They _____ in the room.
(A) slept (B) is sleep (C) are sleeping (D) sleeping

4. My mother _____ food.
(A) has cooked (B) is cook (C) cooking (D) cook

5. Marie _____ a song in the party.
(A) sang (B) are sang (C) is sing (D) sing

6. Dhoni will have _____ .
(A) slept (B) sleep (C) sleeps (D) sleeping

7. The shopkeepers_____much money.
(A) earns (B) was earning (C) have been earned (D) earned

8. At this time tomorrow I _____my friends.
(A) shall be entertaining (B) shall entertained
(C) will entertained (D) shall entertaining

9. She_____to me for more than a year.
(A) is not speaking (B) has not spoken
(C) has not been speaking (D) did not speak

10. She_____a novel now-a-days.
(A) writes (B) has written (C) has been writing (D) is writing

Specimen Copy

Exercise-2

Direction (1 to 20): Fill in the blanks with the correct forms of the verbs given in the bracket.

1. Have you ever _____ such a beautiful scene? (see)

2. The moon has not yet _____ . (appear)

3. I _____ English for ten years. (teach)

4. What _____ your father feel about Resonance ? (do)

5. All work and no play _____ Jack a dull boy. (make)

6. He scratched his head and _____ for a moment. (think)

7. When I reached the temple, a group of people _____ devotional songs. (recite)

8. What _____ you _____here from the time I went to college ? (do)

9. By this time tomorrow, I _____ home. (reach)

10. The students _____ answers to all my questions. (give)

11. _____ the students _____ yesterday ? (study)

12. After school, we _____ and _____ our parents about our English teacher. (go, tell)

13. The new railway bridge _____ two weeks ago. (complete)

14. They _____ the work when the teacher entered the class. (finish)

15. I was teaching English when she _____ the classroom. (enter)

16. They _____ a new power station at the moment. (build)

17. When I _____ the stamps somebody _____my name. (buy) (call)

18. "What time _____ ?" "About an hour ago." (Keshav come)

19. I _____ to the cinema last night. I _____ too tired. (not go) (be)

20. Kavita _____ us to the party but we _____. We had other things to do. (invite) (not go)

Direction (21): Fill in the blanks with the correct forms of the verbs given in brackets.

I (a) _____ (learn) English for seven years now. But last year I (b) _____ (not work) hard enough for English, that's why my marks (c) _____ (not be) really that good then. As I want to (d) _____ (pass) my English exam successfully next year, I (e) _____ (study) harder this term.

Direction (22 to 25): Read the passage given below. Fill in the blanks by choosing the most appropriate word/phrases from the given options.

The butter (22)_____ melted. Onions and vegetables are (23)_____ in it for 3 minutes. Flour and stock are added. It is (24) _____ to a boil while (25) _____ continuously

22. (A) be (B) is (C) are (D) being

23. (A) fried (B) fry (C) fries (D) frying

24. (A) bring (B) brought (C) bringing (D) brings

25. (A) stir (B) stirring (C) stirs (D) stirred

Direction (26 to 29): Read the passage given below. Fill in the blanks by choosing the most appropriate word/ phrases from the given options.

One morning, Shubham's mother (26) _____(get) worried when he (27) _____(not take) the lunch. She asked him what the matter (28) _____(be). He told that he was not (29) _____well in the night due to the headache.

26. (A) got (B) gets (C) is getting (D) are getting

27. (A) is not taking (B) has not taken (C) had not taken (D) was not taking

28. (A) was (B) is (C) being (D) were

29. (A) feel (B) feels (C) feeling (D) felt

Specimen Copy

Direction (30): The following passage has not been edited. There is one error in each of the lines. Write the incorrect word and the correction against the correct blank number. Remember to underline the word that you have supplied.

		Incorrect	Correct
When Vijay enter the cinema hall, the	(a)	_____	_____
film start. It was very dark inside	(b)	_____	_____
There is nobody to show him the way.	(c)	_____	_____
He count the rows and moved into the	(d)	_____	_____
fifth row since his ticket has C-12	(e)	_____	_____
write on it. As it was dark inside	(f)	_____	_____
he moved through the row and sit	(g)	_____	_____
on a chair. But to his horror there			
was somebody already sat on that chair.	(h)	_____	_____

31. In the passage given below, one word has been omitted in each line. Write the missing word along with the word that comes before and the word that comes after it. Ensure that the word that forms your answer is underlined.

		Before	Missing	After
(a)	Pollution not a new problem. In the	_____	_____	_____
(b)	middle ages most towns dirty, water	_____	_____	_____
(c)	supply foul and diseases spread	_____	_____	_____
	quickly. Much has been done to improve			
	sanitation and public health. But since			
(d)	Industrial Revolution disposal of waste become	_____	_____	_____
	more complicated. As factories produce new			
(e)	goods old ones thrown out with the	_____	_____	_____
(f)	rubbish. These rubbish heaps an unpleasant	_____	_____	_____
(g)	sight to watch. Getting rid of plastics particularly	_____	_____	_____
	difficult. Plastics never decay,			
(h)	the more we throw, the more litter produced.	_____	_____	_____

So scientists are trying to make plastics which can be easily broken.

Answers

Exercise-1

Q.	1	2	3	4	5	6	7	8	9	10
A.	D	A	C	A	A	A	D	A	C	D

Exercise-2

1. seen **2.** appeared **3.** have been teaching **4.** does
5. makes **6.** thought **7.** was reciting **8.** did ; do
9. shall have reached **10.** gave **11.** did ; study **12.** went ; told
13. was completed **14.** had finished **15.** entered **16.** are building
17. was buying ; called **18.** did Keshav come **19.** did not go ; was **20.** had invited ; did not go
21. **(a)** have been learning **(b)** did not work **(c)** were not **(d)** pass **(e)** shall study

Specimen Copy

Q.	22	23	24	25	26	27	28	29
A.	B	A	B	B	A	C	A	C

30.

Incorrect	Correct
(a) enter	entered
(b) start	had started
(c) is	was
(d) count	counted
(e) has	had
(f) write	written
(g) sit	sat
(h) sat	sitting

31

Before	Missing	After
(a) pollution	is	not
(b) towns	were	dirty
(c) supply	was	foul
(d) waste	has	become
(e) ones	are	thrown
(f) heaps	are	an
(g) plastics	is	particularly
(h) litter	is	produced

Specimen Copy

LOGICAL ALPHABET NUMBER

A. ALPHABETICAL ORDER

You have to arrange these words in order in which they are arranged in a dictionary. In a dictionary the words are placed in alphabetical order w.r.t. the second alphabet of the words and so on (that is, third alphabet, fourth alphabet...)

Example. 1

Arrange in alphabetical order and find which word comes in the middle ?

Select, Seldom, Selfish, Seller, Send, Second, Section

Solution :

The given words can be arranged in the alphabetical order as

Second, Section, Seldom, **Select**, Selfish, Seller, Send

Clearly, **Select** comes middle.

Example 2.

Arrange the given words in the sequence in which they occur in the dictionary and choose the correct sequence.

1. Precede 2. Precision 3. Precise 4. Precept 5. Preach 6. Prelude

(A) 5, 3, 1, 4, 2, 6 (B) 5, 1, 4, 3, 2, 6 (C) 5, 1, 3, 4, 2, 6 (D) 5, 1, 4, 2, 3, 6

Solution :

(B) The correct alphabetical order of the given words is

Preach, Precede, Precept, Precise, Precision, Prelude. Thus, the correct sequence is **5, 1, 4, 3, 2, 6**.

Example. 3

A group of letters is given which are numbered 1, 2, 3, 4, 5 and 6. Below are given four alternatives containing combinations of these numbers. Select that combination of numbers so that letters arranged accordingly, form a meaningful word.

A	C	P	E	T	S
1	2	3	4	5	6

(A) 1, 6, 3, 4, 2, 5 (B) 2, 3, 4, 1, 5, 6 (C) 5, 6, 3, 4, 1, 2 (D) 6, 5, 3, 4, 2, 1

Solution :

(A) The given letter, when arranged in the order **1, 6, 3, 4, 2, 5**. Form the word **ASPECT**.

Example. 4

If any two letters in the word **PRISON** have as many letters between them in the word as there are in the English alphabet, they form an alpha-pair. How many such alpha-pairs are there in the word **PRISON** ?

(A) 4 (B) 1 (C) 2 (D) 3

Solution :

(A) Letter in the given word Letter in the alphabet series

(i) O N N O

(ii) P R I S P Q R S

(iii) R I S O R Q P O

(iv) R I S O N R Q P O N

Specimen Copy

Example. 5

Number of letters skipped in between adjacent letters in the series is odd. Which of the following series observes this rule ?

(A) BDHLR (B) FIMRX (C) EIMQV (D) MPRUX

Solution :

(A) B C D E F G H I J K L M N O P Q R

1 3 3 5

Clearly, in letter series **BDHLR**, the number of letter skipped in between adjacent letters in the series is odd.

Example. 6

If you count **21** letters in the English alphabet from the end and **20** letters from the beginning which letter will appear exactly in the middle of the sequence thus formed ?

(A) M (B) N (C) L (D) O

Solution :

(A) Consider the English alphabet :

20 Letters from beginning

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

21 Letters from the end

By counting 21 letters from the end and 20 letters from the beginning, we get the following sequence in which **M** comes exactly middle.

F G H I J K L [M] N O P Q R S T

Example. 7

If it is possible to make a meaningful word with the first, the fourth, the seventh and the eleventh letters of the word **INTERPRETATION**, which of the following will be the third letter of that word ? If more than one such word can be made, give **M** as the answer and if no such word can be formed, give **X** as the answer.

(A) T (B) E (C) X (D) M

Solution :

(D) The first, the fourth, the seventh and the eleventh letters of the word **INTERPRETATION** are **I**, **E**, **R** and **T** respectively. The words formed are **RITE**, **TIRE and TIER**.

Example. 8

If the following scrambled letters are rearranged to form the name of a city, the city so formed is famous for its

WILGARO

(A) Locks (B) Steel Plant (C) Temples (D) Pottery

Solution :

(C) The city is **GWALIOR** and it is famous for temples.

Example. 9

Choose the one word which can be formed from the letters of the given word.

RATIONALISATION

(A) NATIONALISTIC (B) NATIONALIST (C) SITUATION (D) REALISATION

Sol. (B) The word **RATIONALISATION** contains all the letters of the word **NATIONALIST**. So, the word **NATIONALIST** can be formed.

Specimen Copy

B. NUMBER RANKING

Example. 10

How many even numbers are there in the above sequence which are immediately preceded by an odd number and immediately followed by an even number ?

5 1 4 7 3 9 8 5 7 2 6 3 1 5 8 6 3 8 5 2 2 4 3 4 9 6

(A) 1 (B) 2 (C) 3 (D) 4

Solution :

(C) We have to find the sequence OEE. O–Odd No. & E - Even No. A odd number followed by two even numbers. 5 *1 4 7 3 9 8 5* ***7 2 6*** *3 1* ***5 8 6*** *3 8* ***5 2 2*** *4 3 4 9 6*.

Example. 11

Nitin was counting down from **32**.Sumit was counting upwards, the numbers starting from **1** and he was calling out only the odd numbers. What common number will they call out at the same time if they were calling out at the same speed ?

(A) 19 (B) 21

(C) 22 (D) They will not call out the same number

Solution :

(D) Nitin : 32 31 30 29 28 27 26 25 24 23 22 21 20...

Sumit : 1 3 5 7 9 11 13 15 17 19 21 23 25...

Clearly, both will never call out the same number.

Example. 12

If all the numbers from **7** to **59**, which are divisible by **3** are arranged in descending order then which number will be at **10th** place from the bottom ?

(A) 36 (B) 39 (C) 30 (D) 27

Solution : (A) The required numbers in descending order are : 57, 54, 51, 48, 45, 42, 39, 36, 33, 30, 27, 24, 21, 18, 15, 12, 9. The **10th** number from the bottom is **36**.

C. RANKING TEST

Example. 13

Thirty six vehicles are parked in a parking lot in a single row. After the first car, there is one scooter. After the second car, there are two scooters. After the third car, there are three scooters and so on. Work out the number of scooters in the second half of the row.

(A) 10 (B) 12 (C) 15 (D) 17

Solution :

(C) Let C and S denote car and scooter respectively.

Then, the sequence of parking is

CSCSSCSSSCSSSSCSSS/SSCSSSSSSCSSSSSSSC

The above sequence has been divided into two equal halves by a line.

Clearly, number of scooters in second half of the row = 2 + 6 + 7 = 15.

Example. 14

Manisha ranked sixteenth from the top and twenty ninth from the bottom among those who passed an examination. Six students did not participate in the competition and five failed in it. How many students were there in the class ?

(A) 40 (B) 44 (C) 50 (D) 55

Solution :

(D) Number of students who passed = (15 + 1 + 28) = 44.

$\therefore$ Total number of students in the class = 44 + 6 + 5 = 55

Specimen Copy

Example. 15

Anil and Sunil are ranked seventh and eleventh respectively from the top in a class of **31** students. What will be their respective ranks from the bottom in the class ?

(A) 20th and 24 th (B) 24th and 20th (C) 25th and 21st (D) 26th and 22nd

Solution :

(B) Number of students behind Anil in rank
= (31 – 7) = 24. So, Anil is 25th from the bottom.
Number of students behind Sunil in rank
= (31 – 11) = 20 So, Sunil is 21st from the bottom.

Exercise-1

1. Arrange the given words in alphabetical order and tick the one that comes last.
(A) plane (B) plain (C) player (D) place

2. Arrange the words in the alphabetical order and tick the one that comes second.
(A) Explosion (B) Emergency (C) Ecstasy (D) Eager

Directions : (3 to 7) In each of the following questions, a group of letters is given which are numbered 1, 2, 3, 4, 5 and 6. Below are given four alternatives containing combinations of these numbers. Select that combination of numbers so that letters arranged accordingly, form a meaningful word.

3. **G A N I M E**
1 2 3 4 5 6
(A) 1, 2, 4, 3, 6, 5 (B) 6, 3, 4, 1, 5, 2 (C) 5, 2, 1, 4, 3, 6 (D) 2, 5, 1, 4, 3, 6

4. **C E L S M U**
1 2 3 4 5 6
(A) 4, 6, 3, 5, 2, 1 (B) 5, 6, 4, 1, 3, 2 (C) 4, 6, 5, 2, 3, 1 (D) 5, 2, 3, 1, 6, 4

5. **R T A O U H**
1 2 3 4 5 6
(A) 1, 3, 4, 5, 6, 2 (B) 2, 3, 6, 4, 5, 1 (C) 6, 3, 2, 4, 5, 1 (D) 3, 5, 2, 6, 4, 1

6. **K A T C E L**
1 2 3 4 5 6
(A) 4, 2, 3, 1, 5, 6 (B) 1, 2, 4, 5, 6, 3 (C) 6, 5, 3, 2, 4, 1 (D) 3, 2, 4, 1, 6, 5

7. **I N L A S G**
1 2 3 4 5 6
(A) 6, 1, 3, 5, 4, 2 (B) 5, 1, 6, 2, 4, 3 (C) 3, 4, 6, 1, 2, 5 (D) 2, 4, 3, 6, 1, 5

8. In the word **PARADISE** how many pairs of letters are there which have as many letters between them in the word as in the alphabet ?
(A) None (B) One (C) Two (D) Three

9. How many such letters are there in the word **CREATIVE**, which have as many letters between them in the word as in the alphabet ?
(A) 1 (B) 2 (C) 3 (D) 4

10. How many pairs of letters in the word **BRIGHTER** have as many letters between them in the word as in the alphabet ?
(A) 2 (B) 3 (C) 4 (D) more than 4

Specimen Copy

11. Number of letters skipped in between adjacent letters in the series are multiples of **3**. Which of the following series observes this rule ?
(A) AELPZ (B) GKOTZ (C) LORUX (D) DHLPU

12. Select the series in which the letters skipped in between adjacent letters decrease in order
(A) AGMRV (B) HNSWA (C) NSXCH (D) SYDHK

13. Number of letters skipped in between adjacent letters in the series decreases by two. Which of the following series observes this rule ?
(A) EPVAF (B) GPWBE (C) UCJOP (D) XFMQU

14. If every even letter beginning from **B** is replaced by odd number beginning with **3**, which letter/number will be the third to the left of the tenth number/ letter counting from your right ?
(A) M (B) S (C) 15 (D) 23

15. Which letter should be fourth to the right of twelfth letter from the right if the second half of the alphabet series is reversed ?
(A) J (B) U (C) L (D) M

16. If it is possible to make a meaningful word with the second, the fourth, the fifth, the seventh and the eleventh letters of the word **DISTRIBUTION** which of the following will be the third letter of that word ? If no such word can be formed give **X** as answer.
(A) O (B) I (C) B (D) X

17. In the alphabet series which letter is midway between **22nd** letter from the left and **21st** letter from the right ?
(A) L (B) M (C) O (D) None of these

18. If the first half of the alphabet is written in the reverse order, which of the following will be the 19th letter from your right ?
(A) H (B) F (C) D (D) E

19. If the following scrambled letters are rearranged to form the name of a city, which letter will appear in the middle ?
AIDMURA
(A) M (B) R (C) U (D) D

20. If in the alphabet series the first and the second letters interchange their positions and similarly the third and the fourth letters, the fifth and the sixth letters and so on, which letter will be the **17th** from your right ?
(A) H (B) I (C) F (D) J

21. If the first and the fifth letters in the word **ORDINARY** are interchanged, the second and the sixth, the third and the seventh and so on what will be the fifth letter from the right end after rearrangement ?
(A) R (B) I (C) Y (D) N

22. If the first and second letters in the word **COMMUNICATIONS** were interchanged, also the third and the fourth letters, the fifth and sixth letters and so on, which letter would be the tenth letter counting from your right ?
(A) N (B) A (C) T (D) U

Directions : (23 to 27) In each of the following questions, find which one word can not be made from the letters of the given word.

23. KALEIDOSCOPE
(A) SCALE (B) PADLOCK (C) PACKET (D) DIESEL

24. SUPERIMPOSABLE
(A) SPIRE (B) REPTILE (C) POSSIBLE (D) REPOSURE

Specimen Copy

25. CORRESPONDING
(A) DROPERS (B) SUPERIOR (C) GRINDER (D) DISCERN

26. TEMPERAMENT
(A) METER (B) PETER (C) TENTER (D) TESTER

27. RAPPROCHEMENT
(A) REPRESENT (B) REPROACH (C) PHANTOM (D) CEMENT

28. In the following series of numbers, find out how many times, **1**, **3** and **7** have appeared together, **7** being in the middle and **1** and **3** on either side of **7**?
2 9 7 3 1 7 3 7 7 1 3 3 1 7 3 8 5 7 1 3 7 7 1 7 3 9 0 6
(A) One (B) Two (C) Three (D) Four

29. In the following number series how many 8's are there which are exactly divisible by the numbers which are preceded and followed by it ?
8 2 4 5 1 7 2 8 4 8 4 2 2 8 2 6 9 8 4 5 4 8 3 2 8 4 3 1 8 3
(A) 1 (B) 2 (C) 3 (D) 4

30. In the following number series, how many **8's** are there which are immediately preceded by a number which does not divide it but followed by a number which divides it ?
2 8 2 8 3 8 5 8 8 5 3 2 8 2 3 8 4 7 1 5 8 3 8 2 8 6
(A) 1 (B) 2 (C) 3 (D) 4

31. How many odd numbers are there in the following sequence which are immediately followed by an odd number ?
5 1 4 7 3 9 8 5 7 2 6 3 1 5 8 6 3 8 5 2 2 4 3 4 9 6
(A) 2 (B) 3 (C) 4 (D) More than 4

32. How many **6's** are there in the following sequence, which are either immediately preceded by **2** or immediately followed by **9** ?
5 6 2 4 3 6 9 2 6 7 1 6 4 7 6 8 2 6 3 4 6 9 8 6 2
(A) 1 (B) 2 (C) 3 (D) 4

33. In a Class Vidhya ranks **7th** from the top, Divya is **7** ranks ahead of Medha and **3** ranks behind Vidhya Sushma who is **4th** from the bottom, is **32** ranks behind Medha. How many students are there in the class ?
(A) 52 (B) 49 (C) 50 (D) None of these

34. If the alphabets were written in the reverse order, which letter will be the fifth letter to the right of the fourteenth letter from the left.
(A) H (B) I (C) S (D) R

35. In a row of girls, Mradula is **18th** from the right and Sanjana is **18th** from the left. If both of them exchange their position, Sanjana becomes **25th** from the left, how many girls are there in the row ?
(A) 40 (B) 41 (C) 42 (D) 35

36. If the numbers from **1** to **45** which are exactly divisible by **3** are arranged in ascending order, minimum number being on the top, which would come at the ninth place from the top ?
(A) 18 (B) 21 (C) 24 (D) 27

Exercise-2

1. If Letters of alphabets are written in reverse way then which letter will be seventh letter right to Q ?
(NTSE Stage-I / Raj./2007)
(A) K (B) U (C) J (D) W

2. Select the word from given alternatives which can not be written from the letters of **EDUCATED** word-
(NTSE Stage-I / Raj./2007)
(A) DUCK (B) CUTE (C) TADE (D) ACTE

Specimen Copy

3. Which name will come at 3rd place in a telephone directory from the following given names ? **(NTSE Stage-I / Raj./2014)**

(A) AMIT (B) AMINA (C) ALOK (D) ABHIMAN

4. How many odd numbers are in the following number series, which does not contains just after it an odd number, but contains an even number just before it ? **(NTSE Stage-I / Raj./ 2007)**

3 5 8 1 4 9 7 6 1 5 9 2 3 4 8 5 2

(A) 2 (B) 3 (C) 4 (D) 5

5. If all the even numbers in between numbers from 32 to 51 are arranged in a row then number at fifth position from right, will be– **(NTSE Stage-I / Raj./ 2007)**

(A) 36 (B) 40 (C) 42 (D) 48

6. How many A are in the given letter series which does not has B just before it but has C just after it ?

D A C B A C D A C B C A C B A C B A D C **(NTSE Stage-I / Raj./ 2007)**

(A) 3 (B) 4 (C) 5 (D) 6

7. In a class the rank of Sohan is sixteen from the top and fortynine from the bottom. The total number of students in the class are - **(NTSE Stage-I / Raj./ 2008)**

(A) 64 (B) 65 (C) 66 (D) 67

8. If the following numbers are written in ascending order, the sum of the digits of middle number will be

810, 912 , 910 , 809, 781, 673, 573 **(NTSE Stage-I / Raj./2014)**

(A) 9 (B) 12 (C) 17 (D) 13

Answers

EXERCISE - 1

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	C	C	B	B	D	D	B	D	C	B	A	D	B	C	B
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	C	D	B	C	B	C	A	C	B	B	D	A	C	D	C
Que.	31	32	33	34	35	36									
Ans.	D	D	A	A	C	D									

EXERCISE - 2

Que.	1	2	3	4	5	6	7	8
Ans.	C	A	B	B	C	A	A	C

Specimen Copy