1 Gravitation

CONCEPT MAP

KEPLER'S LAWS

Kepler's law

- Kepler's first law of orbit
- Kepler's second law of area
- Kepler's third law of time period $T^2 \alpha\ r^3$

Helped in formulating the inverse square Law

Newton's Universal Law of Gravitation

Explains

Gravitational Force

$$F = \frac{GMm}{d^2}$$

Velocity to escape the influence of Gravitational force

Escape velocity

$$v_{esc} = \sqrt{2gR}$$

Value of it on Earth

v_{esc} = 11.2 km/s

Force gives rise to

Acceleration due to gravity (g)

$$g = \frac{GM}{R^2}$$

gives rise to

Weight

W = mg

Variation in the value of g

Shape
Pole - 9.832 m/s^2
Equator - 9.78 m/s^2

Altitude
Altitude increases value of `g' decreases

Depth
Depth increases value of `g' decreases
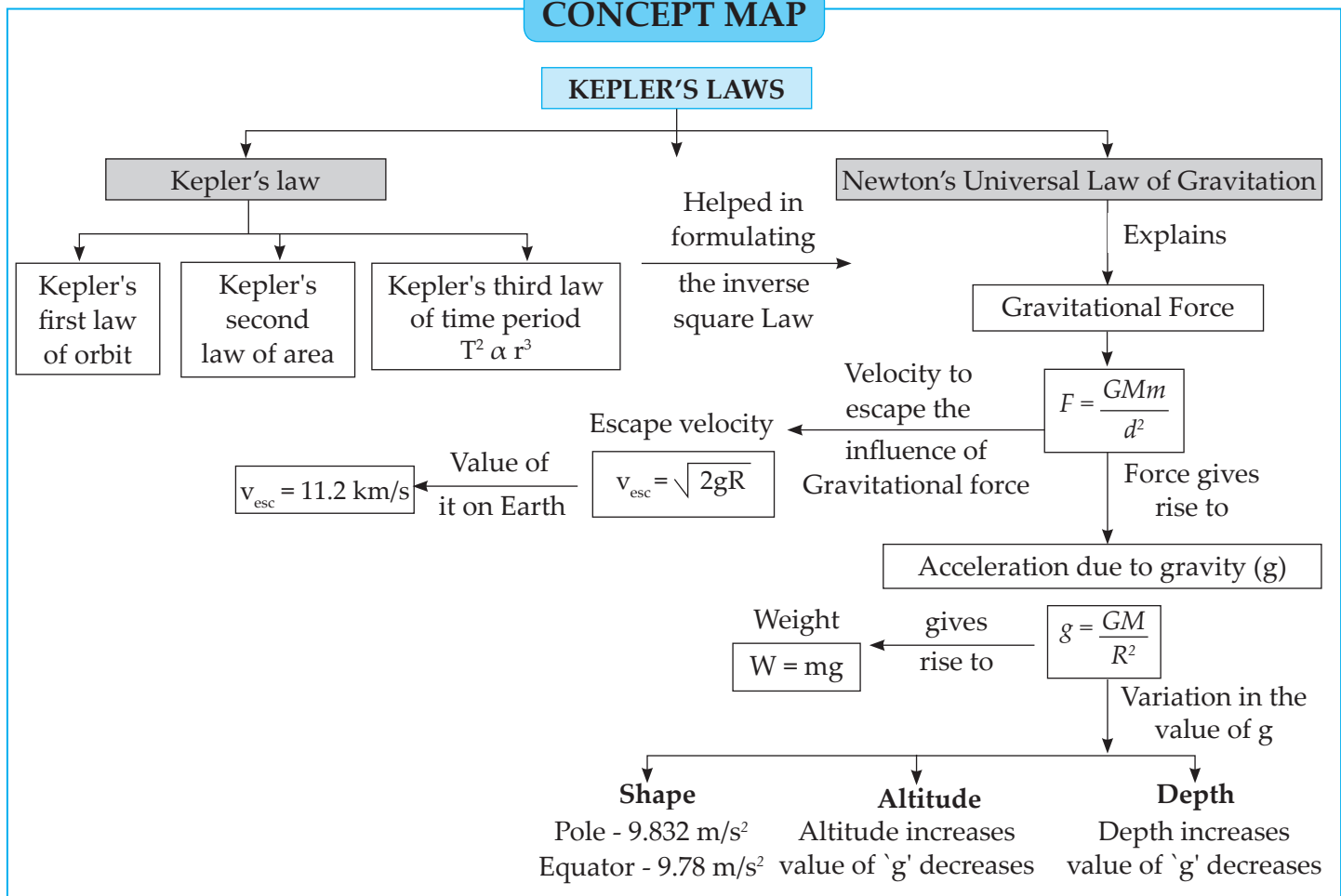
Points to Remember:

- Gravitation was discovered by **Sir Isaac Newton**.
- Gravitational Force is an universal force which is acting not only on any two bodies on the surface of the Earth but also on any two celestial objects.
- Gravitational force is an attractive force.
- Every object in the universe attracts every other object with a force, which is **directly proportional** to the **product of their masses** and **inversely proportional to the square of the distance between** their **centres** $F = \dfrac{G\ m_1 m_2}{d^2}$.
- If two objects are **spherical,** the force between them is along the straight line joining their centres and the segment joining their centres is considered the distance between them.
- Out of the two objects, if mass of one of the objects is **doubled,** then according to law, the gravitational force between the two objects gets doubled. If the distance between the two objects is doubled, the gravitational force between them becomes **one fourth**.
- Value of G is 6.67×10^{-11} Nm^2/kg^2
- The **centripetal force** is centre-seeking or the force which is acting towards the centre of the circle.

- The **centripetal force** between the Sun and the planet Earth is responsible for the revolution of the Earth. It is **inversely proportional** to the square of the distance between them.

- The force that the Earth exerts on any object at or around the surface of the Earth is called the **Earth's gravitational force**. According to Newton's second law, the acceleration is produced in the body due to **applied force**.

- The acceleration produced by the Earth's gravitational force is called **acceleration due to gravity** or **gravitational acceleration**. It is denoted by $g = \dfrac{GM}{R^2}$.

- The acceleration due to gravity depends on **mass of the Earth (M)** and **radius of the Earth (R)** for an object on the surface or **height (h)** at which the object is placed from the surface of the Earth. It does not depend upon the mass of the falling object. Thus, acceleration due to gravity is same for all freely falling objects.

- The unit of 'g' in SI system is **m/s²**. The mass of Earth is **6 × 10²⁴ kg** and its **radius** is **6.4 × 10⁶ m**.

- The Earth **does not have** perfectly spherical shape. It is slightly **flattened** at the **poles** and **bulged** at the **equator**. Therefore, the radius of the Earth at the poles is less than that at the equator.

- The value of 'g' is **maximum** at **poles** and it is **9.83 m/s² or 983 cm/s²**.

- The value of 'g' is **minimum** at the **equator** and it is **9.78 m/s² or 978 cm/s²**.

- As altitude increases, value of g decreases.

- As depth increases, value of g decreases.

- The gravitational acceleration is considered **9.77 m/s²** for all the practical purposes.

- The acceleration on the Moon is $\dfrac{1}{6}$ th of that on the surface of the Earth.

- When a body falls towards the Earth under the influence of the Earth's gravity alone, its motion is called **'free fall'**.

- In 'free fall', body comes to the surface of the Earth with **uniform acceleration**. Initial velocity may be **zero** but it increases at every time interval, due to acceleration due to gravity.

- The mass of an object is the quantity of matter contained in it. The **SI** unit of mass is **(kg)** and **CGS** unit is **gram (g)**.

- From Newton's first law, we know that mass is the measure of **inertia** of a body.

- Mass is a **scalar quantity** and it does not change from place to place on the surface of the Earth and even it does not change on the different planets.

- The weight of the body is defined as the force with which the Earth attracts it towards its centre **W = mg**.

- Since the weight is a **'force'**, its **SI** unit is **newton** and **CGS** unit is **dyne**. (1N = 10⁵ dyne)

- Weight is a **vector** quantity. It changes from place to place on the surface of the Earth and even changes with the planet.

- Since the value of 'g' is **not** same everywhere, the weight of a body keeps on changing with place.

- The weight of an object on the Moon is $\dfrac{1}{6}$ th of that on the Earth. We can write it as, $w_m = m \times g_m$.

- **Spring balance** is used for measuring weight and **two scale balance** is used to compare masses.

- **Johannes Kepler (1571 – 1630)** was a German **astronomer** and a **Mathematician**.

- **Kepler's first law:** The orbit of a planet is an ellipse with the sun at one of the foci.

- **Kepler's second law:** The line joining the planet and the sun sweeps equal areas in equal intervals of time.

- **Kepler's third law:** The square of time period of revolution around the sun is directly proportional to the cube of the mean distance of a planet from the Sun.

- A body can have energy because of its shape or position or configuration. This is known as **potential energy**.

- The gravitational potential energy at the height **(h)** from the ground is $\dfrac{-GMm}{R+h}$.

- **Escape velocity** is that initial velocity of an object by which it overcomes the Earth's gravitational attraction.

- Escape velocity (v_{esc}) can be calculated by the law of conservation of energy and is equal to $v_{esc} = \sqrt{2gR}$.

MASTER KEY QUESTION SET - 1

Q.1. **(A) 1. Fill in the blanks:**

(1) Gravitation was discovered by _____ .

(2) Every object in the universe attracts every other object with _____ force.

(3) F α $\dfrac{m_1 m_2}{d^2}$ means F = _____ .

(4) If the distance between the two objects is doubled, then the gravitational force between them will be _____ times.

(5) If mass increases, force _____ .

(6) If mass triples, value of G _____ .

(7) If Earth attracts a body with a force of 10 N, then the body attracts the Earth with _____ N.

(8) S.I. unit of G is _____ .

(9) Places on Earth exactly 90° to the direction of the moon experiences _____ .

(10) _____ is a constant known as universal gravitational constant.

(11) The Earth's gravitational force is always in the direction of the _____ of the Earth.

(12) The Earth's gravitational acceleration is denoted by letter _____ .

(13) The relation between g and G is _____

(14) The value of acceleration due to gravity at poles is _____ m/s².

(15) The value of acceleration due to gravity at the equator is _____ cm/s².

(16) If altitude increases, value of g _____ .

(17) When a spaceship is two Earth radii distance from the centre of Earth, its g becomes _____ .

(18) During free fall, the object comes vertically downward with uniform _____ .

(19) Mass is also a measure of _____ of an object.

(20) The mass of the Earth is _____ kg.

(21) The radius of the Earth is _____ m.

(22) Value of g at the centre of the Earth is _____ .

(23) The SI unit of weight is _____ .

(24) The gravitational force acting on any object on the Earth is called it's _____ .

(25) The weight of an object on the Earth is _____ times its weight on the Moon.

(26) The weight of an object is maximum at _____ on the surface of the Earth.

(27) The orbit of a planet is an _____ with the Sun at one of the foci.

(28) The energy possessed because of position or configuration is called _____ .

(29) v_{esc} = _____

(30) Gravitational waves are detected by _____

(31) During ascent _____ is zero and during descent _____ is zero.

(32) Formula for centripetal force is _____ .

Ans. *(1) Isaac Newton (2) gravitational (3)* $\dfrac{Gm_1 m_2}{d^2}$ *(4)* $\dfrac{1}{4}$ *(5) increases (6) remains constant (7) 10 (8) Nm²/kg²*

(9) low tide (10) G (11) centre (12) 'g' (13) $g = \dfrac{GM}{R^2}$

(14) 9.83 (15) 978 (16) decreases (17) $\dfrac{1}{4}$th

(18) acceleration (19) inertia (20) 6 × 10²⁴ (21) 6.4 × 10⁶

(22) Zero (23) newton (N) (24) weight (25) six (26) poles (27) ellipse (28) potential energy (29) $\sqrt{2gR}$

(30) LIGO (31) Final velocity (v), Initial velocity (u)

(32) $F = \dfrac{mv^2}{r}$

Q.1. **(A) 2. Find the odd word out:**

(1) Acceleration, mass, force, weight

Ans. Mass - It is scalar, while others are vectors.

(2) Change in value of 'g' at surface, change in value of 'g' at height, change in value of 'g' at depth, change in value of 'g' on thickness

Ans. Change in value of 'g' on thickness. Others are related factors to the value of 'g'.

*(3) Light, sound, heat, laws of planetary motion

Ans. Law of planetary motion. Others are related to Newton.

(4) Mass, potential energy, radius, weight

Ans. Weight. It is vector, while others are scalars.

(5) 9.83 m/s², 9.8 m/s², 980 cm/s², 9.77 m/s²

Ans. 980 cm/s². Others are values of g in MKS.

(6) Weight, Thrust, Force, Pressure

Ans. Pressure. Others are vectors.

(7) Newton's first law, Newton's law of gravity, Newton's third law, Newton's second law

Ans. Newton's law of gravity. Other are related to law of motion.

(8) Newton, Ohm, Kepler, Galileo

Ans. Ohm. Others are concerned with laws of gravity.

(9) 983 m/s², 977 m/s², 980 m/s², 9.83 m/s²

Ans. 9.83 m/s². Others are in CGS system.

(10) 9.83 m/s², 98.3 m/s², 983 m/s, 98.03 m²s

Ans. 9.83 m/s². Others are not values of 'g'.

Q.1. (A) 3. Complete the analogy:

(1) 6×10^{24} kg : Mass of the Earth : : 6.4×10^6 m : ....

Ans. Radius of the Earth - Mass is measured in kg and distance is measured in metres.

(2) Height of a weather satellite : 8.7 m/s² : : Height of Communication satellite : ....

Ans. 0.225 m/s² - The value of 'g' changes with the change in the height of the satellites.

(3) Mass : Scalar quantity : : Weight : ....

Ans. Vector quantity - Weight being a force is a vector quantity and its direction is towards the centre of the earth.

(4) At poles : 9.83 m/s² : : At equator : ....

Ans. 9.78 m/s² - Earth's radius is the largest at the equator and the smallest at the poles.

(5) Shape of the Earth at equator : Bulged : : Shape of the Earth at poles : ....

Ans. Flattened - The shape of the Earth is not exactly spherical. Due to its rotation, the earth bulges at the equator and is flattened at the poles.

(6) Kinetic energy : $\dfrac{1}{2}$ mv² : : Gravitational Potential energy : ....

Ans. $\dfrac{-GMm}{R+h}$ - For small distances, i.e. heights, the potential energy is less than zero, i.e. it is negative.

(7) Force : ma : : Gravitational force : ....

Ans. $\dfrac{Gm_1m_2}{d^2}$ - Mathematically, the gravitational force of attraction between two bodies is given by $\dfrac{Gm_1m_2}{d^2}$

(8) Force : Vector : : Weight : ....

Ans. Vector - Weight is also a force and its direction is towards the centre of the earth. Weight = m × g

Q.1. (A) 4. With the information in three columns, match up and complete the chart:

*(1)

I	II	III
(1) Mass	(a) m/s²	(i) Zero at the centre
(2) Weight	(b) kg	(ii) Measure of Inertia
(3) Acceleration due to gravity	(c) Nm²/kg²	(iii) Same in the entire universe
(4) Gravitational constant	(d) N	(iv) Depends on height

Ans. *(1-b-ii), (2-d-iv), (3-a-i), (4-c-iii),*

(2) Match the columns:

Column A	Column B
(1) Mass	(a) m/s
(2) Weight	(b) m/s²
(3) Acceleration	(c) kg
(4) Velocity	(d) N

Ans. *(1 – c), (2 – d), (3 – b), (4 – a)*

(3) Complete the chart:

	F (N)	m_1 (kg)	m_2 (kg)	d (m)
(1)	....	500	84	02
(2)	30×10^{27}	15×10^5	....	03
(3)	16×10^9	....	17	34
(4)	250×10^{-7}	45	47	....

Ans. *(1) 7×10^{-7} (2) 2.69×10^{33}kg (3) 1.63×10^{22}kg (4) 7.5×10^{-2}m*

Q.1. (A) 5. State whether the following statements are True or False. Correct the false statement.

(1) Force = mass × velocity

(2) 'G' is called gravitational acceleration.

(3) Acceleration is a scalar quantity.

(4) Gravitational force at the Moon is double than the Earth's gravitational force.

(5) 1 N = 1 kg × 1 m/s².

(6) 1 dyne = 10^5 N.

(7) The force towards the centre of the circular orbit is called centripetal force.

(8) The gravitational acceleration does not become zero at the centre of the Earth.

(9) At the poles, the acceleration due to gravity is 9.77 m/s².

(10) 'g' is called universal constant.

(11) Mass is a scalar quantity.

(12) Beyond the surface of the Earth, g α $\dfrac{1}{(R+h)^2}$.

(13) Weight is a vector quantity.

(14) The mass of the Earth is 6.4×10^6 kg.

(15) At a height of 'h' from the ground, the gravitational potential energy is $\dfrac{-GMm}{R+h}$.

Ans. *(1) False. Force = mass × acceleration (2) False. 'G' is called Universal gravitational constant (3) False. Acceleration is a vector quantity*

(4) False. Gravitational force at the moon is $\dfrac{1}{6}^{th}$ of

the Earth's gravitational force (5) True (6) True (7) True (8) False. The gravitational acceleration becomes zero at the centre of the Earth (9) False. The acceleration due to gravity is 9.83 m/s² at the poles (10) False. 'g' is called acceleration due to gravity (11) True (12) True (13) True (14) False. Mass of the earth is 6×10^{24} kg (15) True.

Q.1. (B) Choose and write the correct option:

(1) The gravitational force of attraction between two objects is given by ....

(a) $F \alpha \dfrac{m_1 m_2}{d^2}$ (b) $F \alpha \dfrac{d^2}{m_1 m_2}$

(c) $F \alpha \dfrac{m_1 m_2}{\sqrt{d^2}}$ (d) $F \alpha \dfrac{m_1 m_2}{d^3}$

(2) If the distance between two bodies becomes half, the gravitational force between them becomes ....

(a) half   (b) one forth
(c) 4 times   (d) 2 times

(3) If the distance between two objects increases 5 times, the gravitational force becomes .... times.

(a) 5   (b) 15   (c) $\dfrac{1}{25}$ (d) 25

(4) The gravitational force on the surface of the Moon is .... times than that on the surface of the Earth.

(a) five   (b) one fifth
(c) one sixth   (d) six

(5) The gravitational force causes ....

(a) Tides   (b) Circular motion of moon
(c) None of these   (d) Both a and b

(6) The Earth attracts moon with a force of 10^{20} N. The moon attracts Earth with a force of ....

(a) less than 10^{20} N   (b) 10^{20} N
(c) greater than 10^{20} N   (d) 10^{-20} N

(7) The SI unit of gravitational constant is ....

(a) Nm^2 / kg^2 (b) Nkg^2 / m^2
(c) m/s^2 (d) $N\ cm^2 / g^2$

(8) The value of acceleration due to gravity at the height 'h' from the ground is ....

(a) $g = \dfrac{GM}{R + h}$ (b) $g = \dfrac{GM}{\sqrt{R + h}}$

(c) $g = \dfrac{GM}{(R + h)^2}$ (d) $g = GM\ (R + h)^2$

(9) The value of 'g' is maximum at poles and it is ....

(a) 9.72 m/s   (b) 9.83 m/s²
(c) 9.83 m/s   (d) 9.72 m/s²

(10) The value of 'g' on Earth is zero at ....

(a) Centre of Earth   (b) Poles
(c) Infinite distance   (d) Both a and c

(11) When an object is thrown upward, the force of gravity ....

(a) is opposite to the direction of motion
(b) is in the same direction as that of motion
(c) becomes zero at higher point
(d) increase as it rise up

(12) The value of 'g' .... as the depth from surface increases.

(a) increases   (b) fluctuates
(c) decreases   (d) varies

(13) As the height of the object from the surface of the Earth increases, value of 'g' becomes ....

(a) more   (b) less
(c) equal   (d) can't say

(14) The mass of objects .... at any place on the surface on the Earth.

(a) remains constant   (b) is non-uniform
(c) changes   (d) increases

(15) According to Newton's first law, if mass is more, then the inertia of the body is ....

(a) less   (b) very less
(c) more   (d) can't say

(16) The weight of body gradually decreases from ....

(a) equator to poles   (b) poles to equator
(c) pole to pole   (d) height to surface

(17) A body of mass 1 kg is attracted by the Earth with a force which is equal to ....

(a) 9.8 N   (b) 6.67×10^{-11}
(c) 1 N   (d) 9.8 m/s

(18) The gravitational potential energy at the height of 'h' from the ground is ....

(a) $\dfrac{-GMm}{R + h}$ (b) $\dfrac{-GMm_1}{R^2 + h}$

(c) $\dfrac{GMm_1}{R^2 + h^2}$ (d) $\dfrac{GMm}{R^2 + h}$

(19) The orbit of a planet is an ellipse with the Sun at one of the _____ .

(a) foci   (b) centre   (c) middle (d) surface

(20) The straight line joining the planet and the Sun sweeps equal _____ in equal interval of time.

(a) volume   (b) angle
(c) density   (d) area

(21) The square of time period of revolution around the Sun is directly proportional to the _____ of the planet from the Sun.

(a) mean distance
(b) square of the distance
(c) cube to the distance
(d) cube of the mean distance

(22) Which of the following is not an example of free fall?

(a) Moon revolving around the Earth
(b) Earth revolving around the Sun
(c) Parachute jumping
(d) Artificial satellites revolving around the Earth

(23) The centre of mass of an object having uniform density is at its _____ .

(a) centre   (b) Geometrical centre
(c) centroid   (d) Circumference

Ans. *(1) (a) $F \propto \dfrac{m_1 m_2}{d^2}$ (2) (c) 4 times (3) (c) $\dfrac{1}{25}$ (4) (c) one sixth (5) (d) both a and b (6) (b) 10^{20} N (7) (a) Nm^2/kg^2 (8) (c) $g = \dfrac{GM}{(R+h)^2}$ (9) (b) 9.83 m/s² (10) (d) Both a and c (11) (a) Is opposite to the direction of motion (12) (c) decreases (13) (b) less (14) (a) remains constant (15) (c) more (16) (b) poles to equator (17) (a) 9.8 N (18) (a) $\dfrac{-GMm}{R+h}$ (19) (a) foci (20) (d) area (21) (d) cube of the mean distance (22) (c) Parachute jumping (23) centroid*

Q.2.1. Solve the following:

Type: A
$F = \dfrac{Gm_1 m_2}{r^2}$ $v = u + at$
$F = ma$ $s = ut + \dfrac{1}{2}at^2$
$v^2 = u^2 + 2as$

*(1) **Mahendra and Virat are sitting at a distance of 1 metre from each other. Their masses are 75 kg and 80 kg respectively. What is the gravitational force between them?**

Ans. **Given:**   r = 1 m
m$_1$ = 75 kg
m$_2$ = 80 kg
G = 6.67 × 10^{-11} Nm²/kg²

To find: Force (F) = ?

Formula: $F = \dfrac{Gm_1 m_2}{r^2}$

Solution:

$F = \dfrac{6.67 \times 10^{-11} \times 75 \times 80}{1^2}$

$F = 6.67 \times 10^{-11} \times (6 \times 10^3)$

$= 40.02 \times 10^{-8}$

$= 4.002 \times 10^{-7}$ N

The gravitational force between Mahendra and Virat is 4.002 × 10⁻⁷ N

*(2) **The mass of the Earth and Moon are 6 × 10²⁴ kg and 7.4 × 10²² kg respectively. The distance between them is 3.84 × 10⁵ km. Calculate the gravitational force of attraction between the two? G = 6.7 × 10⁻¹¹ Nm²/kg².**

Ans. **Given:**   m$_1$ = 6 × 10²⁴ kg
m$_2$ = 7.4 × 10²² kg
r = 3.84 × 10⁵ km = 3.84 × 10⁸ m
G = 6.7 × 10⁻¹¹ Nm²/kg²

To find: F = ?

Formula: $F = \dfrac{Gm_1 m_2}{r^2}$

Solution: $F = \dfrac{6.7 \times 10^{-11} \times 6 \times 10^{24} \times 7.4 \times 10^{22}}{(3.84 \times 10^8)^2}$

$= \dfrac{297.48 \times 10^{-11} \times 10^{24} \times 10^{22}}{14.74 \times 10^{16}}$

$\approx \dfrac{300 \times 10^{19}}{15}$

$= 20 \times 10^{19}$

$F = 2 \times 10^{20}$ N

The gravitational force of attraction between Earth and Moon is 2 × 10²⁰ N

*(3) **The mass of the Earth is 6 × 10²⁴ kg. The distance between the Earth and the Sun is 1.5 × 10¹¹ m. If the gravitational force between the two is 3.5 × 10²² N, what is the mass of the sun? G = 6.7 × 10⁻¹¹ Nm²/kg².**

Ans. **Given:**   m$_1$ = 6 × 10²⁴ kg
r = 1.5 × 10¹¹ m
F = 3.5 × 10²² N
G = 6.7 × 10⁻¹¹ Nm²/kg²

To find: m$_2$ = ?

Formula: $F = \dfrac{Gm_1m_2}{r^2}$

Solution: $\dfrac{Fr^2}{Gm_1} = m_2$

$m_2 = \dfrac{3.5 \times 10^{22} \times (1.5 \times 10^{11})^2}{6.7 \times 10^{-11} \times 6 \times 10^{24}}$

$= \dfrac{7.875 \times 10^{44}}{40.2 \times 10^{13}}$

$= \dfrac{7.875}{40} \times 10^{31}$

$= 0.196 \times 10^{31}\,kg$

$= 1.96 \times 10^{30}\,kg$

The mass of the Sun is $1.96 \times 10^{30}\,kg$

*(4) In the previous example, assuming that the bench on which Mahendra is sitting is frictionless, starting with zero velocity. What will be Mahendra's velocity after 1s and how will it change with time? Mass of Mahendra (75 kg) and force (4.002×10^{-7} N).

Ans. **Given:** Initial velocity (u) = 0 m/s

Time (t) = 1 s

Force (F) = 4.002×10^{-7} N

mass (m) = 75 kg

To find: Final velocity (v) = ?

Formulae: $v = u + at$, $a = \dfrac{F}{m}$

Solution: $a = \dfrac{4.002 \times 10^{-7}}{75}$

$a = 0.0534 \times 10^{-7}\,m/s^2$

$a = 5.34 \times 10^{-9}\,m/s^2$

$v = u + at$

$= 0 + 5.34 \times 10^{-9} \times 1$

$= 5.34 \times 10^{-9}\,m/s$

Velocity will increase with time

As distance decreases, force increases thereby increasing acceleration. Hence velocity increases

*(5) Assuming that acceleration remains constant (5.34×10^{-9} m/s²), How long will Mahendra take to move 1 cm towards Virat if he starts from rest? *(Use your brain power; Textbook Page no. 6)*

Ans. **Given:** Acceleration (a) = 5.34×10^{-9} m/s²

$\approx 5 \times 10^{-9}$ m/s²

Displacement (s) = 1 cm = $\dfrac{1}{100}$ m

Initial velocity (u) = 0 m/s

To find: time (t) = ?

Formula: $s = ut + \dfrac{1}{2}at^2$

Solution: $\dfrac{1}{100} = 0 \times t + \dfrac{1}{2} \times 5 \times 10^{-9} \times t^2$

$\dfrac{1}{100} = 2.5 \times 10^{-9} \times t^2$

$\dfrac{1}{100 \times 2.5 \times 10^{-9}} = t^2$

$\dfrac{1 \times 10^9}{250} = t^2$

$\dfrac{1000 \times 10^6}{250} = t^2$

$4 \times 10^6 = t^2$

$t = \sqrt{4 \times 10^6}\,s$

$t = 2 \times 10^3\,s$

Mahendra will take 2×10^3 s to move towards Virat.

(6) A truck starts from rest and rolls down a hill with a constant acceleration. It travels a distance of 400 m in 20s. Find its acceleration. Also find the force acting on it if its mass is 7000 kg.

Ans. **Given:** Initial velocity (u) = 0 ms⁻¹

Distance travelled (s) = 400 m

Time (t) = 20 s

Mass of truck (m) = 7000kg

To find: Acceleration (a) = ?

Force (F) = ?

Formulae: (i) $s = ut + \dfrac{1}{2}at^2$

(ii) $F = ma$

Solution: (i) $s = ut + \dfrac{1}{2}at^2$

$400 = 0 \times 20 + \dfrac{1}{2}a \times (20^2)$

$400 = \dfrac{400\,a}{2}$

$\therefore a = \dfrac{400 \times 2}{400} = 2\,m/s^2$

(ii) $F = ma$

$\therefore F = 7000 \times 2$

$\therefore F = 14000N$

The truck moves with an acceleration of 2 m/s² and the force acting on it is 14000N

(7) Karan and Arjun are two friends of mass m_1 and m_2 respectively, separated by a distance d.

What would happen to the force between them if

(i) Mass of Arjun is doubled.

(ii) Mass of both Karan and Arjun is doubled.

(iii) Distance between them is doubled.

(iv) Value of G doubled.

Ans. The force between Karan and Arjun is

$$F = \frac{G\, m_1\, m_2}{d^2} \qquad ...(i)$$

(i) If 'm_2' is doubled.

$$F^1 = \frac{G\, m_1\, (2m_2)}{d^2} = \frac{2(G\, m_1 m_2)}{d^2}$$

$$F^1 = 2F \qquad\qquad ...[from(i)]$$

Force becomes double.

(ii) If 'm_1' and 'm_2' are doubled.

$$F^1 = \frac{G\,(2m_1)\,(2m_2)}{d^2} = \frac{4(G\, m_1 m_2)}{d^2}$$

$$F^1 = 4F \qquad\qquad ...[from(i)]$$

Force becomes 4 times.

(iii) If 'd' is doubled.

$$F^1 = \frac{G\, m_1 m_2}{(2d)^2} = \frac{1}{4}\frac{(G\, m_1 m_2)}{d^2}$$

$$F^1 = \frac{1}{4}\, F \qquad\qquad ...[from(i)]$$

Force becomes one forth.

(iv) If 'G' is doubled.

$$F^1 = \frac{2G\, m_1 m_2}{d^2} = 2F \qquad\qquad ...[from(i)]$$

Force is doubled.

NUMERICALS FOR PRACTICE

(1) **Two boys are sitting very close to each other at a distance of 0.5 m from each other. If the mass of one boy is 40 kg and other is 50 kg, find the gravitational force between them.**

(5.336 × 10⁻⁷ N)

(2) **If the force of gravitation between the Earth and an object of mass 'm' is 9×10^7 N, find the mass of an object if the mass of the Earth is 6×10^{24} kg and its radius is 6.4×10^6 m.** *(9.2 × 10⁶ kg)*

(3) **If two objects of masses 500kg and 84kg respectively are at a distance of 2m apart from each other. Find gravitational force between them?** *(7 × 10⁻⁷ N)*

(4) **If two objects of 45 kg and 47 kg respectively are attracted towards each other by a gravitational force of 250×10^{-7} N, find the distance between their centres.** *(7 × 10⁻⁷ N)*

Type: B	
$g = \dfrac{GM}{R^2}$	$v = u + at$
$W = F = mg$	$s = ut + \dfrac{1}{2}\, at^2$
$W = F = \dfrac{GM\, m}{R^2}$	$v^2 = u^2 + 2as$

Note:
For Earth g = 9.77 m/s²
For Moon g_m = 1.63 m/s²

*(1) Calculate the gravitational force due to the Earth on Mahendra, if mass of Earth is 6×10^{24} kg, Radius is 6.4×10^6 m, g = 9.77 m/s² and mass of Mahendra is 75 kg.

Ans. **Given:** Mass of Earth (M) = 6×10^{24} kg

Radius of Earth (R) = 6.4×10^6 m

Mass of object (m) = 75 kg

Gravitational acceleration (g) = 9.77 m/s²

To find: Force (F) = ?

Formula: $F = \dfrac{GMm}{R^2}$

Solution:

$$F = \frac{6.67 \times 10^{-11} \times 6 \times 10^{24} \times 75}{40.96 \times 10^{12}}$$

$$= \frac{9.77 \times 75}{1}$$

$$= 732.75\ \text{N}$$

$$F \approx 733\ \text{N}$$

The gravitational force is 733 N

*(2) Starting from rest, due to the gravitational force of the Earth i.e. 733 N, What is the speed of Mahendra after 1 second? If his mass is 75 kg.

Ans. **Given:** Initial velocity (u) = 0 m/s

Force (F) = 733 N

Mass (m) = 75 kg

Time (t) = 1 s

To find: Final velocity (v)= ?

Formulae: $v = u + at$, $a = \dfrac{F}{M}$

Solution:

$$a = \frac{733}{75}$$

$$\therefore\ a = 9.77\ \text{m/s}^2$$

$$v = u + at$$

$$= 0 + 9.77 \times 1$$

$$= 9.77\ \text{m/s}$$

The speed of Mahendra after 1 second is 9.77 m/s

*(3) If a person weighs 750 N on Earth, how much would be his weight on the Moon given that Moon's mass is $\frac{1}{81}$ of that of the Earth and its radius is $\frac{1}{3.7}$ of that of Earth.

Ans. **Given:** Weight on Earth $(W_E) = 750$ N

$$M_m = \frac{1}{81} M_E \quad \therefore \left(\frac{M_m}{M_E}\right) = \frac{1}{81}$$

$$R_m = \frac{1}{3.7} R_E \quad \therefore \left(\frac{R_m}{R_E}\right) = \frac{1}{3.7}$$

To find: Weight on Moon $(W_m) = ?$

Formula: $W = F = \dfrac{GMm}{R^2}$

Solution:

For Earth   For Moon

$$W_E = \frac{G M_E m}{R_E^2} \;...(i) \qquad W_m = \frac{G M_m m}{R_m^2} \;...(ii)$$

Dividing equation (ii) by (i),

$$\frac{W_M}{W_E} = \frac{G M_m m}{R_m^2} \div \frac{G M_E m}{R_E^2}$$

$$\frac{W_M}{W_E} = \frac{G M_m m}{R_m^2} \times \frac{R_E^2}{G M_E m}$$

$$\frac{W_M}{W_E} = \frac{M_m}{M_E} \times \left[\frac{R_E}{R_m}\right]^2$$

$$\frac{W_m}{750} = \frac{1}{81} \times (3.7)^2 \;...\text{ from 'given'}$$

$$\frac{W_m}{750} = \frac{13.69}{81}$$

$$W_m = 13.69 \times \frac{750}{81}$$

$$W_m = 126.8 \text{ N}$$

The weight on the Moon is 126.8 N

*(4) The radius of the planet A is half the radius of planet B. If the mass of A is M_A, What must be the mass of B so that the value of g on B is half that of its value on A?

Ans. **Given:** $R_A = \frac{1}{2} R_B \qquad \therefore \frac{R_A}{R_B} = \frac{1}{2}$

$$g_B = \frac{1}{2} g_a \qquad \therefore \frac{g_B}{g_A} = \frac{1}{2}$$

To find: Mass of planet B, $M_B = ?$

Formula: $g = \dfrac{GM}{R^2}$

Solution: For planet A

$$g_A = \frac{GM_A}{R_A^2} \;...\text{ (i)}$$

$$g_B = \frac{GM_B}{R_B^2} \;...\text{ (ii)}$$

Dividing equation (ii) by (i),

$$\frac{g_B}{g_A} = \frac{GM_B}{R_B^2} \div \frac{GM_A}{R_A^2}$$

$$\frac{g_B}{g_A} = \frac{GM_B}{R_B^2} \times \frac{R_A^2}{GM_A}$$

$$\frac{g_B}{g_A} = \frac{M_B}{M_A} \times \left[\frac{R_A}{R_B}\right]^2$$

$$\frac{1}{2} = \frac{M_B}{M_A} \times \frac{1}{4} \;...\text{ from 'given'}$$

$$\frac{\cancel{4}^2}{\cancel{2}_1} = \frac{M_B}{M_A} \quad \therefore 2M_A = M_B$$

$$M_B = 2M_A$$

The mass of B is twice mass of A

*(5) The mass and weight of an object on Earth is 5 kg and 49 N respectively. What will be their values on the Moon? Assume that the acceleration due to gravity on the Moon is $\frac{1}{6}$th of that on the Earth.

Ans. **Given:** $m_e = 5$ kg

$$W_e = 49 \text{ N}$$

$$g_m = \frac{1}{6} g_e = \frac{1}{6} \times 9.8 = 1.633 \text{ m/s}^2$$

To find: Mass on Moon $m_m = ?$

Weight on Moon $W_m = ?$

Formula: $W = F = mg$

Solution: Mass remains same : $m_m = 5$ kg

$$W_m = m_m \times g_m$$

$$= 5 \times 1.633$$

$$W_m = 8.17 \text{ N}$$

Mass on Moon is 5 kg and weight is 8.17 N

*(6) Suppose you are standing on a tall ladder. If your distance from the centre of the Earth is 2R, what will be your weight? *(Use your brain power; Textbook Page no. 10)*

Ans. **Given:** $R_1 = 2R$

To find: $W_1 = ?$

Formula: $W = F = \dfrac{GMm}{R^2}$

Solution: $W = \dfrac{GMm}{R^2}$ . . . (i)

$$W_1 = \dfrac{GMm}{(2R)^2}$$

$$= \dfrac{GMm}{4R^2} \text{ . . . (ii)}$$

$$W_1 = \dfrac{1}{4} \times \left[\dfrac{GMm}{R^2}\right]$$

$$W_1 = \dfrac{1}{4} W \qquad\qquad \text{...[from(i)]}$$

| Weight will be one fourth the original weight |

***(7)** What would be the value of g on the surface of the earth if its mass was twice as large and its radius half of what it is now?* (Can you tell?; Textbook Page no. 8)

Ans. **Given:**   M' = 2M

        $R' = \dfrac{R}{2}$

To find: g' = ?

Formula: $g = \dfrac{GM}{R^2}$

Solution: $g' = \dfrac{GM'}{R'^2}$

$$= \dfrac{G \times 2M}{\left(\dfrac{R}{2}\right)^2} = \dfrac{G \times 2M}{\dfrac{R^2}{4}} = \dfrac{4 \times 2 \times GM}{R^2}$$

$$= 4 \times 2 \times g \text{ .... } (g = \dfrac{GM}{R^2})$$

    g' = 8 g

| The value of g will become 8 times. |

NUMERICALS FOR PRACTICE

(1) Find the weight of a man whose mass is 50 kg.
                            (490 N)

(2) Find the gravitational force between man of mass 60 kg and the Earth.   *(586 N)*

(3) A stone of mass 2 kg is falling from a certain height. Find the force of attraction between the Earth and the stone. Also, find the acceleration.   *(19.6 N, 9.8 m/s²)*

(4) The planet in space has mass twice as that of the Earth and a radius thrice as that of the Earth. If the weight of a book is 90 N on the Earth, what would be the weight on that planet?
                            (20 N)

(5) Calculate the value of 'g' on the Moon, if its mass is 7.4 × 10²² kg and radius is 1740 km.   *(1.63 m/s²)*

(6) If the weight of a body on the surface of the Moon is 100 N, what is its mass?   *(61.34 kg)*

(7) If the acceleration due to gravity on the surface of the Earth is 9.8 m/s², what will be the acceleration due to gravity on the surface of the planet whose mass and radius both are two times the corresponding quantities for the Earth.   *(4.9 m/s²)*

Type: C
$v_{esc} = \sqrt{2gR}$ $\dfrac{T^2}{R^3} = K$

***(1)** Calculate the escape velocity on the surface of the Moon given the mass and radius of the Moon to be 7.34 × 10²² kg and 1.74 × 10⁶ m respectively.

Ans. **Given:**   Mass (M) = 7.34 × 10²² kg

               Radius (R) = 1.74 × 10⁶ m

               Gravitational acceleration on Moon(g_m)

$$= \dfrac{1}{6} g_e = \dfrac{9.8}{6} \text{ m/s}^2 = 1.63 \text{ m/s}^2$$

To find: v_{esc} = ?

Formula: $v_{esc} = \sqrt{2g_m R}$

Solution: $v_{esc} = \sqrt{2 \times 1.63 \times 1.74 \times 10^6}$

$$= \sqrt{5.67 \times 10^6}$$

$$= 2.38 \times 10^3 \text{ m/s}$$

$$v_{esc} = 2.38 \text{ km/s}$$

| The escape velocity on Moon is 2.37 km/s |

***(2)** Let the period of revolution of a planet at a distance R from a star be T. Prove that if it was at a distance of 2R from the star, its period of revolution will be $\sqrt{8}$ T.

Ans. **Given:**   Distance from Sun = R

              Time of Rotation = T

              New distance = 2R

To find: New time T_N= ?

Formula: $\dfrac{T^2}{R^3} = k$

Solution: Case (i)

$$\dfrac{T^2}{R^3} = k \text{ . . . (i)}$$

    Case (ii)

$$\frac{T_N^{\,2}}{(2R)^3} = k \quad OR \quad \frac{T_N^{\,2}}{8R^3} = k \quad \ldots \text{(ii)}$$

From (i) and (ii),

$$\frac{T_N^{\,2}}{8R^3} = \frac{T^2}{R^3}$$

$$T_N^{\,2} = 8T^2$$

$$T_N = \sqrt{8T^2}$$

$$T_N = \sqrt{8}\, T$$

NUMERICALS FOR PRACTICE

(1) The escape velocity for mass is 5.02 km/s. If its radius is 3390 km, What is the value of g on its surface. *(g = 3.71 m/s²)*

(2) A planet orbits the Sun in time T at a distance of R from it. Another planet orbits the Sun in a time of 8T. What is its distance R' from the Sun. *(R' = 4R)*

Type: D	Downward/Dropped/Falling g (positive) = 10 m/s²
$v = u + gt$	
$s = ut + \dfrac{1}{2}\, gt^2$	Upward/Thrown up g (negative) = -10 m/s²
$v^2 = u^2 + 2gs$	

*(1) An object takes 5s to reach the ground from a height of 5m on a planet. What is the value of g on the planet?

Ans. **Given:** Displacement (s) = 5 m

Time (t) = 5 s

Initial velocity (u) = 0 m/s

To find: Gravitational acceleration (g) = ?

Formula: $s = ut + \dfrac{1}{2}\, gt^2$

Solution: $5 = 0 + \dfrac{1}{2} \times g \times 5^2$

$$5 = g \times \frac{25}{2}$$

$$\frac{5 \times 2}{25} = g$$

$$g = \frac{2}{5}$$

$$g = 0.4\,\text{m/s}^2$$

Value of g on the planet is 0.4 m/s²

*(2) A ball falls off a table and reaches the ground in 1 s. Assuming g = 10 m/s², calculate its speed on reaching the ground and the height of the table.

Ans. **Given:** Time (t) = 1 s

Gravitational acceleration (g) = 10 m/s²

Initial velocity (u) = 0 m/s

To find: Final velocity (v) = ?

Displacement (s) = ?

Formulae: $v = u + gt,\ s = ut + \dfrac{1}{2}\, gt^2$
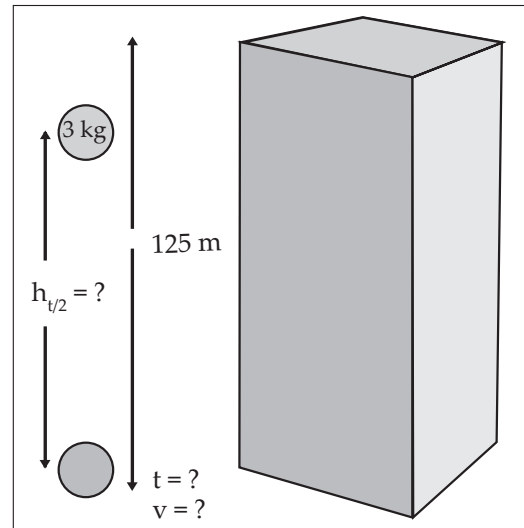
Solution: $v = u + gt$

$$= 0 + 10 \times 1$$

$$v = 10\ \text{m/s}$$

$$s = 0 + \frac{1}{2} \times 10 \times 1^2$$

$$s = 5\ \text{m}$$

Speed on reaching ground is 10 m/s and height of the table is 5 m.

*(3) An iron ball of mass of 3 kg is released from height of 125 m and falls freely to the ground. Assuming that the value of g is 10 m/s², calculate (i) time taken by the ball to reach the ground (ii) velocity of the ball on reaching the ground (iii) the height of the ball at half the time it takes to reach the ground.

3 kg

125 m

$h_{t/2} = ?$

$t = ?$
$v = ?$

(Diagram is only for reference)

Ans. **Given:** Mass (m) = 3 kg

Displacement (s) = 125 m

$g = 10\ \text{m/s}^2$
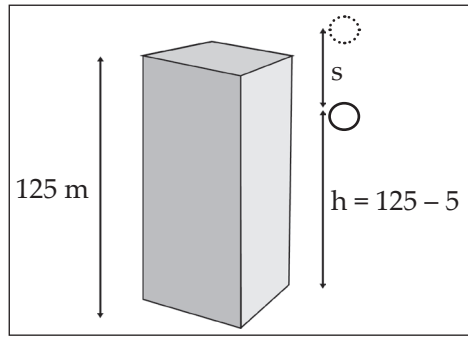
Initial velocity (u) = 0 m/s

To find: Time (t) = ?

Final velocity (v) = ?

Height $(h_{t/2})$ = ?

Formulae: $s = ut + \dfrac{1}{2}\, gt^2,\ v = u + gt$

Solution: Case (i)

$$s = ut + \frac{1}{2}\, gt^2$$

(Diagram is only for reference)

$$125 = 0 \times t + \frac{1}{2} \times 10 \times t^2$$

$$125 = 5t^2$$

$$\frac{\overset{25}{\cancel{125}}}{\underset{1}{\cancel{5}}} = t^2$$

$$t^2 = 25$$

$$t = 5 \text{ s} \quad ...(i)$$

Case (ii)

$$v = u + gt$$

$$= 0 + 10 \times 5$$

$$v = 50 \text{ m/s} ...(ii)$$

Case (iii)

Half time $= \dfrac{t}{2} = \dfrac{5}{2}$ ...(from (i))

$$= 2.5s$$

Height of the ball at 2.5s = s

∴ Using Newton's second equation,

$$s = ut + \frac{1}{2} gt^2$$

$$s = 0 + \frac{1}{2} \times 10 \times (2.5)^2$$

$$s = 31.25 \text{ m}$$

∴ Height of the ball at half time

= 125 - 31.25

= 93.75 m

> **(i) Time taken by the ball to reach the ground is 5s.**
> **(ii) Velocity of ball on reaching ground is 50 m/s.**
> **(iii) Height of ball at half time is 93.75 m.**

*(4)   **A tennis ball is thrown up and reaches a height of 4.05 m before coming down. What was its initial velocity? How much total time will it take to come down? Assume g = 10 m/s²**

Ans. **Given:**   Displacement (s) = 4.05 m

$$g = -10 \text{ m/s}^2$$

Final velocity (v) = 0 m/s

To find:

Initial velocity (u) = ?

$$t_{total} = ?$$

Formulae:

$$v^2 = u^2 + 2gs, \quad v = u + gt$$

$$t_{total} = 2 \times t$$

∴ v, g and s are given,

to find u,

we use 2nd equation

Solution:

(a) v^2 = $u^2 + 2gs$

0^2 = $u^2 + 2 \times (-10) \times 4.05$

0 = $u^2 - 81$

u^2 = 81

u = 9 m/s   ...(i)

∴ we have v, u and g to find t.

we use 1st equation

(b) v = $u + gt$

0 = $9 + (-10) \times t$ (from (i))

$10 t$ = 9

t = 0.9 s

Time of ascent = Time of descent

t_{total} = $2t$

= 2×0.9

= 1.8 s

> **The initial velocity was 9 m/s and total time taken to come down, is 1.8 s.**

*(5)   **An object thrown vertically upwards reaches a height of 500 m. What was its initial velocity? How long will the object take to come back to the Earth? Assume g = 10 m/s².**

Ans. **Given:**   Displacement (s)= 500 m

Gravitational acceleration (g) = -10 m/s²

Final velocity (v) = 0 m/s

To find: Initial velocity (u) = ?

$$t_{total} = ?$$

Formulae: $v^2 = u^2 + 2gs$, $t_{total} = 2t$

$$v = u + gt$$

∴ v, g and s is given,
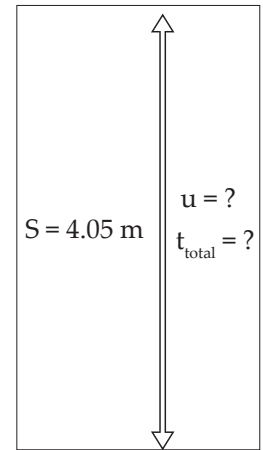
to find u, we use 3rd equation

Solution: $v^2 = u^2 + 2gs$

$0 = u^2 - 10000$

$10000 = u^2$

$u = 100$ m/s

(Diagram is only for reference)

Since, we have v, u and g to find t,

we use 1st equation.

$v = u + gt$

$0 = 100 + (-10) \times t$

$10\,t = 100$

$t = 10s$

Time of ascent = Time of descent

$\therefore t_{total} = 2 \times 10$

$\therefore t_{total} = 20s$

> Initial velocity was 100 m/s and time taken to come back to Earth is 20s.

(6) Find a formula for maximum height attained by object.

Ans. **Solution:** From 3rd equation of motion

$v^2 = u^2 + 2as$

$v = 0$, $a = -g$

$\therefore \quad 0^2 = u^2 + 2(-g)s$

$2gs = u^2$

$s = \dfrac{u^2}{2g}$

***(7)** A stone thrown vertically upwards with initial velocity u reaches a height 'h' before coming down. Show that the time taken to go up is same as the time taken to come down.
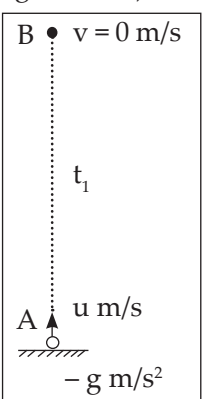
Ans. **When object is thrown up.**   (During Ascent)

Initial velocity = u m/s

Final velocity = 0 m/s

Acceleration = –g m/s²

Time taken to go up = t_1

According to 1st eq. of motion

$v = u + gt$

$0 = u - gt_1$

$gt_1 = u$

$t_1 = \dfrac{u}{g}$ (s) . . . (i)
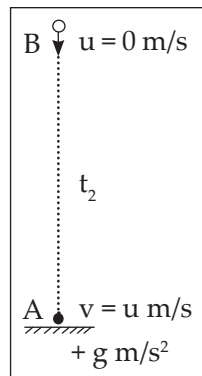
When object falls down. (During Descent)

Initial velocity = 0 m/s

Final velocity (v) = u m/s

Acceleration = g m/s²

Time taken to go down = t_2

According to 1st eq. of motion

$v = u + gt$

$u = 0 + gt_2$

$t_2 = \dfrac{u}{g}$ (s)   . . . (ii)

From (i) and (ii),

$t_1 = t_2$

B ↓ u = 0 m/s

t_2

A ⦁ v = u m/s

+ g m/s²

B ⦁ v = 0 m/s

t_1

A ⦁ u m/s

– g m/s²

(Diagram is only for reference)

(1) A ball thrown up vertically returns to the person after 6s. Find the velocity with which it was thrown up.   *(29.4 m/s)*

(2) A boy drops a coin from the top of a building which is 49m high. Find the velocity with which the coin strikes the ground.   *(v = 31 m/s)*

(3) A ball is thrown vertically upwards with velocity of 49 m/s. Calculate (i) Maximum height to which it rises (ii) total time (t) it takes to return to the surface of Earth.   *(s = 122.5 m, t = 10 s)*

(4) A stone is thrown vertically upwards with initial velocity of 40 m/s. Taking g = 10 m/s² find the maximum height and total distance covered by stone.   *(h = 80 m, d = 160 m)*

Q.2.2. Define/write the laws:

(1) **Force**

Ans. The force is that physical quantity which changes or tends to change the state of rest or of uniform motion in a straight line.

(2) **Newton's universal law of gravitation**

Ans. According to the Newton's universal law of gravitation, every object in the universe attracts every other object with a force, which is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centres.

(3) **Universal constant of gravitation (G)**

Ans. Universal constant of gravitation is the force of attraction between two unit masses placed at unit distance apart from each other.

(4) **Centre of mass**

Ans. It is the point inside or outside the object at which the total mass of the object can be assumed to be concentrated.

***(5)** **Gravitational acceleration (g) OR Acceleration due to gravity**

Ans. The gravitational force due to earth on a body results in its acceleration. This is called acceleration due to gravity.

***(6)** **Free fall**

Ans. When a body falls towards the Earth under the influence of the Earth's gravity alone, its motion is called a 'free fall'.

(7)   Mass (m)

Ans. The mass of an object is the quantity of matter contained in it. Mass is the measure of the inertia of a body.

(8)   Weight (W)

Ans. The weight of a body is defined as the force with which the Earth attracts the object.

*(9)   Centripetal force

Ans. The force that acts on any object moving along a circle, directed towards the centre of the circle is called centripetal force.

(10)   Uniform circular motion

Ans. When an object moves in a circular path with uniform speed, its motion is uniform circular motion.

(11)   Potential energy

Ans. A body can have energy because of its shape or position or configuration. This is known as potential energy.

(12)   Escape velocity

Ans. The minimum initial velocity needed by an object projected upwards to overcome Earths gravitational force and not fall back on Earth is called escape velocity.

Q.2.3. Answer the following in one or two sentences:

*(1)   What do you know about gravitational force? *(Can you recall; Textbook Page no. 1)*

Ans. Every object in the universe attracts every other object with a force. This force is called gravitational force.

*(2)   Will the direction of the gravitational force change as we go inside the earth? *(Think about it; Textbook Page no. 9)*

Ans. The direction of earth's gravitational force is towards the center of earth so it will not change.

*(3)   What would happen if there were no gravity? *(Think about it; Textbook Page no. 8)*

Ans. If gravitational force of the Earth would not have existed, then all the object would have floated in the air. Life would be unstable.

*(4)   What would happen if the value of G was twice as large? *(Think about it; Textbook Page no. 8)*

Ans. If the value of 'G' is doubled, then the gravitational force (F) also will get doubled.

*(5)   What types of forces are we familiar with?
          (Can you recall; Textbook Page no. 1)

Ans. Types of forces are:

(i)   Gravitational force

(ii) Electro-magnetic force

(iii) Nuclear force

(iv) Balanced force

(v) Unbalanced force

*(6)   What is the value of 'g' at the centre of the Earth? *(Think about it; Textbook Page no. 9)*

Ans. At the centre of the Earth the value of 'g' is zero.

*(7)   Will the mass and weight of an object on the earth be same as their values on Mars? Why?

Ans.

(i)   The mass of the object will remain same but its weight will differ on Mars.

(ii) Since mass of an object is the amount of matter present in the body, its value remains the same on Earth and Mars.

(iii) Weight is the force with which the Earth attracts the object. It is given as W = mg. As g changes, weight (W) also changes.

Q.2.4. Write short notes:

(1)   Earth's gravitational force

Ans.

(i)   The Earth attracts all the objects towards the surface of the Earth.

(ii) The attraction is towards the centre of the Earth. Hence, the gravitational force of the Earth acts towards the centre of the Earth.

(iii) Due to this force, all objects fall vertically downwards on the earth.

(2)   Earth's gravitational acceleration

Ans.

(i)   The Earth applies a force of gravitation on any object at or around its surface.

(ii) The uniform acceleration produced in a freely falling body due to the gravitational force of the Earth is called gravitational acceleration or acceleration due to gravity.

(iii) Gravitational acceleration is denoted by 'g' and is a vector quantity. Its SI unit is m/s^2.

(3)   Variation in the value of g.

Ans. The value of g varies based on the following

(a)   Along the surface of the earth.

      - The earth is not perfectly spherical.

      - It is bulged at the equator and flattened at the poles, due to its rotation.

      - The radius is highest at the equator and least at the poles.

      - Value of g is highest at poles($9.832 \ m/s^2$)

- Value of g is least at equator (9.78 m/s^2)

(b) **Change with height.**

- As height increases, value of g decreases.

- The change is negligible for height smaller than the radius of the earth.

(c) **Change with depth.**

- As depth increases, value of g decreases.

- This is because, as we go inside the earth, the mass under consideration decreases.

- Hence, value of g decreases.

Q.2.5. Complete the following table:

Place	Altitude from the Earth's surface (km)	g (m/s^2)
(i) Surface of Earth	0	....
(ii) Mount Everest	8.8	....
(iii) Altitude attained by Man-made balloon	36.6	....
(iv) Orbit of space shuttle	400	....
(v) Communication satellite	35700	....

Ans. *(i) 9.83   (ii) 9.8   (iii) 9.77   (iv) 8.7   (v) 0.225*

Q.2.6. Distinguish between:

(1) **Gravitational constant and Gravitational acceleration.**

Ans.

Gravitational constant (G)	Gravitational acceleration (g)
(i) Gravitational constant is the force of attraction between two unit masses placed at unit distance apart from each other.	(i) The uniform acceleration produced in a freely falling body due to the gravitational force of the Earth is called gravitational acceleration.
(ii) It has SI unit Nm^2/kg^2, while CGS unit is dyne.cm^2/g^2.	(ii) It has SI unit m/s^2, while CGS unit is cm/s^2.
(iii) It is always denoted by 'G'.	(iii) It is always denoted by 'g'.
(iv) Its S.I. value is 6.673×10^{-11} Nm^2/kg^2, while in CGS, it is 6.673×10^{-8} dyne cm^2/g^2.	(iv) Its S.I. value is 9.77 m/s^2, while in CGS, it is 977 cm/s^2.
(v) Its value is fixed and does not change with conditions, hence it is called universal constant.	(v) The value of 'g' depends on various factors like altitude, depth, shape etc.

*(2) **Weight and Mass**

Ans.

| Mass (m)	Weight (W)
(i) Mass is the amount of matter present in the object.	(i) Weight is the force with which the Earth attracts the object.
(ii) Mass does not change with place.	(ii) Weight(W) = mg. As g changes, W also changes.
(iii) SI unit is kg. CGS unit is gram (g).	(iii) SI unit is newton. CGS unit is dyne.
(iv) Mass is a scalar quantity.	(iv) Weight is a vector quantity.

Q.2.7. Give scientific reasons:

(1) **High and low tides are regular phenomena.**

Ans.

(i) The sea level on the Earth is directly influenced by the gravitational force of the moon.

(ii) Due to the gravitational force, the water on the Earth experiences pull towards the direction of the Moon, hence there occurs high tide.

(iii) At the same time, the place which is at right angles or at 90°, the water level gets reduced and experiences low tide.

(iv) This situation occurs two times a day on regular basis, water level rises two times in a day and reduces two times in a day.

(v)
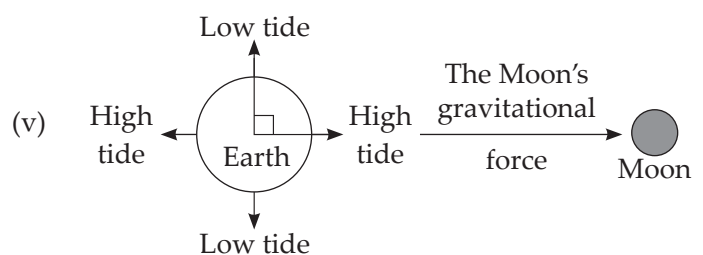
(2) **In the spacecraft, travellers and objects appear floating.**

Ans.

(i) Though the spacecraft is taken to a huge height from the Earth, the value of acceleration due to gravity does not become zero.

(ii) The weightlessness is because the spacecraft is in a state of free fall.

(iii) Any object in a state of free fall will feel weight lessness.

(3) **Weight of an object changes from place to place on the surface of the Earth.**

Ans.

(i) The shape of the Earth is not exactly spherical. It is flattened at poles, while bulged at equator.

(ii) Weight is the Earth's gravitational force acting on the object, which is generally W = mg.

(iii) Mass of the object remains the same but value of 'g' keeps on changing from place to place.

(iv) The value of 'g' is maximum at poles i.e. 9.83 m/s^2 while it is the least at equator i.e. 9.78 m/s^2.

(v) Due to this the weight of an object changes from place to place on the surface of the Earth.

(vi) It is maximum at poles but gets reduced at equator.

Q.3.1. Explain the following:

(1) **Explain the terms:**
(a) Free fall   (b) Acceleration due to gravity
(c) Escape velocity   (d) Centripetal force
(e) Potential energy

Ans.

*(a) **Free fall:**

When a body falls towards the Earth under the influence of the Earth's gravity alone, its motion is called free fall.

*(b) **Acceleration due to gravity:**

The gravitational force due to earth on a body results in its acceleration. This is called acceleration due to gravity.

*(c) **Escape velocity:**

The minimum initial velocity needed by an object projected upwards to overcome Earths gravitational force and not fall back on Earth is called escape velocity.

*(d) **Centripetal force:**

The force that acts on any object moving along a circle, directed towards the centre of the circle is called centripetal force.

(e) **Potential energy:**

The energy possessed due to position or configuration is called potential energy.

(2) **Define: The Universal law of gravitation and derive mathematically.**

Ans. **The Universal law of gravitation:** Every object in the universe attracts every other object with a force which is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centres.
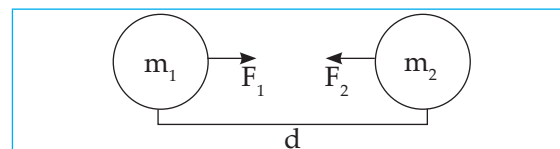

Fig 1.1 Gravitational force between two objects.

Let m_1 and m_2 be the masses of two objects, the distance between their centres be 'd'.

The gravitational attraction between the two will be given by,

$$F \alpha \frac{m_1 m_2}{d^2}$$

$$\therefore \quad F = \frac{G m_1 m_2}{d^2} \qquad \text{(G is constant)}$$

G is called gravitational constant; it is also known as Universal constant of gravitation.

*(3) **What are Newton's laws of motion?**
(Can you recall; Textbook Page no. 1)

Ans.

(i) **Newton's first law of motion :** Every inanimate object continues to be in a state of rest or of uniform motion in a straight line unless it is acted upon by an external unbalanced force.

(ii) **Newton's second law of motion :** The rate of change of momentum is directly proportional to the applied force and it takes place in the direction of force.

(iii) **Newton's third law of motion :** To every action there is always instantaneous, equal and opposite reaction.

*(4) **What are the effects of force acting on an object?**
(Can you recall; Textbook Page no. 1)

Ans. The applied force can:

(i) change the state of rest.

(ii) change the motion of an object

(iii) change the direction of motion

(iv) change the speed of a moving object

(v) change the shape of the object temporarily.

(5) **Define: Acceleration due to gravity and derive mathematically.**

Ans. The gravitational force due to the Earth on an object results in its acceleration. It is called acceleration due to gravity.

We know,

$$F = \frac{GMm}{R^2} \ldots (i)$$

$$F = mg \ldots (ii)$$

From (i) and (ii),

$$mg = \frac{GMm}{R^2}$$

$$g = \frac{GM}{R^2}$$

For Earth, $g = 9.77 \text{ m/s}^2$

*(6) **The value of 'g' at the centre of the Earth is zero. Explain?**

Ans. The acceleration due to gravity is given as

$$g = \frac{GM}{R^2}$$

At the centre of the Earth, the mass under consideration is zero.

i.e. $M = O$

$$\therefore \quad g = 0$$

Hence, acceleration due to gravity, at the centre of the earth, is zero.

*(7) **Write the three laws given by Kepler. How did they help Newton to arrive at the inverse square law of gravity?**

Ans. Kepler's laws:

(i) **Kepler's first law :** The orbit of a planet is an ellipse with the Sun at one of the foci.

(ii) **Kepler's second law :** The line joining the planet and the Sun sweeps equal areas in equal intervals of time.

(iii) **Kepler's third law:** The square of its period of revolution around the Sun is directly proportional to the cube of the mean distance of a planet from the Sun.
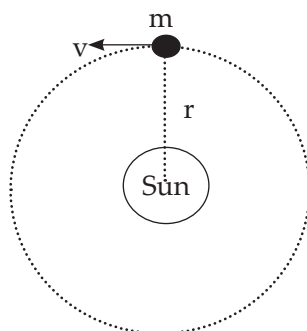
Centripetal force $F = \frac{mv^2}{r} \quad \ldots(i)$

Distance travelled by planet in one revolution	=	Circumference of orbit
	=	$2\pi r$

Time period of revolution = (T)

$$\therefore \quad \text{speed of planet } v = \frac{\text{distance}}{\text{time}}$$

$$= \frac{2\pi r}{T} \quad \ldots(ii)$$

Substituting eq. (ii) in (i)

$$\therefore \quad F = \frac{m\left(\frac{2\pi r}{T}\right)^2}{r} = \frac{m4\pi^2 r^2}{rT^2}$$

$$\therefore \quad F = \frac{4m\pi^2 r}{T^2}$$

Multiplying numerator and denominator with 'r²'.

$$\therefore \quad F = \frac{4m\pi^2 r}{T^2} \times \frac{r^2}{r^2}$$

$$\therefore \quad F = \frac{4m\pi^2 r^3}{r^2 T^2} \quad \ldots(iii)$$

According to Kepler's 3rd law

$$\frac{T^2}{r^3} = k \quad \text{or} \quad \frac{r^3}{T^2} = \frac{1}{k} \quad \ldots(iv)$$

Substituting (iv) in (iii)

$$F = \frac{4m\pi^2 r^3}{r^2 T^2} \times \frac{1}{k} = \frac{4m\pi^2}{r^2 k} \quad \ldots(v)$$

Rearranging eq. (v)

$$F = \frac{4m\pi^2}{k} \times \frac{1}{r^2}$$

Since $\frac{4m\pi^2}{k} = $ constant.

$$\therefore \quad F = \text{constant} \times \frac{1}{r^2}$$

$$\therefore \quad F \, \alpha \, \frac{1}{r^2}$$

(8) **State Kepler's third law and derive mathematically to obtain constant.**

Ans. **Kepler's third law:** The square of its period of revolution around the Sun is directly proportional to the cube of the mean distance of a planet from the Sun.

If 'T' is a periodic time and the average distance of a planet from the Sun is 'r', then,

$$T^2 \, \alpha \, r^3$$

$\therefore$ $T^2 = kr^3$ ... k is constant, $k \neq 0$

$\therefore$ $k = \dfrac{T^2}{r^3}$

*(9) If the value of g suddenly becomes twice its value, it will become two times more difficult to pull a heavy object along the floor. Why?

Ans.
(i)   If the value of g becomes double, the force with which the earth pulls the object i.e weight of object becomes double.

(ii)   As weight increases, frictional force also increases while pulling the object

(iii) Hence, it will become two times more difficult to pull a heavy object along the floor.

(10) Explain centripetal force with suitable example.

Ans. The force on an object revolving in a circular path towards the centre is called centripetal force.
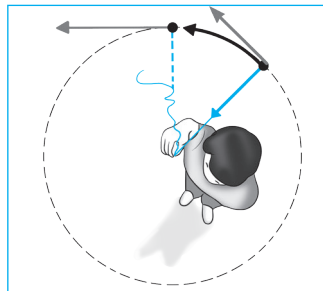

Fig 1.2 Centripetal force

e.g. A stone tied to the string moves in a circular path and its velocity is tangential.

(11) Define: Escape velocity and derive mathematically.

Ans. The velocity required to overcome the Earth's gravitational force to move into the space is called escape velocity.

On surface of Earth

A $K.E. = \dfrac{1}{2} mv_{esc}^2$

B $P.E. = -\dfrac{GMm}{R}$

C $T.E. = P.E. + K.E.$

$E_1 = \dfrac{1}{2} mv_{esc}^2 - \dfrac{GMm}{R}$

At infinity

A $K.E. = 0$

B $P.E. = -\dfrac{GMm}{\infty} = 0$ $\because R + h = \infty$

C $T.E. = P.E. + K.E.$

        $= 0 + 0 = 0$

According to the law of conservation of energy,

$E_1 = E_2$

$\dfrac{1}{2} mv_{esc}^2 - \dfrac{GMm}{R} = 0$

$\dfrac{1}{2} \not{m}v_{esc}^2 = \dfrac{GM\not{m}}{R}$

$v_{esc}^2 = \dfrac{2GM}{R}$

$v_{esc} = \sqrt{\dfrac{2GM}{R} \times \dfrac{\times R}{\times R}}$

$v_{esc} = \sqrt{\dfrac{2GM \times R}{R^2}}$ $...\left[g = \dfrac{GM}{R^2}\right]$

$v_{esc} = \sqrt{2gR}$

For Earth, $v_{esc} = 11.2$ km/s.

Q.3.2. Open Ended Question:

*(1) According to Newton's law of gravitation, every object attracts every other object means if the Earth attracts an apple towards it, then an apple also attracts the Earth with the same force, then why an apple falls down but the Earth does not move towards the apple? *(Use your brain power; Textbook Page no. 7)*

Ans. Yes, the apple attracts the Earth with equal force but the mass of the apple is much less as compared to that of the Earth.

We know, $F = ma$ or $a = \dfrac{F}{m}$

Hence, greater the mass, lesser the acceleration. Therefore, due to greater mass, the Earth's acceleration is almost zero.

*(2) Is there a gravitational force between two objects kept on a table or between you and your friend sitting next to you? If yes, why don't the two move towards each other? *(Use your brain power; Textbook Page no. 5)*

Ans. Yes, there is a force of attraction between the two objects as well as me and my friend.

We know,

$F \propto m_1 m_2$

Since the mass of me and my friend is very less as compared to the Earth, the force is also very less. Hence, we don't move towards each other.

*(3) Will your weight remain constant as you go above the surface of the earth? *(Use your brain power; Textbook Page no. 10)*

Ans.
(i)   Weight of a body depends on acceleration due to gravity. $W = m \times g$

(ii) As we go above the surface of the earth height increases and hence acceleration decreases.

(iii) As acceleration due to gravity decreases consequently weight decreases.

*(4) **According to Newton's law of gravitation, earth's gravitational force is higher on an object of larger mass. Why doesn't that object fall down with higher velocity as compared to an object with lower mass?** *(Use your brain power; Textbook Page no. 12)*

Ans.

(i) The acceleration due to gravity (g) on an object only depends on mass (M) and radius (R) of the earth i.e. $g = \dfrac{GM}{R^2}$.

(ii) It does not depend on mass (m) of the object.

(iii) The acceleration produced at a given point is the same for all objects.

(iv) Hence, object of larger mass does not fall down with higher velocity as compared to an object with lower mass.

Q.3.3. Application based Questions / Questions based on figures:

*(1) **Observe the figure and answer the following questions:** *(Textbook Page no. 4)*
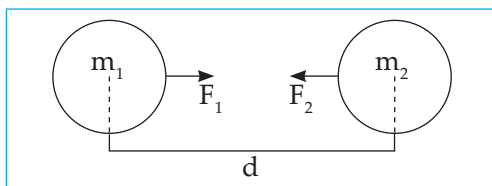
(i) **The force of Gravitation between two bodies having irregular shape is taken to be the distance between their**
(a) centre of mass   (b) centre of the body
(c) Edge of the body

Ans. (a) centre of mass

(ii) **If the distance between the two bodies is tripled, how will the Gravitational force between them change?**

Ans. $F = G\ \dfrac{m_1 m_2}{d^2}$

If the distance is tripled,

$F' = G\ \dfrac{m_1 m_2}{(3d)^2} = G\ \dfrac{m_1 m_2}{9d} = \dfrac{1}{9}\ F$

The gravitational force between them becomes $\dfrac{1}{9}$ th the initial force.

(iii) **The mass of m_2 was reduced to 50% and the force exerted by m_1 on m_2 was found to be 20 N, what will be the force exerted by m_2 on m_1?**

Ans. The force exerted by m_2 on m_1 is 20 N.

(iv) **Why gravitational constant is called universal constant?**

Ans. The value of gravitational constant does not depend upon the nature and size of the bodies. It also does not depend upon the nature of the medium between two bodies; hence it is called universal constant.

(v) **What will happen to gravitational force if mass of one of the objects is doubled?**

Ans. If the mass of one of the objects is doubled, then the gravitational force between them also gets doubled.

(vi) **What is the value of universal constant in SI?**

Ans. In SI system, the value of 'G' is 6.67×10^{-11} Nm^2/kg^2.

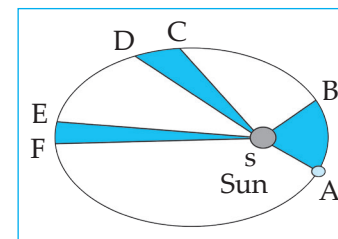***(2)** **Observe the following diagram and answer the questions:**

Fig 1.3: The orbit of a planet moving around the Sun.

(a) **In a given figure, area ESF is equal to ASB, then what can you say about EF?** *(Use your brain power; Textbook Page no. 4)*

Ans.

(i) Distance EF is lesser than AB. Hence, speed will be lesser at EF and greater at AB

(ii) Therefore, in an elliptical orbit, speed is not constant.

(b) **If x, y and z are the speeds of revolution of the planet from A to B, C to D and E to F, then which of the following relation is true?**
(a) x > y > z (b) x < y < z (c) x < y > z (d) x > y < z

Ans. (a) x > y > z

(c) **Correct and rewrite Kepler's third law.**

The period of revolution of a planet around the sun is directly proportional to the cube of the distance of the planet from the sun.
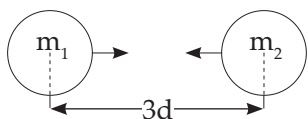
Ans. The square of the period of revolution of a planet around the sun is directly proportional to the cube of the mean distance of the planet from the Sun.

(3) If two objects are at a distance of d from each others
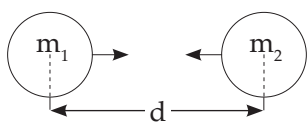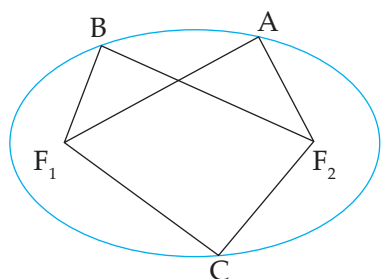

Then $F = \dfrac{Gm_1m_2}{d^2}$

If the distance between two bodies is 3d
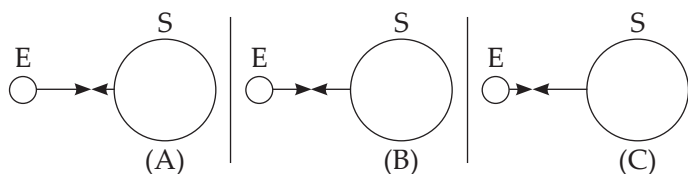

Then F = [ ]

Ans. $\dfrac{Gm_1m_2}{9d^2}$

(4)

$AF_1 + AF_2 = $ [ ] = [ ]

Ans. $BF_1 + BF_2$; $CF_1 + CF_2$

(5) Which of the following best represent force between Sun and Earth.

Ans. B. Force is equally exerted by 2 bodies.

(6) An elephant and a matchbox fall from a height of 200m. If they are in a state of free fall, which of them will reach the ground first and why?

Ans. Both will reach the ground at the same time. Since they are in a state of free fall, there is no resistive force acting on them and the only force acting is the force of gravity. The acceleration due to gravity is same for all the bodies irrespective of the mass of the body.

(7) Complete the following for an object of mass *'m'*

On Earth's surface	At infinity
(A) KE = $\dfrac{1}{2}$ mv²	(A) KE = ...
(B) PE = ...	(B) PE = 0

Ans.

| On Earth's surface	At infinity
(A) KE = $\dfrac{1}{2}$ mv²	(A) KE = **0**
(B) PE = $-\dfrac{GMm}{R}$	(B) PE = 0

(8) An artificial satellite is shifted from LEO to HEO, how will the value of 'g' vary?

Ans. If an artifical satellite is shifted from LEO to HEO, the value of 'g' decreases. This is because as the satellite is shifted from LEO to HEO, its distance from earth's surface increases. Because g $\alpha \dfrac{1}{r^2}$, as distance increases the value of g will decreases.

(9) How will the value of 'g' change if a person travels from Delhi to Moscow?

Ans. From Delhi to Moscow, the value of g will increase. As Delhi lies close to equator and Moscow is close to pole, the value of g from equator to pole goes on increasing.

(10)
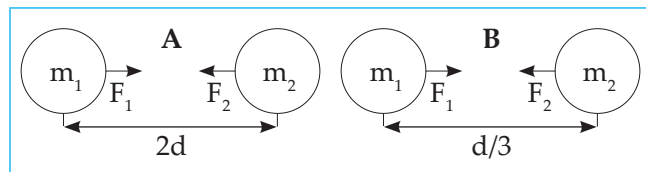
In which of the two cases, A or B, is the force exerted stronger?

Ans. $F = G\,\dfrac{m_1m_2}{d^2}$

Case A : $F_1 = G\,\dfrac{m_1m_2}{4d^2} = \dfrac{1}{4}\,F$

Case B : $F_2 = G\,\dfrac{\dfrac{m_1m_2}{d^2}}{9} = 9\,F$

The force exerted is maximum in case B.

(11) If a traveler in a spacecraft orbiting the Earth releases an object from his hand, it remains stationary and appears to be in a state of weightlessness. Does this mean there is no force of gravity acting on the object?

Ans.

(i) No, there is a force of gravity acting on the body. Though the spacecraft is at a height from the surface of the earth, the value of g there is not zero, but only 11% less than its value on the surface of the earth.

(ii) Thus, the weightlessness is not caused by the height of the satellite but by being in a state of free fall. Though the spacecraft is not falling on the

earth because of its velocity along the orbit, the only force acting on it is the gravitational force of the earth and therefore it is in a state of free fall.

(iii) As the velocity of free fall does not depend on the properties of an object, it is the same for the spacecraft, the travellers and the objects in the craft.

(iv) Thus, if a traveller releases an object from his hand, it will remain stationary with respect to him and will appear to be weightless.

(12) **(i) Will the velocity of a stone thrown vertically upwards remain constant or will it change with time? How will it change?**

(ii) **Why doesn't the stone move up all the time? Why does it fall down after reaching a certain height?**

(iii) **What does its maximum height depend on?**

Ans.

(i) The velocity of the stone thrown vertically upward will not remain constant. It will decrease with time till it becomes zero.

(ii) When the stone is thrown vertically upwards, the gravitational force tries to pull it down and reduces its velocity. Due to this constant downward pull, the velocity becomes zero after a while. The pull continues to be exerted and the stone starts moving vertically downward towards the centre of the earth under its influence.

(iii) The maximum height the stone can achieve depends on the initial velocity with which the stone is thrown vertically upwards.

Q.3.4. Complete the flow chart:
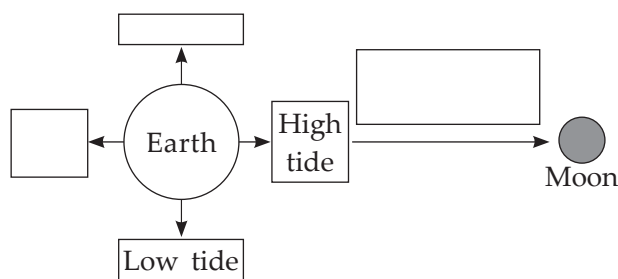
Ans.
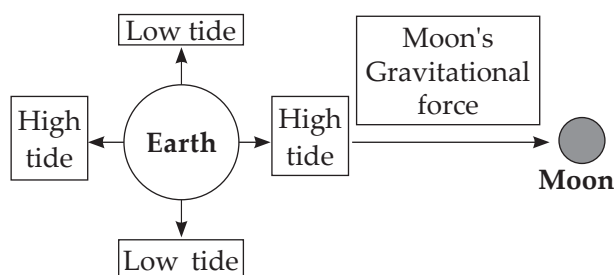
Q.4.1. Paragraph based Questions:

(1) **Read the paragraph and answer the following questions:**

(1) You must be knowing about the high and low tides that occur regularly in the sea. The level of sea water at any given location along sea shore increases and decreases twice a day at regular intervals. High and low tides occur at different times at different places. The level of water in the sea changes because of the gravitational force exerted by the moon. Water directly under the moon gets pulled towards the moon and the level of water there goes up causing high tide at that place. At two places on the earth at 90° from the place of high tide, the level of water is minimum and low tides occur there.

(i) **How many times does the sea level at the coast change?**

Ans. Sea level at the coast increases and decreases two times a day. Two high tides and two low tides.

(ii) **How does sea level get changed?**

Ans. The sea-level at the coastal region gets changed two times a day due to gravitational attraction of the Moon.

(iii) **Where is high tide and low tide caused?**

Ans. Due to gravitational attraction of the Moon, the water mass swells towards the direction of the Moon causing high-tide. The water mass shrinks at 90° from this place which causes low tide.

(2) The centre of mass of an object is the point inside or outside the object at which the total mass of the object can be assumed to be concentrated. The centre of mass of a spherical object having uniform density is at its geometrical centre. The centre of mass of any object having uniform density is at its centroid.

(i) **Where can the total mass of an object be assumed to be concentrated?**

Ans. At the centre of the mass of object.

(ii) **Where is the centre of mass located for an object of uniform density?**

Ans. At its centroid.

(iii) **Where is the centre of mass located for a spherical object?**

Ans. At its geometrical centre.

(iv) **What was the basis of Kepler's laws?**

Ans. Kepler's laws were based on the motion of the planets.

(3) **Gravitational waves:**

Waves are created on the surface of water when we drop a stone into it. Similarly you must have seen the waves generated on a string when both its ends are held in hand and it is shaken. Light is also a type of wave called the electromagnetic wave. Gamma rays, X-rays, ultraviolet rays, infrared rays, microwave and radio waves are all different types of electromagnetic waves. Astronomical objects emit these waves and we receive them using our instruments. All our knowledge about the universe has been obtained through these waves.

Gravitational waves are a very different type of waves. They have been called the waves on the fabric of space-time. Insteine predicted their existence in 1916. These waves are very weak and it is very difficult to detect them. Scientists have constructed extremely sensitive instruments to detect the gravitational waves emitted by astronomical sources. Among these, LIGO (Laser Interferometric Gravitational Wave Observatory) is the prominent one. Exactly after hundred years of their prediction, scientists detected these waves coming from an astronomical source. Indian scientists have contributed significantly in this discovery. This discovery has opened a new path to obtain information about the Universe.

(i) **What are the different types of electro magnetic waves?**

Ans. Gamma rays, X-rays, Ultraviolet rays, infrared rays, microwave and radio waves.

(ii) **What are the waves on the fabric of space - time called?**

Ans. They are called gravitational waves.

(iii) **Is it easy to detect Gravitational waves?**

Ans. No, these waves are very weak and it is very difficult to detect them.

(iv) **What is the device, used to detect Gravitational waves?**

Ans. LIGO (Laser Interferometric Gravitational waves Observatory) is used to detect Gravitational waves.

(4) **Weightlessness in space:**

Space travellers as well as objects in the spacecraft appear to be floating. Why does this happen? Though the spacecraft is at a height from the surface of the earth, the value of g there is not zero. In the space station the value of g is only 11% less than its value on the surface of the earth. Thus, the height of a spacecraft is not the reason for their weightlessness.

Their weightlessness is caused by their being in the state of free fall. Though the spacecraft is not falling on the earth because of its velocity along the orbit, the only force acting on it is the gravitational force of the earth and therefore it is in a free fall state. As the velocity of free fall does not depend on the properties of an object, the velocity of free fall is the same for the spacecraft, the travellers and the objects in the craft. Thus, if a traveller releases an object from her hand, it will remain stationary with respect to her and will appear to be weightless.

(i) **Is the value of g zero in the space station?**

Ans. No, the value of g is only 11% less than its value on the surface of the Earth.

(ii) **Why is weightlessness caused in a spacecraft?**

Ans. The weightlessness is caused by them being in a state of free fall.

(iii) **Why doesn't the spacecraft fall towards the Earth?**

Ans. The spacecraft does not fall towards the Earth because of its velocity along the orbit.

(iv) **If a traveller releases an object from her hand in the spacecraft, what will happen?**

Ans. The object will remain stationary with respect to her, because, the velocity of free fall is the same for the spacecraft, traveller and objects in the craft.

Q.4.2. Activity based Questions:

(1) **Read the following paragraph carefully and answer the following:**

(1) Tie a stone to one end of a string. Take the other end in your hand and rotate the string so that the stone moves along a circle.

As long as we are holding the string, we are pulling the stone towards us i.e. towards the centre of the circle and are applying a force towards it. The force stops acting on it if we

release the string. In this case, the stone will fly off along a straight line which is the tangent to the circle at the position of the stone when the string is released, because that is the direction of its velocity at that instant of time. You may recall a similar activity in which a 5 rupee coin kept on a rotating circular disc flies off the disc along the tangent to the disc. Thus, a force acts on any object moving along a circle and it is directed towards the centre of the circle. This is called the Centripetal force.
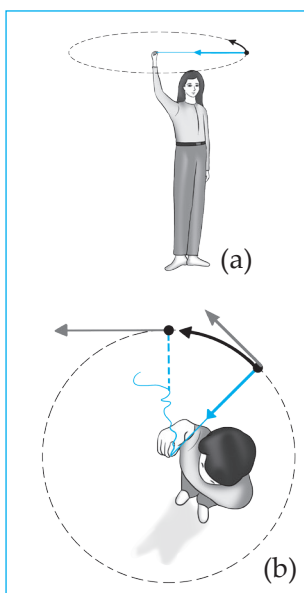
Fig 1.4: A stone tied to a string, moving along a circular path and its velocity in tangential direction

(i) **The impressed force on the stone is in which direction?**

Ans. On the stone, the force is directed towards the centre of the circle.

(ii) **What happens if the string is released?**

Ans. The stone will fly off in a straight line along the tangent to the circle.

(iii) **What is centripetal force?**

Ans. The force exerted towards the centre of the circle on an object moving along a circular path is called centripetal force. It is a centre seeking force.

(2) Take a small stone. Hold it in your hand.

We know that the force of gravity due to the earth acts on each and every object. When we were holding the stone in our hand, the stone was experiencing this force, but it was balanced by a force that we were applying on it in the opposite direction. As a result, the stone remained at rest. Once we release the stone from our hands, the only force that acts on it is the gravitational force of the earth and the stone falls down under its influence. Whenever an object moves under the influence of the force of gravity alone, it is said to be falling freely. Thus the released stone is

in a free fall. In free fall, the initial velocity of the object is zero and goes on increasing due to acceleration due to gravity of the earth. During free fall, the frictional force due to air opposes the motion of the object and a buoyant force also acts on the object. Thus, true free fall is possible only in vacuum. For a freely falling object, the velocity on reaching the earth and the time taken for it can be calculated by using Newton's equations of motion. For free fall, the initial velocity u = 0 and the acceleration a = g. Thus, we can write the equations as

$v = gt; s = \dfrac{1}{2} gt^2; v^2 = 2gs$

For calculating the motion of an object thrown upwards, acceleration is negative, i.e. in a direction opposite to the velocity and is taken to be – g. The magnitude of g is the same but the velocity of the object decreases due to -ve acceleration.

The moon and the artificial satellites are moving only under the influence of the gravitational field of the earth. Thus they are in free fall.

(Try this; Textbook Page no. 11)

(i) **Which force acts on the stone when held in the hand?**

Ans. Gravitational force in downward direction and reaction force of hand in upward direction.

(ii) **Which force acts on the stone in free fall after you release it?**

Ans. Only gravitational force acts on it when it is released.

(iii) **What is free fall?**

Ans. When an object falls towards the Earth under the influence of the Earth's gravity alone it is called free fall.

(iv) **What is the initial velocity and what is the effect of gravitational acceleration on the object in free fall?**

Ans. In free fall, the initial velocity of an object is zero and as the time progresses, velocity increases due to uniform gravitational acceleration.

(v) **Write kinematic equations used in free fall?**

Ans. The kinematic equations are, $v = gt$, $s = \dfrac{1}{2} gt^2$ and $v^2 = 2gs$

❖ ❖ ❖

ASSIGNMENT - 1

Time : 1 Hr.   **Marks : 20**

Q.1. (A) Answer the following questions: (3)

(1)   Fill in the blanks:

(i)   Value of g at the centre of Earth is _____ .

(ii)   Mass is also a measure of _____ of an object.

(2)   Complete the analogy:

At poles : 9.83 m/s^2 : : At equator : _____ .

Q.1. (B) Choose and write the correct option: (2)

(1)   The gravitational force of attraction between two objects is given by _____ .

(a) $F \alpha \dfrac{m_1 m_2}{d^2}$ (b) $F \alpha \dfrac{d^2}{m_1 m_2}$ (c) $F \alpha \dfrac{m_1 m_2}{\sqrt{d^2}}$ (d) $F \alpha \dfrac{m_1 m_2}{d^3}$

(2)   The gravitational force on the surface of the Moon is _____ times than that on the surface of the Earth.

(a) five   (b) one fifth   (c) one sixth   (d) six

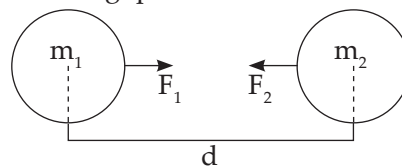**Q.2. Answer the following:** *(Any 2)*   (4)

(1)   Mahendra and Virat are sitting at a distance of 1 metre from each other. Their masses are 75 kg and 80 kg respectively. What is the gravitational force between them?

(2)   Define: (i)   Centre of mass   (ii)   Free fall

(3)   Distinguish between: Weight and Mass

Q.3. Answer the following: *(Any 2)*   (6)

(1)   If a person weighs 750 N on Earth, how much would be his weight on the Moon given that Moon's mass is $\dfrac{1}{81}$ of that of the Earth and its radius is $\dfrac{1}{3.7}$ of that of Earth.

(2)   Define: The Universal law of gravitation and derive mathematically.

(3)   Observe the figure and answer the following questions:

(i)   Write gravitational force between them.

(ii)   What will happen to gravitational force if mass of one of the objects is doubled?

(iii) What is the value of universal constant in SI system?

Q.4. Answer the following: *(Any 1)*   (5)

(1)   Write the three laws given by Kepler. How did they help Newton to arrive at the inverse square law of gravity?
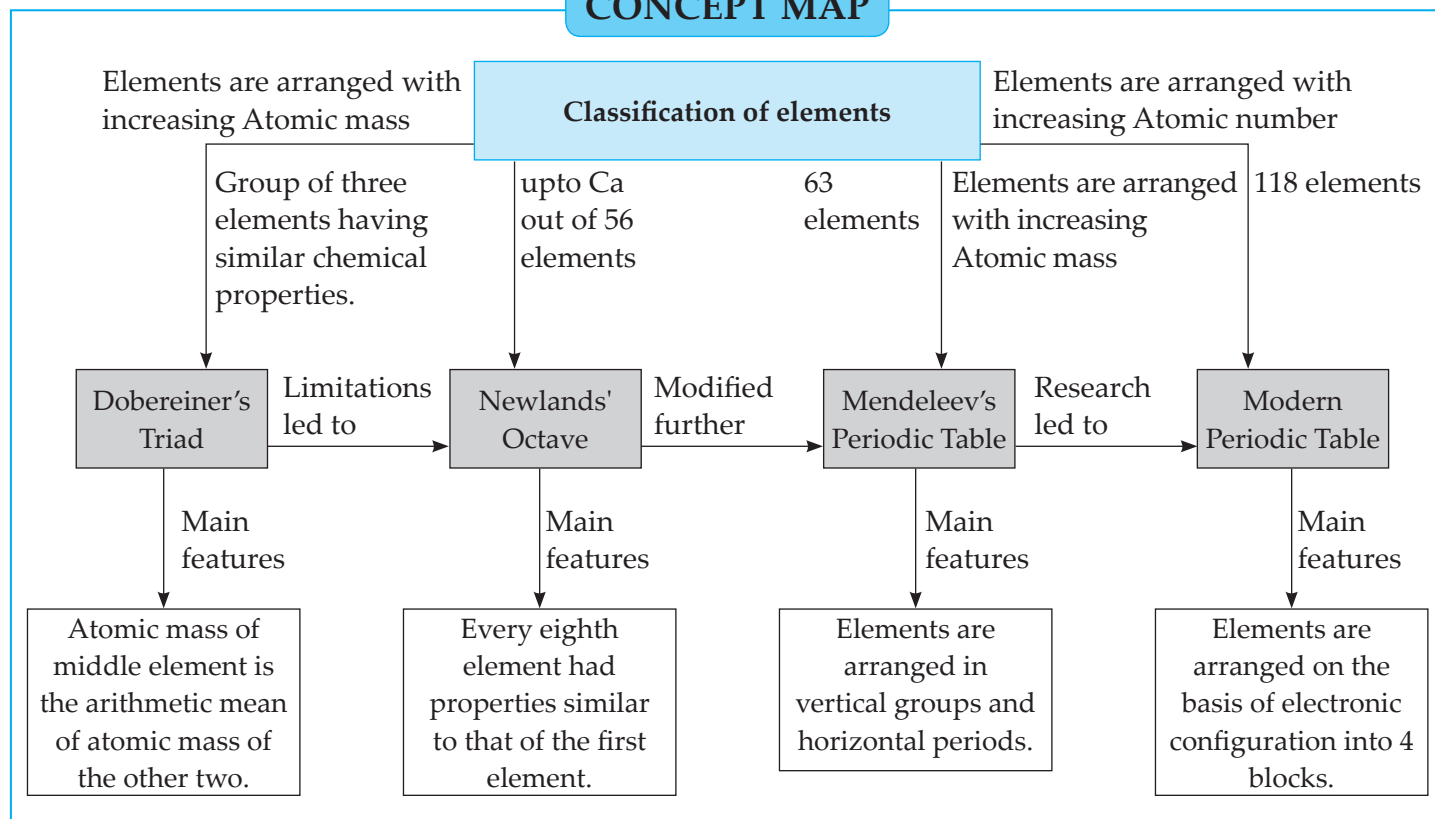
(2)   Define: Escape velocity and derive mathematically.

❖ ❖ ❖

Fig 2.1 Modern Periodic Table

CONCEPT MAP

Classification of elements

Elements are arranged with increasing Atomic mass

Elements are arranged with increasing Atomic number

Group of three elements having similar chemical properties.

upto Ca out of 56 elements

63 elements

Elements are arranged with increasing Atomic mass

118 elements

Dobereiner's Triad	Limitations led to	Newlands' Octave	Modified further	Mendeleev's Periodic Table	Research led to	Modern Periodic Table

Main features

Atomic mass of middle element is the arithmetic mean of atomic mass of the other two.	Every eighth element had properties similar to that of the first element.	Elements are arranged in vertical groups and horizontal periods.	Elements are arranged on the basis of electronic configuration into 4 blocks.

Points to Remember:

- Today **118** elements are known to the scientific world.
- In the year 1817, a German scientist **Dobereiner** suggested that properties of elements are related to their atomic masses.
- Group of three elements having similar chemical properties are known as **Triads**.
- In the year 1866, English scientist **John Newlands** arranged the elements known at that time in an increasing order of their atomic masses.
- Newlands' Octaves or Law of Octaves: **When the elements are arranged in an increasing order of their atomic masses, every eighth element had properties similar to those of the first.**
- The Russian scientist **Dmitri Mendeleev** developed the periodic table of elements during the period **1869 to 1872 A.D**.
- He arranged **63** elements known at that time in an increasing order of their atomic masses.
- Mendeleev's Periodic Law: **Properties of elements are periodic function of their atomic masses.**
- In 1913 A.D., an English scientist **Henry Moseley** revealed through experiments done using x-ray tube that atomic number (Z) is a more fundamental property of an element than its atomic mass.
- Modern Periodic Law: **Properties of elements are a periodic function of their atomic numbers.**
- Modern Periodic table contains **seven** horizontal rows called the **periods** 1 to 7 and the **eighteen** vertical columns are the **groups** 1 to 18.
- Entire Modern Periodic table is divided into four blocks, viz, **s-block**, **p-block**, **d-block** and **f-block**.
- Electronic configuration of an element: The distribution of electrons in the various orbits around the nucleus of an atom of an element is called its electronic configuration.
- It is the electronic configuration of an element which decides the group and the period in which the element is to be placed.

- Valency: **Combining capacity of an element.**
- Valence electrons: **Electrons present in the outermost shell of an atom.**
- **Atomic radius** is the distance between the nucleus of the atom and its outermost shell. It is expressed in the unit **picometer (pm)**. (1 pm = 10^{-12} m)
- Atomic radius goes on **decreasing** while going from **left to right** within a period and goes on **increasing** while going down (from **top to bottom**) in a group.
- **Metal** atoms have a tendency to form a cation by losing their valence electrons. This property is called **electropositivity** of an element.
- An atom of a **non-metal** has a tendency to form an anion by accepting electrons from outside into its valence shell. This property is called **electronegativity**.

MASTER KEY QUESTION SET - 2

Q.1. (A) 1. Fill in the blanks and rewrite the complete statement:

(1) The arrangement of elements in a group of three is known as _____ .

(2) The law used by Newlands' to arrange elements is known as _____ .

(3) Mendeleev arranged _____ elements known at that time.

(4) The vertical columns in the periodic table are called _____, while the horizontal rows are called _____ .

(5) The element eka-boron in Mendeleev's periodic table is known as _____ in the Modern Periodic table.

(6) There was no place for _____ in Mendeleev's original periodic table.

(7) Mendeleev created the _____ group without disturbing the original periodic table.

(8) In the Modern Periodic table, the elements are arranged in accordance with their _____ .

(9) Two rows shown separately at the bottom of the Modern Periodic table are called _____ and _____ .

(10) The _____ contains the group 1 and 2 elements.

(11) The d-block elements are called _____ .

(12) Elements showing properties of both metals and non-metals are called _____ .

(13) Newlands could arrange elements upto _____ out of total 56 elements known.

(14) In the family of alkali metals, the number of valence electrons is _____ .

(15) There are seven electrons in the outermost shell of the elements, such elements belong to the family of _____ .

(16) As we go down a group, the number of shells goes on _____ .

(17) In the Modern Periodic table, the elements placed at the bottom of the periodic table are called as _____ elements.

(18) Atomic radius is expressed in the unit _____

(19) Inert gases belong to _____ group.

(20) Elements with atomic numbers 90 to 103 in the Modern Periodic table are called _____

(21) The valency of an element is determined by the number of _____ electrons present in the outermost shell of an atom.

(22) From left to right, the atomic size of an atom _____ .

(23) An element is placed in 2nd period, so it has _____ shells.

(24) Valency across a period _____ gradually.

(25) An atom is said to be a non-metal if it _____ electrons.

(26) _____ is the only element in duplet state.

(27) Elements of group 1A are called _____ .

(28) Group II A elements are called as _____ .

(29) Group VII A elements are called as _____ .

(30) First period contains _____ elements.

(31) Moseley arranged elements according to _____ .

(32) The number of shells _____ down the group.

(33) The formula of chloride of a metal is MCl_2, the metal M belongs to _____ group.

(34) _____ group contains all gases at room temperature.

Ans. *(1) Triads (2) Newlands' Law of Octaves (3) 63 (4) groups, periods (5) Scandium (6) noble gases (7) zero (8) atomic numbers (9) Lanthanide series, Actinide series (10) s-block (11) transition elements*

(12) metalloids (13) Calcium (Ca) (14) 1 (one) (15) halogens (16) increasing (17) inner transition (18) picometer (19) zero (20) actinides (21) valence (22) decreases (23) 2 (24) varies (25) gains or shares (26) Helium (27) alkali metals (28) alkaline earth metals (29) halogens (30) 2 (31) atomic number (32) increases (33) 2 (II A) (34) 18 or zero

Q.1. (A) 2. Find the odd word out.

(1)   Lithium, Beryllium, Boron, Chlorine

Ans. Chlorine: It belongs to the third period while others are second period elements.

(2)   Helium, Radon, Argon, Boron

Ans. Boron: It is a metal while others are inert or noble gases.

(3)   Chlorine, Bromine, Iodine, Oxygen

Ans. Oxygen: It is a gas belonging to group 16 while others are halogens belonging to group 17

(4)   Sodium, Lithium, Copper, Beryllium

Ans. Copper: Others are normal elements, while copper is a transition element.

(5)   Dalton, Dobereiner, Moseley, Newlands

Ans. Dalton: He put forth the Dalton's theory for atomic structure, whereas all others classified elements.

(6)   Boron, Silicon, Potassium, Antimony

Ans. Potassium: It is a metal while others are metalloids.

(7)   Aluminium, Argon, Xenon, Sodium

Ans. Sodium: It belongs to s-block, whereas others belong to p-block.

(8)   Boron, Silicon, Neon, Polonium

Ans. Neon: It is an inert gas, whereas all others are metalloids.

(9)   Lithium, Magnesium, Sodium, Potassium

Ans. Magnesium: It belongs to group II A (group 2), whereas others belong to group I A (group 1).

(10)   Chlorine, Bromine, Arsenic, Fluorine

Ans. Arsenic: It is a metalloid and others are halogens.

Q.1. (A) 3. Complete the analogy.

(1)   Dobereiner: Triad :: Newlands : ....

Ans. Octaves - Doberiner arranged three elements in a triad whereas Newlands arranged the elements in increasing order of their atomic masses. He found that first element and the eighth element had similar properties and called it law of octaves.

(2)   Mendeleev's Periodic Table : Atomic mass :: Modern Periodic table : ....

Ans. Atomic number - Atomic mass is the basis for Mendeleev's periodic table whereas the atomic number is the basis for Modern Periodic Table.

(3)   Hydrogen : First period :: Lithium : ....

Ans. Second period - The first period contains Hydrogen (1) and Helium (2) Lithium's atomic number is 3, therefore, it is put in the second period.

(4)   Fluorine : 2, 7 :: Chlorine : ....

Ans. 2, 8, 7 - Chlorine's atomic number is 17 therefore its electronic configuration is (2, 8, 7)

(5)   Group 1: Alkali metals :: .... : Alkaline earth metals

Ans. Group 2 - The outermost shell of these elements has 2 electrons, therefore, they are put in group 2.

(6)   Transition elements : d-block :: Inner transition elements : ....

Ans. f-block - The d-block elements have 2 incomplete outermost shells whereas the f-block elements have 3 outermost shells which are incomplete.

(7)   Tellurium : .... :: Radium : Metal

Ans. Metalloid - Tellurium has properties of both metals and non metals, therefore, it is called a metalloid.

(8)   Transition elements : .... :: Inner transition elements : Three incomplete outermost shells

Ans. Two incomplete outermost shells - The d-block elements have 2 incomplete outer most shells whereas the f-block elements have 3 outermost shells which are incomplete.

(9)   Lanthanides : Ce to Lu :: Actinides: ....

Ans. Th to Lr - Ce to Lu are called Lathanides and Th to Lr are called Actinides.

(10)   Ca : Alkaline earth metal :: Cs : ....

Ans. Alkali metal - Cs has one electron in its outermost shell and Ca has 2 electrons in its outermost shell.

(11)   Fe : Electropositive :: Cl : ....

Ans. Electronegative - Fe has a tendency to form a cation by losing its valence electrons and it is called electropositive property whereas Cl has a tendency to gain electron and it is called electronegative property.

(12)   (Li, Na, K) : .... :: (F, Cl, Br) : Group 17

Ans. Group 1 - Li, Na, K have one electron in their outermost shell whereas F, Cl, Br have 7 electrons in their outermost shell.

(13)   Valency of Na (2,8,1) : 1 (One) :: Valency of P(2,8,5) : ....

Ans. 3 (Three) - Na loses 1 electron to get the configuration of He (2b) and P requires 3 electrons to get a configuration 2, 8, 8. (Ar). Therefore, the valency of P is 3.

Q.1. (A) 4. Match the columns:

*(1)

Column A		Column B		Column C	
(i)	Triad	(a)	Lightest and negatively charged particle in all the atoms.	(1)	Mendeleev
(ii)	Octave	(b)	Concentrated mass and positive charge	(2)	Thomson
(iii)	Atomic number	(c)	Average of the first and the third atomic mass	(3)	Newlands
(iv)	Period	(d)	Properties of the eighth element similar to the first	(4)	Rutherford
(v)	Nucleus	(e)	Positive charge on the nucleus	(5)	Dobereiner
(vi)	Electron	(f)	Sequential change in molecular formulae	(6)	Moseley

Ans. $(i - c - 5)$, $(ii - d - 3)$, $(iii - e - 6)$, $(iv - f - 1)$, $(v - b - 4)$, $(vi - a - 2)$

(2)

Column A		Column B	
(1)	Sodium	(a)	Non-metal
(2)	Sulphur	(b)	Lanthanide
(3)	Manganese	(c)	Metal
(4)	Cerium	(d)	Transition metal

Ans. $(1 - c)$, $(2 - a)$, $(3 - d)$, $(4 - b)$

(3)

Column A		Column B	
(1)	Alkali metals	(a)	Valency 4
(2)	Alkaline earth metals	(b)	Valency 0
(3)	Argon	(c)	Divalent
(4)	Carbon	(d)	Monovalent

Ans. $(1 - d)$, $(2 - c)$, $(3 - b)$, $(4 - a)$

(4)

Column A		Column B	
(1)	Atomic size in a period from left to right	(a)	Atomic mass
(2)	Atomic size in a group from top to bottom	(b)	Increases
(3)	Modern Periodic Law	(c)	Atomic number
(4)	Mendeleev's Periodic Law	(d)	Decreases

Ans. $(1 - d)$, $(2 - b)$, $(3 - c)$, $(4 - a)$

(5)

Column A		Column B	
(1)	Alkali metals	(a)	Group 2
(2)	Alkaline earth metals	(b)	Group 1
(3)	Halogens	(c)	Group 18
(4)	Noble gases	(d)	Group 17

Ans. $(1 - b)$, $(2 - a)$, $(3 - d)$, $(4 - c)$

Q.1. (A) 5. State whether the following statement is 'True' or 'False'. If false; write the correct statement for the same.

(1) Lithium, Potassium and Sodium are elements forming Dobereiner's triad.

(2) According to Mendeleev's periodic law, the properties of elements are a periodic function of their atomic numbers.

(3) Periods are the horizontal rows of elements.

(4) Group 17 elements are known as Noble gases.

(5) Silicon is a metalloid.

(6) As we move from left to right in a period of Modern Periodic table, atomic size of the elements gradually increases.

(7) Group 1 elements in Modern Periodic table are referred as "alkali metals".

(8) Argon is not an inert gas.

(9) The d-block elements are called transition elements.

(10) Upto Calcium, the law of octaves was found to be applicable.

(11) Metals are electronegative and non-metals are electropositive.

(12) Eka-aluminium was discovered and named as Gallium (Ga).

(13) Atomic number is the number of protons or electrons present in the nucleus.

(14) Eka boron is known as Germanium.

(15) Tellurium, Polonium are metalloids.

(16) Isotopes have same atomic masses.

(17) Isotopes have similar chemical properties.

(18) La stands for Lutetium.

(19) f-block elements are metalloids.

(20) In an atom of an element, extra-nuclear electrons take part in the chemical reaction.

Ans. *(1) False. Lithium, Sodium and Potassium are elements forming Dobereiner's triad. (2) False. According to Mendeleev's periodic law, the properties of elements are a periodic function of their atomic masses. (3) True (4) False. Group 17 elements are known as Halogens. (5) True (6) False. As we move from left to right in a period of the Modern Periodic table, atomic size of the elements gradually decreases. (7) True (8) False. Argon is an inert gas, belongs to group 18. (9) True (10) True (11) False. Metals are electropositive and non-metals are electronegative. (12) True (13) True (14) Eka-boron is known as Scandium. (15) True (16) False. Isotopes are atoms of the same element having same atomic number but different atomic masses. (17) True (18) False. La stands for Lanthanum. (19) False. f-block elements are metals. (20) True*

Q.1. (A) 6. Answer the following.

*(1) Write the name and symbol of the elements from the description.

(i) The atom having the smallest size.
Ans. Helium (He).

(ii) The atom having the smallest atomic mass.
Ans. Hydrogen (H).

(iii) The most electronegative atom.
Ans. Fluorine (F).

(iv) The noble gas with the smallest atomic radius.
Ans. Helium (He).

(v) The most reactive nonmetal.
Ans. Fluorine (F).

*(2) Write the names from the description.

(i) The period with electrons in the shell, K, L and M.
Ans. Period 3.

(ii) The group with valency zero.
Ans. Group 18

(iii) The family of non-metals having valency one.
Ans. Halogens.

(iv) The family of metals having valency one.
Ans. Alkali metals.

(v) The family of metals having valency two.
Ans. Alkaline Earth metals.

(vi) The metalloids in the second and third periods.
Ans. Boron and Silicon.

(vii) Non-metals in the third period.
Ans. Phosphorus, Sulphur, Chlorine and Argon.

(viii) Two elements having valency 4.
Ans. Carbon, Silicon.

Q.1. (A) 7. Name the following:

*(1) Three elements having a single electron in their outermost shell.
Ans. (i) Lithium (Li) (2,1) (ii) Sodium (Na) (2, 8 1) (iii) Potassium (K) (2,8,8,1).

*(2) Three elements with filled outermost shell.
Ans. (i) Helium (2) (ii) Neon (2,8) (iii) Krypton (2,8,18,8).

*(3) Three elements having 7 electrons in their outermost shell.
Ans. (i) Fluorine (2,7) (ii) Chlorine (2,8,7) (iii) Bromine (2,8,18,7).

(4) Three elements which are metalloids.
Ans. (i) Boron (B) (ii) Silicon (Si) (iii) Germanium (Ge).

(5) Three alkaline earth metals with electronic configuration.
Ans. (i) Beryllium (Be) (2,2) (ii) Magnesium (Mg) (2,8,2) (iii) Calcium (Ca) (2,8,8,2).

(6) Two pairs of Dobereiner's triad.
Ans. (i) Lithium (Li), Sodium (Na), Potassium (K) (ii) Chlorine (Cl), Bromine (Br), Iodine (I).

(7) The scientist who classified elements on the basis of atomic mass.
Ans. Dmitri Mendeleev.

(8) The scientist who classified elements on the basis of atomic number.
Ans. Henry Moseley.

(9) The 3 elements which were predicted by Mendeleev for which he left blank spaces in the periodic table.
Ans. Eka-Boron, Eka-Silicon, Eka-Aluminium.

(10) Series of 14 elements placed below the periodic table having atomic no. from 58 to 71 [Ce to Lu]
Ans. Lanthanides.

(11) Series of 14 elements placed below the periodic table having atomic no. from 90 to 103 [Th to Lr]
Ans. Actinides.

Q.1. (B) Choose and write the correct options:

*(1) The number of electrons in the outermost shell of alkali metals is _____

(a) 1   (b) 2   (c) 3   (d) 7

*(2) Alkaline earth metals have valency 2. This means that their position in the Modern Periodic table is in _____

(a) Group 2   (b) Group 16
(c) Period 2   (d) d-block

*(3) Molecular formula of the chloride of an element X is XCl. This compound is a solid having high melting point. Which of the following elements be present in the same group as X.

(a) Na   (b) Mg   (c) Al   (d) Si

*(4) In which block of the Modern Periodic table are the non-metals present?

(a) s-block   (b) p-block

(c) d-block   (d) f-block

(5) ＿＿＿＿＿ triad does not follow Dobereiner's law of triad.

(a) Li, Na, K   (b) Ca, Sr, Ba

(c) Mg, Ca, Sr   (d) Cl, Br, I

(6) ＿＿＿＿＿ resembles alkali metals as well as halogens.

(a) Lithium   (b) Sodium

(c) Hydrogen   (d) Silicon

(7) First period consists of ＿＿＿＿ elements.

(a) 1   (b) 8   (c) 2   (d) 4

(8) Electronic configuration of Mg is ＿＿＿＿

(a) (2, 8, 4)   (b) (2, 8, 1)

(c) (2, 8, 3)   (d) (2, 8, 2)

(9) ＿＿＿＿ is in liquid state at room temperature.

(a) Fluorine   (b) Chlorine

(c) Bromine   (d) Iodine

(10) Atomic radius of Lithium is ＿＿＿＿ pm.

(a) 41   (b) 151   (c) 152   (d) 157

Ans. *(1) (a) 1 (2) (a) Group 2 (3) (a) Na (4)(b) p-block (5) (c) Mg, Ca, Sr (6) (c) Hydrogen (7) (c) 2 (8) (d) (2, 8, 2) (9) (c) Bromine (10) (c) 152*

Q.2.1. Solve the following:

(1) X, Y and Z are the elements of a Dobereiner's Triad. If the atomic mass of X is 7 and that of Z is 39, what should be the atomic mass of Y?

Ans. Atomic mass of X = 7

Atomic mass of Z = 39

∴ According to Dobereiner's Triad, atomic mass of Y

$$= \frac{X + Z}{2} = \frac{7 + 39}{2} = \frac{46}{2} = 23$$

∴ Atomic mass of Y = 23

(2) Two elements X and Y have atomic number 12 and 16 respectively. Write the electronic configuration for these elements. To which period of the Modern Periodic table do these two elements belong? *[HOTS]*

Ans.

Element	Atomic number	Electronic configuration
X	Z = 12	2, 8, 2
Y	Z = 16	2, 8, 6

Both these elements belong to third period.

*(3) Identify Dobereiner's triads from the following groups of elements having similar chemical properties? *[Can you tell?; Textbook Page 16]*
(i) **Mg (24.3), Ca (40.1), Sr (87.6)**
(ii) **S (32.1), Se (79.0), Te (127.6)**
(iii) **Be (9.0), Mg (24.3), Ca (40.1)**

Ans.

(i) (a) Mg (24.3), (b) Ca (40.1), (c) Sr (87.6)

∴ mean of $\dfrac{a + c}{2} = \dfrac{111.90}{2} = 55.95$

which is not approximately equal to the atomic mass of middle element (Ca). Therefore, it does not form Dobereiner's triads.

(ii) (a) S (32.1), (b) Se (79.0), (c) Te (127.6)

∴ mean of $\dfrac{a + c}{2} = \dfrac{159.70}{2} = 79.85$

which is approximately equal to atomic mass of Se. Hence, it forms Dobereiner's triads.

(iii) (a) Be (9.0), (b) Mg (24.3), (c) Ca (40.1)

∴ mean of $\dfrac{a + c}{2} = \dfrac{49.10}{2} = 24.55$

which is approximately equal to atomic mass of Mg. Hence, it forms Dobereiner's triads.

Q.2.2. State the laws / Define:

(1) Newlands' Law of Octaves:

Ans. Newlands' Law of Octaves states that "When the elements are arranged in an increasing order of their atomic masses, the properties of every eighth element are similar to those of the first."

(2) Mendeleev's Periodic law:

Ans. Mendeleev's Periodic law states that "properties of elements are periodic function of their atomic masses."

(3) Modern Periodic Law:

Ans. Modern Periodic law states that "properties of elements are periodic function of their atomic numbers."

(4) Dobereiner's Triad

Ans. When elements with similar chemical properties are arranged in increasing order of their atomic mass in group of three called as triads, the atomic mass of the middle element is approximately equal to the mean of the atomic masses of the other two elements.

(5)   Periods

Ans. The Horizontal rows of elements in the periodic table are called periods.

(6)   Groups

Ans. The Vertical columns of elements in the periodic table are called groups.

(7)   Normal Elements

Ans. The elements in which only last shell is incompletely filled are called as normal elements.

(8)   Lanthanide Series

Ans. The series of fourteen elements from Cerium [Ce (58)] to Lutetium [Lu (71)] is called Lanthanides Series.

(9)   Actinide Series

Ans. The series of Fourteen elements from Thorium [Th (90)] to Lawrencium [Lr (103)] is called Actinide Series.

(10)   Transition elements

Ans. The elements in which last two shells are incompletely filled are called Transition elements. They belong to d-block of Modern Periodic Table.

(11)   Inner Transition elements

Ans. The f-block elements are placed at the bottom of the periodic table and they have last three shells incompletely filled. These elements are called Inner Transition Elements.

(12)   Atomic radius

Ans. For an isolated atom, atomic radius is the distance between the centre of the nucleus of an atom to its outermost shell.

(13)   Valency

Ans. The number of electrons accepted, donated or shared by an atom so as to complete the octet in its outermost shell is called valency.

<div align="center">**OR**</div>

Valency is the combining capacity of an element.

(14)   Inert elements

Ans. Elements present in group 18 on the extreme right of the Modern Periodic table are called Inert elements or Noble gases. They have all shells including the outermost shell completely filled.

(15)   Isotopes

Ans. Different atoms of the same element having same atomic number but different atomic mass number are called Isotopes.

(16)   Metalloids

Ans. Elements which show the properties of both metals and non-metals are called as metalloids. e.g. Silicon (Si), Arsenic (As), Tellurium (Te).

Q.2.3. Answer the following questions in one or two sentences:

(1)   What is meant by periodicity?

Ans. The repetition of same properties after certain interval is called periodicity.

(2)   How will the tendency to gain electrons change as we go from left to right across a period? Why?

Ans. Tendency to gain electrons increases from left to right in a period because atomic size goes on decreasing and effective nuclear charge increases.

(3)   Why was Dobereiner's classification of elements not useful?

Ans. Dobereiner's Triad was not useful for classification of elements because he could identify only some triads from the known elements as other triads did not obey Dobereiner's rule.

(4)   In the periodic table where are the metalloids placed?

Ans. The metalloids are elements which lie along the border of the zig zag line which separates metals placed on the left side from non-metals placed on the right side.

(5)   Elements of which group are called as alkali metals?

Ans. Elements of group 1 are called alkali metals.

(6)   Which is the incomplete period in the Modern Periodic table?

Ans. Since the Modern Periodic table is complete there is no incomplete period.

(7)   Which law was modified into Modern Periodic law?

Ans. Mendeleev's Periodic law was modified into Modern Periodic law.

(8)   What are periodic properties?

Ans. The properties which show gradual variation in a group and in a period and they repeat themselves after a certain interval of atomic number are called periodic properties.

(9)   What are normal elements?

Ans. Elements of group 1, 2 and 13 to 17 are called normal elements. These elements have only the outermost shell incompletely filled.

(10)   On what basis is Potassium (Z = 19) placed in 4th period and group 1?

Ans. The electronic configuration of potassium is (2, 8, 8, 1). It has four shells so it belongs to the period 4 . The period 4 has elements with the 4th shell being filled. Potassium has 1 electron in its valence shell. Hence, it is placed in group 1. Group 1 has elements with 1 electron in the valence shell.

(11) How will you differentiate between metals and non-metals by the number of valence electrons?

Ans. Elements which have 1, 2 or 3 valence electrons are metals and those which have 4, 5, 6 or 7 valence electrons are non-metals.

*(12) What are the types of matter? *(Can you recall?; Textbook Page 16)*

Ans. There are three types of matters viz elements, compounds and mixtures.

*(13) What are the types of elements? *(Can you recall?; Textbook Page 16)*

Ans. The three types of elements are metals, non-metals and metalloids.

*(14) What are the smallest particles of matter called? *(Can you recall?; Textbook Page 16)*

Ans. The smallest particles of matter are called atoms and molecules.

*(15) What is the difference between the molecules of elements and compounds? *(Can you recall?; Textbook Page 16)*

Ans. Molecules of elements contain atoms of the same element where as molecules of compounds contain atoms of two or more different elements.

*(16) What are the values of 'n' for the shells K, L and M? *(Can you recall?; Textbook Page 24)*

Ans. K - 1   L - 2   M - 3

*(17) What is the maximum number of electrons that can be accommodated in a shell? Write the formula. *(Can you recall?; Textbook Page 24)*

Ans.

Shell	$2n^2$	Electron Capacity
K	$2 \times 1^2 = 2$	2
L	$2 \times 2^2 = 8$	8
M	$2 \times 3^2 = 18$	18
N	$2 \times 4^2 = 32$	32

*(18) Deduce the maximum electron capacity of the shells K, L and M? *(Can you recall?; Textbook Page 24)*

Ans. K - 2 $(2n^2 = 2 \times 1^2 = 2)$

L - 8 $(2n^2 = 2 \times 2^2 = 2 \times 4 = 8)$

M - 18 $(2n^2 = 2 \times 3^2 = 2 \times 9 = 18)$

*(19) There are some vacant places in Mendeleev's Periodic table. In some of these places, the atomic masses are seen to be predicted. Enlist three of these predicted atomic masses along with their group and period. *(Think about it; Textbook Page 19)*

Ans.

Predicted atomic mass	Group	Period	Predicted Name	Present Names
44	III	4	Eka boron	Scandium
68	III	5	Eka aluminium	Gallium
72	IV	5	Eka silicon	Germanium

*(20) Due to uncertainty in the names of some of the elements, a question mark is indicated before the symbol in the Mendeleev's periodic table. What are such symbols? *(Think about it; Textbook Page 19)*

Ans. Mendeleev arranged the elements in the increasing order of atomic masses. In some places the atomic mass of elements would not be in right order to put them in the correct group. Tellurium is heavier than Iodine, but he put Iodine after Tellurium because Iodine has similar properties like F, Cl, Br. He placed the elements according to their properties and put a question mark to indicate that the atomic mass needs to be checked. for e.g. ?Yt = 88 in Mendeleev's periodic table was corrected as Yt = 88.906 in Modern Periodic table.

Q.2.4. Write short notes on:

*(1) Mendeleev's Periodic law:

Ans.

(i) The Russian scientist Dmitri Mendeleev developed the periodic table of elements during the period 1869 to 1872 A.D.

(ii) Mendeleev's periodic table is the most important step in the classification of elements.

(iii) Mendeleev considered the fundamental property of elements, namely the atomic mass as standard and arranged 63 elements known at that time in an increasing order of their atomic masses.

(iv) Then, he transferred this into the periodic table of elements in accordance with the physical and chemical properties of these elements.

(v) He organized the periodic table on the basis of the chemical and physical properties of the elements.

(vi) These were the molecular formulae of hydrides and oxides of the elements, melting points, boiling points and densities of the elements and their hydrides and oxides.

(vii) Mendeleev found that the elements with similar physical and chemical properties repeat after a definite interval.

(viii) On the basis of this finding, Mendeleev, stated the following periodic law "Properties of elements are periodic function of their atomic masses".

*(2)　Structure of the Modern Periodic table.

Ans.

(i)　The Modern Periodic table contains seven horizontal rows called the periods 1 to 7.

(ii)　Similarly, eighteen vertical columns are the groups 1 to 18.

(iii)　The arrangement of the periods and groups results into formation of boxes.

(iv)　Atomic numbers are serially indicated in the upper part of these boxes.

(v)　Each box corresponds to the place for one element.

(vi)　Apart from these seven rows, two separate rows are placed at the bottom of the periodic table.

(vii)　These are called Lanthanide series and Actinide series respectively.

(viii)　There are 118 boxes in the periodic table including the two series.

(ix)　It means that there are 118 places for elements in the Modern Periodic table.

(x)　The Modern Periodic table is now completely filled, means all the 118 elements are now discovered.

(xi)　The entire periodic table is divided into four blocks, viz, s-block, p-block, d-block and f-block.

(xii)　The s-block contains the groups 1 and 2 elements.

(xiii)　The groups 13 to 18 constitute the p-block elements.

(xiv)　The groups 3 to 12 constitute the d-block elements. The d-block elements are called transition elements.

(xv)　The lanthanide and actinide series at the bottom form the f-block elements.

(xvi)　A zig-zag line can be drawn in the p-block of the periodic table.

(xvii)　The metalloid elements lie along the border of the zig-zag line.

(xviii)　All the metals lie on the left side of the zig-zag line, while all the non-metals lie on the right side.

*(3)　Position of isotopes in the Mendeleev's and the Modern Periodic table.

Ans.

(i)　Different atoms of the same element having same atomic number but different atomic mass number are called isotopes.

(ii)　Isotopes were discovered long time after Mendeleev put forth the periodic table.

(iii)　As isotopes have the same chemical properties but different atomic masses, a challenge was posed in placing them in Mendeleev's periodic table.

(iv)　Based on chemical properties, they were to be placed in same group, while based on atomic masses they were to be placed in different groups.

(v)　Hence, there was no definite place for isotopes.

(vi)　This anomaly arose in Mendeleev's periodic table because the elements were arranged in an increasing order of their atomic masses.

(vii)　In 1913 A.D., Henry Moseley revealed that atomic number is a more fundamental property of an element than its atomic mass.

(viii)　Hence, he modified Mendeleev's Periodic Table and arranged the elements in an increasing order of their atomic number in the Modern Periodic Table.

(ix)　By doing so, the anomaly of Mendeleev's Periodic Table regarding isotopes was removed.

(x)　Therefore, in the Modern Periodic Table the isotopes could be placed in the same group and the radioactive isotopes were placed in two separate series below at the bottom of the periodic table.

(4)　Halogens or group 17 elements.

Ans.

(i)　The second last column in the periodic table is group 17 (VII – A) which contains halogens.

(ii)　The members of this group from top to bottom are as given in the following table:

Group 17 elements	Symbol	Atomic Number (Z)	Electronic configuration	Valency
Fluorine	F	9	2, 7	1
Chlorine	Cl	17	2, 8, 7	1
Bromine	Br	35	2, 8, 18, 7	1
Iodine	I	53	2, 8, 18, 18, 7	1
Astatine	At	85	2, 8, 18, 32, 18, 7	1

(iii)　The valence shell of a halogen contains seven electrons.

(iv)　Thus, it needs one electron to complete its octet.

(v)　The halogen complete their octet and attain the stable inert gas configuration by gaining one electron.

(vi)　Hence, the valency of halogens is one, i.e. they are monovalent.

(vii)　All of them have general formula X_2. Fluorine (F_2) and Chlorine (Cl_2) are gases. Bromine (Br_2) is a liquid, while Iodine (I_2) is a solid.

(5) Transition Elements.

Ans.

(i) Elements present in groups 3 to 12 in the middle of the periodic table are called transition elements.

(ii) Their last two outermost shells are incomplete.

(iii) They belong to d-block of Modern Periodic table.

(iv) All these elements are solid metals at room temperature (except Mercury and Gallium).

(6) Inner-Transition Elements.

Ans.

(i) Elements placed in two separate rows at the bottom of the periodic table are called inner transition elements.

(ii) They include two series of elements: Lanthanide series and Actinide series. They belong to f-block elements of Modern Periodic table.

(iii) 14 elements with atomic number 58 to 71 (Cerium to Lutetium) are called lanthanides. These elements are placed along with lanthanum (La = 57) in group 3 and period 6 because of very close resemblance in properties between them.

(iv) 14 elements with atomic number 90 to 103 (Thorium to Lawrencium) are called actinides. These elements are placed along with actinium (Ac = 89) in group 3 and period 7 because of very close resemblance in their properties.

(v) They have last three shells incompletely filled.

(vi) All these elements are metals.

(7) Metallic and Non-metallic properties

Ans.

(i) Metals show tendency to lose electrons. Therefore, they are said to be electropositive.

(ii) Non-metals show the tendency to accept electrons or share electrons with another atoms. Therefore, they are said to be electronegative.

(iii) Across the period from left to right, metallic character decreases and non-metallic character increases.

(iv) This is because the atomic size decreases due to greater nuclear pull because of which valence electrons cannot be easily removed.

(v) Down the group-metallic character increases and non-metallic character decreases from top to bottom in a group.

(vi) As atomic number increases from top to bottom in a group, newer shells get added which in turn increases its atomic size. Thus nuclear pull decreases due to addition of newer shells and thus the valence electrons present in outermost shell can be easily removed from the atom.

(vii) The three types of elements can be easily shown in the Modern Periodic table with the help of zig-zag line.

(viii) The metalloid elements lie along the border of the zig-zag line. All the metals lie on the left side of zig-zag line while all the non-metals lie on the right side.

Q.2.5. Distinguish between:

(1) Mendeleev's Periodic table and Modern Periodic table.

	Mendeleev's Periodic Table	Modern Periodic Table
Ans.	(i) This table is based on the atomic mass of the elements.	(i) This table is based on the atomic number of the elements.
	(ii) Elements are arranged in increasing order of their atomic mass.	(ii) Elements are arranged in increasing order of their atomic number.
	(iii) Mendeelev's Periodic table consists of only 63 elements.	(iii) Modern Periodic table consists of 118 elements.
	(iv) Mendeelev's Periodic table is based on Mendeleev's Periodic Law, 'Properties of element are a periodic function of their atomic masses.'	(iv) Modern Periodic table is based on Modern Periodic Law,'Properties of elements are periodic function of their atomic number.'
	(v) There was no space for inert gases and radioactive isotopes.	(v) The table contains all elements including inert gases and radioactive isotopes.

(vi) Some elements having similar properties were placed in different groups. Some elements in different groups were found to have similar properties.	(vi) All elements placed in the same group have similar properties.
(vii) Elements could not be divided into four blocks.	(vii) Elements are divided into four blocks – i.e. s, p, d and f blocks.

(2)   Transition elements and Inner transition elements

Ans.

Transition elements	Inner transition elements
(i) Elements placed in groups 3 to 12 in the middle of the Modern Periodic table are called transition elements.	(i) Elements placed in two separate rows at the bottom of the Modern Periodic table are called inner transition elements.
(ii) These elements have last two incompletely filled outermost shells.	(ii) These elements have last three incompletely filled outermost shells.
(iii) They belong to the d-block in the Modern Periodic table.	(iii) They belong to the f-block in the Modern Periodic table.

(3)   Inert gases and Normal Elements

Ans.

Inert gases	Normal Elements
(i) In the atoms of inert gases all the shells are completely filled including the outermost shell.	(i) In the atoms of normal elements, all shells are completely filled except the outermost shell.
(ii) They are stable and chemically inert (i.e. chemically non-reactive)	(ii) They are unstable and are chemically reactive.
(iii) They are included in the p-block of the Modern Periodic table.	(iii) They are included in the s-block as well as p-block of the Modern Periodic table.
(iv) They are placed in zero group (Group 18) of the Modern Periodic table.	(iv) These elements are placed in groups 1, 2 and 13 to 17 of the Modern Periodic table.

(4)   Groups and Periods of Modern Periodic Table

Ans.

Groups	Periods
(i) Vertical columns of elements in the Modern Periodic table are called Groups.	(i) Horizontal rows of elements in the Modern Periodic table are called periods.
(ii) There are 18 groups in the Modern Periodic table.	(ii) There are 7 periods in the Modern Periodic table.
(iii) The group number indicates the valence electrons in the outermost shell.	(iii) The period number indicates the number of shells in the atoms of an element.
(iv) The elements in the same group have similar chemical properties.	(iv) The elements in a period exhibit gradual change in properties from left to right.

(5)   Metallic character and Non-metallic character

Ans.

Metallic character	Non-metallic character
(i) It is the tendency of an atom to lose electrons.	(i) It is the tendency of an atom to accept or share electrons.
(ii) Metallic character decreases from left to right in a period.	(ii) Non-metallic character increases from left to right in a period.

(iii) In a group, metallic character increases from top to bottom.	(iii) In a group, non-metallic character decreases from top to bottom.
(iv) Elements having metallic character are said to be electropositive.	(iv) Elements having non-metallic character are said to be electronegative.

(6) **s-block elements and p-block elements**

Ans.

s-block elements	p-block elements
(i) Elements in group 1 and 2 are called s-block elements including hydrogen.	(i) Elements in group 13 to 17 and zero group are called p-block elements.
(ii) They contain 1 or 2 electrons in the outermost shell.	(ii) They contain 3 to 8 electrons in the outermost shell.
(iii) They are all metals (except hydrogen).	(iii) They are metals, non-metals and metalloids.

(7) **Alkali metals and Alkaline earth metals**

Ans.

Alkali metals	Alkaline earth metals
(i) In the Modern Periodic Table, elements in Group 1 are alkali metals.	(i) In the Modern Periodic Table, elements in Group 2 are alkaline earth metals.
(ii) Atoms of these elements have one electron in the valence shell.	(ii) Atoms of these elements have two electrons in their valence shell.
(iii) They are monovalent.	(iii) They are divalent.
(iv) Their oxides and hydroxides dissolve readily in water.	(iv) Their oxides and hydroxides dissolve slightly in water.

Q.2.6. Give Scientific Reasons:

*(1) Atomic radius goes on decreasing while going from left to right in a period.

Ans.

(i) Atomic radius is the distance between the centre of the atom and its outmost shell.

(ii) Atomic radius decreases across a period.

(iii) This is because valence electrons are being added to the same outermost shell or to the same energy level because of which the electrons added experience greater pull from the nucleus.

(iv) This results in the electrons moving closer to the nucleus. Hence, the atomic radius goes on decreasing while going from left to right in a period.

*(2) Metallic character goes on decreasing while going from left to right in a period.

Ans.

(i) Metallic character is the tendency of an atom to lose electrons.

(ii) In a period, electrons are added to the same shell and hence, these electrons experience greater pull from the nucleus. As a result outermost shell comes closer to nucleus, atomic size decreases.

(iii) Thus it becomes difficult to remove an electron from the outermost shell of an atom. Hence, metallic character decreases from left to right in a period.

*(3) Atomic radius goes on increasing down a group.

Ans.

(i) Atomic radius is the distance between the centre of the atom to its outermost shell.

(ii) New shells are added to the atoms of the elements as we go down from top to bottom in a group.

(iii) The outermost electrons go further and further away from the nucleus, extending the radius and ultimately increase in the size of the atom. Hence, atomic radius goes on increasing down a group.

*(4) Elements belonging to the same group have the same valency.

Ans.

(i) Valency is the number of electrons donated, accepted or shared by the atoms of an element so as to complete the octet in the outermost orbit.

(ii) Valency is dependent upon the number of valence electrons present in the outermost shell of an atom called valence electrons.

(iii) Elements in the same group have same number of valence electrons, irrespective of the number of orbits. Hence, elements in the same group have the same valency.

*(5) **The third period contains only eight elements even though the electron capacity of the third shell is 18.**

Ans.

(i) Period 3 of the periodic table consists of elements whose atom has three shells occupied by electrons.

(ii) As per the electron holding capacity of shells, 2 elements are present in the first period, and 8 elements in the second period.

(iii) The third period also contain only eight elements due to the law of electron octet and also electrons will fill orbitals in increasing order of energy, i.e. the lowest energy orbital first.

(6) **Atomic number is a more fundamental property of an element than its atomic mass.**

Ans.

(i) The atomic number of an element indicates the number of protons in the nucleus or the number of electrons in the atom.

(ii) All the atoms of an element have the same atomic number.

(iii) The number of electrons present in the outermost shell of an atom is responsible for the formation of compounds either by sharing, accepting or donating electrons.

(iv) The chemical properties of an element are decided by its atomic numbers. Hence, atomic number is a more fundamental property of an element than its atomic mass.

(7) **Alkali metals are placed in Group 1.**

Ans.

(i) The group number indicates the number of valence electrons present in the outermost shell of an atom of an element.

(ii) All alkali metals have one electron in their outermost shell. Hence, they are placed in Group 1.

(8) **Inert gases exist in the form of free atoms.**

Ans.

(i) Formation of molecules is based on the electronic configuration of the combining elements.

(ii) In the case of inert gases, all the shells, including the outermost shell are completely filled.

(iii) They have electronic configuration with complete duplet or complete octet.

(iv) Due to their stable electronic configuration, atoms of these elements do not lose, gain or share electrons with other atoms. Hence, inert gases exist in the form of free atoms.

*Q.3.1. Answer the following:

(1) **An element has its electronic configuration as 2, 8, 2. Now answer the following questions:**

(i) **What is the atomic number of this element?**

Ans. Electronic configuration of this element is (2, 8, 2)

∴ The atomic number of this element is 12.

(ii) **What is the group of this element?**

Ans. Atomic number of element is 12 and its electronic configuration is (2, 8, 2). As it has 2 valence electrons, this element belongs to group 2 and its name is Magnesium (Mg).

(iii) **To which period does this element belong?**

Ans. Atomic number of this element is 12 and its electronic configuration is (2, 8, 2). It has 3 shells. The number of shells indicates the period number. Hence it belongs to period 3.

(iv) **With which of the following elements would this element resemble? (Atomic numbers are given in the brackets) N (7), Be (4), Ar (18), Cl (17)**

Ans. The atomic number of the given element is 12 and this element is Magnesium which belongs to group 2 and Period 3.

Electronic configuration of Mg (12) = (2, 8, 2)

Electronic configuration of N (7)   = (2, 5)

Electronic configuration of Be (4)   = (2, 2)

Electronic configuration of Ar (18) = (2, 8, 8)

Electronic configuration of Cl (17) = (2, 8, 7)

Number of valence electrons in this element (Magnesium) is 2. Similarly the number of valence electron in Be is 2. As they have same number of valence electrons they belong to same group i.e. group 2 and will resemble in some of their properties.

(2) **Write down the electronic configuration of the following elements from the given atomic numbers. Answer the following questions with explanation.**

(i) **$_3$Li, $_{14}$Si, $_2$He, $_{11}$Na, $_{15}$P Which of these elements belong to period 3?**

Ans.

Name of the element	Atomic Number	Electronic Configuration		
		K	L	M
Lithium (Li)	3	2	1	
Silicon (Si)	14	2	8	4
Helium (He)	2	2		
Sodium (Na)	11	2	8	1
Phosphorous (P)	15	2	8	5

As the elements Silicon (Si), Sodium (Na) and Phosphorous (P) have electrons in the three shells; K, L and M, therefore these elements belong to period 3 as the number of shells indicates the period number.

(ii) $_1$H, $_7$N, $_{20}$Ca, $_{16}$S, $_4$Be, $_{18}$Ar. **Which of these elements belong to the second group?**

Ans.

Name of the element	Symbol	Atomic Number	Electronic Configuration			
			K	L	M	N
Hydrogen	H	1	1			
Nitrogen	N	7	2	5		
Calcium	Ca	20	2	8	8	2
Sulphur	S	16	2	8	6	
Beryllium	Be	4	2	2		
Argon	Ar	18	2	8	8	

From the above electronic configurations, elements Calcium (Ca) and Beryllium (Be) have same number of valence electrons, i.e. 2, therefore Calcium and Beryllium belong to group 2. We can infer from this that the group follows the trend of same valence electrons.

(iii) $_7$N, $_6$C, $_8$O, $_5$B, $_{13}$Al. **Which is the most electronegative element among these?**

Ans.

Name of the element	Symbol	Atomic Number	Electronic Configuration		
			K	L	M
Nitrogen	N	7	2	5	
Carbon	C	6	2	4	
Oxygen	O	8	2	6	
Boron	B	5	2	3	
Aluminium	Al	13	2	8	3

Among the elements given, Nitrogen, Carbon, Oxygen and Boron belong to the second period. As we know in a period from left to right, the electronegativity increases. Electronegativity means the tendency of an element to form anion by accepting the electrons. Therefore, Oxygen is the most electronegative element, since it is present at the extreme right amongst the given elements of period 2.

(iv) $_4$Be, $_6$C, $_8$O, $_5$B, $_{13}$Al. **Which is the most electropositive element among these?**

Ans.

Name of the element	Symbol	Atomic Number	Electronic Configuration		
			K	L	M
Beryllium	Be	4	2	2	
Carbon	C	6	2	4	
Oxygen	O	8	2	6	
Boron	B	5	2	3	
Aluminium	Al	13	2	8	3

Tendency of atoms of an element to lose electrons and form positive ion, cation, is known as electropositivity. These elements lose valence electrons to form cations having a stable noble gas configuration. It is the metallic character of that element. Electropositivity decreases as we move from left to right in a period. Among the elements given, Beryllium, Carbon, Oxygen and Boron belong to the second period. As Beryllium is the left most element, it will show high electropositive characteristic. Therefore, Beryllium is the most electropositive element.

(v) $_{11}$Na, $_{15}$P, $_{17}$Cl, $_{14}$Si, $_{12}$Mg. **Which of these has the largest atom?**

Ans.

Name of the element	Symbol	Atomic Number	Electronic Configuration		
			K	L	M
Sodium	Na	11	2	8	1
Phosphorous	P	15	2	8	5
Chlorine	Cl	17	2	8	7
Silicon	Si	14	2	8	4
Magnesium	Mg	12	2	8	2

Atomic size or radius is the distance between the nucleus of an atom and its outermost shell. Atomic size gradually decreases from left to right across a period. All the above elements belong to period 3, having electrons in the three shells. Atomic size decreases across a period, because valence electrons get added to the same outermost shell. Electrons added experience greater pull from the nucleus. Due to the increased nuclear charge, the electrons are pulled towards the nucleus to a greater extent and thereby, the size of the atom decreases.

In case of sodium, third shell is having only 1 electron. There is less force of attraction for the valence electron towards the nucleus and therefore, size of the atom is larger as compared to remaining elements. Hence, Na is the largest atom.

(vi) $_{19}$K, $_3$Li, $_{11}$Na, $_4$Be. Which of these atoms has smallest atomic radius?

Ans.

Name of the element	Symbol	Atomic Number	Electronic Configuration			
			K	L	M	N
Potassium	K	19	2	8	8	1
Lithium	Li	3	2	1		
Sodium	Na	11	2	8	1	
Beryllium	Be	4	2	2		

From the above elements, potassium, lithium and sodium belong to group 1. As we know, atomic radius increases down a group or from top to bottom. This is because while going down a group, a new shell is added. Therefore, the distance between the outermost electron and the nucleus goes on increasing. Hence, Element Lithium in group 1 and Beryllium in group 2 have the smallest atomic radius as they have only two shells. In period: compared to Lithium, Beryllium has the smallest radius.

(vii) $_{13}$Al, $_{14}$Si, $_{11}$Na, $_{12}$Mg, $_{16}$S. Which of the above elements has the highest metallic character?

Ans.

Name of the element	Symbol	Atomic Number	Electronic Configuration		
			K	L	M
Aluminium	Al	13	2	8	3
Silicon	Si	14	2	8	4
Sodium	Na	11	2	8	1
Magnessium	Mg	12	2	8	2
Sulphur	S	16	2	8	6

All the elements given belong to period 3. Metallic character of an element can be defined as how readily an atom can lose electron. From left to right across a period, metallic character decreases. This is because, electrons are added to the same shell, and hence, these electrons experience greater pull from the nucleus, thus atomic size

decreases, and it becomes difficult to remove an electron from the atom. As in Sodium (2,8,1), only one electron is present in the outermost orbit. So, it easily loses this one electron because of weaker nuclear attraction, hence, it possesses highest metallic character.

(viii) $_6$C, $_3$Li, $_9$F, $_7$N, $_8$O. Which of the above elements has the highest non-metallic character?

Ans.

Name of the element	Symbol	Atomic Number	Electronic Configuration	
			K	L
Carbon	C	6	2	4
Lithium	Li	3	2	1
Fluorine	F	9	2	7
Nitrogen	N	7	2	5
Oxygen	O	8	2	6

All the elements given above belong to second period. While going from left to right in a period, non-metallic character increases. The tendency of an element to form anion or the electronegativity is the non-metallic character of an element. As Fluorine is present in extreme right of period 2, it will also possess highest non-metallic character and also Fluorine has 7 electrons in its outermost shell, that means 1 electron is less to complete its octet.

(3) The following table shows the position of six elements A, B, C, D, E and F in the periodic table. *(Activity Based)*

Groups / Periods	1	2	3 to 12	13	14	15	16	17	18
2	A					B			C
3		D			E				F

Using the above table, answer the following questions:

(i) Which element is a metal with valency 2?

Ans. D

(ii) Which element is a non-metal with valency 3?

Ans. B

(iii) Out of D and E, which one has a bigger atomic radius and why?

Ans. D, because the atomic size decreases along a period from left to right.

(iv) Write a common name for the family of elements C and F?

Ans. Noble gases

Q.3.2. Explain the following

*(1) Chlorine has two isotopes, viz, Cl - 35 and Cl - 37. Their atomic masses are 35 and 37. Their chemical properties are same. Where should these be placed in Mendeleev's periodic table? In different places or in the same place? *(Use your brain power; Textbook Page 19)*

Ans. Mendeleev arranged the elements in increasing order of atomic mass. Since the atomic masses of the isotopes of chlorine are 35 and 37, they should be kept in different positions in the Mendeleev Periodic table.

(2) Write the molecular formulae of oxides of the following elements by referring to the Mendeleev's periodic table. *(Use your brain power; Textbook Page 20)*

Ans.

Element	Oxides
(i) Na	Na_2O
(ii) Ca	CaO
(iii) Rb	Rb_2O
(iv) Ba	BaO
(v) Sn	SnO_2
(vi) Si	SiO_2
(vii) C	CO_2
(viii) P	P_2O_5
(ix) Cl	ClO, ClO_2

*(3) Write the molecular formula of the compounds of the following elements with hydrogen.
(C, S, Br, As, F, O, N, Cl) *(Use your brain power; Textbook Page 20)*

Ans.

Elements	Compound formed with H	Elements	Compound formed with H
C	CH_4	S	H_2S
Br	HBr	As	AsH_3
F	HF	O	H_2O
N	NH_3	Cl	HCl

(4) A metal M forms an oxide having the formula M_2O_3. It belongs to 3rd period in the Modern Periodic table. Write the atomic number and valency of the metal.

Ans. Atomic number = 13

Electronic configuration = (2, 8, 3)

Valency = 3

*(5) What is the relationship between the electronic configuration of an element and its valency? *(Think about it; Textbook Page 24)*

Ans. From electronic configuration, we come to know the number of valence electrons, i.e. the number of electrons in the outermost shell. The valency of an element is determined from valence electrons. That is, how many electrons it has to lose or gain or share to complete its outermost orbit.

*(6) The atomic number of beryllium is 4 while that of oxygen is 8. Write down the electronic configuration of the two and deduce their valency from the same. *(Think about it; Textbook Page 24)*

Ans. Atomic number of Beryllium = 4

Electronic configuration   = (2, 2)

Atomic number of Oxygen   = 8

Electronic configuration   = (2, 6)

Valency of Beryllium is 2,

Valency of Oxygen is = 8 – 6 = 2

Q.3.3. Answer the questions based on Modern Periodic table.

*(1) Use your brain power; Textbook Page 25

Element	O	B	C	N	Be	Li
Atomic radius (pm)	66	88	77	74	111	152

(i) By referring to the Modern Periodic table find out the period to which the above elements belong?

Ans. Elements O, B, C, N, Be, Li belong to period 2.

(ii) Arrange the above elements in a decreasing order of their atomic radii.

Ans. The above elements in the decreasing order of their atomic radii are as follows:

Elements	Li	Be	B	C	N	O
Atomic radii	152	111	88	77	74	66

(iii) Does this arrangement match with the pattern of the second period of the Modern Periodic table.

Ans. Yes. As we move from left to right within a period the atomic number increases one by one, meaning the positive charge on the nucleus increases by one unit at a time, but the electrons are added to the same orbit, thereby, increasing the pull towards the nucleus which decreases the size of the atom.

(iv) **Which of the above elements have the biggest and the smallest atom?**

**Ans.** Li has the biggest atom and O has the smallest atom.

(v) **What is the periodic trend observed in the variation of atomic radius while going from left to right within a period?**

Ans. Atomic radius decreases from left to right within a period.

*(2) **Use your brain power; Textbook Page 25**

Element	K	N	Rb	Cs	Li
Atomic radius	231	186	244	262	152

(i) **By referring to the Modern Periodic table find out the group to which above elements belong?**

Ans. Above elements belong to group 1.

(ii) **Arrange the above elements vertically downwards in an increasing order of atomic radii.**

Ans. The above elements vertically downwards in an increasing order of atomic radii are as follows:

Ans.

Li	152
Na	186
K	231
Rb	244
Cs	262

(iii) **Does this arrangement match with the pattern of the group 1 of the Modern Periodic table?**

Ans. Yes. As we go down a group number of shells increases, therefore the atomic radii also increases.

(iv) **Which of the above elements have the biggest and the smallest atom?**

Ans. 'Cs' has the biggest atom and 'Li' has the smallest atom.

(v) **What is the periodic trend observed in the variation of atomic radii down a group?**

Ans. Atomic radii increases down a group, as number of shells are added one at a time.

*(3) **Use your brain power; Textbook Page 26**

(i) **Classify the elements of the third period into metals and non - metals.**

Ans. Elements of third period are:

Na   Mg   Al   Si   P   S   Cl   Ar
       Metals   Metalloid   Non - Metals
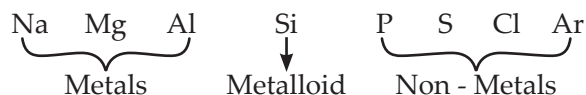
(ii) **On which side of the period are the metals? Left or Right?**

Ans. Left.

(iii) **On which side of the period did you find the Non - metals?**

Ans. Right.

*(4) **Use your brain power; Textbook Page 27.**

(i) **What is the cause of non - metallic character of element?**

Ans. When any element shows tendency to accept or share electrons and forms a negative charge, they are said to be electronegative. Non-metals are electronegative.

(ii) **What is the expected trend in the variation of non-metallic character of element from left to right in a period?**

Ans. Non-metallic character increases from left to right in a period.

(iii) **What would be the expected trend in the variation of non-metallic character of elements down a group?**

Ans. Non-metallic character decreases as we move down a group.

*(5) **Can you tell; Textbook Page 22**

(i) **Go through the Modern Periodic table (fig 2.1) and write the names one below the other of the elements of group 1.**

Ans. H - Hydrogen

Li - Lithium

Na - Sodium

K   - Potassium

Rb - Rubidium

Cs - Caesium

Fr - Francium

are the elements of group 1.

(ii) **Write the electronic configuration of the first four elements in this group.**

Ans.

Element	Atomic No.	Electronic configuration			
		K	L	M	N
H	1	1			
Li	3	2	1		
Na	11	2	8	1	
K	19	2	8	8	1

(iii) **What similarity do you find in their electronic configuration?**

Ans: The outermost shell contains one electron in all these elements.

(iv) **How many valence electrons are there in each of these elements?**

Ans: Number of valence electrons in each of the these elements is 1.

*(6) Can you tell; Textbook Page 23

(i) On going through the Modern Periodic table (fig 2.1) it is seen that the elements Li, Be, B, C, N, O, F and Ne belong to the period-2. Write down the electronic configuration.

Ans.

Element	Atomic no.	Electronic configuration			
		K	L	M	N
Li	3	2	1		
Be	4	2	2		
B	5	2	3		
C	6	2	4		
N	7	2	5		
O	8	2	6		
F	9	2	7		
Ne	10	2	8		

(ii) Is the number of valence electrons same for all these elements?

Ans. No, they are not the same.

(iii) Is the number of shells the same in these ?

Ans. Yes, the number of shells are the same. Each one of this has 2 shells.

*Q.3.4. Write answers with explanation:

(Use your brain power; Textbook Page 21)

(1) How is the problem regarding the position of cobalt (^{59}Co) and nickel (^{59}Ni) in Mendeleev's periodic table resolved in Modern Periodic table?

Ans.

(i) According to Mendeleev's periodic law, elements are arranged in the order of their increasing atomic masses.

(ii) When Co and Ni were put in the group on the basis of their chemical properties it was found that Co having higher mass of 58.9 comes first and Nickel with slightly lower atomic mass of 58.7 comes later.

(iii) Modern Periodic table resolved this problem. According to the Modern Periodic law, elements are arranged in their increasing order of atomic number.

(iv) The atomic number of Cobalt is 27 comes first and Nickel with atomic number 28 comes next even if their atomic masses are in the reverse order.

(2) How did the position of $^{35}_{17}$Cl and $^{37}_{17}$Cl get fixed in the Modern Periodic table?

Ans.

(i) Modern Periodic table is based on atomic numbers, So, the position of isotopes of elements was decided by arranging the elements in the ascending order of their atomic numbers.

(ii) As isotopes have the same atomic number they do not need to be given different positions (slots).

(3) Can there be an element with atomic mass 53 or 54 in between the two elements, Chromium $^{52}_{24}$Cr and Manganese $^{55}_{25}$Mn?

Ans. It is not possible. Since their atomic numbers are continuous, there cannot be an element between Chromium and Manganese.

(4) What do you think? Should hydrogen be placed in the group 17 of halogens or group 1 of alkali metals in the Modern Periodic table?

Ans.

(i) Hydrogen fits in its current position in the periodic table (group 1) much better than in group 17 (though is not a perfect position). For example Hydrogen forms oxide (H_2O) just like oxides of alkali metals (Na_2O, K_2O). It has the same common charge (+ 1) as all alkali metals.

(ii) It resembles halogens in forming diatomic molecules H_2, Cl_2, F_2, Br_2.

(iii) It does not behave like halogens, being mainly in the +1 oxidation state. It does not happen to be like halogens, the most stable compounds of halogens have either -1 or a very high oxidation state like -7 or +5.)

(iv) Hydrogen has one electron in the outermost shell and it is placed in top of group/based on atomic number.

Q.3.5. Activity Based Questions:

(1) Consider isotopes of oxygen ^{16}O and ^{18}O. Would you be able to place them in Mendeleev's Periodic Table?

Ans. No, we cannot place ^{16}O and ^{18}O in Mendeleev's Periodic Table.

(2) Find resemblance between hydrogen and alkali metals by writing compounds of both with chlorine, sulphur and oxygen.

Ans. Alkali metals are : Li, Na, K, Rb, Cs, Fr.

H_2O, Na_2O, H_2S, Na_2S, HCl, NaCl

Hydrogen and alkali metals form similar formulae with oxygen, sulphur and chlorine.

(3) How are isotopes of different elements placed in the Modern Periodic Table?

Ans. Isotopes have same atomic number, but different

atomic mass. In Modern Periodic table the elements are arranged in the increasing order of their atomic numbers. So, all isotopes of an element can be given the same position.

(4) **What should be the position of Hydrogen in the Modern Periodic Table? Why?**

Ans. In the Modern Periodic Table, elements are arranged in the increasing order of their atomic number, so Hydrogen must be the first element in the Modern Periodic Table, because it has the least atomic number.

(5) **How do you calculate valency of an element from its electronic configuration?**

Ans.

(i) Electronic configuration tells about the valence electrons. If the number of valence electrons are 1, 2 or 3, then such elements will donate 1, 2 or 3 electrons. Their valency is also 1, 2 or 3 respectively.

(ii) If an element has 4 valence electrons, it shares all 4 electrons, so the valency is 4. If the number of valence electrons are 5, 6 or 7 electrons, then such elements accept 3, 2 or 1 electrons respectively, thus their valency is 3, 2 or 1.

(iii) When the valence electrons are 2 (for only one shell) or 8 then it is a stable electronic configuration. Thus, the valency is zero.

(6) **What is the valency of elements with atomic number 8, 14, 17 and 20?**

Ans.

Atomic number	Electronic configuration	Valency
8	(2, 6)	2
14	(2, 8, 4)	4
17	(2, 8, 7)	1
20	(2, 8, 8, 2)	2

Q.3.6. Paragraph Based Questions:

(1) **Read the following paragraph and answer the questions given below:**

Dmitri Ivanovich Mendeleev was the first to classify elements on the basis of their fundamental property, the atomic mass, and also on the similarity of chemical properties. When Mendeleev started his work, 63 elements were known. He examined the relationship between the atomic masses of the elements and their physical and chemical properties. Among chemical properties Mendeleev concentrated on the compounds formed by the elements with oxygen and hydrogen. He selected hydrogen and oxygen as they were very reactive and formed compounds with most elements. The formulae of the hydrides and oxides formed were treated as one of the basic properties of an element for its classification. He sorted out the elements with similar properties and pinned the cards together on a wall. He observed that most of the elements got a place in the periodic table and were arranged in the order of their increasing atomic masses. It was also observed that there occurs a periodic recurrence of elements with similar physical and chemical properties. On this basis Mendeleev formulated a periodic law which states that "The properties of the elements are the periodic function of their atomic masses".

(i) **What was the basis of Mendeleev's classification?**

Ans. Mendeleev's classification was based on the fundamental property of atomic mass and also on the similarity of chemical properties.

(ii) **What type of relationship of elements was examined by Mendeleev?**

Ans. Mendeleev examined the relationship between the atomic masses of the elements and their physical and chemical properties.

(iii) **How many elements were known when Mendeleev started his work?**

Ans. 63 elements were known when Mendeleev started his work.

(iv) **What is meant by periodicity according to Mendeleev?**

Ans.

(i) Mendeleev observed that elements with similar physical and chemical properties reoccur when elements were arranged in the increasing order of their atomic masses.

(ii) So according to Mendeleev, the recurrence of elements with similar physical and chemical properties when they are arranged in an increasing order of their atomic masses, is called periodicity.

(iii) **What is Mendeleev's Periodic Law?**

Ans. Mendeleev's Periodic Law is "The properties of elements are the periodic function of their atomic masses".

(2) **Read the following paragraph and answer the questions given below:**

> In the Modern Periodic table, the elements are arranged in the increasing order of their atomic numbers. This arrangement is based on the Modern Periodic law, which states that the properties of elements are a periodic function of their atomic numbers. In the Modern Periodic table, each column is called a group and each row is called a period. Elements within the same group show similarity and gradation in properties. This is due to the same number of electrons in the outermost shell.

(i) **State the law on which modern periodic table is based.**

Ans. Modern periodic table is based on modern periodic law which states that 'Properties of elements are a periodic function of their atomic numbers'.

(ii) **How many groups are there in the modern periodic table?**

Ans. There are 18 groups in Modern periodic table.

(iii) **What is the number of valence electrons in an element of group 1 and group 18 respectively?**

Ans. The number of valence electrons in an element of group 1 is 1 and the number of valence electrons in an element of group 18 is 8.

(iv) **What is the trend in the variation of valency while going down a group?**

Ans. All elements in a group have the same number of electrons in the outermost shell. Therefore, down the group, valency remains the same. Valency of group 1 elements is 1 and that of group 2 elements is 2. The valency of group 18 elements is zero because they are noble gases with completed outermost shell.

(v) **Which pair of elements do you think will have similar properties?**

(a) Sodium and Argon

(b) Sodium and Potassium

(c) Potassium and Neon

Ans. The pair of elements having similar properties are, (b) Sodium and Potassium as they belong to the same group i.e. group 1 of Modern periodic table.

Q.4.1. Answer in detail:

(1) **State the merits of Mendeleev's Periodic Table.**
Ans.
(i) Atomic masses of some elements were revised so as to give them proper place in the periodic table in accordance with their properties. For example, the previously determined atomic mass of beryllium, 14.09, was changed to the correct value 9.4, and beryllium was placed before boron.

(ii) Mendeleev kept vacant spaces in the periodic table for elements not discovered till then. Three of these unknown elements were given the names eka-boron, eka-aluminium and eka-silicon from the known neighbours and their atomic masses were indicated as 44, 68 and 72, respectively. Not only this but their properties were also predicted. Later on these elements were discovered and named as scandium (Sc), gallium (Ga) and germanium (Ge) respectively. The properties of these elements matched well with those predicted by Mendeleev.

(iii) There was no place reserved for noble gases in Mendeleev's original periodic table. However, when noble gases such as helium, neon and argon were discovered towards the end of the nineteenth century, Mendeleev created the 'zero' group without disturbing the original periodic table in which the noble gases were fitted very well.

(2) **What are the demerits of Mendeleev's periodic table?**

Ans.

(i) No fixed position could be given to hydrogen which resembles alkali metals and halogens in the periodic table.

(ii) Isotopes have different atomic masses but same chemical properties. Based on chemical properties, they were to be placed in same group, while based on atomic masses, they were used to be placed in different groups. Hence, there was no definite place for isotopes.

(iii) In certain places, elements with higher atomic mass were placed before elements of lower mass e.g. Co (At. Mass 58.93) was placed before Ni (At. Mass 58.71)

(iv) Some elements with different properties were placed in the same group. e.g. (Mn) Manganese was placed with halogens which totally differ in properties.

(3) **Merits of Modern Periodic table over Mendeleev's periodic table.**

Ans. In Modern Periodic table elements were arranged on the basis of their atomic number.

(i)   All isotopes of the same element have different masses but same atomic number. Therefore, they occupy same position in the Modern Periodic table.

(ii)   When the elements are arranged according to their atomic numbers, the anomaly regarding certain pairs of elements in Mendeleev's periodic table disappears. e.g. atomic numbers of Cobalt and Nickel are 27 and 28 respectively. Therefore, Cobalt will come first and then Nickel, although its atomic mass is greater.

(iii)   Elements are classified according to their electronic configuration into different blocks.

*(4)   Think about it; Textbook Page 24

(i)   What is the relationship between the electronic configuration of an element and its valency?

(iii) Write the Electronic configuration and valency of first 20 elements.
Ans.

Ans. Electronic configuration means the arrangement of electrons in their respective shells including valence shell. The number of electrons in the valence shell determines its valency.

Thus, electronic configuration in a way determines the valency of an element.

(ii)   The atomic number of beryllium is 4 while that of oxygen is 8. Write down the electronic configuration of the two and deduce their valency from the same.

Ans.   Atomic number of Beryllium is 4
        $\therefore$ Its electronic configuration is 2, 2
            Atomic number of oxygen is 8
        $\therefore$ Its electronic configuration is 2, 6
            Valency of Beryllium is 2
            and valency of Oxygen is also 2.

Elements/ Symbol	Atomic No.	Electronic Configuration				Valency
		K	L	M	N	
Hydrogen **H**	1	1				1
Helium **He**	2	2				0
Lithium **Li**	3	2	1			1
Beryllium **Be**	4	2	2			2
Boron **B**	5	2	3			3
Carbon **C**	6	2	4			4
Nitrogen **N**	7	2	5			3
Oxygen **O**	8	2	6			2
Fluorine **F**	9	2	7			1
Neon **Ne**	10	2	8			0

Elements/ Symbol	Atomic No.	Electronic Configuration				Valency
		K	L	M	N	
Sodium **Na**	11	2	8	1		1
Magnesium **Mg**	12	2	8	2		2
Aluminium **Al**	13	2	8	3		3
Silicon **Si**	14	2	8	4		4
Phosphorous **P**	15	2	8	5		3
Sulphur **S**	16	2	8	6		2
Chlorine **Cl**	17	2	8	7		1
Argon **Ar**	18	2	8	8		0
Potassium **K**	19	2	8	8	1	1
Calcium **Ca**	20	2	8	8	2	2

(iv)   What is the periodic trend in the variation of valency while going from left to right within a period. Explain the answer with reference to period 2 and period 3.

Ans.   Period 2

Elements	Li	Be	B	C	N	O	F	Ne
Valency	1	2	3	4	3	2	1	0

Period 3

Elements	Na	Mg	Al	Si	P	S	Cl	Ar
Valency	1	2	3	4	3	2	1	0

For periods 2 and 3, on going from left to right, the valency increases from 1 to 4, then starts decreasing upto 0.

(v)   What is the periodic trend in the variation of valency while going down a group? Explain the answer with reference to group 1, group 2 and group 18.

Ans.

(i)   All the elements in a group have the same number of electrons in the outermost shell. Therefore, down the group, valency remains the same.

(ii)   Valency of group 1 elements is 1 and that of group 2 elements is 2.

(iii)   The valency of group 18 elements is zero because they are noble gases with completed outermost shell.

(5) Comparative study of all the four-blocks of Modern Periodic table.

Ans. Comparative study of blocks

	s-block	**p-block**	**d-block**	**f-block**
No. of shells incomplete/ valence electrons	Outermost shell incomplete (1 or 2 valence electrons).	Outermost shell incomplete except zero group elements that have completely filled shells (3 to 8 valence electrons).	Last two shells are incomplete.	Last three shells are incomplete.
Position	Group 1, Group 2 and Hydrogen	Group 13 to Group 17 and zero group	Group 3 to Group 12	Lanthanides series and actinides series placed separately at the bottom of periodic table.
Includes	All metals except hydrogen.	Metals, non-metals, metalloids, zero group elements.	Metals.	Metals.
Types of elements	Normal elements	Normal and inert elements.	Transition elements	Inner-transition elements.

(6) How could the Modern Periodic Table remove various anomalies of Mendeleev's table?

Ans.

(i) The Modern Periodic Table was classified on the basis of atomic number. All isotopes of the same elements have different masses but same atomic number. Therefore, they occupy the same position in the Modern Periodic table.

(ii) When elements are arranged according to their atomic numbers, the anomaly regarding certain pairs of elements in Mendeleev's Periodic Table disappears e.g. atomic number of cobalt and nickel are 27 and 28 respectively. Therefore, cobalt will come first and then nickel, although atomic mass of cobalt is greater.

(iii) Elements are classified according to their electronic configuration into different blocks.

(iv) Hydrogen has one electron in the outermost shell. It is placed on top of the group 1 with alkali metals which have one electron in the outermost shell. This is because in the Modern Periodic Table elements are arranged on the basis of electronic configuration.

Q.4.2.

(1) Answer the questions based on the given data.

Elements	K	Na	Rb	Cs	Li
Atomic radius (pm)	231	186	244	262	152

(i) To which group do the elements belong? What is the family called?

Ans. The elements belong to group 1. The family is called as alkali metals.

(ii) Arrange the above elements in an increasing order of atomic radii. Does this arrangement match with the pattern of the group in the above answer?

Ans. The above elements in an increasing order of atomic radii are as follows.

Elements	Li	Na	K	Rb	Cs
Atomic radius (pm)	152	186	231	244	262

This arrangement match with the pattern of the group in the above answer (i.e. group 1)

(iii) Which of the above elements have the biggest and the smallest atom?

Ans. The element with biggest atom is Caesium (Cs) and the element with smallest atom is Lithium (Li).

(iv) What is the periodic trend observed in the variation of atomic radii down a group?

Ans. While going down the group the atomic radii goes on increasing, this is because new shells are added to the atoms of the elements as we go down from top to bottom in a group. The outermost electron go further and further away from the nucleus, extending the radius and

ultimately increasing the size of the atom inspite of the increased nuclear charge.

(2) **In the following table, seven elements P, Q, R, S, T, U and V (here letters are not the usual symbols of the elements) of the modern periodic table with their atomic numbers are given.**

3	4	5	6	7	8	9	10
P					T		V
11	12	13	14	15	16	17	18
Q	R		S			U	

(i) **Which of these is an inert gas? Name it.**

Ans. Element 'V' is an inert gas. It is Neon (Ne).

(ii) **Which of these is a halogen? Name it.**

Ans. Element 'U' is a halogen. It is Chlorine (Cl).

(iii) **Which of these are metals? Name them.**

Ans. Elements P, Q and R are metals. Element P is Lithium metal. Element Q is Sodium metal. Element R is Magnesium metal.

(iv) **If Q combines with U, what would be the formula of the compound formed? If Q and U are replaced by their respective metal what will be the formula of the compound formed.**

Ans. If Q combines with U the formula of the compound formed is QU. If Q and U are replaced by their respective metal and non - metal. Element Q is sodium (Na). Element U is chlorine (Cl). The formula of the compound formed is NaCl.

(v) **Write the electronic configuration of R and T, and the type of bond formed by their combination.**

Ans. Electronic configuration of : R is (2, 8, 2) and T is (2, 6). They combine with each other forming Ionic bond.

(3) **Write the answers of the questions with reference to the structure of the periodic table.**
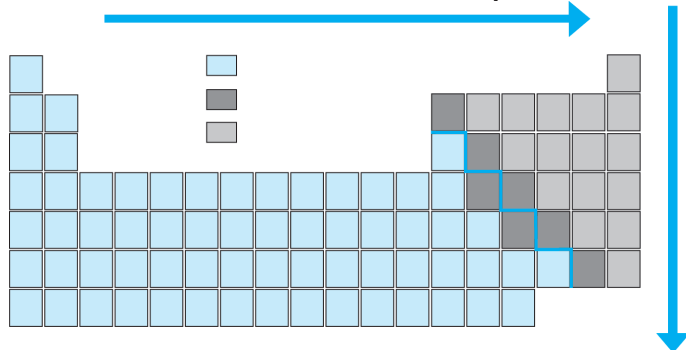
(i) **Which points are considered for the arrangement of the Modern Periodic table?**

Ans. In the Modern Periodic table, the elements are arranged in the order of their increasing atomic number. In the Modern Periodic table there are seven horizontal rows called periods and eighteen vertical columns (1 to 18) called groups. The arrangement of the periods and groups results into formation of boxes. Atomic numbers are serially indicated in the upper part of these boxes.

(ii) **How are blocks indicated?**

Ans. On the basis of the electronic configuration, the elements in the Modern Periodic table are divided into four blocks, viz, s - block, p - block, d - block and f - block. The s - block constitutes the groups 1 and 2. Groups 13 to 18 constitute the p - block. Groups 3 to 12 constitute the d - block, while the lanthanide and actinide series at the bottom form the f - block. The d - block elements are called transition elements. A zig-zag line is shown in the p - block of the periodic table.

(iii) **Which elements are present near the zig zag line?**

Ans. The zig-zag line shows the three traditional types of elements, i.e. metals, non-metals and metalloids. The metalloid elements lie along the border of the zig-zag line. All the metals lie on the left side of the zig-zag line while all the non - metals lie on the right side.

(iv) **Draw the electronic configuration of the period 2 elements of first group in the periodic table.**

Ans. The electronic configuration of the second period element of the first group in the periodic table is shown below:

(2, 1)
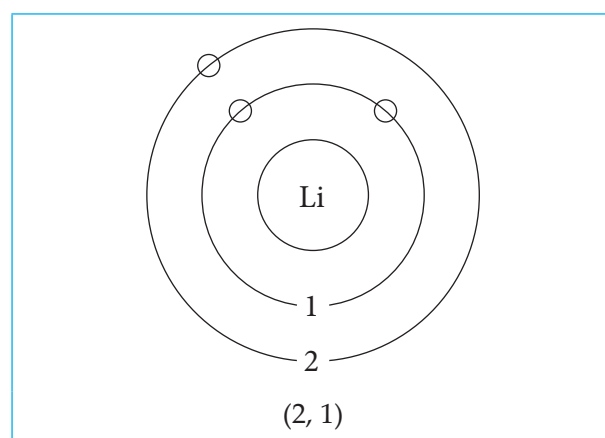
(4) **A part of periodic table is shown in the following figure.**

	1								18
1		2	13	14	15	16	17	
2		P			Q	R		
3						S		T
4								

(i) **Write the symbol of the element 'Q'.**

Ans. Symbol of the element 'Q' is N (Nitrogen)

(ii) Will elements 'R' and 'S' have same number of valence electrons?

Ans. Yes elements 'R' and 'S' will have the same number of valence electrons (six electrons) as they belong to the same group i.e. group 16.

(iii) Arrange elements 'P', 'Q' and 'R' in increasing order of their metallic character.

Ans. The elements in the increasing order of their metallic character are as follows: P > Q > R

(iv) What is the number of electrons in L shell of element T?

Ans. Element T is in the 3rd period of periodic table, hence it has three shells K, L and M. As it also belongs to 18th group i.e., Zero group all it's shells are completely filled. Therefore number of electrons in it's L shell will be 8.

(v) Name any two elements that will have properties similiar to that of element 'P'.

Ans. The two elements that will have properties similar to that of element 'P' are Magnesium (Mg) and Calcium (Ca) as they also belong to group 2 of the modern periodic table.

(5) Study the below given periodic table in which four elements are indicated by alphabets: A, B, C and D

(i) Which element is a metalloid? Name this element and also mention the metalloids in modern periodic table.

Ans. Element 'B' is a metalloid. This element is Silicon (Si). The metalloids in periodic table are : Boron (B), Silicon (Si), Germanium (Ge), Arsenic (As), Antimony (Sb), Tellurium (Te) and Polonium (Po).

(ii) Among 'A' and 'C' which element has larger atomic radius? Why?

Ans. Element A and C belong to the same period. So according to the periodic trends in the modern periodic table, the atomic radius goes on decreasing while going from left to right within a period. Therefore atomic size of element 'A' is larger than atomic size of element 'B'.

(iii) Identify element 'D' and write its electronic configuration. Also write the electronic configuration of the elements above and below 'D' in the same group.

Ans. Element 'D' is sulphur (S) and its electronic configuration is (2, 8, 6). The electronic configuration of element above 'D' in the same group will be (2, 6) and the electronic configuration of element below 'D' in the same group will (2, 8, 18, 6)

(6) A scientist was studying reactions of metals and non-metals. He knew group 1 and 2 elements are metals while group 17 elements are non-metals. So, he chooses different elements from group 1, group 2 and group 17.

(i) What is the valency of magnesium?

Ans. As Magnesium belongs to group 2, its valency is 2.

(ii) Name the element in group 17 which forms a diatomic molecule and exists in solid state at room temperature.

Ans. The element in group 17 which forms a diatomic molecule and exists in solid state at room temperature is Iodine.

(iii) Name the element in group 17 which belongs to the same period as sodium.

Ans. The element in group 17 which belongs to the same period as sodium (Na) is chlorine (Cl).

(iv) Write the formula of compound formed in the reaction between lithium and bromine.

Ans. The formula of compound formed in the reaction between lithium (Li) and bromine (Br) is LiBr (Lithium bromide).

(v) Write the formula of compound formed in the reaction between calcium and fluorine.

Ans. The formula of compound formed in the reaction between Calcium (Ca) and fluorine (F) is CaF_2 (Calcium Fluoride).

❖ ❖ ❖

ASSIGNMENT - 2

Time : 1 Hr.   **Marks : 20**

Q.1. (A) Answer the following questions: **(3)**

(1)   Fill in the blanks:

(i) The element eka-boron in Mendeleev's periodic table is known as _____ in the Modern
      periodic table.

(ii) In the family of alkali metals, the number of valence electrons is _____.

(2)   Name the following:

The most electronegative non-metal.

Q.1. (B) Choose and write the correct option: **(2)**

(1)   The number of electrons in the outermost shell of alkali metals is _____

       (a) 1   (b) 2   (c) 3   (d) 7

(2)   Alkaline earth metals have valency 2. This means that their position in the Modern Periodic table is in

       _____

       (a) Group 2   (b) Group 16 (c)   Period 2   (d) d-block

Q.2. Answer the following: *(Any 2)*   **(4)**

(1)   (i)   State the Modern Periodic law.   (ii)   Define Dobereiner's Triad.

(2)   Distinguish between Transition and Inner transition elements.

(3)   Give scientific reason: Inert gases exist in the form of free atoms.

Q.3. Answer the following: *(Any 2)*   **(6)**

(1)   Identify Dobereiner's triads from the following:

(i) Mg (24.3), Ca (40.1), Sr (87.6)   (ii) S (32.1), Se (79.0), Te (127.6)   (iii) Be (9.0), Mg (24.3), Ca (40.1)

(2)   Draw the atomic structure of Calcium and Fluorine.

(3)   Write the molecular formula of the compound of the following elements with Hydrogen.

(i)   S   (ii)   C   (iii)   F   (iv)   N   (v)   Cl   (vi)   P

Q.4. Answer the following: *(Any 1)*   **(5)**

(1)   (a) $_4$Be, $_6$C, $_8$O, $_5$B. Which is the most electronegative element among these? Justify your answer.

(b) $_{13}$Al, $_{14}$Si, $_{11}$Na, $_{12}$Mg, $_{16}$S. Which of these elements has the highest metallic character?

(2)   What are the merits and demerits of Mendeleev's Periodic table?

❖ ❖ ❖

3 Chemical Reactions and Equations

CONCEPT MAP

CHANGE

PHYSICAL   CHEMICAL

Shown by

Identified by permanent changes in   CHEMICAL REACTION   Represented by   CHEMICAL EQUATION

- Chemical properties
- Colour
- State of matter
- Evolution of gas
- Change in temperature

Takes place by

Chemical Process

Various types

Consists of

- Reactants (L. H. S.)
- Products (R. H. S.)
- Arrow head in (middle)

Like

- Endothermic (heat taken)
- Exothermic (heat given out)
- Oxidation (gain of O_2, loss of H_2)
- Reduction (gain of H_2, loss of O_2)
- Precipitation (formation of a precipitate)
- Neutralization (formation of salt and water)

Combination
$A + B \longrightarrow AB$

Decomposition
$AB \xrightarrow{Energy} A + B$

Displacement
$A + BC \longrightarrow AC + B$

Double decomposition
$A^+B^- + C^+D^- \longrightarrow A^+D^- + C^+B^-$

Points to Remember:

- **Compounds** are formed by chemical combination of elements.
- Many **physical** and **chemical** changes occur in our surroundings.
- When chemical changes occur, a **chemical reaction** takes place.
- Chemical change is **irreversible** whereas physical change is **reversible.**
- Representation of a chemical reaction with the help of chemical formulae, is a **chemical equation.**
- A chemical equation is to be balanced, because total mass of reactants should be **equal** to total mass of products.
- A chemical reaction involves **breaking** and **making** of the bonds between the atoms to produce new substances.
- Chemical reactions are classified into **four types.** in accordance with the nature and the number of the reactants and products.

- Four types of chemical reactions - **(a) Combination (b) Decomposition (c) Displacement (d) Double displacement.**
- When heat or light is evolved in a chemical reaction, this reaction is known as **Exothermic reaction**. e.g. burning of Mg wire, dissolving NaOH in water.
- When heat, light or electricity is absorbed, then this type of reaction is known as **Endothermic reaction**. e.g. electrolysis of water, melting of ice.
- Many types of substances give reactions called **oxidation** and **reduction**.
- When a reactant combines with oxygen or loses hydrogen to form the product, this reaction is called **oxidation reaction**.
- In a **reduction reaction,** oxygen is removed from a substance or hydrogen combines with a substance.
- When oxidation and reduction occur simultaneously in the same reaction, then this type of reaction is known as **redox reaction**. e.g. $2H_2S + SO_2 \rightarrow 3S + 2H_2O$, Here, SO_2 is reduced and H_2S is oxidized.
- Oxidation of vegetable oil causes **rancidity.**
- **Antioxidants** are used to prevent oxidation of fats and oil.
- The slow process of decay or destruction of metal due to the action of air, water, salt or acid, alkali is known as **corrosion**.
- Corrosion of metals can be prevented by **coating** them with suitable paints or plastic coat, **galvanizing, electroplating** with non-corrosive metal.
- When an acid reacts with an alkali, we get salt and water, we call it **neutralization.**

MASTER KEY QUESTION SET - 3

Q.1.   (A) 1. Fill in the blanks and rewrite the complete statements:

(1)   The reaction $CaCO_3 \rightarrow CaO + CO_2$ is a .... reaction.

(2)   The reaction in which oxygen is added to the substance is called .... reaction.

(3)   Corrosion can be prevented by using ....

(4)   The chemical reaction in which heat is absorbed is called .... reaction.

(5)   The substance undergoing oxidation acts as a .... agent.

(6)   Formation of Nitric oxide from nitrogen and oxygen is a .... reaction.

(7)   When Oxidation and Reduction takes place simultaneously in a given chemical reaction, it is known as ....

(8)   The substances taking part in a chemical reaction are called .... , whereas the substances formed as a result of a chemical reaction are called ....

(9)   A chemical reaction is represented by writing a ....

(10) The reaction of a vegetable oil with hydrogen gas takes place in the presence of .... as a catalyst to form vanaspati ghee.

(11) The reaction in which heat is given out along with products is known as .... reaction.

(12) $AgNO_3 + NaCl \rightarrow AgCl + $ ....

(13) A redox reaction takes place during .... respiration.

(14) Rancidity in the food stuff cooked in oil or ghee is prevented by using ....

(15) The chemical reaction during which $H_{2(g)}$ is lost is termed as ....

(16) When acids and alkalis react together, ... and .... is formed.

(17) $Fe + CuSO_4 \rightarrow FeSO_4 + $ ....

(18) The symbol 'aq' in a chemical equation represents ....

(19) All chemical reactions obey law of conservation of mass, hence, chemical equations should be ....

(20) Double displacement reaction in which an insoluble salt is formed is also called .... reaction.

Ans. *(1) decomposition (2) oxidation (3) anti-rust solution (4) endothermic (5) reducing (6) combination (7) redox reaction (8) reactants, products (9) chemical equation (10) Nickel (Ni) (11) Exothermic (12) NaNO$_3$ (13) cellular (14) anti-oxidants (15) oxidation (16) salt, water (17) Cu$_{(s)}$ (18) aqueous solution (19) balanced (20) precipitation*

Q.1. (A) 2. Match the columns:

(I)

Reactants	Products	Types of Reaction
(1) Fe + S	(a) NaCl + H_2O	(i) Oxidation
(2) $CuSO_4$ + Zn	(b) 2CuO	(ii) Neutralization
(3) $2Cu + O_2$	(c) $ZnSO_4$ + Cu	(iii) Displacement
(4) HCl + NaOH	(d) FeS	(iv) Combination

Ans. *(1-d-iv), (2-c-iii), (3-b-i), (4-a-ii)*

*(II)

Reactants	Products	Types of Reaction
(1) $BaCl_{2(aq)}$ + $ZnSO_{4(aq)}$	(a) $H_2CO_{3(aq)}$	(i) Displacement
(2) $2\,AgCl_{(s)}$	(b) $FeSO_{4(aq)}$ + $Cu_{(s)}$	(ii) Combination
(3) $CuSO_{4(aq)}$ + $Fe_{(s)}$	(c) $BaSO_4 \downarrow$ + $ZnCl_{2(aq)}$	(iii) Decomposition
(4) $H_2O_{(l)}$ + $CO_{2(g)}$	(d) $2Ag(s)$ + $Cl_{2(g)}$	(iv) Double displacement

Ans. *(1-c-iv), (2-d-iii), (3-b-i), (4-a-ii)*

(III)

Column A	Column B
(1) Heating of Potassium Chlorate	(a) Turns lime water milky
(2) Depositing a layer of zinc on iron	(b) Physical change
(3) Souring of milk	(c) Rust
(4) Carbon dioxide	(d) MnO_2 is used as catalyst
(5) Iron oxide	(e) Chemical change
(6) Dissolving common salt in water	(f) Galvanisation

Ans. *(1-d), (2-f), (3-e), (4-a), (5-c), (6-b)*

Q.1. (A) 3. State whether the following statements are True or False. Write the correct statements:

(1) Digestion of food is a chemical change.

(2) A catalyst slows down the rate of reaction to make a better product.

(3) Reaction that releases energy is called Endothermic.

(4) Ammonium chloride is a sublimable salt.

(5) Rusting of iron is an oxidation reaction.

(6) Size of the particles of reactants does not affect the rate of chemical reaction.

(7) Combustion is the rapid reaction between carbon dioxide and fuel.

(8) A precipitate is an insoluble solid formed from solution during a chemical reaction.

(9) A chemical equation shows a chemical reaction using symbols and chemical formulae instead of words.

(10) Decomposition of compost is an endothermic reaction.

(11) Unlike physical changes, chemical changes cannot be easily reversed.

(12) A burning of match stick is an example of chemical change.

(13) The reaction Zn(s) + $CuSO_4$(aq) $\rightarrow$ $ZnSO_4$(aq) + Cu(s) is an example of double displacement reaction.

(14) Chemical change is a temporary change.

(15) (g) indicates the physical state of a substance as solid.

(16) Conversion of quick lime into slaked lime is an example of displacement reaction.

(17) Calcium oxide is also called lime or quicklime.

(18) In a chemical equation, the symbol $\downarrow$ is used to denote precipitation formation.

Ans. *(1) True (2) False. Catalyst speed up the rate of reaction. (3) False. Reaction that releases energy is called Exothermic. (4) True (5) True (6) False. Size of the particles of reactants affect the rate of chemical reaction. (7) False. Combustion is the rapid reaction between oxygen and fuel. (8) True (9) True (10) False. Decomposition of compost is an exothermic reaction. (11) True (12) True (13) False. It is a displacement (single) reaction (14) False. It is a permanent change. (15) False. (g) indicates the physical state of a substance as gas. (16) False. It is an example of combination reaction. (17) True (18) True.*

Q.1. (A) 4. Name the following:

(1) A change that takes place due to change in the parameters such as temperature, pressure.

Ans. Physical change

(2) A process in which some substances undergo bond breaking and are transformed into new substances by formation of new bonds.

Ans. Chemical reaction

(3) Representation of a chemical reaction in a condensed form using chemical formulae.

Ans. Chemical equation

(4) If the number of atoms of each element is not same on the two sides of an equation.

Ans. Unbalanced equation

(5) Fuel formed when organic waste is decomposed by micro-organism.

Ans. Biogas

(6) The substance in whose presence the rate of a chemical reaction changes without causing any chemical change to it.

Ans. Catalyst

(7) The life on earth is protected from ultraviolet radiation of the sun.

Ans. Ozone layer

(8) A state prior to the formation of the O_2 molecule.

Ans. Nascent oxygen.

Q.1. (A) 5. Complete the following reactions and name the products:

(1) $CuSO_{4(aq)} + Fe_{(s)} \rightarrow$ $\underset{\substack{Ferrous \\ Sulphate}}{FeSO_{4(aq)}}$ $+$ $\underset{Copper}{Cu_{(s)}}$

(2) $CuSO_{4(aq)} + Pb_{(s)} \rightarrow$ $\underset{\substack{Lead \\ Sulphate}}{PbSO_{4(aq)}}$ $+$ $\underset{Copper}{Cu_{(s)}}$
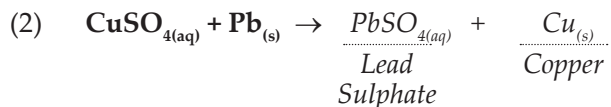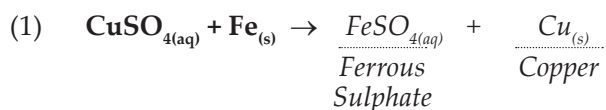
Q.1. (B) Choose and write the correct option:

(1) A chemical reaction involves _____ .

   (a) Only breaking of bonds.

   (b) Only formation of bonds.

   (c) Both breaking and formation of bonds.

   (d) None of these.

(2) A balanced chemical equation always obeys _____ .

   (a) Law of conservation of Mass

   (b) Law of thermal equilibrium

   (c) Law of conservation of energy

   (d) All of the above

(3) Oily food kept out for few days gives a bad taste and a bad smell because of _____ .

   (a) Corrosion   (b) Displacement

   (c) Heating   (d) Rancidity

(4) The sign $\downarrow$ indicates.

   (a) Release of gas

   (b) Dissolution of gas

   (c) Formation of precipitate

   (d) Lowering of temperature

(5) What is rust?

   (a) Sodium oxide   (b) Iron oxide

   (c) Copper oxide   (d) Silver oxide

(6) Because of the formation of which of the following, lime water turns milky when carbon dioxide is passed through it?

   (a) Calcium Carbonate

   (b) Calcium bicarbonate

   (c) Calcium hydroxide

   (d) Sodium Carbonate

(7) Which of the following is formed when Sodium hydroxide reacts with hydrochloric acid?

   (a) Calcium Chloride

   (b) Hydrogen Chloride

   (c) Sodium hydroxide

   (d) Sodium Chloride

(8) _____ is a physical change.

   (a) Ice changes into water

   (b) Milk is set into curd

   (c) Ripening of fruit

   (d) Respiration process

(9) When sulphuric acid is poured over zinc, which of the following gas is formed?

   (a) Sulphur dioxide   (b) Hydrogen

   (c) Oxygen   (d) Zinc dioxide

(10) Heating of sugar is called a _____ reaction.

   (a) Combination reaction

   (b) Displacement reaction

   (c) Double displacement reaction

   (d) Decomposition reaction

(11) Antioxidants are used to prevent _____ of food containing fats and oils.

   (a) Reduction

   (b) Oxidation

   (c) Oxidation and reduction

   (d) Decomposition

(12) In the reaction given $CuO_{(s)} + H_{2(g)} \rightarrow Cu_{(s)} + H_2O_{(l)}$. Copper oxide is _____ and hydrogen is _____ .

   (a) Oxidized, reduced   (b) Reduced, oxidized

   (c) Unaffected, reduced   (d) Unaffected, oxidized

(13) Which among the following is double displacement reaction?

(a) $Pb + CuCl_2 \rightarrow PbCl_2 + Cu$

(b) $Na_2SO_4 + BaCl_2 \rightarrow BaSO_4\downarrow + 2NaCl$

(c) $C + O_2 \rightarrow CO_2$

(d) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

Ans. *(1) (c) Both breaking and formation of bonds. (2) (a) Law of conservation of Mass (3) (d) Rancidity (4) (c) formation of precipitate (5) (b) Iron oxide (6) (a) Calcium carbonate (7) (d) Sodium chloride (8) (a) Ice changes into water (9) (b) Hydrogen (10) (d) Decomposition Reaction (11) (b) oxidation (12) (b) reduced, oxidized (13) (b) $Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 \downarrow + 2NaCl$*

Q.2.1. Answer the following:

(1) What is a balanced chemical equation?

Ans. The chemical equation in which the number of atoms of different elements are equal in reactant side (L.H.S.) and product side (R.H.S.) is called a balanced chemical equation.

(2) "We need to balance an unbalanced skeletal chemical equation". Justify the statement.

Ans.

(i) Skeletal chemical equations are either self balanced or unbalanced.

(ii) We need to balance the unbalanced chemical equation because of law of conservation of mass which states that "In any reaction, the total mass of each of the elements in the reactants is the same as that of the total mass of each of the respective elements in the products".

(iii) Therefore, chemical equation must be balanced in each and every chemical reaction.

(3) Giving an example list two information which make a chemical equation more useful. (informative).

Ans. (i) Physical state of reactants must be mentioned, e.g. $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}$.

(ii) Condition in which a reaction takes place is written on the arrow head,

e.g. $2H_{2(g)} + O_{2(g)} \xrightarrow{\text{burning}} 2H_2O_{(l)}$.

(4) What type of reaction takes place when vegetable matter is converted to compost?

Ans. During composting complex substances are broken down into simpler substances with the evolution of heat. Hence, it is an exothermic decomposition reaction.

(5) What is rust? Write the chemical formula.

Ans.

(i) Due to moisture and various components of atmosphere, oxidation of iron takes place.

(ii) A certain type of reddish coloured solid layer collects on the iron surface. This layer is called rust.

(iii) The chemical formula is $Fe_2O_3 . xH_2O$.

(6) Why respiration is considered an exothermic reaction?

Ans. In the process of respiration glucose is broken into Carbon dioxide and energy is released. That is why, it is considered as an exothermic reaction.

$C_6H_{12}O_{6(aq)} + 6O_{2(g)} \rightarrow 6CO_{2(g)} + 6H_2O_{(l)} + \text{Energy (ATP)}$
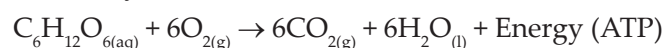
(7) Name the factors on which the speed of a chemical reaction depends.

Ans. The speed of a chemical reaction depends on factors like size of the particles of reactants, concentration of the reactants, nature of the reactants, temperature of the reaction and presence or absence of catalyst.

(8) What is meant by reactants?

Ans. The chemicals that undergo chemical change in a chemical reaction are called reactants.

(9) What is meant by the term products of a chemical reactions?

Ans. The substances that are formed after a chemical reaction takes place, are called products of a chemical reaction.

(10) When carbon dioxide is passed through lime water it turns milky. Why?

Ans. Lime water (Calcium hydroxide) combines with carbon dioxide to form a suspension of calcium carbonate which turns lime water milky.

$Ca(OH)_{2(aq)} + CO_{2(g)} \rightarrow CaCO_{3(s)} + H_2O_{(l)}$
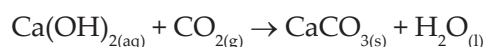
(11) What type of reaction is this: $Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2NaCl$.

Ans. It is a double displacement reaction.

(12) What do you understand by precipitation reaction? Explain with examples.

Ans.

(i) When two ionic compounds react and two ionic compounds (product) are formed of which one product is insoluble and settles as a solid, it is called a precipitate.

(ii) Such reactions in which precipitate is formed are called precipitation reactions.

(iii) Example: When aqueous solution of Sodium Sulphate is mixed with the aqueous solution of Barium Chloride, it forms Barium Sulphate in the form of white precipitate.

$Na_2SO_{4(aq)} + BaCl_{2(aq)} \rightarrow BaSO_4\downarrow + 2NaCl_{(aq)}$
$(White)$
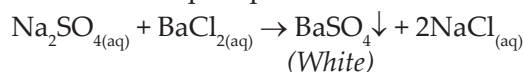
(13) **Which soloution is used in voters ink?**

Ans. Solution of Silver nitrate ($AgNO_3$) is used in the voters ink.

(14) **What happens when a piece of zinc metal is added to copper sulphate solution?**

Ans.

(i) When a piece of zinc metal is added to copper sulphate solution, more reactive zinc metal displaces the less reactive copper from copper sulphate solution and a solution of zinc sulphate is obtained while copper gets deposited on zinc making it reddish brown in colour.

(ii) $Zn_{(s)} + CuSO_{4(aq)} \rightarrow ZnSO_{4(aq)} + Cu_{(s)}$
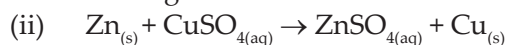
*(15) **Which is the oxidant used for purification of drinking water?** *(Use your brain power! Textbook page number 42)*

Ans.

(i) Chlorine is a strong oxidant commonly used in water treatment for oxidation and disinfection.

(ii) Even Potassium permanganate can be used as oxidant for purification of water.

*(16) **Why is potassium permanganate used for cleaning of water tanks?** *(Use your brain power! Textbook page number 42)*

Ans.

(i) Potassium permanganate oxidises dissolved iron, manganese and hydrogen sulphide into solid particles.

(ii) $KMnO_4$ is used to remove organic matter from the water tank by oxidation which also removes unwanted taste and odour.

(iii) It also kills harmful bacteria and fungi.

*(17) **Some examples of redox reaction are given. Identify the reductants and oxidants from them.** *(Use your brain power! Textbook page number 43)*
$2H_2S + SO_2 \rightarrow 3S\downarrow + 2H_2O$
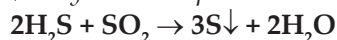
Ans.

(i) In a redox reaction, the reductant transfers electrons to the oxidant.

(ii) Then in the reaction, the reductant or reducing agent loses electrons and is oxidised and the oxidant or oxidizing agent gains electrons and is reduced.

(iii) $\therefore$ Hence, in the above equation, reductant is SO_2 and oxidant is H_2S
$MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2\uparrow$

(i) Reductant: MnO_2 - as it loses oxygen.

(ii) Oxidant: HCl - as it gains oxygen.

*(18) **If oxidation means losing electrons, what is meant by reduction?** *(Use your brain power! Textbook page number 43)*

Ans. If oxidation means losing electrons, then reduction means gaining electrons.

*(19) **Write the reaction of formation of Fe^{2+} by the reduction Fe^{3+} by making use of the symbol (e^-)?** *(Use your brain power! Textbook page number 43)*

Ans. $Fe^{3+}_{(aq)} + e^- \xrightarrow[\text{reduce}]{} Fe^{2+}_{(aq)}$.
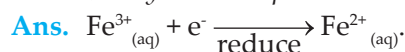
(20) **Write two conditions necessary for rusting of iron.**

Ans. Rusting of iron takes place in (i) the presence of air and (ii) presence of moisture.

(21) **Name the term used for the solution of a substance in water.**

Ans. Aqueous (aq) is the term used for the solution of a substance in water.

(22) **What are the changes that take place when fats and oils are oxidized?**

Ans. When fats and oils are oxidized, they become rancid and their taste changes.

*(23) **Identify the reactants and products of equation:**
Vegetable Oil$_{(l)}$ + H$_{2(g)}$ $\xrightarrow[\text{Ni Catalyst}]{60°C}$ Vanaspati ghee$_{(s)}$
(Use your brain power! Textbook page number 35)
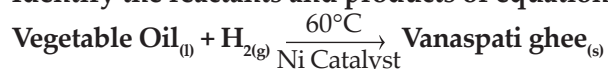
Ans. Reactants: Vegetable oil and hydrogen gas
Product: Vanaspati ghee

*(24) **Use your brain power!** *(Textbook page number 36)*

(i) **What is the number of reactants in the following reactions.**

$NH_{3(g)} + HCl_{(g)} \rightarrow NH_4Cl_{(s)}$ - (1)
$2Mg + O_2 \rightarrow 2MgO$ - (2)
$CaO + H_2O \rightarrow Ca(OH)_2 + Heat$ - (3)
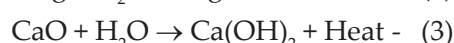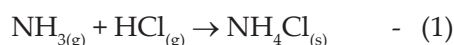
Ans. In all the above equations, there are two reactants.

(ii) **What is the number of molecules of reactants taking part in the above reactions?**
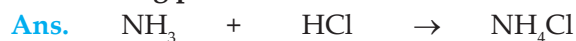
Ans. NH_3 +   HCl $\rightarrow$ NH_4Cl
    1 molecule   1 molecule

     $2Mg$ + O_2 $\rightarrow$ $2MgO$
    2 molecules   1 molecule

     CaO   + H_2O $\rightarrow$ $Ca(OH)_2 + Heat$
    1 molecule   1 molecule

(iii) **How many products are formed in each of the above reaction?**

Ans. In all the above reactions, only one product is formed.

Q.2.2. Define the following/write notes:

(1) **Physical Change**

Ans. It is a change in which only the physical properties of substances are changed and no new substance is formed. This change is a temporary and reversible change.

(2)   Chemical Change

Ans. It is a change in which substances are converted into new substance or product possessing properties altogether different from the original. This is a permanent and irreversible change.

(3)   Chemical Reaction

Ans. A chemical reaction is a process in which some substances undergo bond breaking and are transformed into new substances by formation of new bonds.

(4)   Chemical Equation

Ans. The representation of a chemical reaction in a condensed form using chemical formulae is called as the chemical equation.

*(5)   Combination Reaction

Ans.
(i)   When two or more reactants combine in a reaction to form a single product, it is called a combination reaction.
(ii)   e.g.: When a Magnesium strip is burnt in air, it combines with oxygen, to form white ash of magnesium oxide.
(iii) $2Mg_{(s)}$ + $O_{2(g)} \rightarrow$ $2MgO_{(s)}$ (white ash)
       Magnesium   Oxygen   Magnesium
                                    oxide
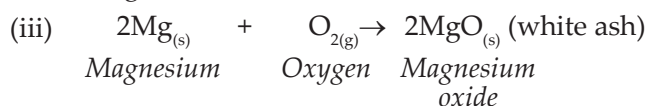
(6)   Decomposition Reaction

Ans.
(i)   The chemical reaction in which two or more products are formed from a single reactant is called Decomposition Reaction.
(ii)   e.g.: When Calcium carbonate is strongly heated it decomposes to form Calcium oxide and Carbon dioxide gas.
(iii) e.g. $CaCO_{3(s)} \xrightarrow{\Delta} CaO_{(s)}$ + $CO_2\uparrow$
            Calcium   Calcium   Carbon
            Carbonate   Oxide   dioxide
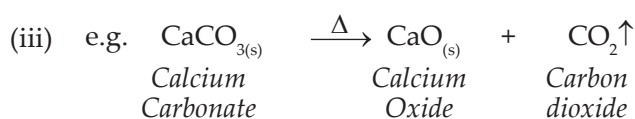
*(7)   Displacement Reaction
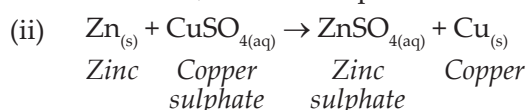
Ans.
(i)   The reaction in which the place of the ion of a less reactive element in a compound is taken by another more reactive element by formation of its own ions, is called displacement reaction.
(ii) $Zn_{(s)} + CuSO_{4(aq)} \rightarrow ZnSO_{4(aq)} + Cu_{(s)}$
       Zinc   Copper   Zinc   Copper
               sulphate   sulphate
(iii) In the above equation when zinc dust is added to blue coloured copper sulphate solution, a colourless solution of zinc sulphate is formed and copper is deposited on zinc.

(iv)   The Zn^{2+} ions formed from Zn atom take the place of Cu^{2+} ions in copper sulphate, and Cu atoms formed from Cu^{2+} ion come out. It means that Zn displaces Cu from $CuSO_4$.

(8)   Double displacement Reaction
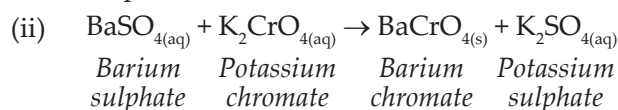
Ans.
(i)   The reaction in which the ions in the reactants are exchanged to form a precipitate are called double displacement reactions.
(ii) $BaSO_{4(aq)} + K_2CrO_{4(aq)} \rightarrow BaCrO_{4(s)} + K_2SO_{4(aq)}$
       Barium   Potassium   Barium   Potassium
       sulphate   chromate   chromate   sulphate
(iii) Potassium chromate solution reacts with Barium sulphate solution to form Potassium sulphate solution and a yellow precipitate of Barium chromate ($BaCrO_4$).

*(9)   Endothermic Reaction

Ans.
(i)   A reaction in which heat is either absorbed from the surrounding or has to be supplied continuously from outside is called as endothermic reaction.
(ii)   e.g. melting of ice, dissolution of potassium nitrate in water. During the process of dissolution of potassium nitrate (KNO_3) in water, heat from the surroundings is absorbed and therefore, the temperature of the resulting solution is less.
(iii) The process in which heat is absorbed from outside is called endothermic process.
(iv) $KNO_{3(s)}$ + $H_2O_{(l)}$ +   Heat $\rightarrow$ $KNO_{3(aq)}$
       Potassium   Water   Potassium nitrate
        nitrate   solution
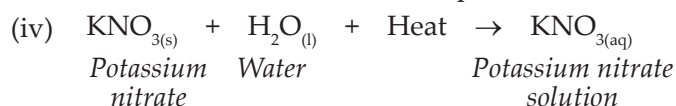
(10)   Exothermic Reaction

Ans.
(i)   A reaction in which heat is given away when reactants are transformed into the products is called as exothermic reaction.
(ii)   e.g. formation of ice from water, dissolution of sodium hydroxide in water.
(iii) When solid NaOH is dissolved in water, heat is given out and therefore, the temperature increases.
(iv) $NaOH_{(s)}$ + $H_2O_{(l)}$ $\rightarrow$ $NaOH_{(aq)}$ +   Heat
       Sodium   Water   Sodium hydroxide
       hydroxide   solution
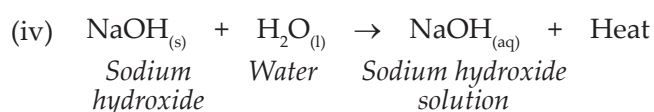
*(11)   Oxidation Reaction

Ans. The chemical reaction in which a reactant combines with oxygen or loses hydrogen to form a product is called oxidation reaction.

       e.g. (1) $2Mg_{(s)}$ + $O_{2(g)}$ $\rightarrow$ $2MgO_{(s)}$
              Magnesium   Oxygen   Magnesium oxide

(2) $2Cu_{(s)}$ + $O_{2(g)}$ → $2CuO_{(s)}$
   Copper   *Oxygen*   *Copper oxide*

(3) MgH_2 → $Mg_{(s)}$ + $H_{2(g)}$
   Magnesium   Magnesium   Hydrogen
   hydride
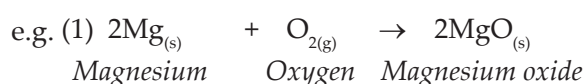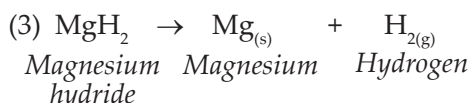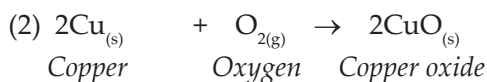
(12) Reduction Reaction

Ans. The chemical reaction in which reactants gain hydrogen or loses oxygen to form the product is called reduction reactions.

  e.g. (1) $HgO_{(s)}$ → $Hg_{(l)}$ + $O_{2(g)}$
       Mercuric   Mercury Oxygen
       oxide

   (2) $H_{2(g)}$ + $Cl_{2(g)}$ → $2HCl_{(g)}$
      Hydrogen Chlorine   Hydrogen
                              Chloride
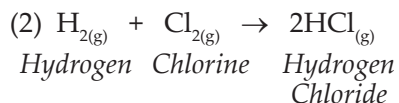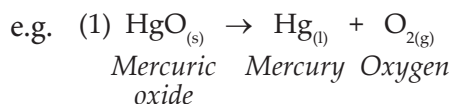
(13) Redox Reaction

Ans. A chemical reaction in which oxidation and reduction takes place simultaneously is called redox reaction.

            Oxidation
e.g. $CuO_{(s)}$ + $H_{2(g)}$ → $Cu_{(s)}$ + $H_2O_{(l)}$
   Copper   Hydrogen   Copper   Water
   Oxide
            Reduction
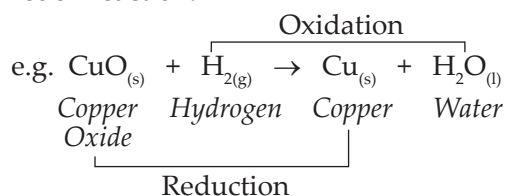
(14) Catalyst

Ans.

(i) The substance in whose presence the rate of a chemical reaction changes, without causing any chemical change to it is called a catalyst.

(ii) e.g. Potassium chlorate $(KClO_3)$ decomposes rapidly in presence of manganese dioxide (MnO_2) to liberate O_2 gas, where manganese dioxide acts as a catalyst.

(ii) $2KClO_3 \xrightarrow[\text{MnO}_2]{\Delta} 2KCl + 3O_2$
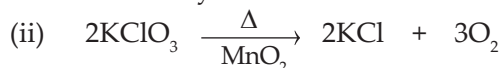
(15) Neutralisation Reaction

Ans.

(i) The reaction in which an acid and a base react together to form salt and water is called Neutralisation reaction.

(ii) e.g. $HCl_{(aq)}$ + $NaOH_{(aq)}$ → $NaCl_{(aq)}$ + $H_2O_{(l)}$
   Hydrochloric   Sodium   Sodium   Water
   acid   hydroxide   chloride
   (acid)   (base)   (Salt)   (Water)
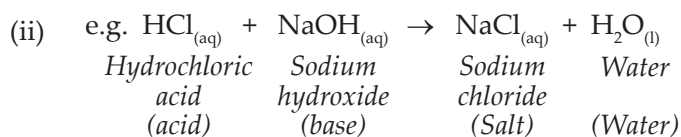
(16) Rancidity

Ans. Rancidity is the oxidation of oils and fats resulting in change in taste and giving out foul smell. Rancidity in the food stuff is prevented by antioxidants.

*(17) Balanced Equation

Ans.

(i) The number of atoms of the elements in the reactants is same as the number of atoms of those elements in the products. Such an equation is called a 'balanced equation'.

(ii) In any reaction, the total mass of each of the respective elements in the reactants is same as the total mass of each of the respective elements in the products.

(iii) This is in accordance with the law of conservation of mass.

(iv) e.g. $SO_2 + 2H_2S \rightarrow 3S + 2H_2O$
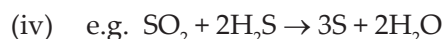
On reactant side	On product side
No. of atoms of Sulphur (S) = 3	No. of atoms of Sulphur (S) = 3
No. of atoms of Oxygen (O) = 2	No. of atoms of Oxygen (O) = 2
No. of atoms of hydrogen (H) = 4	No. of atoms of hydrogen (H) = 4

∴ The given equation is balanced.

Q.2.3. Complete the following chemical equations, balance and state the type of reactions:
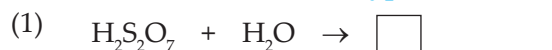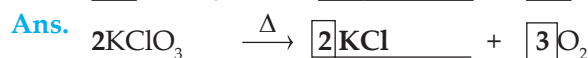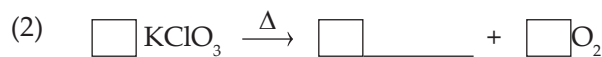
(1) $H_2S_2O_7$ + H_2O → [   ]

Ans. $H_2S_2O_7$ + H_2O → $\boxed{2}\,\mathbf{H_2SO_4}$

It is a Combination reaction.

(2) [ ]$KClO_3 \xrightarrow{\Delta}$ [   ] + [ ]O_2

Ans. $\boxed{2}KClO_3 \xrightarrow{\Delta} \boxed{2}\,\mathbf{KCl}$ + $\boxed{3}\,O_2$

It is a Decomposition reaction.

(3) [   ] $\xrightarrow{\text{Sunlight}}$ [ ]Ag + Cl_2

Ans. $\boxed{2}\,\mathbf{AgCl} \xrightarrow{\text{Sunlight}} \boxed{2}Ag$ + Cl_2

It is a Decomposition reaction.

(4) [ ]Al + [ ]HCl → [   ] + [ ]H_2

Ans. $\boxed{2}Al$ + $\boxed{6}HCl \rightarrow \boxed{2}\,\mathbf{AlCl_3}$ + $\boxed{3}H_2$

It is a Displacement reaction.

(5) [ ]NaOH + H_2SO_4 → [   ] + [ ]H_2O

Ans. $\boxed{2}NaOH$ + $H_2SO_4 \rightarrow \mathbf{Na_2SO_4}$ + $\boxed{2}H_2O$

It is a Double displacement reaction.

(6) N_2 + [   ] → [ ]NH_3

Ans. N_2 + $\boxed{3}H_2$ → $\boxed{2}NH_3$
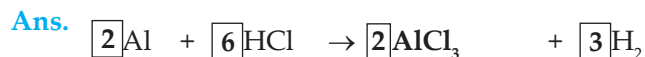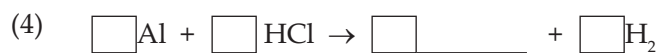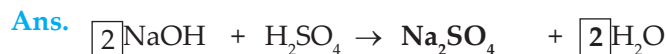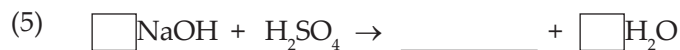
It is a Combination reaction.

Q.2.4.Distinguish between:

(1) **Physical Change and Chemical Change.**

Ans.

Physical Change	Chemical Change
(i) In this change, the composition of substance does not change and no new substance is formed.	(i) In this change, the composition of substance changes and a new substance is formed.
(ii) There is a change only in physical properties.	(ii) There is a change in both physical and chemical properties.
(iii) This change is temporary.	(iii) This change is permanent.
(iv) The original substance can be recovered by simple means.	(iv) The original substance cannot be recovered by simple means.
(v) e.g.: Steam is condensed.	(v) e.g.: Ripening of fruit, Milk is converted to curd.

(2) **Displacement and Double displacement Reaction**

Ans.

Displacement Reaction	Double displacement Reaction
(i) The reaction in which the place of the ion of a less reactive element in a compound is taken by another more reactive element by formation of its own ions, is called displacement reaction.	(i) The reaction in which the ions in the reactants are exchanged to form a precipitate are called double displacement reactions.
(ii) These reactions are usually slow and take longer time for their completion.	(ii) These reactions are usually fast and take place instantaneously.
(iii) During these reactions, change of colour takes place. $Fe_{(s)} + CuSO_{4(aq)} \rightarrow FeSO_{4(aq)} + Cu_{(s)}$ *Iron Copper Iron copper sulphate sulphate*	(iii) During these reactions, precipitates are formed. $AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow AgCl_{(s)}\downarrow + NaNO_{3(aq)}$ *Silver Sodium Silver Sodium nitrate chloride chloride nitrate*

(3) **Combination reaction and Decomposition reaction**

Ans.

Combination reaction	Decomposition reaction
(i) When two or more reactants combine in a reaction to form a single product, it is called a combination reaction.	(i) The chemical reaction in which two or more products are formed from a single reactant is called decomposition reaction.
(ii) It is a synthesis reaction.	(ii) It is a degradation reaction.
(iii) New substances are synthesized in industry using this reaction.	(iii) In nature, complex substances are broken down into simpler compounds.
(iv) $CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2(aq)}$ *Calcium Water Calcium oxide hydroxide*	(iv) $CaCO_{3(s)} \xrightarrow{\Delta} CaO_{(s)} + CO_{2(g)}\uparrow$ *Calcium Calcium Carbon carbonate oxide dioxide*

(4) **Exothermic reaction and Endothermic reaction**

Ans.

Exothermic reaction	Endothermic reaction
(i) The reaction where heat energy is evolved or liberated is called as exothermic reaction.	(i) The reaction where heat energy is absorbed is called as endothermic reaction.
(ii) Temperature of the reaction mixture rises.	(ii) Temperature of the reaction mixture lowers.

(iii) Generally, the reactions are fast.	(iii) Generally, the reactions are slow.
(iv) e.g.: When NaOH dissolves in water heat is evolved.	(iv) e.g.: When Calcium carbonate is strongly heated, calcium oxide is formed.

(5)   **Oxidation reaction and Reduction reaction**

Ans.

Oxidation reaction	Reduction reaction
(i) It is a chemical process in which a substance gains oxygen or loses hydrogen.	(i) It is a chemical process in which a substance gains hydrogen or loses oxygen.
(ii) During oxidation reaction, an atom or an ion loses electron.	(ii) During reduction reaction, an atom or ion gains electron.
(iii) Oxidizing agents are used to carry out this reaction.	(iii) Reducing agents are used to carry out this reaction.
(iv) Example: $C + O_2 \rightarrow CO_2\uparrow$	(iv) Example: $C + 2H_2 \rightarrow CH_4$

Q.2.4. Give scientific reasons:

*(1) **When the gas formed on heating limestone is passed through freshly prepared lime water, the lime water turns milky.**

Ans.

(i) On heating, limestone undergoes thermal decomposition to form calcium oxide (quick lime) and carbon dioxide.

$$CaCO_{3(s)} \xrightarrow{\Delta} CaO_{(s)} + CO_2\uparrow$$
quick lime
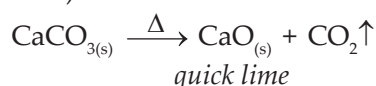
(ii) Calcium oxide when dissolved in water forms Calcium hydroxide (lime water).
$$CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2(aq)}$$
Calcium hydroxide
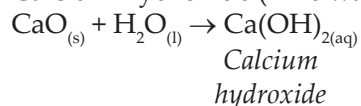
(iii) When carbon dioxide is passed through lime water it turns milky due to formation of white precipitate of Calcium carbonate.
$$Ca(OH)_{2(aq)} + CO_{2(g)} \rightarrow CaCO_{3(s)} + H_2O_{(l)}$$
Calcium carbonate
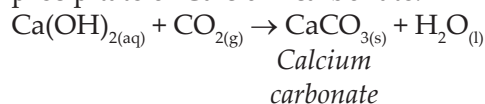
*(2) **It takes time for pieces of Shahabad tiles to disappear in HCl, but its powder disappears rapidly.**

Ans.

(i) When HCl is added to Shahabad stone effervescence of CO_2 is formed.

(ii) The CO_2 effervescence is formed slowly with the pieces of Shahabad tiles while at the faster speed with the powder.

(iii) This is because the rate of a reaction depends upon the size of the particles of the reactants taking part in the reaction.

(iv) Smaller the size of the reactant particles more is the surface area available for the reaction and higher is the rate of reaction.

(v) Hence, it takes time for pieces of Shahabad tiles to disappear in HCl, but its powder disappears rapidly.

*(3) **While preparing dilute sulphuric acid from concentrated sulphuric acid in the laboratory, the concentrated sulphuric acid is added slowly to water with constant stirring.**

Ans.

(i) Concentrated sulphuric acid (H_2SO_4) is a hazardous, highly corrosive chemical. It has a higher density than water and is hygroscopic, which means that it absorbs water from the air.

(ii) In the process of dilution of concentrated sulphuric acid with water, very large amount of heat is liberated.

(iii) As a result, water gets evaporated instantaneously along with splashing of acid which may cause an accident.

(iv) To avoid this, required amount of water is taken in a glass container and small quantity of concentrated sulphuric acid at a time is added with stirring.

(v) Therefore, only a small amount of heat is liberated at a time.

*(4) **It is recommended to use air tight container for storing oil for long time.**

Ans.

(i) Air, heat and light affect the quality of edible oil, which deteriorates through oxidation (rancidity).

(ii) The oxidation process is greatly enhanced when edible oils are stored in containers that are not air tight and in areas where oil is exposed to air, heat and light.

(iii)   Hence, it is recommended to use air tight containers for storing oil for long time, to prevent it from getting oxidised.

(5)   Grills of doors and windows are always painted before they are used.

Ans.

(i)   The grills of doors and windows are generally made of the metal iron.

(ii)   When they are exposed to air, due to the effect of moisture in air, iron undergoes slow oxidation reaction and forms a layer of reddish brown rust which gets deposited on the surface of grills.

(iii)   Thus, due to the reaction of slow process of decay or destruction of metal iron, the grills of doors and windows made of metal iron get corroded.

(iv)   Hence, in order to prevent the rust and corrosion, grills of doors and windows are always painted before they are used.

(v)   By doing this, air and moisture cannot come in contact with the iron and hence rusting doesn't take place.

(6)   Digestion of food is an example of decomposition reaction.

Ans.   During digestion, the starch in the various food items gets decomposed into simple sugar while proteins get decomposed into amino acids. Hence digestion of food is an example of decomposition reaction.

(7)   Respiration is considered to be an exothermic reaction.

Ans.

(i)   When heat is given out during a chemical reaction, it is an exothermic reaction.

(ii)   Glucose formed in our body during the process of digestion, combines with oxygen in our body and provides energy.

(iii)   Therefore, respiration is considered to be an exothermic reaction.

(8)   We store silver chloride in dark coloured bottles.

Ans.

(i)   A chemical reaction that proceeds by absorption of light is called a photo chemical reaction.

(ii)   We store silver chloride in dark coloured bottles in order to protect it from the effect of sunlight.

(iii)   Sunlight decomposes silver chloride and forms silver and chlorine.

$$2AgCl_{(s)} \xrightarrow{\text{Sunlight}} 2Ag_{(s)} + Cl_2\uparrow$$

Silver chloride   Silver   Chlorine
(white)   (Grey)
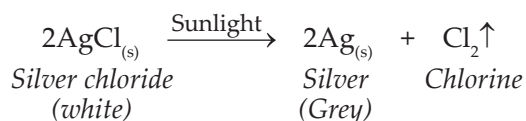
(iv)   As dark coloured bottles obstruct light, silver chloride will get prevented from decomposition.

*Q.3.1.Choose the correct option from the bracket and explain the statement giving reason:

(oxidation, displacement, electrolysis, reduction, zinc, copper, double displacement, decomposition)

(1)   To prevent rusting, a layer of ___*zinc*___ metal is applied on iron sheets.

Ans.   Explanation: Due to moisture and various components of atmosphere, oxidation of iron takes place. A certain type of reddish coloured solid layer collects on the iron surface. This layer is called rust. Its chemical formula is $Fe_2O_3 \cdot x\,H_2O$. To avoid rusting, a layer of zinc metal is applied on iron sheets which prevents iron sheets from directly coming in contact with the atmosphere and hence, prevents rusting. This process of giving a thin coating of zinc on iron to protect it from rusting is called galvanisation.

(2)   The conversion of ferrous sulphate to ferric sulphate is ___*oxidation*___ reaction.

Ans.   Explanation: The conversion of ferrous sulphate ($FeSO_4$) into ferric sulphate $Fe_2(SO_4)_3$ is an oxidation reaction.

$$2FeSO_4 \rightarrow Fe_2(SO_4)_3$$
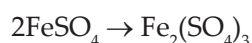
Net ionic reaction: $Fe^{2+} \rightarrow Fe^{3+}$
                     (Ferrous) (Ferric)

(a)   In the above ionic reaction, when ferric ion is formed from ferrous ion, the positive charge is increased by one unit. While this happens, the ferrous ion loses one electron and losing of electrons is an oxidation reaction.

(3)   When electric current is passed through acidulated water ___*electrolysis*___ of water takes place.

Ans.   Explanation:

(i)   Water decomposes into hydrogen and oxygen gases on passing electric current through acidulated water.

(ii)   This decomposition takes place by means of electrical energy.

(iii)   Therefore, it is called as electrolysis.

(4)   Addition of an aqueous solution of $ZnSO_4$ to an aqueous solution of $BaCl_2$ is an example of ___*double displacement*___ reaction.

Ans.   Explanation:

(i)   When aqueous solution of $ZnSO_4$ is added to aqueous solution of $BaCl_2$, a reaction takes place forming an aqueous solution of $ZnCl_2$ and a white precipitate of $BaSO_4$.

(ii)   In this reaction, ions in the reactants are

exchanged to form a precipitate. Such reactions are called double displacement reactions.

Q.3.2.Answer the following:

*(1) What is the reaction called when oxidation and reduction take place simultaneously? Explain with one example.

Ans.

(i) When oxidation and reduction take place simultaneously in a given reaction it is termed as Redox reaction.

(ii) During oxidation a reactant combines with oxygen or loses hydrogen and during reduction it gains hydrogen or loses oxygen.

(iii) Example of Redox reaction:

oxidation (O_2 added)

$$2H_2S + SO_2 \rightarrow 3S + 2H_2O$$

reduction (O_2 lost)
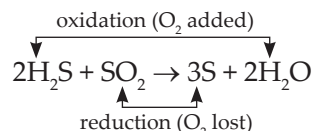
(iv) In the above reaction, SO_2 is reduced and H_2S is oxidised.

*(2) How can the rate of the chemical reaction namely decomposition of hydrogen peroxide be increased?

Ans.

(i) The chemical reaction in which two or more products are formed from a single reactant is called decomposition reaction. Hydrogen peroxide decomposes into water and oxygen.

$$2H_2O_{2(l)} \rightarrow 2H_2O_{(l)} + O_2\uparrow$$

Hydrogen   Water   Oxygen
peroxide
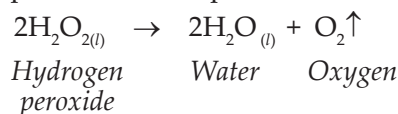
(ii) The decomposition of hydrogen peroxide into water and oxygen takes place slowly at room temperature. However, the rate of this chemical reaction can be increased on adding manganese dioxide (MnO_2) powder in it, here manganese dioxide acts as a catalyst.

*(3) Explain the term reactant and product giving examples.

Ans.

(i) A chemical reaction is a process in which some substances undergo bond breaking and are transformed into new substances by formation of new bonds.

(ii) The substances taking part in chemical reaction are called reactants, whereas the substances formed as a result of a chemical reaction by formation of new bonds are called products.

(iii) For example :

(a) Formation of carbon dioxide gas by combustion of coal in air is a chemical reaction. In this reaction Coal (carbon) and Oxygen (from air) are the reactants while carbon dioxide is the product.

$$\underbrace{C + O_2} \rightarrow \underbrace{CO_2}$$
Reactants product
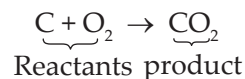
(b) $$CuSO_4 + Zn \rightarrow ZnSO_4 + Cu$$
Copper   Zinc   Zinc   Copper
sulphate   sulphate

In the above equation, copper sulphate and zinc are the reactants and zinc sulphate and copper are the products.

*(4) Explain the types of reaction with reference to oxygen and hydrogen. Illustrate with examples.

Ans. Types of reaction with reference to oxygen and hydrogen are oxidation reaction and reduction reaction.

Oxidation reaction: The chemical reaction in which a reactant combines with oxygen or loses hydrogen to form the product is called Oxidation reaction.

e.g. $2Mg + O_2 \rightarrow 2MgO$

Here O_2 combines with magnesium (Mg) to form magnesium oxide (MgO)

$MgH_2 \rightarrow Mg + H_2$
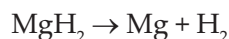
Here MgH_2 loses hydrogen.

Reduction reaction: The chemical reaction in which a reactant combines with hydrogen or loses oxygen to form product is called reduction reaction.

e.g. $C + 2H_2 \rightarrow CH_4$

Here carbon combines with hydrogen and forms compound CH_4 (Methane).

$HgO \xrightarrow{\Delta} Hg + O_2$
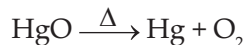
Here Mercuric oxide loses oxygen to form mercury.

*(5) Explain the similarity and difference in two events, namely adding NaOH to water and adding CaO to water.

Ans. Similarity:

(i) Both NaOH and CaO dissolve in water. NaOH dissolves in water forming aqueous NaOH while CaO reacts with water to form Calcium Hydroxide [$Ca(OH)_2$]

(ii) Both are bitter in taste, and turn red litmus to blue. i.e. both are basic in nature.

$NaOH_{(s)} + H_2O_{(l)} \rightarrow NaOH_{(aq)} + Heat$

$CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2(aq)} + Heat$
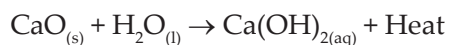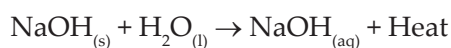
Both are exothermic reactions.

(iii) After adding water, the properties of aqueous solution of sodium hydroxide (NaOH) and aqueous solution of calcium oxide (CaO) are different.

Difference:

(i) Sodium Hydroxide (NaOH) is highly soluble in water, whereas calcium oxide (CaO) is less soluble in water.

(ii) Aqueous solution of NaOH is monovalent, whereas aqueous solution of $Ca(OH)_2$ is divalent.

(iii) As NaOH is highly soluble in water, makes strong base whereas $Ca(OH)_2$ is a weak base.

(6) **Explain two ways by which food industries prevent rancidity.**

Ans.

(i) Rancidity can be prevented by adding antioxidants to food containing fat and oil.

(ii) It can be prevented by packaging fat and oil containing food in airtight containers or by filling the extra space by nitrogen gas.

(7) **Will it be possible for you to decompose water by heat or light energy? If you pass current from a 6 volt battery, is decomposition of water possible?**

Ans. Pure water cannot be decomposed by heat, light or by passing current from a 6 volt battery. However, if few drops of acid is added to water it can be decomposed by passing current from a 6 volt battery.

*(8) A. **Identify from the following reactions the reactants that undergo oxidation and reduction.**

Ans.

(a) $Fe + S \rightarrow FeS \cdot Fe$ undergoes oxidation and S undergoes reduction.

(b) $2Ag_2O \rightarrow 4Ag + O_2\uparrow$ – Silver oxide undergoes reduction.

(c) $2Mg + O_2 \rightarrow 2MgO$ – Mg undergoes oxidation.

(d) $NiO + H_2 \rightarrow Ni + H_2O$ Redox reaction.

In the above equation, reactant NiO (Nickel oxide) loses oxygen, thus undergoes reduction whereas H_2 (Hydrogen gas) gains oxygen forming water and undergoes oxidation.

$$\overset{\text{oxidation}}{\underset{\text{Reduction}}{NiO + H_2 \rightarrow Ni + H_2O}}$$
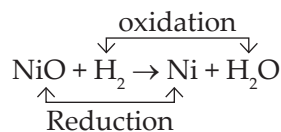
(8) B. **Classify the following reactions into different types.**

(a) $AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow AgCl_{(s)} + NaNO_{3(aq)}$

Ans. (Double displacement reaction) Precipitation reaction

(b) $CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2(aq)} + Heat$
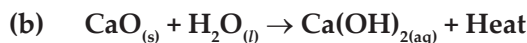
Ans. Combination reaction [Exothermic reaction.]

(c) $2KClO_{3(s)} \xrightarrow{\Delta} 2KCl_{(aq)} + 3O_{2(g)}$

Ans. Decomposition reaction/Thermal decomposition reaction.

(d) $CuO + H_2 \xrightarrow{heat} Cu + H_2O$
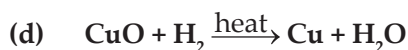
Ans. Displacement reaction [Redox reaction.]

(e) $CuSO_{4(aq)} + Pb_{(s)} \rightarrow PbSO_{4(aq)} + Cu_{(s)}$

Ans. Displacement reaction

(f) $2H_2O_2 \xrightarrow{UV\ light} 2H_2O + O_{2(l)}$
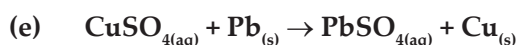
Ans. Photolytic decomposition is a chemical reaction in which molecules are broken down into smaller units through the absorption of light.

(g) $BaS_{(aq)} + ZnSO_{4(aq)} \rightarrow BaSO_{4(s)} + ZnS_{(aq)}$

Ans. Double displacement reaction.

*(9) **Balance the following equation stepwise.**

(a) $H_2S_2O_{7(l)} + H_2O_{(l)} \rightarrow H_2SO_{4(l)}$
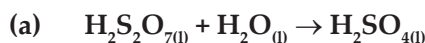
Ans. **Step 1:** Write the equation and then count the number of atoms of each element on the R.H.S. and L.H.S. of the arrow.

$H_2S_2O_7 + H_2O \rightarrow H_2SO_4$ ....(1)
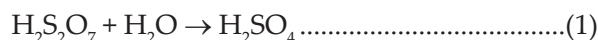
Elements	No. of atoms in reactants (L.H.S.)	No. of atoms in products (R.H.S.)
H	4	2
S	2	1
O	8	4

Step 2: Check whether no. of atoms on both sides is equal. It is seen from the above table number of atoms of all the elements on the two sides are not the same.

Step 3: To balance the number of atoms on both sides, we write coefficient 2 for H_2SO_4.

Now the equation becomes.

$H_2S_2O_{7\ (l)} + H_2O_{\ (l)} \rightarrow 2H_2SO_{4\ (l)}$ ....(2)
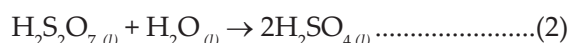
Now see that the number of atoms of each element are equal on both sides.

Elements	No. of atoms in reactants	No. of atoms in products
H	4	4
S	2	2
O	8	8

Hence, the equation (2) is a balanced equation.
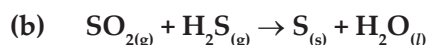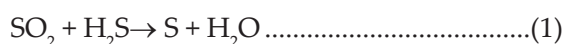
(b) $SO_{2(g)} + H_2S_{(g)} \rightarrow S_{(s)} + H_2O_{(l)}$

Ans. **Step 1:** Write the equation given.

$SO_2 + H_2S \rightarrow S + H_2O$ ....(1)

Count the number of atoms of each element in products and reactants.

Elements	No. of atoms in reactants	No. of atoms in products
S	2	1
O	2	1
H	2	2

Step 2: It is seen from the above table, number of atoms on both sides are not the same. It means that equation (1) needs to be balanced.

Step 3: We will start with oxygen. On product side we need 2 atoms of oxygen, hence coefficient 2 for H_2O. Now the equation will be

$\therefore\ SO_2 + H_2S \rightarrow S + 2H_2O$ ....(2)
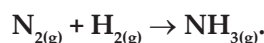
Again count the number of atoms of elements on both the sides.

Elements	No. of atoms in reactants	No. of atoms in products
S	2	1
O	2	2
H	2	4

Still the equation is unbalanced. To balance sulphur and hydrogen atoms on reactant side, write coefficient 2 for H_2S

$\therefore\ SO_2 + 2H_2S \rightarrow S + 2H_2O$ ....(3)
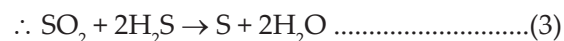
Again count the number of atoms on both the sides.

Elements	No. of atoms in reactants	No. of atoms in products
S	3	1
O	2	2
H	4	4

Now if we count number of atoms of hydrogen and oxygen, they are equal. But number of atoms of sulphur is not balanced. Now there are 3 atoms of sulphur on reactant side, whereas

on product sides it is only one atom. Hence, we write coefficient 3 for sulphur on R.H.S. Now the equation becomes.

$SO_2 + 2H_2S \rightarrow 3S + 2H_2O$ ....(4)

Again count number, of atoms in equation (4)

Elements	No. of atoms in reactants	No. of atoms in products
S	3	3
O	2	2
H	4	4

It means equation (4) is a balanced equation.

(c) $Ag_{(s)} + HCl_{(aq)} \rightarrow AgCl \downarrow + H_2 \uparrow$

Ans. **Step 1:** Write the chemical equation and count the numbers of atoms in reactants and products.

$Ag + HCl \rightarrow AgCl + H_2$ ....(1)
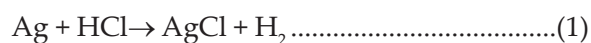
Elements	No. of atoms in reactants	No. of atoms in products
Ag	1	1
H	1	2
Cl	1	1

Step 2: From the above table, we see the number of atoms of hydrogen on reactant side is not balanced. So, to balance hydrogen atom, we write coefficient 2 for HCl.
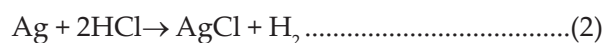
$Ag + 2HCl \rightarrow AgCl + H_2$ ....(2)

Again count the number of atoms of elements on both sides.

Elements	No. of atoms in reactants	No. of atoms in products
Ag	1	1
H	2	2
Cl	2	1

Step 3: Now to balance chlorine, we write coefficient 2 for AgCl
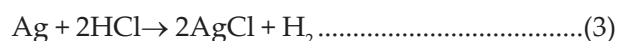
$Ag + 2HCl \rightarrow 2AgCl + H_2$ ....(3)

Again count the number of atoms of elements on both sides.

Elements	No. of atoms in reactants	No. of atoms in products
Ag	1	2
H	2	2
Cl	2	2

Step 4: Atoms of elements, hydrogen and chlorine are now balanced. Number of atoms of Ag on product side is 2, and on reactant side is 1 to balance number of atoms of Ag on reactant

side, we write coefficient 2 for Ag.

$\therefore 2Ag + 2HCl \rightarrow 2AgCl + H_2$ ....(4)
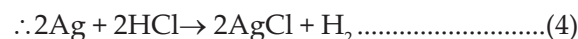
Now count number of atoms in equation (4) again

Elements	No. of atoms in reactants	No. of atoms in products
Ag	2	2
H	2	2
Cl	2	2

It means equation (4) is a balanced equation.

(d) $NaOH_{(aq)} + H_2SO_{4(aq)} \rightarrow Na_2SO_{4\,(aq)} + H_2O_{(l)}.$

Ans. **Step 1:** Write the equation given.

$NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$ ...(1)

Count the number of atoms of each element in products and reactants.

Elements	No. of atoms in reactants	No. of atoms in products
Na	1	2
O	5	5
H	3	2
S	1	1

The number of oxygen and sulphur atoms are equal on both sides. Hence, we will balance Na atoms on both sides.

Step 2: To balance Na atom we write coefficient 2 for NaOH.

$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$ ...(2)

Step 3: Count the number of Na atoms, H atoms, O atoms and S atoms on both sides.

Elements	No. of atoms in reactants	No. of atoms in products
Na	2	2
O	6	5
H	4	2
S	1	1

Step 4: To balance H, we write coefficient 2 for H_2O on the product side. Hence the equation becomes.

$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ ...(3)

Again count the number of atoms of elements on both sides.

Elements	No. of atoms in reactants	No. of atoms in products
Na	2	2
O	6	6
H	4	4
S	1	1

Now the number of atoms of elements are equal on both sides. Hence, equation (3) is a balanced equation.

*(e) **Write down the steps in balancing the equation.** *(Use your Brain Power! Textbook page no.35)*

$N_{2(g)} + H_{2(g)} \rightarrow NH_{3(g)}.$

Ans. **Step 1:** Write the equation given.

$N_2 + H_2 \rightarrow NH_3$ ...(1)

Now count the number of atoms of each elements on reactants and product side.

Elements	No. of atoms of reactants	No. of atoms of product
N	2	1
H	2	3

Step 2: Number of atoms of elements on both side is not the same. So we need to balance it. First we will balance Nitrogen by writing coefficient 2 for the product NH_3.

$N_2 + H_2 \rightarrow 2NH_3$ ...(2)
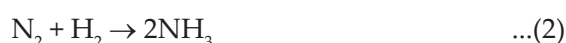
Step 3: Again count the number of atoms of elements on both sides.

Elements	No. of atoms in reactants	No. of atoms in products
N	2	2
H	2	6

Step 4: Number of atoms of Nitrogen is now balanced on both sides, but number of atoms of hydrogen is not balanced. Therefore, we write coefficient 3 for Hydrogen on reactant side. The equation becomes:

$N_2 + 3H_2 \rightarrow 2NH_3$ ...(3)

Now, count the number of atoms on both side.

Elements	No. of atoms in reactants	No. of atoms in products
N	2	2
H	6	6

It means the equation (3) is a balanced equation.

*(f) **Write down a balanced chemical equation for the following reaction.** *(Use your Brain Power! Textbook page no.35)*

Calcium chloride + Sulphuric acid → Calcium sulphate + Hydrogen chloride

Ans. $CaCl_{2(s)} + H_2SO_{4\,(aq)} \rightarrow CaSO_{4(s)} + 2HCl_{(aq)}$
Calcium   Sulphuric   Calcium   hydrogen
chloride   acid   sulphate   chloride
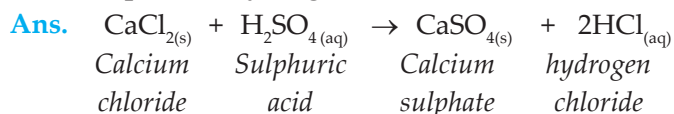
*(g) **Write down the physical states of reactants and products in following reactions.** *(Use your Brain Power! Textbook page no.35)*

(i) **$SO_2 + 2H_2S \rightarrow 3S + 2H_2O$**

Ans. $SO_{2(g)} + 2H_2S_{(g)} \rightarrow 3S_{(s)} + 2H_2O_{(l)}$

(ii) **$2Ag + 2HCl \rightarrow 2AgCl + H_2$**

Ans. $2Ag_{(s)} + 2HCl_{(l)} \rightarrow 2AgCl_{(s)} + H_{2(g)}$
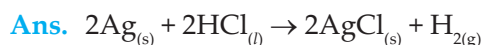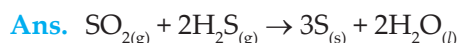
*(h) **Is it possible to produce hydrogen by decomposition of water by means of heat, electricity or light ?** *(Can you recall; Textbook page no.37)*

Ans. Yes. It is possible to produce hydrogen by decomposition of water. Water decomposes into hydrogen and oxygen gases on passing electric current through acidulated water. This decomposition takes place by means of electrical energy.

$$2H_2O(l) \xrightarrow{\text{electric current}} 2H_2\uparrow + O_2\uparrow$$

It is called electrolysis.

*(i) **What is the difference in the process of dissolution and a chemical reaction ?** *(Use your Brain Power; Textbook page no.39)*

Ans. In dissolution, solute dissolves in the solvent without reacting chemically with it. In chemical reaction, reactants will react chemically with each other and new products are formed. The bonds in the reactants are broken and new bonds are formed.

(j) **Does a new substance form when a solute dissolves in a solvent ?** *(Use your Brain Power; Textbook page no.39)*

Ans. No new substance is formed when a solute dissolves in a solvent.

*(k) **Take into account the time required for following processes. Classify them into two groups and give titles to the groups.** *(Can you tell; Textbook page no.39)*

(i)   Cooking gas starts burning on ignition .

(ii)   Iron article undergoes rusting.

(iii) Erosion of rocks takes place to form soil.

(iv) Alcohol is formed on mixing yeast in glucose solution under proper conditions.

(v)   Effervescence is formed on adding baking soda into a test tube containing dilute acid.

(vi) A white precipitate is formed on adding dilute sulphuric acid to barium chloride solution.

Ans.

Fast reaction	Slow reaction
(i) Cooking gas starts burning on ignition .	(i) Iron article undergoes rusting.
(ii) Effervescence is formed on adding baking soda into a test tube containing dilute acid.	(ii) Erosion of rocks takes place to form soil.
(iii) A white precipitate is formed on adding dilute sulphuric acid to barium chloride solution.	(iii) Alcohol is formed on mixing yeast in glucose solution under proper condition.

*(l) **Complete the following reactions and give names of the products.** *(Use your Brain Power; Textbook page no.38)*

(i) **$CuSO_{4(aq)} + Fe_{(s)} \rightarrow$ .... + ...**

Ans. $CuSO_{4(aq)} + Fe_{(s)} \rightarrow FeSO_{4(aq)} + Cu_{(s)}$
                                   Iron   copper
                                   sulphate

(ii) **$CuSO_{4(aq)} + Pb_{(s)} \rightarrow$ .... + ...**

Ans. $CuSO_{4(aq)} + Pb_{(s)} \rightarrow PbSO_{4(aq)} + Cu_{(s)}$
                                   Lead   copper
                                   sulphate
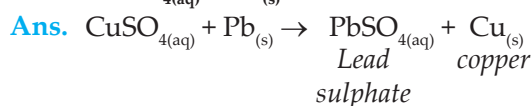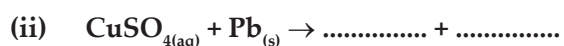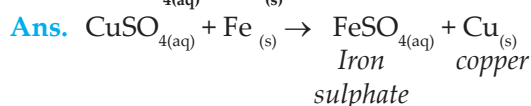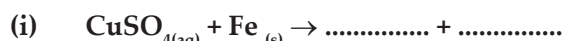
*(10) **Observe the following picture write down the chemical reaction with explanation.**
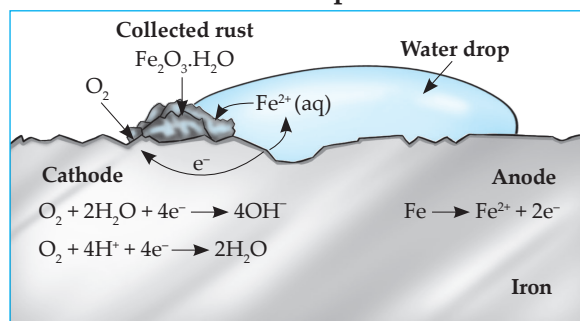
Ans.

(i) In the above diagram, process of rusting takes place.

(ii) A certain type of reddish coloured solid layer collects on the metallic surface.

(iii) This layer is called rust.

(iv) Its chemical formula is $Fe_2O_3.xH_2O$. The rust is formed by an electrochemical reaction.

(v) Different regions on the surface of iron become anode and cathode.

(vi) Fe is oxidised to Fe^{2+} in the anode region.

$$Fe_{(s)} \rightarrow Fe^{2+}_{(aq)} + 2e^-$$

(vii) O_2 reduces to form water in the cathode region.

$$O_{2(g)} + 4H^+_{(aq)} + 4e^- \rightarrow 2H_2O_{(l)}$$

When Fe^{2+} ions migrate from the anode region, they react with water and further get oxidised to form Fe^{3+} ions.

(viii) A reddish coloured hydrated oxide is formed from Fe^{3+} ions, it is called rust. It collects on the surface.

(ix) $2Fe^{3+}_{(aq)} + 4H_2O_{(l)} \rightarrow Fe_2O_3. H_2O_{(s)} + 6H^+_{(aq)}$.

(x) Due to various components of atmosphere, oxidation of metals takes place, consequently resulting in their damage.

(xi) This is called Corrosion Iron rusts and a reddish coloured layer is collected on it. This is corrosion of iron.

(11) Explain what happens when following reactions take place and give the balanced chemical equations.

(i) Iron sulphide reacts with sulphuric acid.

Ans. Iron sulphide reacts with sulphuric acid to form ferrous sulphate and hydrogen sulphide.

$$\underset{\substack{Iron \\ sulphate}}{FeS_{(s)}} + \underset{\substack{Sulphuric \\ acid}}{H_2SO_{4(aq)}} \rightarrow \underset{\substack{Ferrous \\ sulphate}}{FeSO_{4(aq)}} + \underset{\substack{Hydrogen \\ sulphide}}{H_2S_{(g)}} \uparrow$$
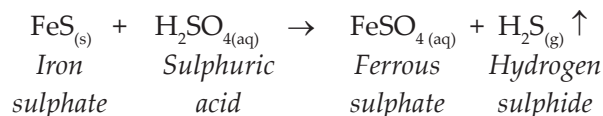
(ii) Zinc dust is added to copper sulphate solution.

Ans. Zinc dust reacts with copper sulphate solution, forming zinc sulphate and copper. Zinc displaces copper from copper sulphate and an aqueous solution of zinc sulphate is formed.

$$\underset{Zinc}{Zn_{(s)}} + \underset{\substack{Copper \\ sulphate}}{CuSO_{4(aq)}} \rightarrow \underset{\substack{Zinc \\ sulphate}}{ZnSO_{4(aq)}} + \underset{Copper}{Cu_{(s)}} \downarrow$$
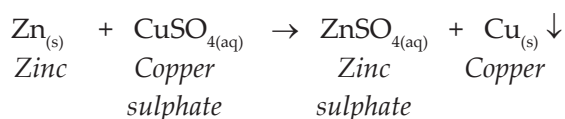
(iii) Potassium chromate solution is added to solution of Barium sulphate.

Ans. When potassium chromate solution is added to solution of Barium sulphate, yellow precipitate of barium chromate is formed. It is a double displacement reaction.

$$\underset{\substack{Potassium \\ chromate}}{K_2CrO_{4(aq)}} + \underset{\substack{Barium \\ Sulphate}}{BaSO_{4(aq)}} \rightarrow \underset{\substack{Potassium \\ sulphate}}{K_2SO_{4(aq)}} + \underset{\substack{Barium \\ chromate}}{BaCrO_{4(s)}} \downarrow$$
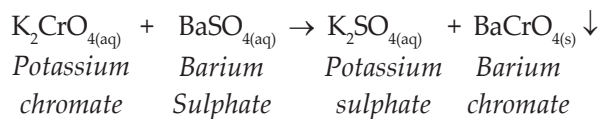
(iv) Sodium carbonate solution is added to calcium chloride solution.

Ans. When sodium carbonate solution is added to calcium chloride solution, solid calcium carbonate and aqueous solution of sodium chloride is formed. It is a double displacement reaction.

$$\underset{\substack{Sodium \\ carbonate}}{Na_2CO_{3(aq)}} + \underset{\substack{Calcium \\ chloride}}{CaCl_{2(aq)}} \rightarrow \underset{\substack{Calcium \\ carbonate}}{CaCO_{3(s)}} + \underset{\substack{Sodium \\ chloride}}{2NaCl_{(aq)}}$$
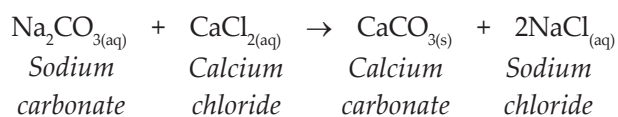
(v) Copper reacts with concentrated Nitric acid.

Ans. When copper reacts with concentrated nitric acid, reddish coloured poisonous nitrogen dioxide gas is formed.

$$\underset{Copper}{Cu_{(s)}} + \underset{\substack{conc. \\ Nitric\ acid}}{4HNO_{3(aq)}} \rightarrow \underset{\substack{Copper \\ nitrate}}{Cu(NO_3)_{2(aq)}} + \underset{\substack{Nitrogen \\ dioxide}}{2NO_{2(g)}} + \underset{Water}{2H_2O_{(l)}}$$
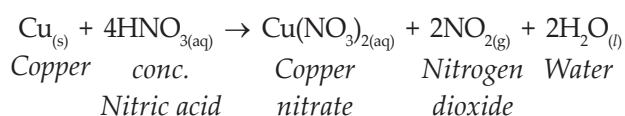
(vi) Silver nitrate solution added to solution of sodium chloride.

Ans. Silver nitrate reacts with sodium chloride to form a white coloured precipitate of silver chloride and solution of sodium nitrate.

$$\underset{\substack{Silver \\ nitrate}}{AgNO_{3(aq)}} + \underset{\substack{Sodium \\ chloride}}{NaCl_{(aq)}} \rightarrow \underset{\substack{Silver \\ chloride}}{AgCl} \downarrow + \underset{\substack{Sodium \\ nitrate}}{NaNO_{3(aq)}}$$
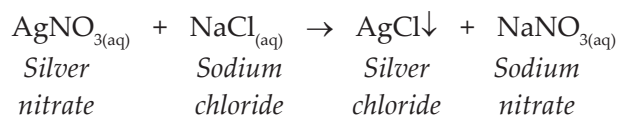
(vii) Sulphur dioxide and hydrogen sulphide reacts.

Ans. Sulphur dioxide and hydrogen sulphide react to form sulphur and water.

$$\underset{\substack{Sulphur \\ dioxide}}{SO_{2(g)}} + \underset{\substack{Hydrogen \\ sulphide}}{2H_2S_{(g)}} \rightarrow \underset{Sulphur}{3S} \downarrow + \underset{Water}{2H_2O_{(l)}}$$
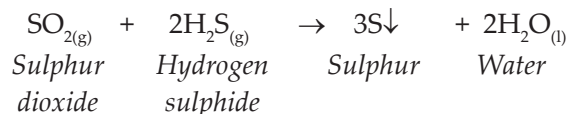
(viii) Glucose reacts with oxygen.

Ans. When glucose combines with oxygen, carbon dioxide and water are formed with the release of energy.

$$\underset{Glucose}{C_6H_{12}O_6} + \underset{Oxygen}{6O_{2(g)}} \rightarrow \underset{\substack{Carbon \\ dioxide}}{6CO_{2(g)}} + \underset{Water}{6H_2O_{(l)}} + energy$$
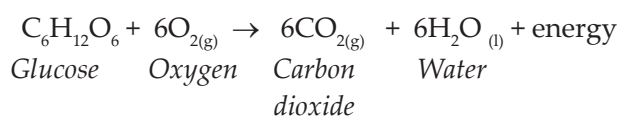
Q.4.1. Describe an activity to observe what happens when quick lime is added to water taken in a beaker. State two important observations and name the type of reaction taking place.

Ans. **Aim:** To observe what happens when quicklime is added to water taken in a beaker.

Material Required: Quicklime (Calcium oxide), water, beaker

Procedure:

(i) Take 5g of calcium oxide in a beaker.

(ii) Add water to it slowly.

(iii) Touch the beaker.

(iv) Note down the observations.

Observation: The beaker becomes hot Calcium oxide reacts with water vigorously to form calcium hydroxide with the evolution of heat.

$$CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2(aq)} + Heat$$
Quick lime   Water   Slaked lime
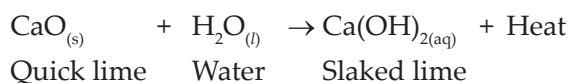
Conclusion: The reaction between CaO and H_2O is a combination reaction. It is an exothermic reaction because heat is evolved.

Q.4.2. Activity based questions:

(1) The following diagram displays a chemical reaction. Observe carefully and answer the following questions.

(a) Identify the type of chemical reaction that will take place and define it. How will the colour of the salt change?

(b) Write the chemical equation of the reaction that takes place.

(c) Mention one commercial use of this salt.

Ans.

(a) Photochemical decomposition reaction: Those reaction in which a compound breaks down into simple substances in the presence of light are called Photochemical decomposition reactions. The colour of salt will change from white to grey.

(b) $2AgCl_{(s)} \xrightarrow{\text{sunlight}} 2Ag_{(s)} + Cl_{2(g)}$

(c) Silver chloride is used in photography.

(2) Check the given materials and chemicals required for a chemical reaction and answer the following questions.

Material - Copper wire, iron nail, beaker or big test tube.

Chemicals - Ferrous sulphate solution and copper sulphate solutions.

(a) Which reaction will you study with the help of above material and solutions? Draw the diagram of the experiment arrangement.

(b) How would identify that the reaction is carried out?

(c) Write a balanced chemical equation for the reaction.

Ans.
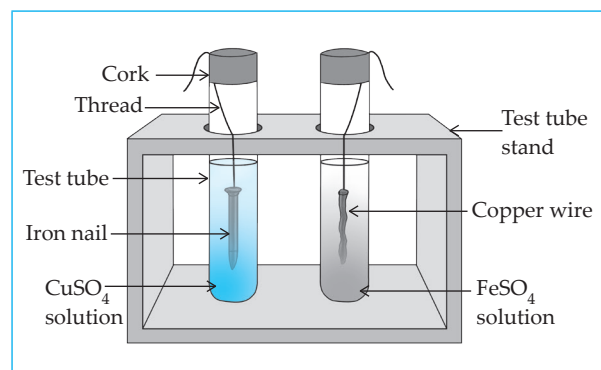
(a) Reaction of metal with solution of salts of other metals (Displacement reaction)

(b) The reaction is carried out in the test tube where iron nail is kept in copper sulphate solution. This is because iron being more reactive than copper, iron displaces copper from copper sulphate solution. The colour of copper sulphate changes from blue to light green due to formation of ferrous sulphate and copper gets deposited on iron nail making it reddish brown in colour.

$$Fe_{(s)} + CuSO_{4(aq)} \rightarrow FeSO_{4(aq)} + Cu_{(s)}$$
Iron   Copper   Ferrous   Copper
           sulphate   sulphate
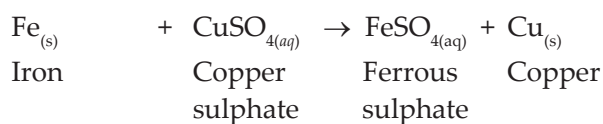
Q.4.3.Answer the following questions in detail:

(1) **What is the importance of a chemical equation? OR Give the significance of a chemical equation.**

Ans. The significance of a chemical equation is as follows:

(i) Chemical equation describes briefly the names of the reactants, the products and the state of matter.

(ii) It explains the specific conditions of temperature, pressure, catalyst, etc. under which the reaction takes place.

(iii) It also states whether energy is evolved or needs to be supplied.

(iv) Chemical equation also represents the relative number of molecules and moles of reactants and products.

(v) The relative masses of the reactants and products can also be calculated using a chemical equation. Thus, a chemical equation describes a chemical reaction qualitatively as well as quantitatively.

(2) **What is rancidity? Mention only two ways by which rancidity can be prevented.**

Ans. The process in which taste and smell of food gets spoiled is called rancidity. It happens due to oxidation.

Prevention of rancidity.

(i) Antioxidants are added to fatty acids to prevent oxidation.

(ii) Food should be kept in airtight containers in refrigerator. Chips are packed in presence of nitrogen gas which prevents spoilage by oxidation.

(3) **Give four uses of decomposition reaction.**

Ans.

(i) Decomposition reaction helps all the living matter to return back to nature, after death.

(ii) Management of garbage.

(iii) Photosynthesis $\rightarrow$ decomposition of water.

(iv) Photography $\rightarrow$ decomposition of silver bromide.

(v) Used in chemical industry to obtain elements from complex compounds.

(vi) Decomposition of agricultural waste leads to formation of compost.

(4) **What is corrosion? Do gold ornaments corrode? Justify.**

Ans.

(i) The slow process of decay or destruction of metal due to the effect of air, moisture and acids on it is known as corrosion.

(ii) Gold ornaments do not get corroded.

(iii) Gold is a noble metal and is least reactive.

(iv) It does not react with water or any of the gases present in the atmosphere. Common acids do not have any effect on gold.

(v) Thus, gold ornaments do not corrode.

(5) **What are the factors which affect the rate of a chemical reaction.**

Ans. The rate of reaction depends upon the following factors.

(i) Nature of the reactants:

(a) $2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$ --------► Fast

$2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$ --------► Slow
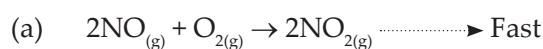
These reactions appear to be similar but the first is fast while second is slow. This is due to the difference in the amounts of energies which are required for breaking up of different bonds and different amounts of energies are released in the formation of different bonds.

(b) $2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2 \uparrow$

$Zn + 2HCl \rightarrow ZnCl_2 + H_2 \uparrow$
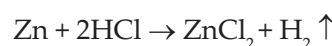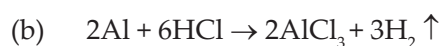
Al and Zn react with dilute hydrochloric acid, H_2 gas is liberated and water soluble salts of the metals are formed. However, the reaction of aluminium metal takes place faster as compared to zinc metal. The nature of metal is responsible for this difference. Al is more reactive than Zn. Therefore, the rate of reaction of Al with hydrochloric acid is higher than that of zinc. Nature of reactivity of reactants influences the rate of a chemical reaction.

(ii) Concentration of the reactants:

Greater the concentration of the reactants, faster is the reaction conversely, as the concentrations of the reactants decrease the rate of reaction also decreases. Dilute HCl reacts slowly with $CaCO_3$ and thereby, $CaCO_3$ disappears slowly and CO_2 also liberates slowly on the other hand the reaction with concentrated HCl takes place rapidly and $CaCO_3$ disappears fast. Concentrated acid reacts faster than dilute acid, which means that rate of reaction is proportional to the concentration of reactants.

(iii) Temperature:

The rate of reaction increases with increase of temperature. In most of the cases, the rate of reaction becomes nearly double for 10K rise of temperature. In some cases, reactions do not take place at room temperature but take place at higher temperature.

(iv) Presence of catalyst:

A catalyst generally increases the speed of a reaction without itself being consumed in the reaction. In case of reverse reaction, a catalyst helps to attain the equilibrium quickly without disturbing the state of equilibrium.

(v) Size of the particles of reactants:

For a reaction involving a solid reactant or catalyst, smaller the particle size, greater is the surface area, and faster is the reaction.

(vi) Presence of light:

Some reactions do not take place in the dark but can take place in the presence of light like photosynthesis or photochemical reactions.

❖ ❖ ❖

ASSIGNMENT - 3

Time : 1 Hr.   **Marks : 20**

Q.1. (A) Fill in the blanks: **(3)**

(1) The reaction $CaCO_3 \rightarrow CaO + CO_2$ is a _____ reaction.

(2) The chemical reaction in which heat is absorbed is called _____ reaction.

(3) A redox reaction takes place during _____ respiration.

Q.1. (B) Choose and write the correct options: **(2)**

(1) Because of the formation of which of the following, lime water turns milky when carbon dioxide is passed in it?

   (a) Calcium Carbonate (b) Calcium bicarbonate (c) Calcium hydroxide (d) Sodium Carbonate

(2) When sulphuric acid is poured over zinc, which of the following gas is formed?

   (a) Sulphur dioxide   (b) Hydrogen   (c) Oxygen   (d) Zinc dioxide

Q.2. Answer the following: *(Any 2)*   **(4)**

(1) What happens when a piece of zinc metal is added to copper sulphate solution?

(2) Write a note on Endothermic Reaction.

(3) Distinguish between physical change and chemical change.

Q.3. Answer the following: *(Any 2)*   **(6)**

(1) Explain the term reactant and product giving examples.

(2) Balance the given Chemical Equations:

   (a) $HNO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + H_2O$

   (b) $FeSO_4 \xrightarrow{\text{heat}} Fe_2O_3 + SO_2 + SO_3$
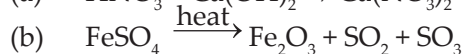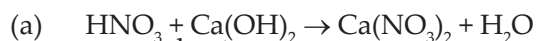
(3) Identify the type of reaction:
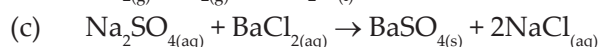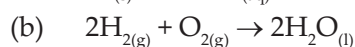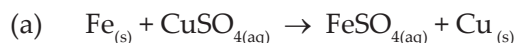
   (a) $Fe_{(s)} + CuSO_{4(aq)} \rightarrow FeSO_{4(aq)} + Cu_{(s)}$

   (b) $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}$

   (c) $Na_2SO_{4(aq)} + BaCl_{2(aq)} \rightarrow BaSO_{4(s)} + 2NaCl_{(aq)}$

Q.4. Answer the following: *(Any 1)*   **(5)**

(1) Explain the types of reaction with reference to oxygen and hydrogen. Illustrate with examples.

(2) (a) What is rancidity? Mention two ways by which rancidity can be prevented.

   (b) What is corrosion? Do gold ornaments corrode? Justify your answer.

❖ ❖ ❖

4 Effects of Electric Current

Points to Remember:

- **Electric current** is the flow of **electrons** in a conductor or amount of **electric charge** flowing through a particular cross sectional area in unit time.

- A continuous path consisting of conducting wires and other resistances between the terminals of a battery, along which an electric current flows, is called an **electric circuit**.

- The production of heat energy in a conductor by electric current flowing through it is called the **heating effect of the electric current.**

- Force that exists in the space around a magnet of a current carrying conductor is called **magnetic field**.

- **Right hand thumb rule** is a convenient rule for finding out direction of the magnetic field produced by a current flowing through an electrical conductor.

- When a copper wire with a resistive coating is wound in a chain of loop (like a spring) is called **solenoid**.

- **Fleming's left hand rule:** According to this rule, the left hand's thumb, index finger and the middle finger are stretched so as to be **perpendicular** to each other. If the **index finger** is in the **direction of the magnetic field**, and the **middle finger** points in the **direction of current,** then the direction of **thumb** is the **direction of force** on the conductor.

- A device which converts **electrical energy** into **mechanical energy** is called an **electric motor**.

- The process by which a changing magnetic field in a conductor induces a current in another conductor is called **electromagnetic induction**.

- **Faraday's law of electromagnetic induction** states that whenever the number of magnetic lines of force passing through the coil changes, current is induced in the coil. The current produced in the coil is called as **Induced current.**

- **Fleming's Right hand rule:** According to this rule when thumb, index finger and middle finger are stretched in the direction perpendicular to each other then the position of **thumb** indicates direction of **motion of conductor**, the **index finger** indicates **direction of magnetic field** and **middle finger** indicates the direction of **induced current.**

- The device which converts **mechanical energy** into **electrical energy** is called an **electric generator**.

- A current that flows only in one direction is called **direct current** (D.C.).

- A current whose direction **reverses** periodically with time is called **alternating current**. (A.C.)

- A generator which converts **mechanical energy** into **electrical energy** in the form of alternating current is called **AC generator**.

- A generator which converts **mechanical energy** into **electrical energy** in the form of direct current is called **DC generator**.

MASTER KEY QUESTION SET - 4

Q.1. (A) 1. Fill in the blanks:

(1) The generation of heat in a resistor when an electric current is passed through the circuit is called ....

(2) The electric bulb consists of a filament made up of ....

(3) The potential difference between a live wire and neutral wire is ....

(4) In the electric bill, the electricity usage is expressed in ....

(5) 1 kWh electrical energy used, is also called _____.

(6) When a copper wire with a resistive coating is wound in a chain of loop (like a spring), it is called_____ .

(7) The device which converts electrical energy into mechanical energy is called _____ .

(8) In a straight current carrying conductor, if the current through the wire is increased, the intensity of magnetic field _____ .

(9) The right hand thumb rule is also called as _____ .

(10) The magnetic lines of force inside the solenoid are parallel to each other, which means the magnetic field is _____ .

(11) The frequency of AC current in India is _____ .

(12) The direction of force acting on a current carrying conductor depends on _____ and _____ .

(13) The force acting on a current carrying conductor is maximum when the direction of current is _____ to the direction of magnetic field.

(14) A galvanometer is a sensitive device which works on the same principle as that of an _____ .

(15) The commercial unit of power is _____ .

(16) Generator works on the principle of _____ .

(17) The electric oven is an example of _____ .

(18) The SI unit of heat energy is _____ .

(19) The electric current that reverses its direction periodically with time is called _____ .

(20) When the potential difference between two terminals becomes _____ , the electric current stops flowing.

(21) The _____ is used in the electric circuit to protect it from loss due to excessive current.

(22) When live wire and neutral wire come in contact, _____ takes place.

(23) The unit of electric resistance is _____ .

Ans. *(1) heating effect (2) Tungsten (3) 220 V (4) kWh (5) 1 unit (6) Solenoid (7) Electric motor (8) increases (9) Maxwell's cork-screw rule (10) uniform (11) 50Hz (12) direction of the current, direction of magnetic field (13) perpendicular (14) electric motor (15) kilowatt (kW) (16) electromagnetic induction (17) heating effect of electric current (18) joule (19) Alternating Current (20) zero (21) Electric fuse (22) Short circuit (23) ohm (Ω)*

Q.1. (A) 2. Find the odd word out.

*(1) Fuse wire, insulator, rubber gloves, generator

Ans. Generator (All others are concerned with safety measures.)

*(2) Voltmeter, Ammeter, Thermometer, Galvanometer

Ans. Thermometer (All others are based on magnetic effect of electric current.)

*(3) Loudspeaker, Microphone, Electric motor, Magnet

Ans. Magnet (All others are related to magnet effect of an electric current.)

(4) Armature coil, Brushes, Magnet, Direct current

Ans. Direct current (All others are the parts of electric motor.)

(5) Refrigerator, Electric fan, Mixer, Electric water heater

Ans. Electric water heater (All others are applications of magnetic effect of current.)

(6) Fuse wire, Neutral wire, Earthing wire, Live wire

Ans. Fuse wire (All others are concerned with electric supply wires.)

(7) Electric heater, Electric bulb, Electric fuse, Electric press

Ans. Electric fuse (All others are wires with high melting points.)

(8) Electric oven, Electric bulb, Electric press, Electric fan

Ans. Electric fan (All others are based on heating effect of electric current.)

(9) Electric bell, Electric fuse, Solenoid, Microphone

Ans. Electric fuse (All others work on the principle of magnetic effect of electric current.)

Q.1. (A) 3. Answer the following in one sentence:

(1) What is heating effect of an electric current?

Ans. The generation of heat in a metallic conductor by the effect of electric current flowing through it is called heating effect of electric current.

(2) What are the appliances that work on the principle of heating effect of electric current?

Ans. Electric bulb, electric press, electric heater, electric oven, electric fuse, electric stove etc. are some appliances that work on the principle of heating effect of electric current.

(3) What is solenoid?

Ans. When a copper wire with a resistive coating is wound in a chain of loop (like a spring), it is called solenoid.

(4) What is electric motor?

Ans. The device that converts electrical energy into mechanical energy is called an electric motor.

(5) What do you understand by the term 'Direct current (D.C.)?

Ans. The electric current that flows in one direction, i.e. from higher potential to lower potential is called as direct current (D.C.).

(6) What is alternating current (A.C.)?

Ans. The electric current that reverses its direction periodically with time is called an alternating current (A.C.).

(7) Name two types of electric current.

Ans. Direct current and Alternating current are two types of electric current.

(8) Name the types of electric generator.

Ans. AC generator and DC generator are the two types of generators.

(9) Name the three types of wires or cables used in domestic electric circuit.

Ans. There are three types of wires or cables used in domestic electric circuit namely live wire (phase wire), neutral wire and earth wire.

(10) Which electrical appliance converts electrical energy into mechanical energy?

Ans. The electric motor converts electrical energy into mechanical energy.

(11) Which appliance converts mechanical energy into electrical energy?

Ans. The electric generator converts mechanical energy into electrical energy.

(12) What is the frequency of alternating current in India?

Ans. In India, the frequency of alternating current (A.C.) is 50 Hz.

(13) What do you mean by induced current?

Ans. The electric current that is set up in the coil due to the motion of either coil or a magnet (magnetic field) is called induced current.

(14) Name the two components or devices used for the safety of electrical gadgets?

Ans. Electric fuse and earth wire are the two devices used for the safety of electrical components or gadgets.

(15) Write the relation between kilowatt hour and joule.

Ans. 1 kWh = 3.6×10^6 J

(16) Write the relation between watt hr and joule.

Ans. 1 watt hr = 3.6×10^3 J

(17) When will the induced current in the electrical conductor (coil) be maximum?

Ans. It will be maximum when the direction of motion of the electric conductor is perpendicular to the magnetic field.

Q.1. (A) 4. Match the columns:

(1)

	Column A		Column B
(1)	Fleming	(a)	Relation between electric energy and magnetism
(2)	Faraday	(b)	Law of electromagnetic induction
(3)	Oersted	(c)	Magnetic field, direction of electric current direction of motion of a conductor.

Ans. *(1 – c), (2 – b), (3 – a)*

(2)

	Column A		Column B
(1)	Earthing wire	(a)	Electric motor
(2)	Overloading	(b)	Electric generator
(3)	Electromagnetic force	(c)	Protection against electric shock
(4)	Electromagnetic induction	(d)	Excessive electric current

Ans. *(1 – c), (2 – d), (3 – a), (4 – b)*

(3)

	Column A		Column B
(1)	Right hand thumb rule	(a)	Magnetic effect of electric current
(2)	Hans Oersted	(b)	Properties of a bar magnet
(3)	Solenoid	(c)	Do not intersect each other
(4)	Magnetic lines of force	(d)	Direction of current and magnetic field

Ans. *(1 – d), (2 – a), (3 – b), (4 – c)*

(4)

Column A	Column B
(1) Electric generator	(a) Transmitted over long distances
(2) Electric motor	(b) Unidirectional flow of current
(3) Direct current	(c) Converting mechanical energy into electrical energy
(4) Alternating current	(d) Used in mixers, refrigerator etc.

Ans. *(1 – c), (2 – d), (3 – b), (4 – a)*

Q.1. (A) 5. State whether the following statement 'True' or 'False'. If false; write the correct statement for the same.

(1) The SI unit of electric charge is coulomb (C).

(2) The SI unit of electric current is volt (V).

(3) Resistivity of a conductor does not depend upon its temperature.

(4) The filament in the electric bulb is made of a wire with high melting point.

(5) The direct current always flows in one direction only.

(6) The electric motor is used to generate electricity.

(7) During lightning, all the electrical appliances must be switched off.

(8) Many high power rating electrical appliances can be connected to a circuit at a time.

(9) Direct current has a frequency of 50 Hz in India.

(10) Electric power (P) = VI

(11) According to Ohm's law, $V = I \times t$

(12) The production of heat in a wire when connected to electric circuit is called heating effect of an electric current.

(13) 1 kWh = 3.6×10^9 J

(14) 1 kWh electric unit = 10 units.

(15) The device which converts electrical energy to mechanical energy is called an electric generator.

(16) Alternating current is perfectly used for domestic electric circuits.

(17) When more electrical appliances work together in a circuit, it results in a short circuit.

(18) When a live wire and a neutral wire come in contact with each other, it may cause short circuit.

Ans. *(1) True (2) False. SI unit of electric current is ampere. (A) (3) False. Resistivity depends on temperature. (4) True (5) True (6) False. Electric generator is used to generate electricity. (7) True (8) False. Many high power rating electrical appliances should not be connected simultaneously in the electric circuit. (9) False. Direct current flows in one direction. (10) True (11) False. According to Ohm's law,* $V = I \times R$ *(12) True (13) False. 1 kWh =* 3.6×10^6 *J (14) False. 1 kWh energy is 1 unit. (15) False. The device which converts electric energy into mechanical energy is called electric motor. (16) True (17) False. When more appliances are connected simultaneously, it results in overloading, causing fire. (18) True.*

Q.1. (B) Choose and write the correct option:

(1) The direction of magnetic field due to electric current is decided by ....

(a) Right hand thumb rule
(b) Fleming's left hand rule
(c) Fleming's right hand rule
(d) None of the above

(2) The device which converts mechanical energy into electrical energy is called ....

(a) Electric bell (b) Electric generator
(c) Electric fuse (d) Electric motor

(3) 1 mA = ...

(a) 10^{-6}A (b) 10^{6}A (c) 10^{-3}A (d) 10^{3}A

(4) 1 watt = ...

(a) 1 joule/1 second (b) 1000 J/s
(c) 1 calorie/1 second (d) 1 joule.second

(5) Electric power (P) = ...

(a) V.t/Q (b) Q.t/V (c) V.Q.t (d) V.Q/t

(6) 1 kWh = ...

(a) 36×10^6 J (b) 3.6×10^6 J
(c) 3.6×10^9 J (d) 36×10^9 J

(7) The deflection of the pointer of .... is on either side of zero mark.

(a) Voltmeter (b) Ammeter
(c) Galvanometer (d) Thermometer

(8) If the potential difference across a wire is 2 V and the current through the wire is 1 A, the electric power is ....

(a) 4 W (b) $\frac{1}{2}$ W (c) 2 W (d) $\frac{1}{4}$ W

(9) At the centre of which of the following four circular rings is the magnetic field strongest, for equal magnitude of current?

(1) 2 I b

(2) 2 I d

(3) 2 I a

(4) 2 I c
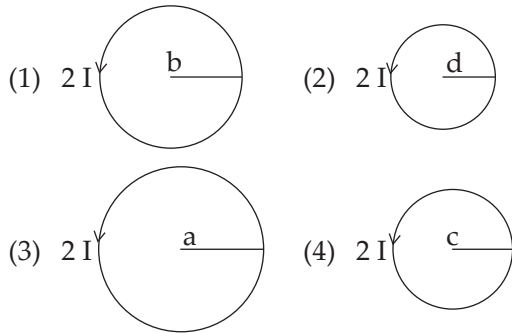
(a) 3   (b) 1   (c) 4   (d) 2

(10) Which of the following is used to find the direction of the magnetic lines of force around a conductor?

(a) Bar magnet   (b) Magnetic needle

(c) Disc magnet   (d) Spherical magnet

(11) A galvanometer can be used to measure ....

(a) only DC   (b) only AC

(c) both DC and AC   (d) potential difference

(12) Write the correct option by observing the figures:

Magnetic lines   Conductor loop

Cardboard

R

A

Magnetic lines   Conductor loop

Cardboard

R

B
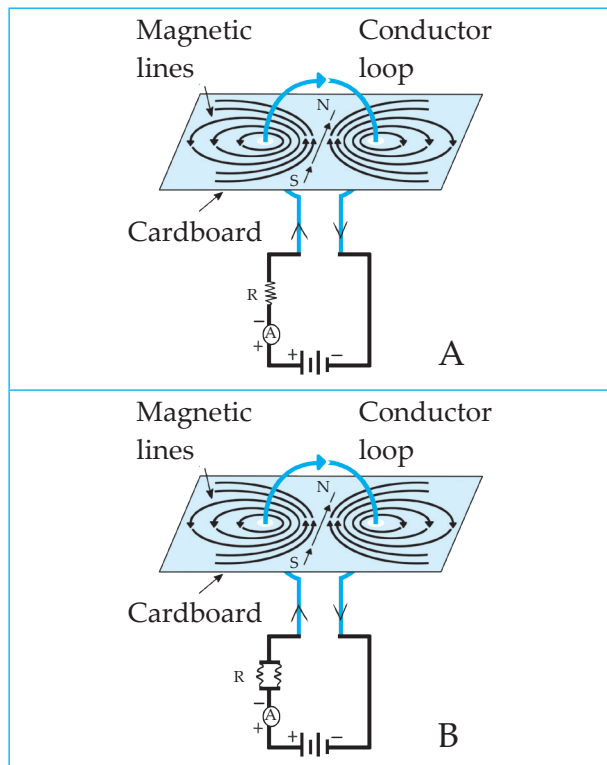
(a) Magnetic field in A is stronger.
(b) Magnetic field in B is stronger.
(c) Magnetic fields in A and B are same.
(d) Magnetic fields in A and B are weaker.

(13) In the arrangement shown in figure, there are two coils wound on a non-conducting cylindrical rod. Initially the key is not inserted. Then the key is inserted and later removed. Then,
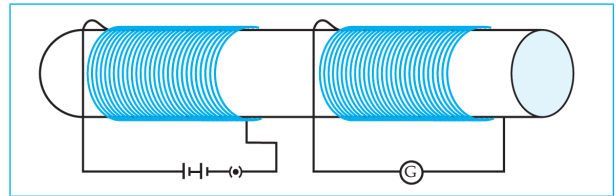
(a) The galvanometer will not deflect.
(b) The galvanometer will deflect in one direction when the key is inserted and in the opposite direction when the key is removed.
(c) The galvanometer will deflect in one direction when the key is inserted and remain still when the key is removed.
(d) The galvanometer will deflect in one direction when the key is inserted and in the same direction when the key is removed.

(14) Out of the four circuits shown, for studying the dependence of current on the potential difference across a resistor, the correct circuit is

(a)   (b)

(c)   (d)
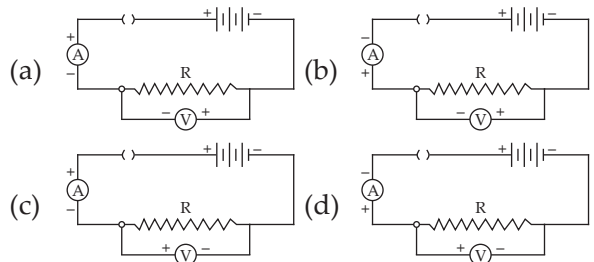
(15) The intensity of magnetic field is expressed in ....

(a) ampere   (b) volt

(c) coulomb   (d) oersted

Ans. *(1) (a) Right hand thumb rule (2) (b) Electric generator (3) (c) $10^{-3}A$ (4) (a) 1 joule / 1 second (5) (d) V.Q/t (6) (b) 3.6×10^6 J (7) (c) Galvanometer (8) (c) 2 W (9) (d) 2 (10) (b) Magnetic needle (11) (c) both DC and AC (12) (b) Magnetic field in B is stronger (13) (b) The galvanometer will deflect in one direction when the key is inserted and in the opposite direction when the key is removed. (14) (c) (15) (d) oersted*

Q.2.1. Solve the following:

Type: A	
$H = I^2Rt$ joules	$P = I^2R$ watt
$H = \dfrac{V^2t}{R}$ joules	$P = \dfrac{V^2}{R}$ watt
$H = VIt$ joules	$P = VI$ watt

*(1) **Heat energy is being produced in a resistance in a circuit at the rate of 100 W. The current of 3 A is flowing in the circuit. What must be the value of the resistance?**

Ans. **Given:** $I = 3A$

$P = 100$ W

To find: $R = ?$

Formulae: $P = I^2R$

Solution: $P = I^2R$

$100 = (3)^2 \times R$

$100 = 9R$

$R = \dfrac{100}{9}$

$R = 11.11\Omega$

$\boxed{R \approx 11\Omega}$

Ans. The value of the resistance is 11Ω.

*(2) **Two tungsten bulbs of wattage 100 W and 60 W power work on 220 V potential difference. If they are connected in parallel, how much current will flow in the main conductor?**

Ans. **Given:** $P_1 = 100$ W

$P_2 = 60$ W

$V = 220$ V

To find: $I = ?$

Formulae: $P = VI$

Solution:

Total power $(P) = P_1 + P_2 = 100 + 60 = 160W$

$P = VI$

$I = \dfrac{P}{V} = \dfrac{160}{220} = \dfrac{8}{11}$

$\boxed{I = 0.72A}$

Ans. The current flowing in the main conductor is 0.72A.

*(3) **A 6 m long wire made from an alloy, nichrome, is shaped into a coil and given for producing heat. It has a resistance of 24 ohm. Can we get more heat if the wire is cut into half of its original length and shaped into a coil? For getting Energy, the two ends of the wire are connected to a source with a potential difference of 220 V.**

Ans. **Given:**   Case (i) (For length 6m)

$R = 24 \, \Omega$

Case (ii) (For length 3m)

$R = 12 \, \Omega$

$V = 220$ V

To find: Power $(P) = ?$

Formulae: $P = \dfrac{V^2}{R}$

Solution: Case (i) (For length 6m)

$P = \dfrac{V^2}{R} = \dfrac{(220)^2}{24}$

$\therefore \quad P = \dfrac{220 \times 220}{24} = \dfrac{55 \times 110}{3} = \dfrac{6050}{3}$

$\boxed{P = 2016.67 \text{ W}}$

Case (ii) (For length 3m)

$P = \dfrac{V^2}{R} = \dfrac{(220)^2}{12}$

$\therefore \quad = \dfrac{220 \times 220}{12} = \dfrac{12100}{3}$

$\boxed{P = 4033.33 \text{ W}}$

Ans. Hence more heat will be obtained after cutting the wire into half as power consumption increases.

*(4) **An electric iron uses a power of 1100 W when set to higher temperature. If set to lower temperature, it uses 330 W power. Find out the electric current and the respective resistance of 220 V.**

Ans. **Given:** $P_1 = 1100$ W

$P_2 = 330$ W

$V = 220$ V

To find: $I_1 = ?, I_2 = ?, R_1 = ?, R_2 = ?,$

Formulae: $P = VI, P = \dfrac{V^2}{R}$

Solution:

$P_1 = VI_1$

$I_1 = \dfrac{P_1}{V} = \dfrac{1100}{220}$

$\boxed{I_1 = 5 \text{ A}}$

$I_2 = \dfrac{P_2}{V} = \dfrac{330}{220} = \dfrac{3}{2}$

$\boxed{I_2 = 1.5 \text{ A}}$

$P_1 = \dfrac{V^2}{R_1}$

$\therefore \quad R_1 = \dfrac{V^2}{P_1} = \dfrac{(220)^2}{1100} = \dfrac{220 \times 220}{1100} = 2 \times 22$

$$\boxed{R_1 = 44\ \Omega}$$

$$R_2 = \frac{V^2}{P_2} = \frac{(220)^2}{330} = \frac{220 \times 220}{330} = \frac{440}{3}$$

$$\boxed{R_2 = 146.67\ \Omega}$$

Ans. If power is 1100 W, then the current is 5 A and resistance is 44 Ω and when power is 330 W, then the current is 1.5 A and resistance is 146.67 Ω

*(5) A cell is connected to a 9 ohm resistance, because of which heat of 400 J is produced per second due to current flowing through it. Obtain the potential difference applied across the resistance.

Ans. **Given:** R = 9 Ω

$\qquad\qquad$ H = 400 J

$\qquad\qquad$ t = 1 s

To find: V = ?

Formula: $H = \dfrac{V^2 t}{R}$

Solution: $H = \dfrac{V^2 t}{R}$

$$400 = \frac{V^2 \times 1}{9}$$

$$3600 = V^2$$

$$V = \sqrt{3600}$$

$$\boxed{V = 60\ V}$$

Ans. The potential difference applied across the resistance is 60 V.

NUMERICALS FOR PRACTICE

(1) The resistance of a wire is 25 Ω. Due to electric current passing through it, 6.25 J/sec heat is generated in the wire. Find the potential difference. **Ans: *12.5 V***

(2) If 90 W bulb is connected to a circuit with potential difference of 360 V, find the current flowing through the bulb. **Ans: *0.25 A***

(3) An electric bulb is connected to 250 V. The current passing through it is 0.27 A. What is the power of the bulb? **Ans: *67.5 W***

(4) If the bulb of 60 W is connected across a source of 220 V, find the electric current drawn by it. **Ans: *0.2727 A.***

(5) A potential difference of 250 V is applied across a resistance of 1000 Ω in an electric iron. Find (i) the current and (ii) heat energy produced in 12 sec. **Ans: *(i) 0.25 A   (ii) 750 J.***

(6) Find the resistance of a coil of power 60 W when potential difference of 240 V is applied across it. **Ans: *960 Ω.***

(7) If a bulb is rated 220 V and 100 W . Find resistance. **Ans: *484 Ω***

(8) An electric current of 5 A flows through a wire of resistance 41.8 Ω. Find the time to obtain heat of 3000 cal. **Ans: *12 seconds***

> **Type: B**
>
> **Energy = Power $\times$ Time**
>
> **H = P $\times$ t**
>
> **Note: Power should be in kW**
> $\qquad$ **Time should be in hours**

*(1) Who will spend more electrical energy, 500 W TV set in 30 mins or 600 W heater in 20 mins?

Ans. (i) For TV set

Electrical energy consumed = P $\times$ t

$$= \frac{500}{1000} \times \frac{30}{60}$$

$$= 0.5 \times 0.5$$

$$= 0.25\ kWh$$

(ii) For Heater

Electrical energy consumed = P $\times$ t

$$= \frac{600}{1000} \times \frac{20}{60}$$

$$= 0.6 \times \frac{1}{3}$$

$$= 0.2\ kWh$$

Ans. Therefore, TV will consume more electrical energy.

*(2) An electric tungsten bulb is connected into a home circuit. The home electric supply runs at 220 V potential difference. When switched on, a current of 0.45 A flows through the bulb. What must be power (wattage) of the bulb? If it is kept on for 10 hours, how many units of electricity will be consumed?

Ans. **Given:** V = 220 V

$\qquad\qquad$ I = 0.45 A

$\qquad\qquad$ t = 10 h

To find: P = ?

Unit of energy = ?

Formulae: $P = VI$, $H = P \times t$

Solution: $P = VI$

$$= 220 \times 0.45$$

$$\boxed{P = 99 \text{ W}}$$

$$\therefore \ P = \frac{99}{1000} \text{ kW}$$

$$H = P \times t$$

$$= \frac{99}{1000} \times 10$$

$$\boxed{H = 0.99 \text{ kWh}}$$

Ans. The power of the bulb will be 99 W and the units of electricity consumed is 0.99.

*(3) An electric iron of 1100 W is operated for 2 hrs daily. What will be the electrical consumption expenses for the month of April? (The electric company charges ₹ 5 per unit of energy).

Ans. Given: $P = 1100$ W

$$= \frac{1100}{1000} \text{ kW} = \frac{11}{10} \text{ kW}$$

$$t = 2 \times 30 = 60 \text{ h}$$

Unit cost = ₹ 5

To find: Total cost = ?

Formula: $H = P \times t$

Solution: $H = P \times t$

$$= \frac{11}{10} \times 60$$

$$\therefore \qquad H = 66 \text{ kWh}$$

Total cost = 66 × 5

$$\boxed{\text{Total cost} = ₹\ 330}$$

Ans. The electrical consumption expenses for the month of April will be ₹ 330.

(4) An electric iron rated 750 W operates 2 hours/day. If the cost of unit is ₹ 3.00 per kWh. Find the cost of energy to operate electric iron for 30 days.

Ans. Given: $(P) = 750$ W

$$= \frac{750}{1000} \text{ kW} = \frac{75}{100}$$

$$(t) = 2 \times 30 = 60 \text{ hours}$$

Unit cost = ₹ 3

To find: Total Cost = ?

Formula: $H = P \times t$

Solution: $H = P \times t$

$$\therefore \ H = \frac{75}{100} \times 60 = 45 \text{ kWh}$$

$$\therefore \ \text{Total Cost} = 45 \times 3$$

$$\boxed{\text{Total cost} = ₹\ 135}$$

Ans. Cost of energy to operate electric iron for 30 days is ₹ 135.

(5) A washing machine rated 300 W operates one hour/day. If the cost of unit is ₹ 3.00, find the cost of the energy to operate a washing machine for the month of March.

Ans. Given: $(P) = 300$ W

$$= \frac{300}{1000} \text{ kW} = \frac{3}{10} \text{ kW}$$

$$(t) = 1 \times 31 = 31 \text{ hrs}$$

Unit cost = ₹ 3

To find: Total Cost = ?

Formula: $H = P \times t$

Solution: $H = P \times t$

$$\therefore \qquad H = \frac{3}{10} \times 31 \ = \frac{93}{10} = 9.3 \text{ kWh}$$

$$\therefore \qquad \text{Cost of energy} = 9.3 \times 3$$

$$\boxed{\text{Cost of energy} = ₹\ 27.9}$$

Ans. The cost of the energy to operate a washing machine for the month of March is ₹ 27.90.

(6) If a TV of rating 100W is operated for 6 hrs per day, find the number of units consumed in a leap year.

Ans. Given: Power $(P) = 100$ W

$$P = \frac{100}{1000} \text{ kW} = \frac{1}{10} \text{ kW}$$

$$\text{Time } (t) = 6 \times 366 = 2196 \text{ hrs}$$

To find: Unit consumed = ?

Formula: $H = P \times t$

Solution: $H = P \times t$

$$H = \frac{1}{10} \times 2196$$

$$\boxed{H = 219.6 \text{ kWh}}$$

Ans. Number of units consumed is 219.6.

NUMERICALS FOR PRACTICE

(1) The potential difference of 260 V is applied at the domestic circuit. An LED is connected to the circuit. An electric current of 0.35 A flows through the LED.

Then find : (i) Power of LED Bulb

(ii) Units consumed if the bulb is operating for

10 hr.   **Ans:** *(i) 91 W (ii) 0.91 unit (kWh)*

(2) **A 300 W T.V is operated every day for 6 hr. Find the electrical energy (no. of units) consumed.**
                                                  Ans: *657 kWh.*

(3) **An electric iron rated 750 W is operated for 2 hr/day. If the cost of unit is ₹ 3.00 per kWh, find the cost of energy used to operate electric iron for 30 days.**   **Ans:** ₹ *135.*

(4) **If T.V. of rating 100 W is operated for 6 hr per day. Find the number of units consumed in a leap year.**   **Ans:** *219.6 units*

Q.2.2. Write the definition / laws:

(1) **AC generator:**

Ans. The device which converts mechanical energy into electrical energy in the form of alternating current is called AC generator.

(2) **DC generator:**

Ans. A device which converts mechanical energy into electrical energy in the form of direct current is called DC generator.

(3) **Right Hand Thumb Rule:**

Ans. Imagine that you have held the conductor in your right hand in such a way that your thumb points in the direction of the current. Then turn your fingers around the conductor, the direction of the fingers is the direction of the magnetic lines of force.

(4) **Fleming's left hand rule:**

Ans. According to the rule, the left hand thumb, index finger, and the middle finger are stretched so as to be perpendicular to each other. If the index finger is in the direction of the magnetic field, middle finger points in the direction of the current, then the direction of the thumb is the direction of the force on the conductor.

(5) **Heating effect of electric current:**

Ans. The production of heat energy in a conductor by the electric current flowing through it is called the heating effect of an electric current.

(6) **Fleming's Right Hand Rule:**

Ans. Stretch the thumb, the index finger and the middle finger in such a way that they will be perpendicular to each other. In this position, the thumb indicates the direction of motion of the conductor, the index finger shows the direction of the magnetic field, and the middle finger shows the direction of the induced current.

*(7) **Maxwell's cork - screw rule:**

Ans. If a right handed cork screw is assumed to be held along the conductor, and screw is rotated such that it moves in the direction of the current, then the direction of magnetic field is same as that of the rotation of screw.

(8) **Faraday's law of induction:**

Ans. If the number of magnetic lines of force passing through the coil changes, current is induced in the coil. This is known as Faraday's law of induction. The current produced in the coil is called the induced current.

Q.2.3. Distinguish between:

*(1) **AC generator and DC generator**

Ans.

AC generator	DC generator
(i) AC generator converts mechanical energy into electrical energy in the form of alternating current.	(i) DC generator converts mechanical energy into electrical energy in the form of direct current.
(ii) In this, brass slip rings are used.	(ii) In this, brass split rings are used.

(2) **Electric motor and AC generator**

Ans.

Electric motor	AC generator
(i) The device which converts electrical energy into mechanical energy is called electric motor.	(i) The device which converts mechanical energy into electrical energy is called electric generator.
(ii) A battery is used to pass a current through the armature coil.	(ii) A galvanometer is used to detect the presence of electric current.
(iii) In motor, a current carrying coil is set in rotation due to the magnetic field.	(iii) In generator, a current is produced when the coil rotates in the magnetic field.
(iv) In motor, the split ring commutator is used.	(iv) In the AC generator, slip ring commutator is used.
(v) Electric motor runs on electricity.	(v) Electric generator generates electricity.

(3)   Short circuiting and Overloading

Ans.

Short circuiting	Overloading
(i) If a live wire and neutral wire come in contact or touch each other, short circuiting takes place.	(i) If electrical appliances of high power rating are switched on simultaneously, overloading occurs.
(ii) During a short circuit, the resistance becomes very small.	(ii) In overloading, the power consumption of a circuit becomes large.
(iii) In this, large amount of current flows which produces heat and can cause fire.	(iii) In this, large amount of current flows through appliance beyond its permissible limit.
(iv) Can be avoided by periodic checking.	(iv) Can be avoided by not using many appliances at a time.

(4)   Direct current and Alternating current

Ans.

Direct current	Alternating current
(i) The electric current that flows in one direction, i.e. from higher potential to lower potential is called as direct current (D.C.).	(i) The electric current that reverses its direction periodically with time is called an alternating current (A.C.).
(ii) The frequency of DC is zero.	(ii) The frequency of AC in India is 50 Hz.
(iii) DC cannot be used on a large scale for household purpose.	(iii) AC can be used on a large scale for household purpose.

Q.2.4. Give Scientific Reasons:

*(1)   Tungsten metal is used to make a solenoid type coil in an electric bulb.

Ans.

(i)   The electric bulb works on the principle of heating effect of electric current.

(ii)   The intensity of light emitted by the filament of an electric bulb depends on the temperature of the filament.

(iii) When electric current is passed through the filament, a large amount of heat is generated and filament becomes hot, then emits light.

(iv)   The melting point of Tungsten is very high (3380°C), so that filament can be heated to a high temperature without melting.

(v)   Hence, the filament of electric bulb is made up of Tungsten.

*(2)   In the electric equipments producing heat e.g. iron, electric heater, boilers, toaster, etc an alloy such as Nichrome is used, not pure metal.

Ans.

(i)   The appliances like iron, electric toaster etc. works on the principle of heating effect of an electric current.

(ii)   At high temperature pure metal can get oxidised and also pure metals have low resistivity.

(iii) An alloy such as Nichrome, has high resistivity

and can be heated to a high temperature without undergoing oxidation.

(iv)   Thus, Nichrome is preferred over other pure metals and are used for making coil for devices working on heating effect of electric current.

*(3)   For electric power transmission, copper or aluminium wire is used.

Ans.

(i)   Copper and Aluminium are good conductors of electricity.

(ii)   Copper and aluminium have large number of free electrons and are highly ductile metals.

(iii) They have less resistivity, due to which these metals have high conductivity.

(iv)   Hence, connecting wires in the electric circuit are generally made of copper and aluminium.

*(4)   In practice the unit kWh is used for the measurement of electrical energy rather than joule.

Ans.

(i)   The unit of electric power (W) is a very small unit, hence 1000W or 1kW is used in practice.

(ii)   Now if 1kW power is used for 1 hour, it means 1kW × 1h i.e. 1kWh energy is consumed.

(iii) joule is the SI unit for energy which is very small, hence on commercial scale kWh is used to measure electrical energy.

*(5) **Why are carbon brushes used? How do these work?** *(Find out; Textbook Page 65)*

Ans. Brushes make contact with the split ring and are responsible for the make and break of the circuit.

As the brushes are made up of carbon they offer less resistance and act as a good conductor and are also cheaper to replace.

*(6) **Iron is a conductor of electricity, but when we pick up a piece of iron resting on the ground, why don't we get electric shock?** *(Can you recall?; Textbook Page 47)*

Ans. In a piece of iron, the net flow of electrons is zero and hence current is zero. Hence we don't get electric shock. If we want an electric current to flow through it, then we need to connect it to a source of potential difference i.e. cell.

(7) **The material used for making fuse wire has low melting point.**

Ans.
(i) The fuse wire works on the principle of heating effect of electric current.
(ii) The fuse is made up of an alloy with low melting point.
(iii) This wire can allow certain maximum current to flow through it. If current exceeds this value, the heat generated in the coil is sufficient to melt it.
(iv) Due to this electric current stops flowing through the circuit and the valuable electrical appliances can be saved from possible damage due to excessive electric current.
(v) Due to this, the material used for making fuse wire should have low melting point.

Q.2.5. Answer the following:

(1) **If lines of force passing through the coil are increased, will current be induced? Why?**

Ans. Yes current will be induced. As the lines of force passing through the coil are increased, there is a change in intensity of magnetic field and thus, current is induced in the conductor.

(2) **What is overloading?**

Ans. A flow of large amount of current in a circuit, beyond a permissible value of current, is called overloading. It occurs when many electrical appliances of high power rating, such as geyser, heater, oven etc., are switched on simultaneously.

Q.3.1. Explain the following:

*(1) **How does short circuit form? What is its effect?**

Ans. **Shortcircuiting:**
(i) If a live wire (phase wire) and a neutral wire come in direct contact or touch each other, short-circuiting takes place.

(ii) It is caused if the insulating coating of a wire is spoilt or lost or if faulty electric appliances are used.
Effects of shortcircuiting:
(a) During a shortcircuit, the resistance of the circuit becomes very small and hence huge amount of current flows through it.
(b) This produces a large amount of heat and raises the temperature. As a result, the circuit catches fire and can cause damage.

*(2) **What is Solenoid ? Compare the magnetic field produced by a solenoid with the magnetic field of a bar magnet. Draw neat figure and name various components.**

Ans. **Solenoid:**
(i) When a copper wire with a resistive coating is wound in a chain of loops (like a spring) it is called solenoid.
(ii) When an electric current is passed through a solenoid, magnetic field is produced in it.
(iii) The magnetic lines of force are similar to that of the lines of a bar magnet.
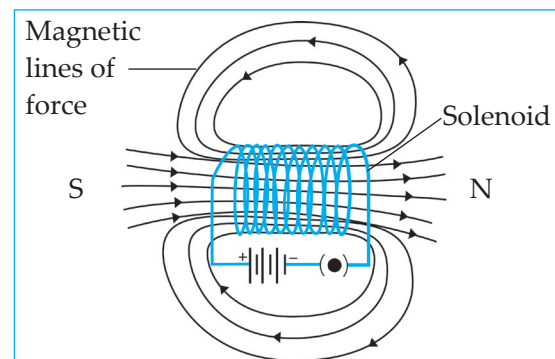(iv) Solenoid has all properties of the field produced by a bar magnet.

Fig 4.1: Magnetic lines of force of a magnetic field produced by a current passing through a solenoid coil.

(v) One end of the coil acts as the south pole, while the other end as the north pole.
Various components are:
(a) Copper wire with Resistive coating,
(b) Battery
(c) Plug key

*(3) **Which device is used to produce electricity? Describe with a neat diagram.**
(a) **Electric motor** (b) **Galvanometer**
(c) **Electric generator (DC)** (d) **Voltmeter**

Ans. (c) Electric generator (DC) - The device which converts mechanical energy into electrical energy is called electric generator.
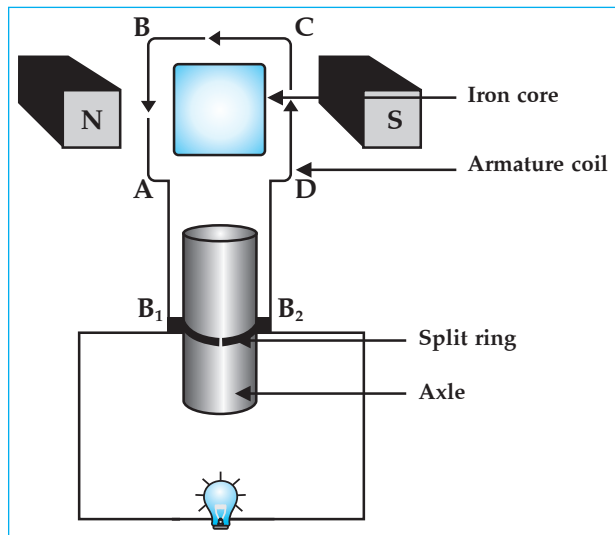
Fig 4.2: DC generator

For description refer Q. 4.2 1 (c)

*(4) **How do we decide that a given material is a good conductor of electricity or is an insulator?** *(Can you recall?; Textbook Page 47)*

Ans. (a) If the current passes easily through a material, that means it has large number of free electrons and it is a good conductor of electricity.

(b) If a material does not allow current to flow through it, that means it has less or practically no free electrons. Hence, it is an insulator.

*(5) **How can we write mechanical power in a manner similar to the electrical power?** *(Think about it; Textbook Page 48)*

Ans. Electrical Power $= \dfrac{\text{Electric Work}}{\text{Time}}$

$= \dfrac{\text{Energy consumed}}{\text{Time}}$

Mechanical Power $= \dfrac{\text{Work}}{\text{Time}}$

*(6) **Derive Joules Law with the help of a neat circuit diagram.**
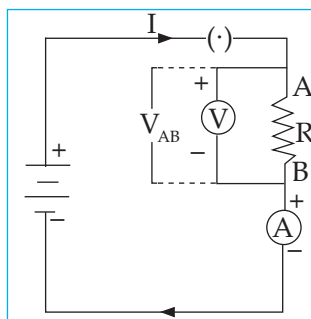
Fig 4.3

Ans. Power $= \dfrac{\text{Work}}{\text{Time}}$

$\therefore P = \dfrac{V_{AB}Q}{t}$ $[\therefore W = VQ]$

$\therefore P = V_{AB}I$ .... (i) $\left[\therefore I = \dfrac{Q}{t}\right]$

Now, $H = P \times t$ .... (ii)

Substituting (i) in (ii),

$H = V_{AB}It$

$\therefore H = IR \times I \times t$

$\therefore H = I^2Rt$

This is called Joules Law of Heating Effect.

*(7) **In the above circuit, if the resistor is replaced by a motor, in which form will the energy given by the cell get transformed into?** *(Use your brain power?; Textbook Page 47)*

Ans. In the above circuit, if the resistor is replaced by a motor, then the energy given by the cell will get transformed into mechanical energy.

(8) **How will you increase the strength of magnetic field in an electromagnet?**

Ans. We can increase the strength of magnetic field by three ways:

(i) Increase the magnitude of current in the circuit

(ii) Increase the number of turns of the coil

(iii) Reduce the radius of the coil.

(9) **Write a note on Galvanometer.**

Ans.

(i) A galvanometer is an instrument which is used to detect the presence of electric current in a circuit.

(ii) If the current in the circuit is zero, the galvanometer will show zero or no deflection.

(iii) The deflection is on either side of the zero mark depending upon the direction of the current.

(10) **What do you mean by earthing?**

Ans.

(i) Many electrical appliances have metallic body. If by chance insulation of the wire melts, the live wire may touch the metallic body of the appliance. If we touch this body with bare hands, we may receive severe electric shock.

(ii) To avoid such accidents, metal casings of all electrical appliances must be earthed. One end of the copper wire is connected to the metal case of the appliance and the other end is connected to

the copper plate which is burried deep inside the earth.

(iii) This system of connecting the metal casing of an electrical appliance with a copper plate burried deep inside the earth is called as earthing.

(11) State the factors on which the strength of the magnetic field of a circular loop depends?

Ans.

(i) Current flowing through the loop

(ii) Number of turns in the loop

(iii) Radius of the loop

Q.3.2. Open Ended Questions

(1) Which of the statement given below correctly describes

***(i) The magnetic field near a long, straight current carrying conductor?**

(a) The magnetic lines of force are in a plane perpendicular to the conductor in the form of straight lines.

(b) The magnetic lines of force are parallel to the conductor on all the sides of a conductor.

(c) The magnetic lines of force are perpendicular to the conductor going radially outward.

(d) The magnetic lines of force are in concentric circles with the wire at the centre, in a plane perpendicular to the conductor.

Ans: The correct statement is, (d) The magnetic lines of force are in concentric circles with the wire as the centre, in a plane perpendicular to the conductor.

***(ii) Electromagnetic induction**

(a) Charging of an electric conductor.

(b) Production of Magnetic field due to a current flowing through the coil.

(c) Generation of a current in a coil due to relative motion between the coil and the magnet.

(d) Motion of coil around the axle in an electric motor.

Ans. The correct statement is (c), Generation of a current in a coil due to relative motion between the coil and the magnet.

The process by which a changing magnetic field in a conductor induces a current in another conductor is called electromagnetic induction.

This was first studied by the scientist Michael Faraday.

(2) State the rule you will use:

(a) To find the direction of the motion of a conductor, if direction of the current and magnetic field are known to you.

(b) To find the direction of the induced current, if the direction of motion of conductor and magnetic field are known to you.

Ans.

(a) If the direction of current and directions of magnetic field is known, then we will use Fleming's Left Hand Rule to know the direction of motion of the conductor.

(b) If the direction of motion and magnetic field is known we will use Fleming's Right Hand Rule to know the direction of the induced current.
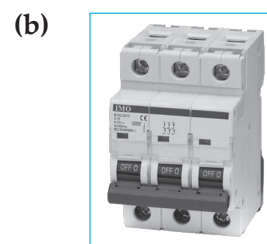
Q.3.3. Figure/Application Based Questions

***(1) Identify the figure and explain the uses of following:**

(a)

Fig 4.4
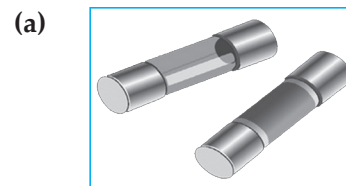
Ans.

(i) Cartridge Fuse

(ii) Fuse is a device which protects the appliances from excess current.

(b)

Fig 4.5

Ans.

(i) Miniature circuit breaker (MCB)

(ii) When the current in the circuit suddenly increases, this switch opens and current stops.
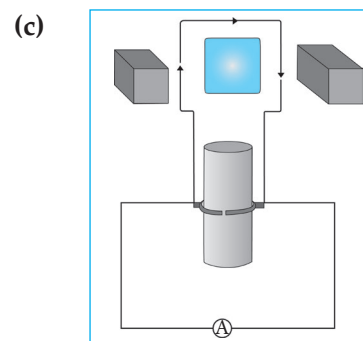
(c)

Fig 4.6

Ans.

(i)   DC generator

(ii)   It is used to generate direct current.

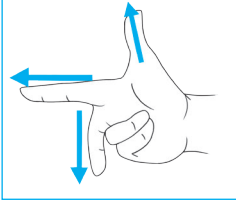**(2)   Name the following diagrams and explain the concept behind them.**

*(a)

Fig 4.7

Ans.

(i)   Fleming's right hand rule

(ii)   This rule is used to find the direction of the induced current.

(iii)   Stretch the thumb, the index finger and the middle finger of the right hand in such a way that they are perpendicular to each other. In this position, the thumb indicates the direction of motion of the conductor, the index finger indicates the direction of the magnetic field, and the middle finger shows the direction of the induced current. This rule is known as Fleming's right hand rule.

*(b)
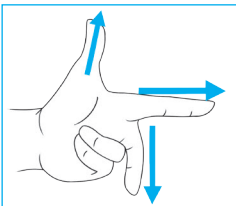
Fig 4.8

Ans.

(i)   Fleming's left hand Rule.

(ii)   This rule is used to find the direction of the force on the conductor.

(iii)   According to this rule, the left hand thumb, index finger, and the middle finger are stretched such that they are perpendicular to each other. If the index finger is in the direction of the magnetic field, and the middle finger points in the direction of the current, then the direction of the thumb is the direction of the force on the conductor.

(c)
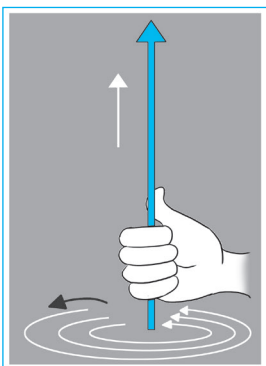
Fig 4.9

Ans.

(i)   Right Hand Thumb Rule

(ii)   This rule is used to find out the direction of the magnetic field produced by current flowing through an electrical conductor.

(iii)   Imagine that you have held the conductor in your right hand in such a way that your thumb points in the direction of the current. Then turn your fingers around the conductor, the direction of the fingers is the direction of the magnetic lines of force.

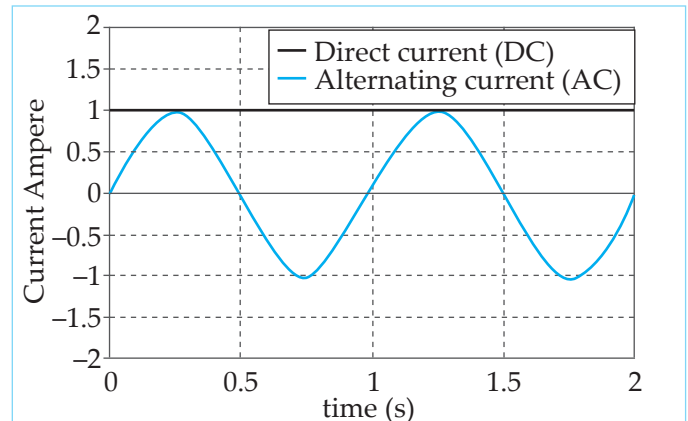**(3)   Answer the following based on the graph given below.**

Fig 4.10

(i)   After how many seconds does AC change its direction?

Ans: 0.5 sec

(ii)   What is the maximum value of AC?

Ans: 1A

(iii)   What is the maximum value of DC?

Ans: 1A

(iv)   What is the time interval for 1 cycle of AC?

Ans: 1 sec

(v)   What is the frequency of AC and DC?

Ans: $f = \dfrac{1}{T}$ $\therefore$ AC = 1 Hz and DC = 0 Hz

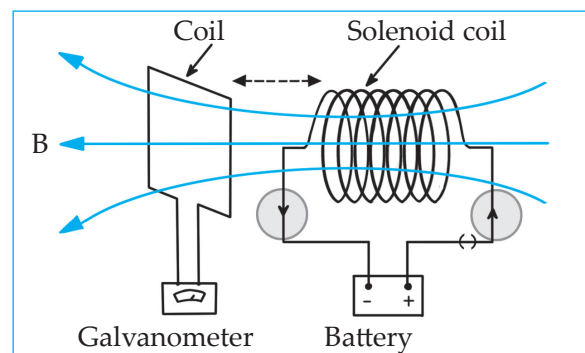**(4)   Answer the following based on the diagram given below.**

Fig 4.11

(i) **What change do we observe in the Galvanometer when the current in the Solenoid coil is switched off?**

Ans. If we open the plugkey and turn the current to zero in the coil, the pointer of the Galvanometer deflects to a side and quickly comes back to zero. If the current in the coil is started again, the pointer again deflects to the other side and then returns quickly to zero.

(ii) **What change do we observe in the galvanometer when a current is passing through the solenoid coil and the coil is displaced laterally with respect to the coil?**

Ans. If the coil is displaced laterally, then current will be induced in the coil and the Galvanometer will show a deflection.

(iii) **What change do we observe in the galvanometer if the displacement of the Solenoid is faster?**

Ans. The faster is the displacement of the solenoid, larger is the deflection of the Galvanometer pointer.

(iv) **What change do we observe in the galvanometer if the current in the Solenoid coil is increased?**

Ans. If the current is increased, the strength of the magnetic field increases and the deflection in the galvanometer also increases.

(v) **Name and state the law responsible for the above phenomena.**

Ans. Faraday's law of induction: Whenever the number of magnetic lines of force passing through the coil changes, current is induced in the coil. The current produced in the coil is called the induced current.

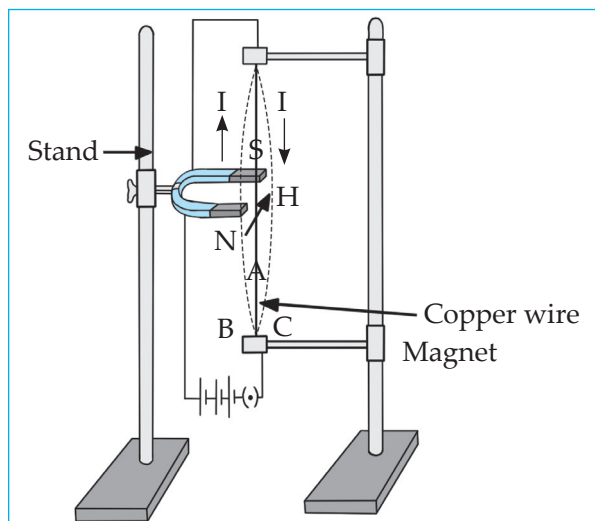**(5)** **Answer the following based on the diagram given below.**

Fig 4.12

(i) **What is the direction of the force experienced by the conductor when the current is downward?**

Ans. When the current is downward, the force experienced by the conductor will be outward.

(ii) **If the conductor experiences force inwards, then what would be the direction of current?**

Ans. If the conductor experiences force inwards, then the direction of current would be upward.
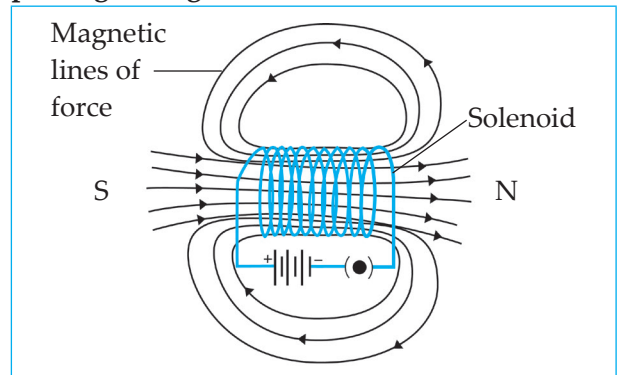
(iii) **Which rule helps us to find the force experienced by a current carrying conductor in the above diagram?**

Ans. Fleming's Left Hand Rule.

(6) **Answer the following based on the diagram given below.**
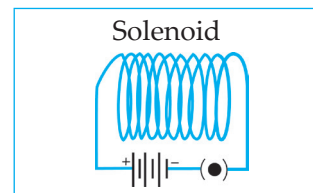
**(i)** **Complete the diagram of magnetic lines of force passing through a solenoid.**

(ii) **Define : Solenoid**

Ans. When a copper wire with a resistive coating is wound in a chain of loops (like a spring) it is called solenoid.

(iii) **What is the nature of the magnetic field inside the solenoid?**

Ans. The magnetic lines of force inside a solenoid are parallel to each other.

(7) **Answer the following based on the diagram given below.**
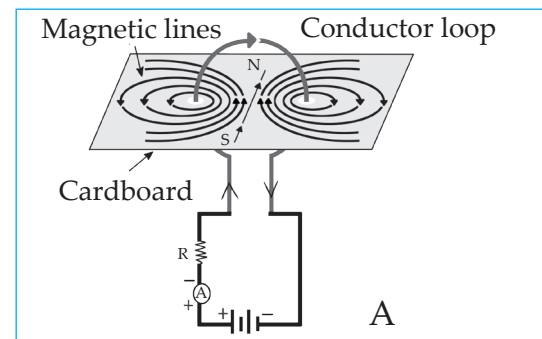
(i) **Which rule helps to find the direction of magnetic field?**

Ans. Right Hand Thumb Rule.

(ii) **State any 2 factors on which the strength of magnetic field, for a circular loop depends?**

Ans. The strength of the magnetic field, for a circular loop, depends on the current flowing through the wire and the number of turns.

Q.4.1. Draw a neat and labelled diagram:
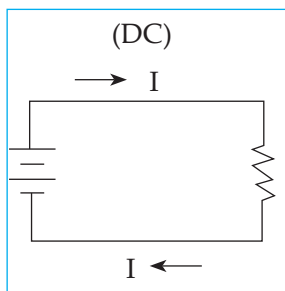
(1) **Circuit for Direct Current**

Ans.

Fig 4.13

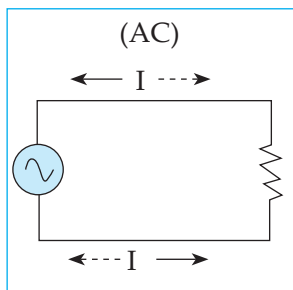**(2)** **Circuit for Alternating Current**

Ans.

Fig 4.14

(3) **DC generator**

Ans. For diagram refer fig 4.2.

(4) **Magnetic lines of force through a Solenoid**

Ans. For diagram refer fig 4.1.

Q.4.2. Answer in brief

(1) **Explain the construction and working of the following. Draw a neat diagram and label it.**

*(a) **Electric Motor**

Ans. A device which converts electrical energy into mechanical energy is called electric motor.

Principle of working:

Electric motor works on the principle that a current carrying conductor placed in a magnetic field experiences a force.
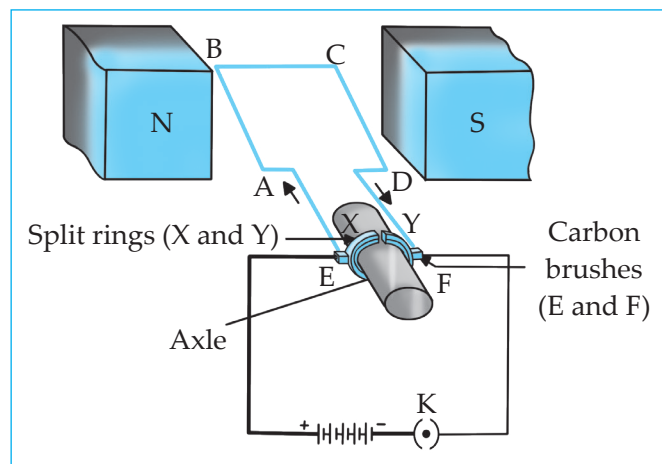

Fig 4.15: Electric Motor

Construction:

(i) **Armature coil:** Rectangular loop of copper wire having resistive coating.

(ii) **Strong Magnet:** Armature coil is placed between the north pole and south pole of the magnet (such as horse shoe magnet).

(iii) **Split ring:** The two halves of the ring (X and Y) have a resistive coating on the inner side and conducting surface on the outer side.

(iv) **Carbon Brushes:** Two stationary carbon brushes (E and F) are connected to the outer side of the split ring.

(v) **Battery:** The battery supplies the electric current to the armature coil.

Working:

(i) When the circuit is completed, the current flows in the branch AB of the loop from A to B through the carbon brushes E and F.

(ii) Since the direction of the magnetic field is from north pole to south pole, according to the Fleming's left hand rule, a force is exerted on the branch AB in downward direction and CD in upward direction.

(iii) Thus, the loop and the axle start rotating in an anticlockwise direction.

(iv) After half rotation, the current in a loop starts flowing in the direction DCBA.

(v) Therefore, a force is exerted on the branch CD in downward direction and on the branch AB in the upward direction, and the loop continues to rotate in the anticlockwise direction.

(vi) Thus, the current in the loop is reversed after each half rotation and the loop and the axle continue to rotate in the anticlockwise direction.
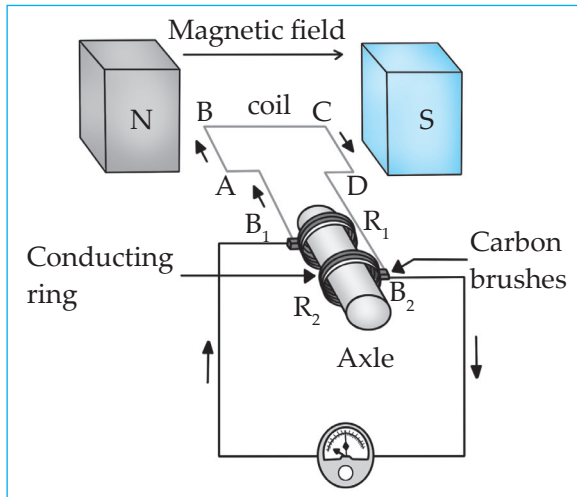
*(b) AC Generator:

Fig 4.16: Electric generator

Ans: A generator which converts mechanical energy into electrical energy in the form of alternating current is called AC Generator.

Principle of working:

(i) Electric generators works on the principle of electromagnetic induction.

Construction:

(i) **Armature coil:** Rectangular loop of copper wire having resistive coating.

(ii) **Strong Magnet:** Armature coil is placed between the north pole and south pole of the magnet (such as horse shoe magnet).

(iii) **Slip rings:** The ends of the armature are connected to conducting rings R_1 and R_2 which are fixed to the axle with the resistive coating in between the ring and the axle.

(iv) **Carbon Brushes:** The stationary carbon brushes B_1 and B_2 are connected to a galvanometer.

(v) **Galvanometer:** It detects the presence of current in the circuit.

Working:

(i) When the armature coil ABCD is rotated by external force in the magnetic field provided by strong magnets, it cuts the magnetic lines of forces. Thus, the changing magnetic field induces current in the coil.

(ii) After rotation of axle, arm AB moves upwards, while arm CD moves downwards. Therefore, ABCD rotates in the clockwise direction. As per the Fleming's right hand rule, the current is induced in the Coil and flows from A $\longrightarrow$ B and C $\longrightarrow$ D. Current flows in the direction ABCD.

(iii) Current flows from B_2 to B_1 in the first half of the revolution in the external circuit.

(iv) After half revolution, arms AB and CD exchange their positions. Due to this, the induced current flows in the direction DCBA. But, arm AB is in contact with B_1, through slip ring and arm CD is in contact with B_2.

(v) In the second half cycle, in the external circuit, electric current flows from B_1 to B_2, i.e. opposite to the previous half rotation.

(vi) This repeats after every half rotation, and alternating current is produced.

(c) DC Generator:

(For diagram, refer fig 4.2)

Ans. The device that converts mechanical energy into the electrical energy in the form of direct current is called DC generator.

Principle of working:

(i) DC generator works on the principle of electromagnetic induction.

Construction:

(i) **Armature coil:** Rectangular loop of copper wire having resistive coating.

(ii) **Strong Magnet:** Armature coil is placed between the north pole and south pole of magnet (such as horse shoe magnet).

(iii) **Split ring:** The two halves of the ring (X and Y) have a resistive coating on the inner side and conducting surface on the outer side.

(iv) **Carbon Brushes:** Two stationary carbon brushes (E and F) are connected to the outer side of the split ring.

(v) **Electric bulb or Ammeter :**

(a) The output is shown by the glowing bulb connected across the carbon brushes.

(b) Ammeter is connected in the circuit to detect the presence of electric current in the circuit.

Working:

(i) When the coil of DC generator rotates in the Magnetic field, potential difference is produced in the coil.

(ii) As the coil rotates in the magnetic field, the potential difference produces induced current according to Fleming's right hand rule.

(iii) The presence of current can be detected either by electric bulb or galvanometer.

(iv)   In DC generator, the flow of current in the external circuit is in one direction as long as the coil rotates in the magnetic field. This is because one brush is always in contact with the arm moving up and other brush is in contact with the arm moving downward in the magnetic field.

(v)   Thus, this generator is called DC generator.

Q.4.3. Paragraph Based Question

(1)   **Read the paragraph and answer the following question.**

> Galvanometer is a sensitive device which works on the same principle as that of an electric motor that we have studied earlier. We can make some electrical measurements with it. A coil is positioned between the pole pieces of a magnet in such a way that the pointer on the galvanometer dial is connected to it. When a small current (for example 1 mA) flows through the coil, the coil will rotate. The rotation will be proportional to the current. Voltmeter and Ammeter also work on the same principle. In galvanometer, the pointer deflects on both the sides of the zero mark depending on the direction of the current.

(i)   **State the principle on which Galvanometer works.**

Ans. It works on the principle that a current carrying conductor placed in a magnetic field experiences a force.

(ii)   **State the relation between the strength of the current and the deflection of Galvanometer?**

Ans. As the strength of the current increases, the deflection of galvanometer also increases.

(iii)   **Name any three devices working on the same principle as Galvanometer.**

Ans. Electric motor, Voltmeter and Ammeter.

(iv)   **When the current in the Galvanometer is switched on and later switched off, how will the deflection in the Galvanometer change?**

Ans. The galvanometer will deflect on one side of the zero mark when the current is switched on and on the opposite size, when the current is switched off.

Q.4.4. Activity Based Question.

*(1)   (i)   **What do you observe in the following pictures?**

(ii)   **Which effects of electric current do you find?** *(Use your brain power?; Textbook Page 47)*

(a)

(b)   (c)

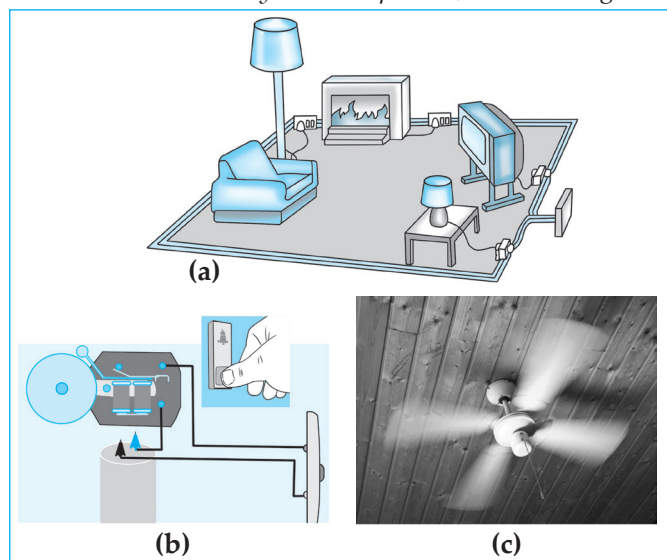*Fig 4.17*

Ans.

(i)   In the above pictures, we observe different household appliances, which work on electricity.

(ii)   In the picture (a), The electric heater and the 2 lamps work on heating effect of electric current and in picture (b) and (c), the fan and the bell work on magnetic effect of electric current.

(2)   **Take two coils of about 50 turns. Insert them over a non-conducting cylindrical roll, as shown in the following figure (thick paper roll can be used). Connect coil 1 to a battery with a plug key. Connect coil 2 to a galvanometer. Plug the key and observe the deflection in the galvanometer. Unplug the key and again observe the deflection. (HOTS)**
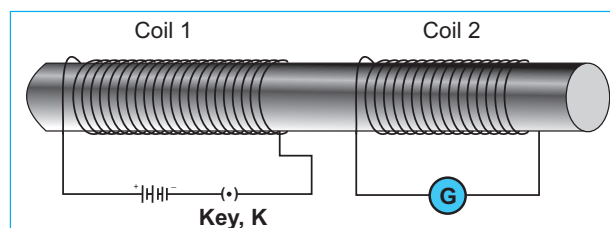

Fig 4.18

(i)   **What do you observe when you switch on the current in coil 1, i.e. when you connect coil 1 to the battery?**

Ans: When coil 1 is connected to the battery, we observe deflection in the galvanometer connected to coil 2.

(ii)   **What do you observe when current in coil 1 reaches a steady value or zero?**

Ans: When the current in coil 1 reaches a steady value or becomes zero, there is no deflection in the galvanometer.

(iii) **Why is current induced in coil 2 when we connect coil 1 to a battery?**

Ans:

(i) When we connect the coil to a battery, current starts flowing, hence there is change in the magnetic field.

(ii) This change in magnetic field induces a current in coil 2.

(iii) The process by which changing magnetic field induces a current in another conductor, is called electromagnetic induction.

(3) **Place the white paper on the drawing board and place a bar magnet in the middle of the paper. Sprinkle some iron filings on it**
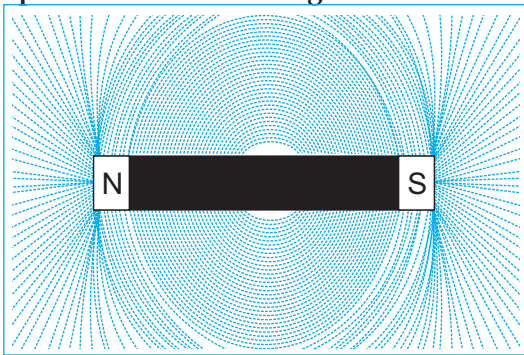

Fig 4.19

(i) **Tap the board gently, what do you observe?**

Ans: The iron filings arrange themselves in the form of concentric circle, which indicates the direction of magnetic field of a bar magnet.

(ii) **Why do the iron filings arrange themselves in a pattern as shown in the figure above?**

Ans: The magnetic field of the bar magnet influence the iron filings due to which they behave like tiny magnets and hence align themselves along the direction of magnetic lines.

(4) **Take a battery, (12V) a variable resistance (or a rheostat), an ammeter (0.5 A), a plug key, needle and a long straight thick copper wire. Take a rectangular cardboard, pass this wire through center. Fix the cardboard and see that it does not slide up or down. Sprinkle iron filings uniformly on the cardboard. Close the key and tap the cardboard gently.**
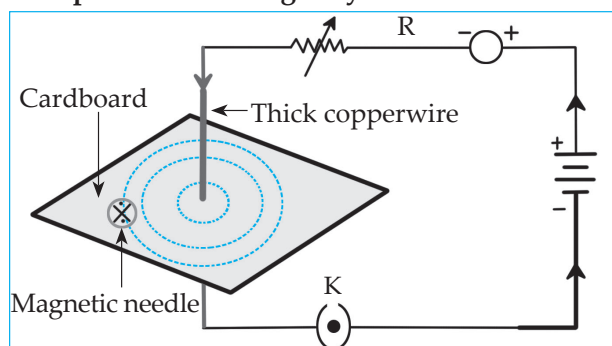

Fig 4.21

(i) **Observe the pattern of iron filings.**

Ans: The iron filings which are sprinkled get magnetized and on tapping the cardboard sheet, they arrange themselves in concentric circles around the wire.

(ii) **What changes are seen in the magnetic field lines when the current is increased?**

Ans: When current is increased the magnetic field lines are formed more closer and more distinctly indicating that the intensity of the magnetic field increases.

(iii) **What happens to the magnetic needle of the compass when the compass is brought near the wire, and moved away from the wire? Also observe what happens to the magnetic needle when strength of current is increased.**

Ans:

(i) The magnetic needle in the compass deflects more when we moved towards the wire and it starts deflecting less when we move it away from the wire.

(ii) Similarly, on increasing the strength of the current, it is observed that the magnetic needle deflects more.

(iii) This indicates that the strength of magnetic field increases with increase in strength of the current.

(iv) **What happens to the magnetic needle of the compass when direction of the current is reversed in the straight conductor? State the reasons for your observation.**

Ans:

(i) The direction in which the magnetic needle gets deflected changes, when direction of the current is reversed.

(ii) This shows that if direction of current is reversed, the direction of magnetic field lines is also reversed.

(6) **Take a rectangular cardboard with two holes. Take a coil of large numbers of turns. Insert the coil through the holes such that the turns are normal to the plane of the cardboard. Connect two ends of the coil in series with battery, a key and a rheostat as shown in figure. Sprinkle iron filings uniformly on the cardboard. Plug the key, tap the cardboard gently. Note your observations.**
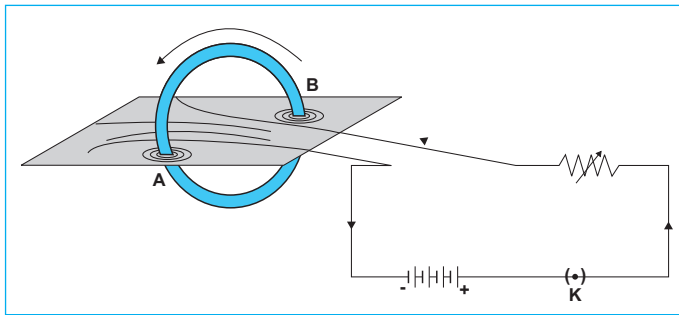
Fig 4.22

Ans:

(i)   Observation: On tapping the cardboard, the iron filings align themselves in concentric circles near the current carrying loop.

(ii)   Thus, it can be seen that the magnetic field lines are circular near the current carrying loop.

(iii)   It is observed that when we move away from the loop the concentric circles representing the magnetic field lines become bigger and bigger.

(iv)   At the centre of the circular loop, the magnetic field lines are straight.

(7)   **State what is the direction of the magnetic field lines with respect to each other in every segment of the loop and the centre of the loop. Where is the magnetic field strongest? (Refer the following figure).**
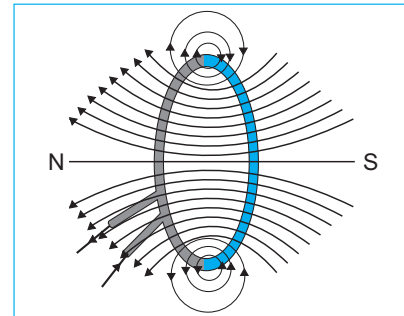

Fig 4.23

Ans:

(i)   It can be seen that each segment of the circular loop carrying current produces magnetic field lines in the same direction within the loop.

(ii)   At the centre of the circular loop all the magnetic field lines are in the same direction, due to which the strength of magnetic field increases and it is the strongest.

❖ ❖ ❖

ASSIGNMENT - 4

Time : 1 Hr. **Marks : 20**

Q.1. (A) Fill in the blanks: **(3)**

(1) The electric bulb consists of a filament made up of ....

(2) In the electric bill, the electricity usage is expressed in ....

(3) When a live wire and a neutral wire come in contact, ... takes place.

Q.1. (B) Choose and write the correct option: **(2)**

(1) The device which converts mechanical energy into electrical energy is called ....

(a) Electric charge (b) Electric generator (c) Electric fuse (d) Electric motor

(2) The deflection of the pointer of .... is on either side of zero mark.

(a) Voltmeter (b) Ammeter (c) Galvanometer (d) Thermometer

Q.2. Answer the following: *(Any 2)* **(4)**

(1) A cell is connected to a 9 ohm resistance, because of which heat of 400 J is produced per second due to current flowing through it. Obtain the potential difference applied across the resistance.

(2) Distinguish between: Direct current and Alternating current

(3) State Maxwell's cork - screw rule.

Q.3. Answer the following: *(Any 2)* **(6)**
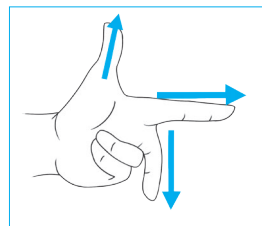
(1) Name the following diagrams and explain the concept behind them.
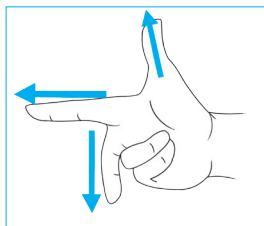
(a)   (b)

(2) An electrical iron uses a power of 1100 W when set to higher temperature. If set to lower temperature, it uses 330 W power. Find out the electric current and the respective resistance of 220 V.

(3) An electric tungsten bulb is connected into a home circuit. The home electric supply runs at 220 V potential difference. When switched on, a current of 0.45 A flows through the bulb. What must be power (wattage) of the bulb? If it is kept on for 10 hours, how many units of electricity will be consumed?.

Q.4. Answer the following: *(Any 1)* **(5)**

(1) Explain the construction and working of Electric Motor. Draw a neat labelled diagram.

(2) Derive Joules Law with the help of a neat circuit diagram.

❖ ❖ ❖

5 Heat

Points to Remember:

- **Heat** is one of the forms of energy and can be obtained by transforming any other form of energy.
- **Temperature** is the degree of hotness or coldness; it is measured with the help of **thermometer**.
- Heat is one of the important factors on which the **change of state** depends.
- Generally substances **expand on heating** and **contract on cooling**.
- During change of the state of a substance, heat may be **gained** or **lost** but there is **no change** in temperature.
- The constant temperature at which substance changes from solid state to liquid state is called **melting point of that solid**.
- The constant temperature at which substance changes from liquid state to gaseous state is called as **boiling point of the liquid**.
- **Latent heat:** The amount of heat energy either absorbed or released during change of state is called '**Latent Heat**'. Latent heat is not recorded on the thermometer in the form of rise or fall in temperature.
- **Specific latent heat of fusion:** The amount of heat energy absorbed at constant temperature by unit mass of a solid to convert into liquid phase is called the specific latent heat of fusion.
- **Latent heat of vapourization:** The amount of heat energy absorbed at constant temperature during transformation of liquid into gas is called Latent heat of vapourization.
- **Specific latent heat of vapourization:** The amount of heat energy absorbed at constant temperature by unit mass of a liquid to convert into gaseous phase is called specific latent heat of vapourization.
- Different substances have different melting points and boiling points. The values of melting point, boiling point and latent heat depend on atmospheric pressure.
- The phenomenon in which ice converts to liquid due to applied pressure and then re-converts into ice, once the pressure is removed is called regelation.
- The behaviour of water between its temperature from 0°C to 4°C is called **anomalous behaviour of water**.
- At **4°C,** the **volume** of water is **minimum,** hence its **density** is **maximum**.
- Effects of anomalous behaviour of water in nature:
  - **Survival of aquatic plants and animals.**
  - **Cracking of rocks in winter.**
  - **Pipelines carring water may burst in cold region during winter.**
- Atmosphere contains **water vapour**. The amount of moisture in air due to the presence of water vapour in it is called '**humidity**'.
- The temperature at which air becomes saturated with water vapour is called '**dew point**'.
- The mass of water vapour per unit volume of air is called **absolute humidity**. It is measured in **kg/ m³**.
- The ratio of the mass of water vapour in a given volume of air at given temperature to the mass of water vapour required to saturate the same volume of air at the same temperature is called **relative humidity.**
- At dew point, relative humidity is **100%**. If the relative humidity is **greater than 60%,** the air is called '**humid**' (moist) and if the relative humidity is **less than 60%,** the air is '**dry**'.
- In SI system, heat is measured in **joule (J)** and in CGS system, it is measured in **calorie (cal)**.
- The amount of heat required to raise the temperature of 1 g of water by 1°C (from 14.5°C to 15.5°C) is called **one calorie of heat.**

- The amount of heat required to raise the temperature of 1 kg of water by 1°C (from 14.5°C to 15.5°C) is called **one kilocalorie of heat**.

- The amount of heat required to raise the temperature of unit mass of substance through 1°C is called the **specific heat capacity of a substance**.

- Specific heat capacity is denoted by letter, **'c'**. Its SI unit is **J/g°C** and its CGS unit is **cal/ g°C**.

- **Specific heat capacity** can be measured by mixing method.

- If the system of both the objects is isolated from the environment:
  - **Heat lost by hot object = Heat gained by cold object**

- **Heat Q = mL** (m – mass, L – latent heat) : (change of state)

- **Heat Q = mcΔt** (m – mass, c – specific heat capacity, Δt – change in temperature) : (change of temperature)

- **Heat lost by hot object = heat gained by calorimeter + Heat gained by water**

MASTER KEY QUESTION SET - 5

Q.1. (A) 1. Fill in the blanks:

(1) Temperature is a degree of _____ of a substance.

(2) The melting point of ice is _____ °C.

*(3) During transformation of liquid phase to solid phase, the latent heat is _____ .

(4) The quantity of heat absorbed by liquid at constant temperature to convert into gas is _____ .

(5) When substance is converted from liquid to solid state, the heat energy is _____ .

(6) Melting of ice due to applied pressure, getting converted back into ice after the pressure is removed is called _____ .

(7) The density of water is maximum at _____ °C.

(8) The temperature at which the air gets saturated with water vapour is called _____ temperature.

(9) Absolute humidity is measured in _____ .

(10) The presence of water vapour in the atmosphere is called _____ .

*(11) The amount of water vapour in air is determined in terms of its _____ .

(12) At dew point, the relative humidity is _____ .

(13) If the relative humidity is more than 60%, then the air is _____ .

(14) If the relative humidity is _____ 60%, then the air is dry.

(15) In SI system, heat is measured in _____ .

(16) In CGS, heat is measured in _____ .

(17) 1 calorie = _____ joule.

(18) SI unit of specific heat capacity is _____ .

(19) The heat energy required to raise the temperature of unit mass of a substance through 1°C is called _____ of the substance.

(20) CGS unit of specific heat capacity is _____ .

*(21) If objects of equal masses are given equal heat, their final temperature will be different, this is due to difference in their _____ .

(22) Heat lost by hot object = _____ .

(23) The specific heat capacity of a substance can be measured by _____ method.

Ans. *(1) hotness or coldness (2) 0 (zero) (3) given out (released) (4) Latent heat of vaporisation (5) lost (6) Regelation (7) 4 (8) dew point (9) kg/m^3 (10) Humidity (11) Absolute humidity (12) 100% (13) humid (14) less than (15) joules (J) (16) calorie (17) 4.18 (18) $J/kg°C$ (19) specific heat capacity (20) cal/g^0c (21) specific heat capacities (22) Heat gained by cold object (23) Mixing.*

Q.1. (A) 2. Complete the analogy:

(1) Boiling point of water : 100°C :: Melting point of ice: _____

Ans. 0°C - Ice melts at 0°C

(2) Latent heat of fusion of ice : 80 cal/g :: Steam : _____

Ans. 540 cal/g - Latent heat of fusion of steam is 540 cal/g

(3) CGS unit of heat : calorie :: CGS unit of heat capacity: _____

Ans. cal/g°C - Heat capacity of substance is measured per gram of the substance per degree, increase in temperature

(4) Water : 1 cal/g°C :: Kerosene: _____

Ans. 0.1 cal/g°C - The specific heat of Karosene is 0.52 cal/g°C.

(5) Dry air : less than 60% Relative humidity :: Humid air: _____

Ans. More than 60% Relative humidity - When the relative humidity is more than 60%, we feel that the air is humid.

Q.1   (A) 3. Answer in one sentence.

(1) What is melting point of a solid?

Ans. The constant temperature at which a solid converts to liquid is called melting point.

(2) What do you mean by latent heat of fusion?

Ans. The amount of heat energy absorbed at constant temperature during transformation of solid into liquid is called latent heat of fusion.

(3) Define boiling point of liquid.

Ans. The constant temperature at which a liquid transforms into gaseous state, is called boiling point of that substance.

(4) What do you mean by Latent heat of vapourization?

Ans. The heat energy absorbed at constant temperature during transformation of liquid into gas is called Latent heat of vapourization.

*(5) What are the different ways of heat transfer?

Ans. Three different ways of heat transfer are Conduction, Convection and Radiation.

*(6) Is the concept of latent heat applicable during transformation of gaseous phase to liquid phase and from liquid phase to solid phase? *(Use your Brain Power! Textbook page no. 63)*

Ans. Yes, the concept of Latent heat is applicable in both the cases. The heat energy will be evolved from the substance.

*(7) Where does the latent heat go during these transformation? *(Use your Brain Power! Textbook page no. 63)*

Ans. The latent heat is used for the transformation of state and is released into the atmosphere.

(8) How anomalous behaviour of water can be experimented in the laboratory?

Ans. Anomalous behaviour of water can be experimented by using Hope's apparatus.

(9) What do you understand by the term 'Humidity'?

Ans. The moisture of air due to the presence of water vapour in it is called Humidity.

(10) What is dew point temperature?

Ans. The temperature at which the air gets saturated with water vapour is called dew point temperature.

(11) What is absolute humidity?

Ans. The mass of water vapour in a unit volume of air is called absolute humidity.

(12) What is relative humidity?

Ans. The ratio of actual mass of water vapour in a given volume of air at a given temperature to the mass of water vapour required to saturate the same volume of air at the same temperature is called relative humidity.

(13) Write the formula of percentage relative humidity.

Ans. % relative humidity

$$= \frac{\text{Actual mass of water vapour in the air in a given volume}}{\text{Mass of water vapour required to saturate the same volume at same temperature}} \times 100$$

(14) What is kilocalorie?

Ans. The amount of heat energy required to raise the temperature of 1 kg of water by 1°C, i.e. 14.5°C to 15.5°C is called kilocalorie.

(15) What is calorie?

Ans. The amount of heat energy required to raise the temperature of 1 g of water by 1°C, i.e. 14.5°C to 15.5°C is called calorie.

(16) Write the units of heat in CGS and SI systems.

Ans. In CGS system, heat is measured in calorie and in MKS, is joule (J).

(17) What is specific heat capacity?

Ans. The amount of heat energy required to raise the temperature of a unit mass of a substance by 1°C is called specific heat capacity.

(18) What are the units of specific heat capacity?

Ans. The units of specific heat capacity, in CGS is cal/g°C and in SI, it is J/kg°C.

(19) How does heat get transfered?

Ans. Heat always gets transferred from a hot body to the cold body till the temperature of both the bodies becomes equal.

(20) What is the principle of heat exchange?

Ans. The principle of heat exchange is, when a hot object is kept in contact with a cold object then, Heat lost by hot object = Heat gained by cold object. [Isolated from the environment]

Q.1.   (A) 4. Match the columns:

(1)

Column A	Column B
(1) Melting point of ice	(a) 100°C
(2) Boiling point of water	(b) 540 cal/g
(3) Specific Latent heat of vaporisation of water	(c) 80 cal/g
(4) Specific Latent heat of fusion of ice	(d) 0°C

Ans. *(1 – d), (2 – a), (3 – b), (4 – c)*

(2)

Column A	Column B
(1) Humidity	(a) Mass of water vapour
(2) Absolute humidity	(b) Moistness or dampness in air
(3) Relative humidity	(c) Proportion of vapour content of air

Ans. *(1 – b), (2 – a), (3 – c)*

(3)

Column A	Column B
(1) Heat	(a) cal/g°C
(2) Specific heat capacity	(b) kg/m^3
(3) Absolute humidity	(c) calorie

Ans. *(1 – c), (2 – a), (3 – b)*

Q.1 (A) 5. State whether following statement are True or False. If false; rectify the statement.

(1) Different substances have different melting points.

(2) Different substances have same specific heat capacities.

(3) At 4°C the volume of water is maximum.

(4) Density of water is maximum at 4°C.

(5) Presence of moisture in air is called humidity.

(6) Heat is necessary to saturate the air with vapour.

(7) Water vapour content of air is measured by relative humidity.

(8) Absolute humidity is measured in kg/m^3.

(9) Humidity is measured by relative humidity.

(10) At dew point, the relative humidity is 60%.

(11) S.I. unit of heat is joule.

(12) In CGS system, heat is measured in joules.

(13) 1 J = 4.18 cal.

(14) Specific heat is denoted by letter 'h'.

(15) Specific heat capacity is measured in SI system in J/g°C.

(16) In CGS, specific heat capacity can be measured in calorie.

(17) Thermometer is used to measure specific heat capacity.

(18) The specific heat capacity of water is 1.0 cal/g°C.

Ans. *(1) True (2) False. Different substances have different specific heat capacities. (3) False. At 4°C volume is minimum, density is maximum. (4) True (5) True (6) False. Temperature has influence on saturation of air. (7) False. It is measured by absolute humidity. (8) True (9) True (10) False. At dew point the*

relative humidity is 100% (11) True (12) False. In CGS, heat is measured in calorie. (13) False. 1 cal = 4.18 J. (14) False. Specific heat is denoted by letter 'c'. (15) True (16) False. Specific heat capacity in CGS is measured in cal/g°C (17) False. Calorimeter is used to measure specific heat capacity. (18) True

**Q.1 (B) Choose and write the correct option:**

(1) The specific heat capacity of _____ is maximum.

   (a) Mercury   (b) Copper
   (c) Water   (d) Iron

(2) If temperature of water increases from 1°C to 3°C, the density of water _____ .

   (a) remains the same   (b) decreases
   (c) increases   (d) fluctuates

(3) Aquatic plants and animals can survive in cold region because of _____ .

   (a) humidity
   (b) dew point
   (c) heat capacity
   (d) Anomalous behaviour of water

(4) Water is such a substance which _____ at 0°C upto 4°C

   (a) expands on heating
   (b) contracts on heating
   (c) contracts on cooling
   (d) remains unchanged

(5) If temperature of water is lowered from 4°C to 3°C; its volume _____ .

   (a) increases   (b) decreases
   (c) remains the same   (d) fluctuates

(6) The specific heat capacity is measured in C.G.S. system in _____ .

   (a) cal   (b) kcal
   (c) cal/g°C   (d) joule/kg°C

(7) At dew point, the relative humidity is _____

   (a) 100%   (b) 10%
   (c) 60%   (d) 50%

(8) If the pressure is applied on ice, its melting point _____ .

   (a) decreases   (b) increases
   (c) remains the same   (d) fluctuates

(9) The specific heat capacity of water is _____ kcal/kg°C

   (a) 10   (b) 1.0
   (c) 1.5   (d) 0.5

(10) When water boils and is converted into steam, then ....

    (a) heat is taken in and temperature remains constant.

    (b) heat is taken in and temperatures rises.

    (c) heat is given out and temperatures lowers.

    (d) heat is given out and temperature remains constant.

(11) In Hope's a apparatus when the temperature of water drops from 4°C to 3°C water ....

    (a) Remains still   (b) moves upwards

    (c) moves downwards   (d) freezes solid

(12)
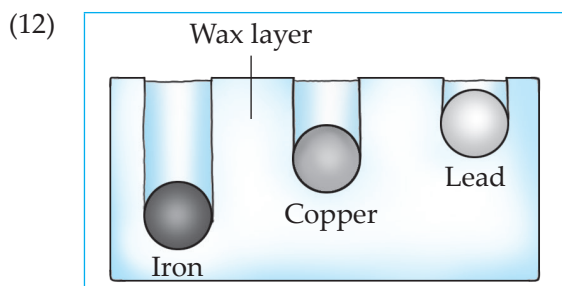
With reference to the above diagram, which of the following relation is incorrect?

    (a) $C_{Iron} > C_{copper}$ (b) $C_{copper} > C_{lead}$

    (c) $C_{Iron} > C_{lead}$ (d) $C_{lead} > C_{copper}$

(13) Which of the following is a correct relation?

    (a) 4.18 calories = 1 joule

    (b) 1 calories = 4.18 joule

    (c) 10^7 calories = 1 joule

    (d) 1 calories = 10^7 joule

(14) In the experiment of Hope's apparatus, the point of intersection of the two curves in the graph corresponds to the ....
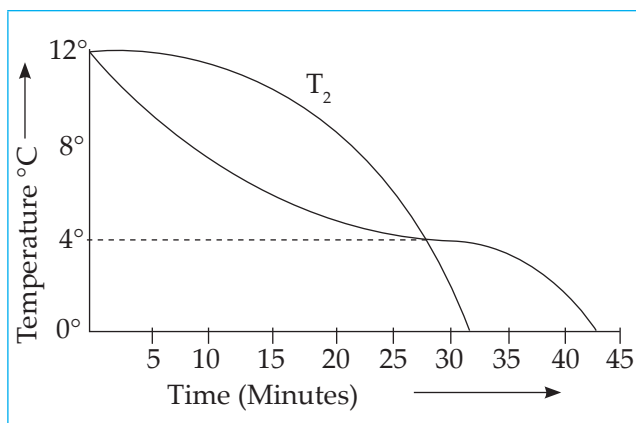
    (a) melting point of ice

    (b) freezing point of water

    (c) temperature at which the density of water is minimum

    (d) temperature at which the density of water is maximum

(15) Why do street ice cream vendors add salt their freezing mixture intermittently?

    (a) to increase the melting point of the freezing mixture.

    (b) to maintain the melting point of the freezing mixture as constant.

    (c) to reduce the melting point of the freezing mixture

    (d) to reduce the weight of the freezing mixture.

(16) Heat needed to raise the temperature of 1 kg of water from 14.5°C to 15.5°C is ....

    (a) 4180 J   (b) 103 J

    (c) 1 cal   (d) 4180 cal

(17) Heat is absorbed when ....

    (a) water is converted into vapour

    (b) water is converted into ice

    (c) steam is converted into water

    (d) all of these

(18) Heat absorbed when 1 g of ice melts at 0°C to form 1g of water at the same temperature is .... cal

    (a) 80   (b) 800

    (c) 540   (d) 54

(19) A sample of air containing certain amount of water vapour is saturated at a particular temperature. If the temperature of air sample is raised further, then ....

    (a) The sample becomes oversaturated.

    (b) The sample remains saturated.

    (c) The sample reaches dewpoint.

    (d) The sample becomes unsaturated.

Ans. *(1) (c) water (2) (c) increases (3) (d) Anomalous behaviour of water (4) (b) contracts on heating (5) (a) increases (6) (c) cal/g°C (7) (a) 100% (8) (a) decreases (9) (b) 1.0 (10) (a) heat is taken in and temperature remains constant. (11) (b) moves upwards (12) (d) $C_{lead} > C_{copper}$ (13) (b) 1 calories = 4.18 joule (14) (d) temperature at which the density of water is maximum (15) (c) to reduce the melting point of the freezing mixture (16) (a) 4180 J (17) (a) water is converted into vapour (18) (a) 80 (19) (d) The sample becomes unsaturated.*

Q.2.1. Solve the following:

> **Type: A**
>
> $Q = mc\Delta T$ (Heat energy during change in temperature)
>
> $Q = mL$ (Heat energy during change of state)
>
> Note: Specific heat capacity (c) = 1 cal/g°C = 1 kcal/kg°C
>
> ΔT = Higher temperature – Lower temperature

*(1) **(a) How much heat energy is necessary to raise the temperature of 5 kg of water from 20°C to 100 °C.**

Ans. **Given:**   Mass (m) = 5 kg

Temp. difference (ΔT) = 100 - 20 = 80°C

Specific heat capacity (c) = 1 kcal/kg°C

To find: Heat energy (Q) = ?

Formula: $Q = mc\Delta T$

Solution: $Q = 5 \times 1 \times 80$

= 400 kcal

> Heat energy needed is 400 kcal.

(1) **(b) How much energy needs to be supplied to 150g of water at 100°C to convert it to steam at 100°C. (L_{vap} = 540 cal/g)**

Ans. **Given:**   m = 150g

L = 540 cal/g

To find: Q = ?

Formula: Q = mL

Solution: Q = 150 × 540

= 81000 cal

> Heat energy needed is 81000 cal.

*(2) **Equal heat is given to two objects A and B of mass 1g. Temperature of A increases by 3°C and B by 5°C. Which object has more specific heat? And by what factor?**

Ans. **Given:**

	For A	For B
Mass (m)	1g	1g
Temperature difference (ΔT)	3°C	5°C

$Q_A = Q_B$

To find: c_A = ? c_B = ?

Formula: $Q = mc\Delta T$

Solution: $Q_A = Q_B$

$m_A c_A \Delta T_A = m_B c_B \Delta T_B$

$1 \times c_A \times 3 = 1 \times c_B \times 5$

$3c_A = 5c_B$

$c_A = \dfrac{5}{3} c_B$

> $\rightarrow$ **Specific heat of A is more.**
>
> $\rightarrow$ **It is greater by a factor of $\dfrac{5}{3}$**

NUMERICALS FOR PRACTICE

(1) How much heat is required to raise the temperature of 500 g of mercury from 20°C to 100°C. (Sp. heat cap. of Hg is 0.033 kcal/kg°C)   *(1.32 kcal)*

(2) The initial temperature of 40 g copper ball is 24°C. When 200 cal heat is supplied, the temperature rises to 74°C. Find the specific heat capacity of copper?   *(0.1 cal/g°C)*

(3) Calculate the heat gained by 50 g of ice at 0°C to change into water of the same temperature. (Latent heat of fusion of ice is 80 cal/g)   *(4000 cal)*

(4) Calculate the amount of heat absorbed by 100 g of ice to change into water of 30°C. (Specific heat capacity of water is 1 cal/g°C)   *(11000 cal)*

> **Type: B**
>
> **Principle of Heat Exchange**
>
> | Heat energy lost by hot object | = | Heat energy gained by cold object |
> |---|---|---|
> | Heat lost by hot body (Q_A) | = | Heat gained by cold body (Q_B) |
>
> $Q = mc\Delta T$
>
> $Q = mL$
>
> Note: $c_{water/Ice/Steam}$ = 1 cal/g°C = 1 kcal/kg°C
>
> $L_{fusion\ for\ water}$ = 80 cal/g = 80 kcal/kg
>
> $L_{vap\ for\ water}$ = 540 cal/g = 540 kcal/kg

*(1) **Liquid ammonia is used in ice factory for making ice from water. If water at 20 °C is to be converted into 2 kg ice at 0 °C, how many grams of ammonia is to be evaporated? (Given: The latent heat of vaporization of ammonia= 341 cal/g)**

Ans. **Given:**

	Q_A Water/Ice	Q_B Ammonia
(m)	2kg	m_1
(c)	1 kcal/kg°C	-
t_1	20°C	-
t_2	0°C	-
L	80 kcal/kg	341 kcal/kg

To find: m_1 = ?

Formulae: $Q_A = Q_B$

$Q = mc\Delta T$, Q = mL

Solution:

(1) Water

$$\text{Water (20°C)} \xrightarrow{mc\Delta T} \text{Water (0°C)} \xrightarrow{mL} \text{Ice (0°C)}$$

$Q_A = mc\Delta T + mL$ .... (i)

(2) Ammonia

$Q_B = m_1 L_1$ .... (ii)

from (i) and (ii)

$Q_A = Q_B$

$mc\Delta T + mL = m_1 L_1$

$2 \times 1 \times (20 - 0) + (2 \times 80) = m_1 \times 341$

$40 + 160 = m_1 \times 341$

$200 = m_1 \times 341$

$$m_1 = \frac{200}{341}$$

$m_1 = 0.5865$ kg

or

$m_1 = 586.5$ g

Hence, 586.5g of ammonia has to be evaporated.

*(2) **A thermally insulated pot has 150 g ice at temperature 0 °C. How much steam of 100 °C has to be mixed to it, so that water of temperature 50 °C will be obtained?**

Ans. **Given:**

	Q_A Steam	Q_B Ice
(m)	m_1	150g
(c)	1 cal/g°C	1 cal/g°C
t_1	100°C	0°C
t_2	50°C	50°C
L	540 cal/g	80 cal/g

To find: $m_1 = ?$

Formulae: $Q_A = Q_B$

$Q = mc\Delta T$, $Q = mL$

Solution:

(1) Steam

$$\text{Steam(100°C)} \xrightarrow{mL} \text{Water (100°C)} \xrightarrow{mc\Delta T} \text{Water (50°C)}$$

∴ $Q_A = m_1 L_1 + m_1 c_1 \Delta T_1$ .... (i)

(2) Ice

$$\text{Ice (0°C)} \xrightarrow{mL} \text{Water (0°C)} \xrightarrow{mc\Delta T} \text{Water (50°C)}$$

∴ $Q_B = mL + mc\Delta T$ .... (ii)

from (i) and (ii)

$Q_B = Q_A$

$mL + mc\Delta T = m_1 L_1 + m_1 c_1 \Delta T$

$(150 \times 80) + \{150 \times 1 \times (50 - 0)\} = \{m_1 \times 540\} + \{m_1 \times 1 \times (100 - 50)\}$

$12000 + 7500 = m_1 (540 + 50)$

$19500 = m_1 \times 590$

$$m_1 = \frac{19500}{590}$$

$m_1 = 33.05 = 33$

Hence, 33g steam has to be mixed.

*(3) **If 80 g steam of temperature 97 °C is released on an ice slab of temperature 0 °C, how much ice will melt? How much energy will be transferred to the ice when the steam will be transformed to water?**

Ans. **Given:**

	Q_A Steam	Q_B Ice
(m)	80g	m_1
(c)	1 cal/g°C	1 cal/g°C
t_1	97°C	0°C
t_2	0°C	0°C
L	540 cal/g	80 cal/g

To find: $Q_A = ?$, $m_1 = ?$

Formulae: $Q_A = Q_B$

$Q = mc\Delta T$, $Q = mL$

Solution:

(1) Steam

$$\text{Steam(97°C)} \xrightarrow{mL} \text{Water (97°C)} \xrightarrow{mc\Delta T} \text{Water (0°C)}$$

∴ $Q_A = mL + mc\Delta T$

$= (80 \times 540) + \{80 \times 1 \times (97 - 0)\}$

$= 43200 + 7760$

$Q_A = 50960$ cal .... (i)

(2) Ice

$$\text{Ice (0°C)} \xrightarrow{mL} \text{Water (0°C)}$$

$Q_B = m_1 L_1$ .... (ii)

from (i) and (ii)

$Q_A = Q_B$

$50960 = m_1 L_1$

$50960 = m_1 \times 80$

$$m_1 = \frac{50960}{80}$$

$m_1 = 637$g

Hence, 637g of ice will melt and 50960 cal of heat energy is transfered to ice.

Type: C
Calorimeter

| Heat lost by hot object | = | Heat gained by calorimeter | + | Heat gained by liquid |

$$Q = Q_1 + Q_2$$
$$Q = mc\Delta T$$
$$Q = mL$$

Note: $C_{(copper)}$ = 0.1 cal/g°C = 0.1 kcal/kg°C
Final temperature becomes equal to 'T' for all substances

*(1) A copper sphere of 100g mass is heated to raise its temperature to 100°C and is released in water of mass 195g and temperature 20°C in a copper calorimeter. If the mass of calorimeter is 50g, what will be the maximum temperature of water?

Ans. Given:

	Q Copper	Q_1 Water	Q_2 Calorimeter
(m)	100g	195g	50g
(c)	0.1 cal/g°C	1 cal/g°C	0.1 cal/g°C
t_1	100°C	20°C	20°C
t_2	T	T	T

To find: T = ?

Formulae: $Q = Q_1 + Q_2$
$$Q = mc\Delta T$$

Solution:

(1) Copper
$$Q = mc\Delta T \ .... \ (i)$$

(2) Water
$$Q_1 = m_1 c_1 \Delta T_1 \ .... \ (i)$$

(3) Calorimeter
$$Q_2 = m_2 c_2 \Delta T_2 \ .... \ (iii)$$

from (i), (ii) and (iii)

$$Q = Q_1 + Q_2$$
$$mc\Delta T = m_1 c_1 \Delta T_1 + m_2 c_2 \Delta T_2$$
$$\{100 \times 0.1 \times (100 - T)\} = \{195 \times 1 \times (T - 20)\} + \{50 \times 0.1 \times (T - 20)\}$$
$$10 (100 - T) = 195 (T - 20) + 5 (T - 20)$$
$$1000 - 10T = (T - 20) (195 + 5)$$
$$1000 - 10T = (T - 20) 200$$
$$1000 - 10T = 200\,T - 4000$$
$$1000 + 4000 = 200\,T + 10\,T$$
$$5000 = 210\,T$$
$$T = \frac{500\cancel{0}}{21\cancel{0}} = 23.8°C$$

The maximum temperature of water will be 23.8°C.

*(2) A calorimeter has mass 100g and specific heat 0.1 kcal/ kg°C. It contains 250 gm of liquid at 30 °C having specific heat of 0.4 kcal/kg°C. If we drop a piece of ice of mass 10 g at 0°C, what will be the temperature of the mixture?

Ans. Given:

	Q Ice	Q_1 Water	Q_2 Calorimeter
(m)	10g	250g	100g
(c)	1 cal/g°C	0.4 cal/g°C	0.1 cal/g°C
t_1	0°C	30°C	30°C
t_2	T	T	T
L	80 cal/g	–	–

To find: T = ?

Formulae: $Q = Q_1 + Q_2$
$$Q = mc\Delta T, \ Q = mL$$

Solution:

(1) Ice

Ice (0°C) $\xrightarrow{mL}$ Water (0°C) $\xrightarrow{mc\Delta T}$ Water (T°C)

$\therefore Q = mL + mc\Delta T$ .... (i)

(2) Water
$$Q_1 = m_1 c_1 \Delta T_1 \ .... \ (ii)$$

(3) Calorimeter
$$Q_2 = m_2 c_2 \Delta T_2 \ .... \ (iii)$$

from (i), (ii) and (iii)

$$Q = Q_1 + Q_2$$
$$mL + mc\Delta T = m_1 c_1 \Delta T_1 + m_2 c_2 \Delta T_2$$
$$(10 \times 80) + \{10 \times 1 \times (T - 0)\} = \{250 \times 0.4 \times (30 - T)\} + \{100 \times 0.1 \times (30 - T)\}$$
$$800 + 10\,T = 100 (30 - T) + 10 (30 - T)$$
$$800 + 10T = 110 (30 - T)$$
$$10T + 110T = 3300 - 800$$
$$120T = 2500$$
$$T = \frac{250\cancel{0}}{12\cancel{0}} = 20.8°C$$

The temperature of the mixture will be 20.8°C.

NUMERICALS FOR PRACTICE

(1) A solid of mass 250 g at 90°C is dropped in a calorimeter containing 100 g of water at 15°C. The resulting temperature of mixture becomes 40°C. The mass of calorimeter is 100 g and its specific heat capacity is 0.1 cal/g°C. Find the specific heat capacity of the solid.   *(0.2 cal/g°C)*

(2) A copper sphere of mass 500 g is heated to 100°C and then introduced into a copper calorimeter containing 100 g of water at 20°C. Find the maximum temperature of the mixture, if the mass of calorimeter is 100g and specific heat capacity is 0.1 cal/g°C.   *(45°C)*

Q.2.2. Define/ write the laws:

(1) Latent heat of fusion

Ans. The heat energy absorbed at a constant temperature during transformation of solid into liquid is called latent heat of fusion.

(2) Specific latent heat of fusion

Ans. The amount of heat energy absorbed at a constant temperature by unit mass of a solid to convert into liquid phase is called the specific latent heat of fusion.

(3) Melting point

Ans. The constant temperature at which solid changes to liquid state is called melting point of that solid.

(4) Latent heat of vaporisation

Ans. The heat energy absorbed at constant temperature during transformation of liquid into gas is called Latent heat of vapourization.

(5) Specific latent heat of vapourization

Ans. The amount of heat energy absorbed at constant temperature by unit mass of a liquid to convert into gaseous phase is called specific latent heat of vapourization.

(6) Boiling point

Ans. The constant temperature at which a liquid changes to gaseous state is called as boiling point of the liquid.

(7) Regelation

Ans. The phenomenon in which the ice converts to liquid due to applied pressure and then re-converts to ice again once the pressure is removed is called regelation.

(8) Humidity

Ans. The presence of dampness or moistness in air due to presence of water vapour in it is called humidity.

(9) Dew point temperature

Ans. The temperature at which the air becomes saturated with water vapour is called dew point.

(10) Absolute humidity

Ans. The mass of water vapour in unit volume of air is called absolute humidity. It is measured in kg/m^3

(11) Relative humidity

Ans. The ratio of the mass of water vapour in given volume of air at given temperature to the mass of water vapour required to saturate the same volume of air at the same temperature is called relative humidity.

(12) One calorie of heat

Ans. The amount of heat required to raise the temperature of 1 g of water by 1°C (from 14.5°C to 15.5°C) is called one calorie of heat.

(13) One kcal heat

Ans. The quantity of heat required to raise the temperature of 1 kg of water through 1°C (from 14.5°C to 15.5°C) is called kilocalorie heat.

(14) Specific heat capacity

Ans. The quantity of heat required to raise the temperature of unit mass of substance through 1°C is called specific heat capacity.

(15) Principle of heat exchange:

Ans. When a hot body is kept in contact with a cold body, isolated from the environment, then the quantity of heat lost by the hot body is equal to the quantity of heat gained by the cold body.

Q.2.3. Write short notes:

*(1) Latent heat

Ans.

(i) The quantity of heat absorbed or released by a substance to change its state at constant temperature is called latent heat.

(ii) The heat energy absorbed at constant temperature during transformation of solid into liquid is called latent heat of fusion. Latent heat of fusion of ice is 80 cal/g.

(iii) The heat energy absorbed at constant temperature during transformation of liquid into gas is called Latent heat of vapourization. The latent heat of vaporisation of water is 540 cal/g.

(iv) During change of state there is no rise or fall of temperature.

(2)   Regelation

Ans.

(i)   If two small ice cubes are pressed upon each other, the pressure at the surfaces of contact increases and melting point is reduced.

(ii)   Due to this, ice melts and forms water.

(iii) When pressure is removed, then the melting point comes back to normal and water freezes again to form ice, sticking the two pieces of ice together.

(iv)   Ice melts when subjected to pressure and then when pressure irreleased, it reconverts into ice again. This is called regelation.

(3)   Anomalous behaviour of water

Ans.

(i)   Generally, liquids expand on heating and contract on cooling.

(ii)   Water, however, shows an exceptional behaviour.

(iii) If water at room temperature is cooled, it contracts till 4°C, but if it is cooled below 4°C (between 4°C and 0°C), it expands instead of contracting.

(iv)   On the contrary, if water at 0°C is heated, it contracts instead of expanding upto 4°C.

(v)   This exceptional behaviour of water between 4°C and 0°C is called anomalous behaviour of water.

(vi)   Examples found in nature:

    (a)   Survival of aquatic plants and animals.

    (b)   Cracking of rocks in winter.

    (c)   Pipes conducting water in cold regions burst in a winter.
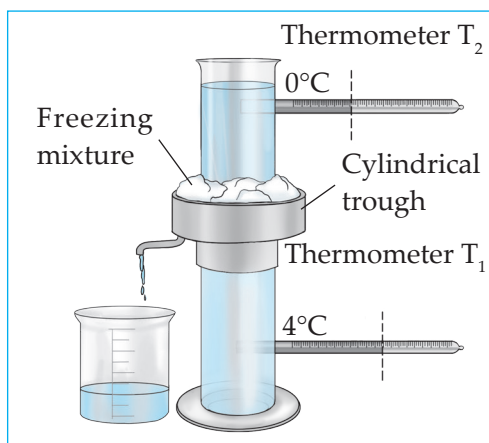
(4)   Hope's apparatus

Ans.

Fig 5.1 Hope's apparatus

(i)   The anomalous behavior of water can be studied with Hope's apparatus.

(ii)   In Hope's apparatus, there is a metallic cylindrical container. At the middle of the cylinder, there is a flat bowl.

(iii) Two thermometers, one at the upper region and other at the lower region are fixed to record the temperature.

(iv)   The freezing mixture of salt and ice is taken in the flat bowl. Temperatures are recorded after every 30 min.

(v)   Water of 10°C is poured into the cylindrical container. Initially, both the thermometers show the temperature of 10°C.

(vi)   As the temperature of water decreases due to freezing mixture, it contracts, density increases and goes to the bottom of the container till 4°C.

(vii) Due to this, for sometime the thermometer at the bottom shows temperature of 4°C.

(viii) As the temperature falls below 4°C, water in the region expands instead of contracting, density decreases and this water rises towards the surface.

(ix)   After sometime, the upper thermometer shows the temperature of 0°C and the lower thermometer shows 4°C.

(x)   Finally both thermometer show 0°C

(xi)   In this way, the anomalous behaviour of water can be demonstrated in the laboratory by using Hope's apparatus.

(5)   Relative Humidity

Ans.

(i)   The ratio of actual mass of vapour content in the air for a given volume and temperature to that required to make the air saturated with vapour at that temperature is called the relative humidity.

% relative humidity

$$= \frac{\text{Actual mass of water vapour in the air in a given volume}}{\text{Mass of water vapour required to saturate the same volume at same temperature.}} \times 100$$

(ii)   The relative humidity at the dew point is 100%. If the relative humidity is more than 60%, we feel that the air is humid.

(iii) If the relative humidity is less than 60%, we feel that the air is dry.

Q.2.4. Distinguish between:

*(1) **What is the difference between heat and temperature?**

Ans.

Heat	Temperature
(i) It is a form of energy.	(i) It is a measure of degree of hotness or coldness of an object.
(ii) SI unit is joule (J)	(ii) SI unit is kelvin (K)
(iii) Two bodies of different materials having same quantity of heat can be at different temperatures.	(iii) Two bodies at same temperature can have different quantities of heat.
(iv) It can be measured by using Calorimeter.	(iv) It can be measured using Thermometer.

(2) **Absolute Humidity and Relative Humidity**

Ans.

Absolute Humidity	Relative Humidity
(i) The mass of water vapour per unit volume of air is called absolute humidity.	(i) The ratio of the mass of water vapour in a given volume of air at given temperature to the mass of water vapour required to saturate the same volume of air at the same temperature is called relative humidity.
(ii) It has a unit.	(ii) It has no unit.
(iii) It is measured in kg/m^3.	(iii) It is measured in percentage.
(iv) Mass of water vapour present is measured.	(iv) Extent of humidity is measured.

(3) **Humidity and Dew point**

Ans.

Humidity	Dew point
(i) The dampness or moistness of air due to the presence of water vapour in it is called humidity.	(i) The temperature at which air becomes saturated with water vapour is called dew point.
(ii) It is usually measured in terms of relative humidity which is a percentage.	(ii) It is measured in terms of temperature in degree celcius.
(iii) When air is saturated with water vapour, the relative humidity is 100%.	(iii) When the temperature falls below the dew point, then relative humidity is 100%, dew starts forming.

Q.2.5. Give Scientific Reasons:

*(1) **You know that as we go higher than the sea level, the boiling point of water decreases. What would be effect on the melting point of solid?** *(Use your Brain Power!; Textbook page no. 64)*

Ans.

(i) As we go higher than sea level, the atmospheric pressure decreases.

(ii) So melting point of ice increases.

*(2) **We feel that some objects are cold, and some are hot. Is this feeling related in some way to our body temperature?** *(Can you tell?; Textbook page no. 64)*

Ans.

(i) If two objects are in contact with each other, there will be an exchange of heat between them.

(ii) We feel that an object is hot, when our body temperature is low as compared to that of the object because heat is transferred from object to body.

(iii) Similarly when body temperature is high as compared to that of object, we feel that the object is cold because heat is transferred from body to object.

(3) **Why is a white trail observed at the back of a flying plane in clear sky?**

Ans.

(i) In winter, as the plane flies the vapour released by the aeroplane engine condenses and forms clouds.

(ii) This cloud appears in the form of a white trail behind the flying aircraft.

(iii) Hence, a white trail is observed at the back of a flying plane.

*(4)   How will you explain following statements with the help of the anomalous behaviour of water? *(Use your Brain Power!; Textbook page no. 66)*

(a)   In regions with cold climate, the aquatic plants and animals can survive even when the atmospheric temperature goes below 0°C.

Ans.

(i) In cold countries during winter, the temperature of air falls to 0°C or even below.

(ii) As the temperature of air decreases, the water at the surface of the lake begins to contract due to which its density increases.

(iii) When the temperature of the water falls below 4°C, due to its anomalous behaviour, the water expands instead of contracting.

(iv) As the temperature of water falls to 0°C, the water on the surface of the lake gets converted to ice.

(v) Since ice is a bad conductor of heat the water below the ice layer continues to remain at 4°C even though the temperature of air may fall below 0°C.

(vi) Hence, due to the anomalous behaviour of water, aquatic animals stay alive even when the temperature of air falls below 0°C

(b)   In cold regions in winter the pipes for water supply break and even rocks crack.

Ans.

(i) During winter season, in cold countries the temperature of atmosphere falls well below 0°C.

(ii) Therefore, the temperature of water inside the pipeline also decreases.

(iii) When the temperature of the water falls below 4°C, it starts expanding instead of contracting due to anomalous behaviour of water.

(iv) Since there is no place for water to expand it exerts tremendous pressure on the walls of the pipeline causing them to burst. Hence, in winter the pipeline carrying water burst in cold countries.

*(5)   In cold regions, the winter rocks crack due to anomalous expansion of water.

Ans.

(i) During winter season, in cold countries the temperature of atmosphere falls well below 0°C.

(ii) If water is present within the crevices of the rocks, then due to its anomalous behaviour, water begins to expand below 4°C.

(iii) As there is no place in the crevices for the expansion of water, it exerts tremendous pressure on the rocks which results in the crumbling of the rocks.

(iv) Hence, sometimes rocks crumble into pieces in cold countries during winter.

Q.3.1. Explain the following / meaning of statement:

*(1)   Role of Latent heat in the change of state of a substances.

Ans.

(i) During change of state of a substance, object absorbs or release heat energy.

(ii) But the temperature does not change.

(iii) The heat energy is utilized for weakening the bonds between the atoms or molecules in the substance.

(iv) Hence, this energy which causes a change in state and does not change the temperature is called Latent heat.

*(2)   On what basis and how will you determine whether air is saturated with vapour or not?

Ans.

(i) We can determine whether air is saturated with vapour or not on the basis of relative humidity.

(ii) Relative humidity is the ratio of actual mass of vapour content in air for given volume and temperature to that required to make air saturated with vapour at that temperature.

(iii) If relative humidity is 100%, the air is saturated with vapour. This is called dew point.

(iv) If its value is less than 100%, then air is unsaturated.

*(3)   How can you relate the formation of water droplets on the outer surface of a bottle taken out of refrigerator with formation of dew.

Ans.

(i) When the bottle is taken out of the refrigerator, the air around the bottle cools.

(ii) As the air cools, due to decrease in temperature it becomes saturated with water vapour.

(iii) As a result, the excess water vapour gets converted into tiny droplets on the outer surface of the bottle called dew.

(iv) This is similar to the dew we see in the early mornings on leaves of plants and window glass of vehicle.

(4)   Specific heat capacity

Ans.

(i) The amount of heat energy required to raise the temperature of unit mass of substance through 1°C is called specific heat capacity.

(ii) 'm' is a mass of and object which has specific heat capacity of 'c'. If its temperature is to be increased by ΔT, then the heat absorbed by a substance can be calculated as,

Heat absorbed = mc ΔT ... ΔT is rise in temperature

(iii) If the temperature of a substance is reduced, then heat lost by a substance can be given as,

Heat lost = mc ΔT ..... ΔT is fall in temperature.

∴ Specific heat capacity is necessary to find amount of heat loss or gain.

(5) Principle of heat exchange

Ans.

(i) When a hot and a cold object are kept in contact, then, Heat lost by hot object = Heat gained by cold object. [In an isolated environment]

(ii) When a hot object and cold object are placed in contact, then there is transfer of heat from hot object to cold object till the temperature of both become equal.

(iii) If there is no other loss or gain of heat energy from the surrounding, then principle of heat exchange is written as.

Heat lost by hot body = Heat gained by cold body

(6) How is specific heat measured? or Explain 'mixing method' for measurement of specific heat.

Ans.

(i) The specific heat of an object can be measured by mixing method using a calorimeter.

(ii) When a hot solid metallic ball (sphere) is put in water in a calorimeter, heat exchange starts between hot object, water and calorimeter.

(iii) This continues till the temperature of all the three becomes equal.

(iv) Heat lost by hot object (Q_1) is equal to Heat gained by water and calorimeter.

(v) If the specific heat of water and calorimeter are known, then the specific heat of solid object can be calculated.

*(7) What is meant by latent heat? How will the state of matter transform if latent heat is given off?

Ans. The quantity of heat absorbed or released by a substance to change its state at constant temperature is called latent heat. If Latent heat is given off, then a gas will convert into a liquid, and a liquid will convert into a solid.

*(8) What is meant by 'specific heat capacity'? How will you prove experimentally that different substances have different specific heat capacities?

Ans.

(i) The quantity of heat energy required to raise a temperature of unit mass of a substance through 1°C is called specific heat capacity of a substance. *(refer Fig 5.3)*

(ii) Three solid spheres of equal masses of material iron, copper and lead are placed in boiling water for same time. After removing them simultaneously, they are placed on the wax tray together.

(iii) Initially, all spheres have temperature of 100°C. The sphere which absorbs more heat can melt more wax.

(iv) Iron sphere melts more wax and goes deep into it ray. The lead sphere goes less deep into the molten wax. The copper sphere goes to intermediate depth.

(v) This indicates that the heat absorbed by different material differs. This is specific heat capacity of metals.

(vi) Specific heat capacity is denoted by letter 'c'. In CGS, it is measured in cal/g°C, while in MKS, it is measured in J/kg°C.

*(9) Which principle is used to measure the specific heat capacity of a substance?

Ans. The specific heat capacity of a substance is measured using principle of heat exchange.
It states that,
Heat lost by hot object = Heat gained by cold object.

(10) Explain the given graph:

*(a) Observe the graph below. Temperature of water is raised from 0°C, observe the change in volume at different temperatures and explain the anomalous behaviour of water.

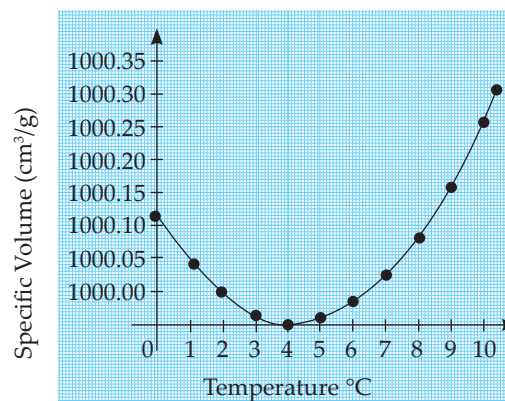*Fig : 5.2 Graph between the volume and temperature of water*

Ans.

(i) As water at 0°C is heated upto 4°C, it contracts instead of expanding. The volume of water at

4°C is minimum. If water at 4°C is further heated, then it expands and its volume increases.

(ii)   This exceptional behaviour which water shows between 0°C to 4°C is called anomalous behaviour of water.

(iii)   From graph, we come to know that if water is heated from 0°C to 4°C, it contracts instead of expanding. Since volume at 4°C is minimum, hence, density is maximum.
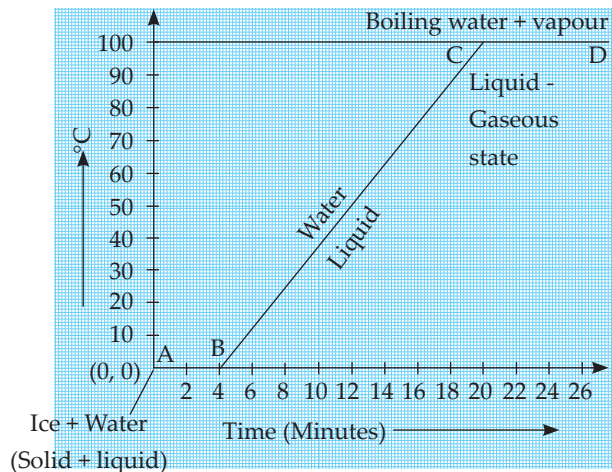
*(11)   Explain the following graph:

Fig 5.3: Temperature vs Time Graph

Ans.

(i)   The graph shown is a temperature - time graph of Ice transforming into water and steam.

(ii)   **AB shows that**, at constant temperature of 0°C ice changes to water.

(iii)   The temperature at which ice changes to water, is called melting point of ice i.e. 0°C.

(iv)   Now, water at 0°C starts heating and its temperature gradually increases to 100°C.

(v)   **BC shows** increase in temperature from 0°C to 100°C without a change in state.

(vi)   **CD shows that**, at constant temperature of 100°C, water changes to vapour.

(vii)   The temperature at which water changes to vapour is called boiling point of water i.e. 100°C.

Q.3.2. Open Ended Question:

*(1)   While deciding the unit for heat, which temperatures interval is chosen? Why?

Ans.   The temperature range of 14.5°C to 15.5°C is chosen while deciding the unit for heat. If we heat 1 kg of water by 1°C in different temperature range other than 14.5°C to 15.5°C, the amount of heat required will be slightly different.

*(2)   In the below experiment, the wire moves through the ice slab. However, the ice slab does not break. Why? *(Use your Brain Power!; Textbook page no. 64*
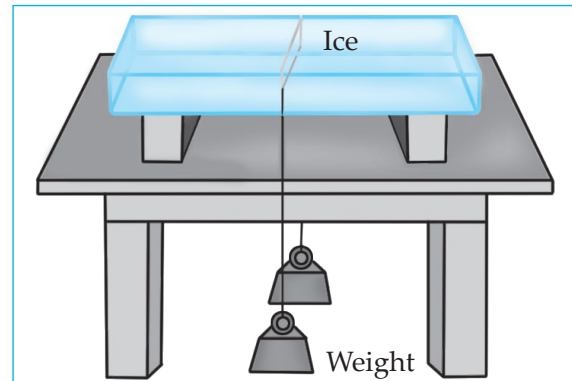

Fig 5.4

Ans.

(i)   The melting point of ice becomes lower than 0°C due to the applied pressure by the wire.

(ii)   So the Ice gets converted into water and the wire moves through the ice slab.

(iii)   Once the pressure is removed, the water becomes ice again. In this way the wire moves through the ice slab without breaking it.

*(3)   Is there any relationship of latent heat with the regelation? *(Use your Brain Power! Textbook page no. 64)*

Ans.   Yes there is relationship between latent heat and regelation

(i)   The amount of heat energy absorbed or released during change of state is called Latent heat.

(ii)   The phenomenon in which ice converts to liquid due to applied pressure and then reconverts to ice once the pressure is removed is called Regelation.

(iii)   Since there are change of states during Regelation process latent heat is one of the factors affecting Regelation.

Q.3.3. Draw a neat and labelled diagram:

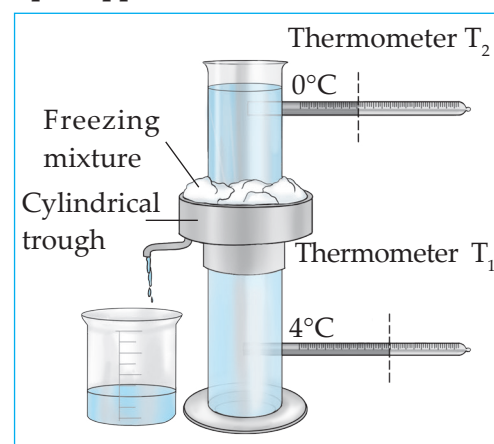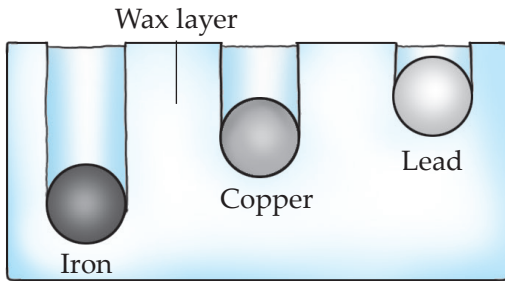***(1)   Hope's apparatus**

Ans.

Fig 5.5

*(2) Experiment of specific heat capacity with three solid spheres.

Ans.

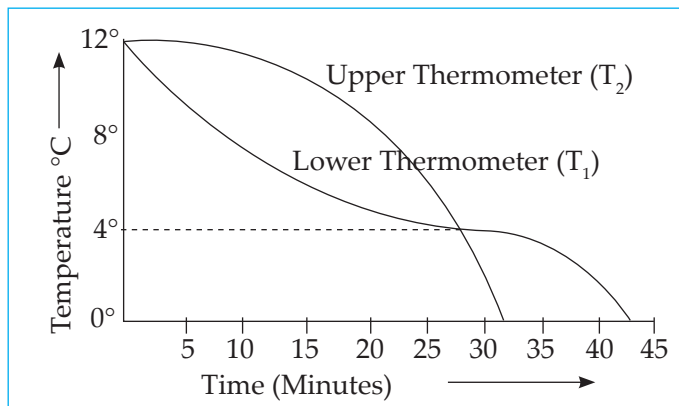***(3) Graph of time against temperature for Hope's Apparatus.**

Ans.

Fig 5.6: Time - Temperature Graph
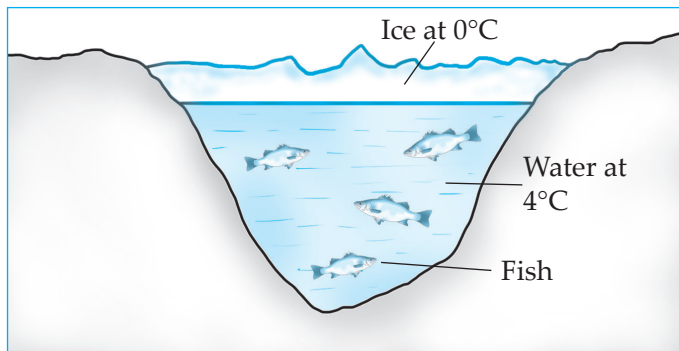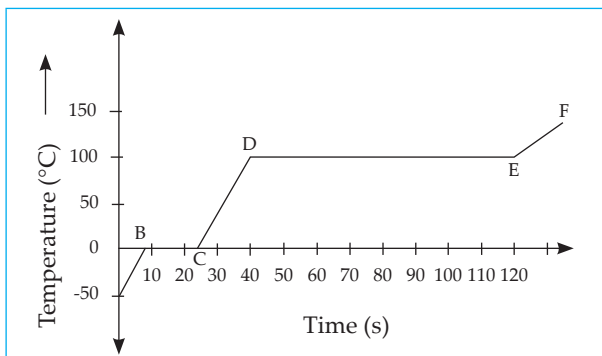
*(4) Survival of aquatic life.

Ans.

Fig 5.7: Aquatic animals in cold regions

Q.3.4. Figure/Application Based Questions.

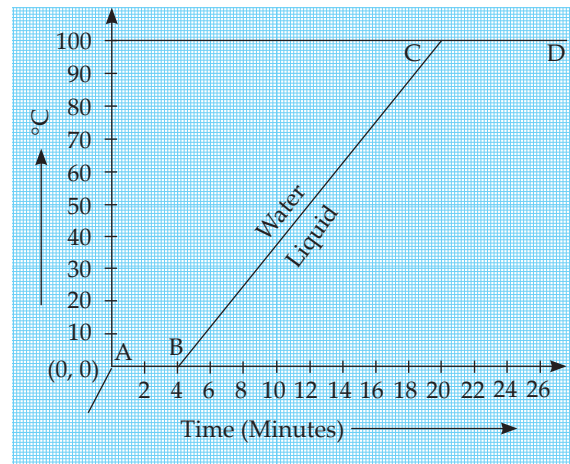**(1) Answer the following based on the graph given below.**

(i) What is the state of the substance in the region DE of the graph?

Ans: Liquid and gas

(ii) What is the heat energy absorbed in the region EF called?

Ans: Latent heat of vaporization

(2) Answer the following questions based on the diagram given below.

Temperature vs Time Graph

(i) What part of the graph shows a change from ice to water at a constant temperature?

Ans. Part AB

(ii) Which part of the graph shows a change in the temperature without a change in the state?

Ans. Part BC

(iii) Define : Latent heat of Vapourization.

Ans. The heat energy absorbed at constant temperature during transformation of liquid to gas is called latent heat of vaporization.
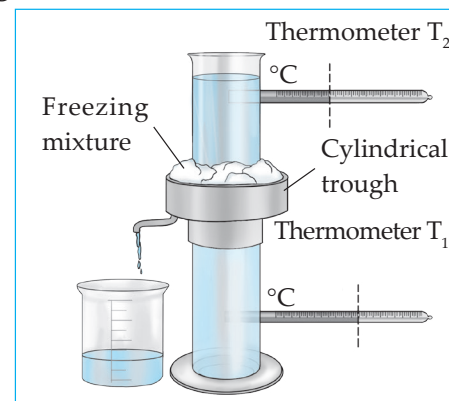
(iv) What is the heat energy absorbed from A to B called?

Ans. Latent heat of fusion.

(v) What is the heat energy absorbed from C to D called?

Ans. Latent heat of vaporization.

(3) Answer the following based on the diagram given below.

(i) **When the temperature of water decreases from 4°C to 2°C, will the level of water rise or fall in the cylinder?**

Ans. When the temperature of water decreases from 4°C to 2°C, water expands and therefore it will rise in the cylinder.

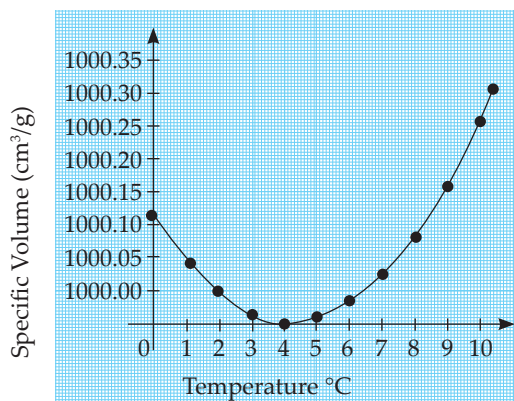**(ii)** **Which of the two thermometers, T_1 or T_2, will show a temperature of 0°C first?**

Ans. Thermometer T_2 will show temperature of 0°C first.

(iii) **Pipe lines crack in winter season in cold countries due to which phenomena?**

Ans. Pipelines crack in winter season due to anomalous behaviour of water.

(4) **Answer the following based on the diagram given below.**

(i) **Which behavior of water is shown in the graph?**

Ans. Anomalous behavior of water.

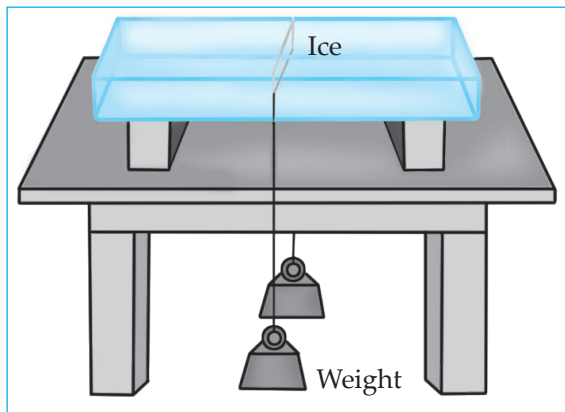**(ii)** **At what temperature is the volume of water minimum?**

Ans. 4°C

(iii) **On cooling from 0°C to 4°C, what is the effect on (a) Volume (b) Density of water**

Ans. (a) The volume of water decreases on cooling from 0°C to 4°C

(b) The density of water increases on cooling from 0°C to 4°C.

(5) **Answer the following based on the diagram given below.**

(i) **Above experiment is meant to understand which phenomenon of heat?**

Ans. Regelation

(ii) **Define the phenomenon in minimum words.**

Ans. The phenomena in which the ice converts to water due to applied pressure and then re-converts to ice again once the pressure is removed is called regelation.

(iii) **What is the effect of the increase in pressure on the melting point of ice?**

Ans. As the pressure increases, the melting point of ice decreases.

(iv) **The wire does not breaks the ice slab while passing through it. Why?**

Ans. On applying pressure, the melting point of ice reduces and it melts. As the wire moves down, the pressure is removed the melting point comes back to normal and water freezes back to ice again. Thus, the ice slab doesnot breaks.

(v) **Will latent heat affect the process?**

Ans. Yes, latent heat will affect the process since there is a change in state involved.

(6) **The graph given in daigram represents a cooling curve for a substance being cooled from its vapour to solid phase by releasing heat at a constant rate of 100 J s^{-1}.**
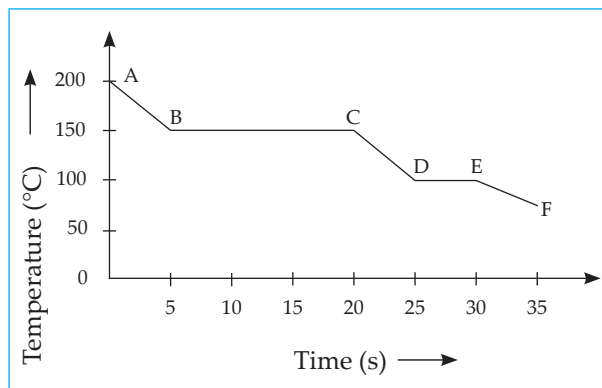
(i) **What is the boiling point of the substance?**

Ans. The boiling point of the substance is 150°C.

(ii) **What happens in the region DE?**

Ans. The region DE represents freezing of the substance where the liquid changes into solid at a constant temperature (= 100°C).

(iii) **What is the melting point of the substance?**

Ans. The melting point of the substance is 100°C.

Q.4.1. Paragraph Based Question:

*(1) **Read the following paragraph carefully and answer the following questions:**

> If heat is exchanged between a hot and cold object, the temperature of the cold object goes on increasing due to gain of energy and the temperature of the hot object goes on decreasing due to loss of energy.
>
> The change in temperature continues till the temperatures of both the objects attain the same value. In this process, the cold object gains heat energy and the hot object loses heat energy. If the system of both the objects is isolated from the environment by keeping it inside a heat resistant box (meaning that the energy exchange takes place between the two objects only), then no energy can flow from inside the box or come into the box.

*(i) **Heat is transferred from where to where?**

Ans. Heat gets transferred from hot object to the cold object.

*(ii) **Which principle do we learn about from this process?**

Ans. Principle of Heat exchange.

*(iii) **How will you state the principle briefly?**

Ans. The principle of Heat exchange states that, if heat is exchanged between a hot and cold object, then heat energy lost by hot object is equal to heat energy gained by the cold object.

*(iv) **Which property of the substance is measured using this principle.**

Ans. Using this principle, the specific heat capacity of a substance can be measured.

❖ ❖ ❖

ASSIGNMENT - 5

Time : 1 Hr.   **Marks : 20**

Q.1. (A) Answer the following: **(3)**

(1)   What is Specific latent heat of fusion?

(2)   Name the apparatus used to experiment anomalous behavior of water.

(3)   What is the Principle of Heat exchange?

Q.2. (B) Choose and write the correct option.   **(2)**

(1)   The specific heat capacity of _____ is maximum.

(a) Mercury   (b) Copper   (c) Water   (d) Iron

(2)   Aquatic plants and animals can survive in cold regions because of _____ .

(a) Humidity   (b) Dew point   (c) Heat capacity   (d) Anomalous behaviour of water

Q.2. Answer the following: *(Any 2)*   **(4)**

(1)   In cold regions in winter, rocks crack due to anomalous expansion of water.

(2)   Distinguish between heat and temperature.

(3)   Equal heat is given to two objects A and B of mass 1g. Temperature of A increases by 3°C and B by 5°C. Which object has more specific heat? and by what factor?

Q.3. Answer the following: *(Any 2)*   **(6)**

(1)   **Answer the following based on the diagram given below.**

Ice

Weight
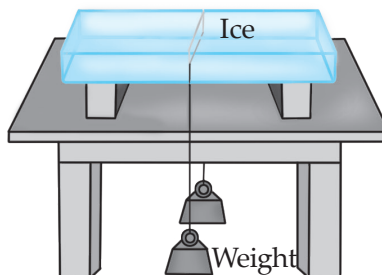
(i) Above experiment is meant to understand which phenomenon of heat?

(ii) Define the phenomenon in minimum words.

(iii) What is the effect of the increase in pressure on the melting point of ice?

(2) A calorimeter has mass 100 g and specific heat 0.1 kcal/kg°C. It contains 250 gm of liquid at 30°C having specific heat of 0.4 kcal/kg°C. If we drop a piece of ice of mass 10g at 0°C, what will be the temerature of the mixture?

(3) If 80 g steam of temperature 97°C is released on an ice slab of temperature 0°C, how much ice will melt? How much energy will be transferred to the ice when the steam will be transformed to water?

Q.4. Answer the following: *(Any 1)* **(5)**

(1) Explain Hope's apparatus with a neat and labelled diagram.

(2) Answer the following questions based on the diagram given below.
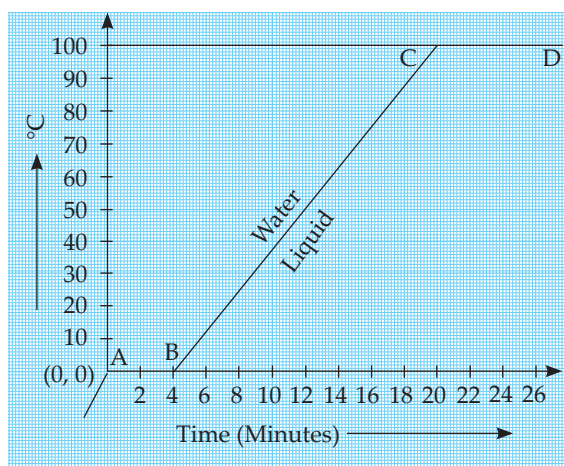
Temperature vs Time Graph

(i) What part of the graph shows a change from ice to water at a constant temperature?

(ii) Which part of the graph shows a change in the temperature without a change in the state?

(iii) Define : Latent heat of Vapourization.

(iv) What is the heat energy absorbed from A to B called?

(v) What is the heat energy absorbed from C to D called?below.

❖ ❖ ❖

6 Refraction of Light

CONCEPT MAP

Refraction of Light

Phenomena

Total Internal Reflection

e.g. mirage

Refraction

Dispresion

When light is incident

Combined Effect Leads to the formation of

Rainbow

Refractive index

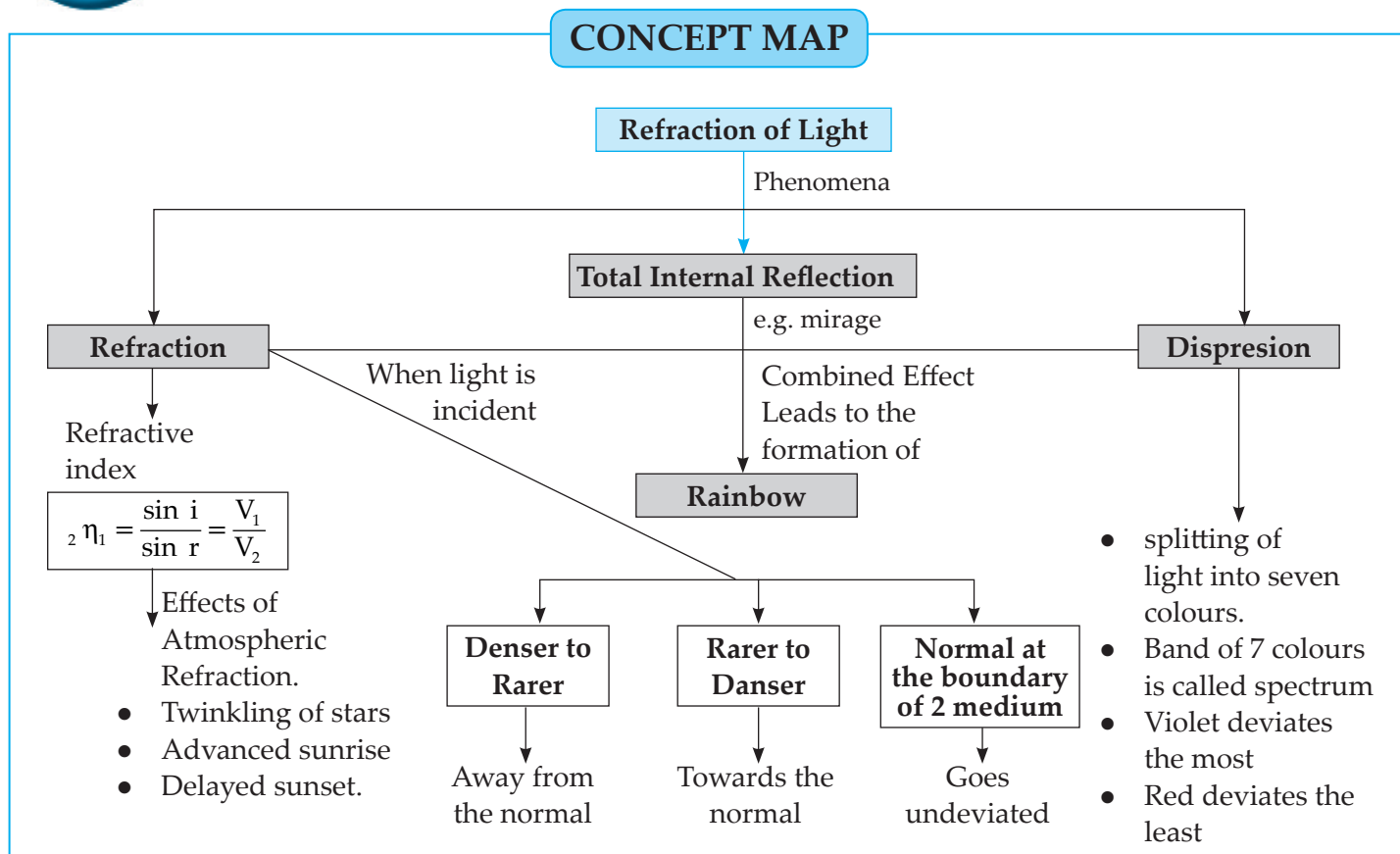$$_2\eta_1 = \frac{\sin\ i}{\sin\ r} = \frac{V_1}{V_2}$$

Effects of Atmospheric Refraction.
- Twinkling of stars
- Advanced sunrise
- Delayed sunset.

Denser to Rarer

Away from the normal

Rarer to Danser

Towards the normal

Normal at the boundary of 2 medium

Goes undeviated

- splitting of light into seven colours.
- Band of 7 colours is called spectrum
- Violet deviates the most
- Red deviates the least

Points to Remember:

- Refraction of light: The phenomenon of change in the direction of light when it passes from one transparent medium to another obliquely, is called **refraction of light**.

- **Laws of Refraction:**

  (a) The incident ray and the refracted ray are on the **opposite** sides of the normal at the point of incidence and all the three lie in the **same plane**.

  (b) For a given pair of media,

  If 'i' is angle of incidence and 'r' is the angle of refraction; then,

  $$\frac{\sin\ i}{\sin\ r} = constant = \eta$$

  This constant is called as the '**refractive index**' of second medium with respect to the first medium. It is denoted by $_2n_1$.

  $$\therefore\ _2n_1 = \frac{\sin\ i}{\sin\ r} = n.$$

  This is also called Snell's law. A ray incident along the normal (i = O) goes forward in the same direction (r = O).

  The refractive index of the second medium with respect to the first medium is given by the ratio of magnitude of velocity of light in the first to that in second medium. It is denoted by $_2n_1$.

- The refractive index depends upon the **relative speed of propagation of light** in different media.

- Suppose v_1 is the velocity of light in medium 1 and v_2 is the velocity in medium 2.

∴ Refractive index $= \dfrac{\text{Velocity of light in first medium}}{\text{Velocity of light in second medium}}$

$${}_2\mathbf{n}_1 = \dfrac{\mathbf{v}_1}{\mathbf{v}_2}$$

In the same way, the refractive index of the first medium with respect to second medium is denoted as,

$${}_1\mathbf{n}_2 = \dfrac{\mathbf{v}_2}{\mathbf{v}_1}$$

- Refraction of light across the medium:
  - (a) When the light ray moves from an optically **rarer medium** to optically **denser medium**, it bends **towards the normal**.
  - (b) When a ray of light travels from an optically **denser medium** to an optically **rarer medium**, it bends **away from the normal**.
  - (c) When the ray is incident normally at the boundary between the two media, it **does not** change its direction and hence **does not get refracted**.

- Mirage is due to the apparent **random wavering of the hot air rising above the heated roads**. It is the apparent image of an object originating from the ground below the object.

- Twinkling of stars:
  - (a) Stars emit their **own light** and **shine** at night. They are at **infinite** distances from us, hence appear as the **point source**.
  - (b) Because of **mobility** of **atmospheric air** and **change** in air density and the **temperature**, the atmosphere is **not steady**. Hence, refractive index of air goes on changing continuously and randomly.
  - (c) When atmosphere refracts **more light** towards us, the star is seen **bright**. When atmosphere refracts **less light** towards us, the star is seen **dim**. Thus, due to change in the refractive index of atmosphere, stars appear **twinkling at night**. Different colour lights have different frequencies. In vacuum, the velocity of light rays of all frequencies is the same. In a medium like glass, the angle of refraction are different for different colours.

- Dispersion of light:
  - (a) The phenomenon of **splitting** of **white light or sunlight** into its component colours while passing through a medium is called the **dispersion of light**.
- (b) The band of coloured components of a light beam is called its 'spectrum'.
- (c) Various colours obtained after splitting are in a sequence - Violet, Indigo, Blue, Green, Yellow, Orange and Red. The acronym is VIBGYOR and can be used to remember the colours.

- The angle of incidence for which the angle of refraction is 90° is called as critical angle.

- When the angle of incidence is larger than the critical angle, the angle of refraction is **more than 90°**, then the ray comes back in the denser medium. Hence, total internal reflection takes place. When angle of incidence is more than critical angle, **total internal reflection** takes place.

∴ $_1\mathbf{n}_2 = \dfrac{\sin i}{\sin r}$

For total internal reflection, i = Critical angle, r = 90°

∴ $_1\mathbf{n}_2 = \dfrac{\sin i}{\sin 90°} = \sin i$ (∵ sin 90° = 1)

- When light enters a **rarer** medium from a **denser** medium, it gets **partially reflected**. This is called **partial reflection**.

- Formation of rainbow: Rainbow is a **natural phenomena** with a combined effect of **dispersion, refraction** and **total internal reflection of light**.

MASTER KEY QUESTION SET - 6

Q.1. **(A) 1. Fill in the blanks and rewrite the completed statements:**

*(1)   Refractive index depends on the .... of light.

*(2)   The change in the .... of light rays while going from one medium to another is called refraction.

(3)   The refractive index of air goes on .... while coming to the earth surface.

(4)   The splitting of sunlight into its component colours is called .... of light.

(5)   In the dispersion of sunlight through glass prism the .... light deviates the most.

(6)   When the light ray is incident normal to the interface between any two media, the angle of incidence is ....

(7)   When the ray of light passes from denser medium to rarer medium obliquely, it bends .... the normal.

(8)   When the value of 'r' is 90°, then the 'i' for it is called as ....

(9)   When light travels from denser medium to rarer, then the partial .... takes place.

(10)   The refractive index $_2n_1 = \dfrac{v_1}{\text{.........}}$

(11)   The refractive index of diamond is ....

(12)   When the light passes through glass prism, the .... light deviates the least.

(13)   The scientist .... used the glass prism for obtaining spectrum from the sunlight.

(14)   The wavelength of visible light range for human is between ....

(15)   The wavelength of .... light is the least which is ....

(16)   1 nm = ... m.

(17)   The wavelength of violet light is ....

(18)   When the angle of incidence is more than critical angle .... takes place.

Ans. *(1) velocity (2) direction (3) increasing (4) dispersion (5) violet (6) 0° (7) away from (8) critical angle (9) reflection (10)* v_2 *(11) 2.42 (12) red (13) Isaac Newton (14) 400 nm and 700 nm (15) violet, 400 nm (16)* 10^{-9} *(17) 400 nm (18) Total internal reflection*

Q.1. **(A) 2. Find the odd word out:**

(1)   Mirage, twinkling of stars, scattering of light, apparent position of stars

Ans. *Scattering of light.* It is reflection, rest are refraction.

(2)   Critical angle, angle of incidence, angle of refraction, alternate angle

Ans. *Alternate angle.* Others are concerned with refraction.

(3)   Reflection, dispersion, refractive index, refraction

Ans. *Refractive index.* Refractive index is a value while the rest are natural phenomena of light.

(4)   Brown, blue, green, red

Ans. *Brown.* It is not a component of white light. Blue, red and green are components of white light.

Q.1. **(A) 3. Complete the analogy:**

(1)   Refractive index of water : 1.33 : : Refractive index of air : ....

Ans. 1.0003 : The value of refractive index is different for different media.

(2)   Stars : Point source of light : : Planets : ....

Ans. Collection of point sources of light : Planets are much closer to us as compared to stars, therefore, they appear as a collection of point sources.

(3)   Diamond : Denser medium : : Air : ....

Ans. Rarer medium : The speed of light is more in air than in diamond.

(4)   Least deviation : Red : : Maximum deviation : ....

Ans. Violet : The wavelength of violet is the smallest and therefore it deviates the maximum.

(5)   Spectrum : Dispersion : : Twinkling of stars : ....

Ans. Refraction : Spectrum is formed by dispersion of white light or sunlight, whereas the changes in the refractive index of air stars appear to twinkle.

(6)   Ice : 1.31 : : Water : ....

Ans. 1.33 : Liquid water is denser than solid ice.

(7)   Maximum refractive index : Violet : : Minimum refractive index : ....

Ans. Red : Red light has the maximum wavelength and its refractive index is minimum compared to violet light which has the smallest wavelength.

(8) $_2n_1 = \dfrac{v_1}{v_2} : : {}_1n_2 : $ ....

Ans. $\dfrac{v_2}{v_1}$: Velocity of light in a medium depends on the refractive index of the medium.

(9) $\angle$ i < critical angle : Partial reflection : : $\angle$ i > critical angle : ....

Ans. Total internal reflection : If the angle of incidence is greater than the critical angle, then all the light gets reflected back into the dense medium

(10) Lens : Transparent : : Mirror : ....

Ans. Opaque : Light can pass through the lens whereas in a mirror, light cannot pass through because it is covered by a mirror coating on the side.

Q.1. (A) 4. Answer in one sentence:

(1) What is the refractive index of water?

Ans. The refractive index of water is 1.33.

(2) Write the ratio of velocity of light in first medium to the velocity of light in the second medium.

Ans. Refractive index

$$= \frac{\text{Velocity of light in the first medium}}{\text{Velocity of light in the second medium}}$$

$$\therefore \quad _{2}n_{1} = \frac{v_1}{v_2}$$

(3) What do you mean by dispersion of light?

Ans. The process of separation of light into its component colours while passing through a medium is called dispersion of light.

(4) What is critical angle?

Ans. The angle of incidence for which the angle of refraction is 90° is called critical angle.

(5) What is refraction of light?

Ans. Light changes its direction when passing from one transparent medium to another transparent medium. This is called the refraction of light.

(6) What is the value of angle of refraction if angle of incidence is 0°?

Ans. If the angle of incidence is zero, then the angle of refraction is also zero.

(7) When sunlight passes through glass prism which light deviates the least?

Ans. When sunlight passes through glass prism, the red light deviates the least.

(8) What is total internal reflection?

Ans. When the angle of incidence in a denser medium is more than its critical angle, then the light reflects back into the denser medium. This is called total internal reflection.

(9) What is partial reflection?

Ans. When light enters a rarer medium from denser medium, a part of it gets reflected and comes back into the denser medium as per laws of reflection. This is called partial reflection.

(10) What is absolute refractive index?

Ans. The refractive index of medium with respect to vacuum is called its absolute refractive index.

(11) What is meant by reflection of light?(Can you recall?; Textbook page no. 73)*

Ans. When rays of light fall on a smooth surface they turn back. This is called reflection of light.

*(12) Have you seen a mirage which is an illusion of the appearance of water on a hot road or in a desert? *(Can you tell?; Textbook page no. 76)*.

Ans. Yes. I have seen mirage on hot road during summer days.

Q.1. (A) 5. Match the pairs:

(1)

Column A	Column B
(1) Diamond	(a) 1.5
(2) Air	(b) 2.42
(3) Alcohol	(c) 1.77
(4) Benzene	(d) 1.36
	(e) 1.0003

Ans. *(1 – b), (2 – e), (3 – d), (4 – a)*

(2)

Column A	Column B
(1) Formation of rainbow	(a) Total internal reflection
(2) Twinkling of stars	(b) Dispersion
(3) Mirage	(c) Dispersion, refraction, reflection
(4) Spectrum	(d) Atmospheric refraction

Ans. *(1 – c), (2 – d), (3 – a), (4 – b)*

(3)

Column A	Column B
(1) Refraction	(a) With respect to vacuum
(2) Refractive index	(b) Change in direction of light
(3) Absolute refractive index	(c) Spectrum
(4) Dispersion	(d) $\dfrac{\sin i}{\sin r}$
	(e) Mirage

Ans. *(1 - b), (2 - d), (3 - a), (4 - c)*

Q.1. (A) 6. State whether the following statements are 'True' or 'False'.

(1) Light has different velocities in different media.

(2) The speed of violet light is less than that of red light.

(3) Incident ray and refracted rays are parallel to the normal.

(4) The refractive index of the medium depends on the wavelength of light.

(5) When light rays travel from rarer to denser medium, it bends towards the normal.

(6) When light ray travels from denser medium to rarer medium, it travels parallel to the normal.

(7) If angle of incidence is zero, then the angle of refraction is 90°.

(8) When light travels obliquely from glass to air, it bends away from the normal.

(9) The splitting of white light into its component colours is called dispersion.

Ans. *(1) True (2) True (3) False. Incident ray and refracted ray lie on the opposite sides of normal. (4) True (5) True (6) False. Light ray bends away from the normal. (7) False. The angle of refraction would also be zero. (8) True (9) True*

Q.1. **(A) 7. Name the following:**

(1) The phenomenon of splitting of sunlight into spectrum.

Ans. Dispersion of light

(2) A material whose refractive index is 2.42.

Ans. Diamond

(3) The reason for stars twinkling at night.

Ans. Atmospheric refraction

(4) The ratio of sine of angle of incidence to the sine of angle of refraction.

Ans. Refractive index

(5) The light ray which gets deviated the least while passing through glass prism.

Ans. Red light

(6) Phenomenon behind formation of rainbow.

Ans. Dispersion, total internal reflection and refraction

(7) The unit of refractive index.

Ans. No unit

(8) Refractive index of kerosene.

Ans. 1.39

Q.1. **(B) Choose and write the correct option:**

*(1) What is the reason for the twinkling of stars?

(a) Explosions occuring in the stars from time to time

(b) Absorption of light in the earth's atmosphere

(c) Motion of stars

(d) Changing refractive index of the atmospheric gases

*(2) If the refractive index of glass with respect to air is $\dfrac{3}{2}$, then the refractive index of air with respect to glass ....

(a) $\dfrac{1}{2}$ (b) 3 (c) $\dfrac{1}{3}$ (d) $\dfrac{2}{3}$

*(3) We can see the sun even when it is little below the horizon because of ....

(a) Reflection of light (b) Refraction of light

(c) Dispersion of light (d) Absorption of light

(4) When light ray passes from air to glass slab then it ....

(a) bends towards normal (b) bends away

(c) does not bend (d) turn back

(5) When light passes through glass slab, the incident ray and emergent ray are ....

(a) intersecting (b) parallel

(c) making an angle (d) touching

(6) When light ray travels from denser medium to rarer, then it ....

(a) bends towards normal

(b) bends away from normal

(c) goes undeviated

(d) deviates randomly

(7) The velocity of light in air is .... m/s.

(a) 3×10^{10} (b) 3×10^{8}

(c) 1.5×10^{8} (d) 0.3×10^{8}

(8) Rakesh performs the experiments on tracing the path of a ray of light passing through a rectangular glass slab for different angles of incidence. He observes that in all cases

(a) $\angle i > \angle r$ but $\angle i = \angle e$ (b) $\angle i < \angle r$ but $\angle i = \angle e$

(c) $\angle i > \angle e$ but $\angle i = \angle r$ (d) $\angle i < \angle e$ but $\angle i = \angle r$

(9) When a ray of light travels from air to glass and strikes the surface of separation at 90°, then it ....

(a) bends towards the normal

(b) bends away from the normal

(c) passes without bending

(d) reflects to air

(10) A ray of light incident from a denser medium passes through a rarer medium in a straight line. What should be angle of incidence ?

(a) 0° (b) 30° (c) 60° (d) 120°

(11) The ray of light gets deviated when it passes from one medium to another medium because ....

    (a) the colour of light changes

    (b) the frequency of light changes

    (c) the velocity of light changes

    (d) None of these

(12) A ray of light strikes the glass slab at an angle of 50°. What is the angle of incidence ?

    (a) 50°   (b) 40°   (c) 60°   (d) 120°

(13) A glass-slab is placed in the path of convergent light. The point of convergence of light ....

    (a) moves towards the slab

    (b) moves away from slab

    (c) remains at the same point

    (d) undergoes lateral shift

(14) What is the speed of light in a transparent medium having absolute refractive index 1.25?

    (a) 1.25×10^8 m/s   (b) 2.4×10^8 m/s

    (c) 3.0×10^8 m/s   (d) 1.5×10^8 m/s

(15) Which colour of light deviates the least in the spectrum obtained with a prism ?

    (a) Red   (b) Yellow   (c) Violet   (d) Blue

(16) The figure shows the path of ray of light propagating from medium 1 to medium 2. The refractive index of medium 1 with respect to medium 2 is ....

    (a) $\dfrac{\sin 45^0}{\sin 60^0}$ (b) $\dfrac{\sin 60^0}{\sin 45^0}$

    (c) $\dfrac{\sin 45^0}{\sin 30^0}$ (d) $\dfrac{\sin 30^0}{\sin 45^0}$
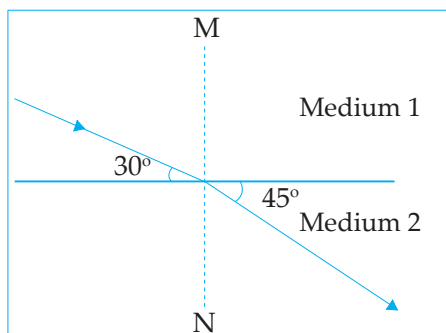
(17) After tracing the path of a ray of light through a glass prism, a student marked the angle of indicence ($\angle$i), angle of emergence ($\angle$e) and the angle of deviation ($\angle$D) as shown in the diagram.

The correctly marked angles are:
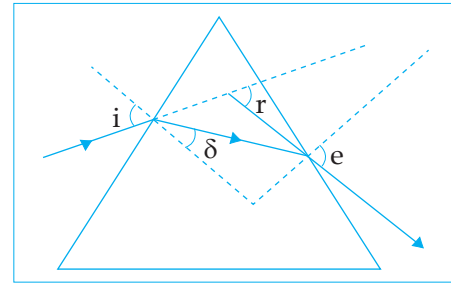
    (a) $\angle$i and $\angle$r   (b) $\angle$i and $\angle$e

    (c) $\angle$i, $\angle$e and $\angle\delta$ (d) $\angle$i, $\angle$r and $\angle$e

(18) Will the light travel through soapy water with the same velocity as it travels through air?

    (a) Yes   (b) No

    (c) Depends on the conditions

    (d) None of these

(19) In an experiment to trace the path of a ray of light passing through a rectangular glass slab, four students tabulated their observations as given below. Which student is correct.

(a)

S.N.	$\angle$i	$\angle$r	$\angle$e
1.	30^0	20^0	30^0
2.	45^0	29^0	43^0
3.	60^0	36^0	60^0

(b)

S.N.	$\angle$i	$\angle$r	$\angle$e
1.	30^0	15^0	38^0
2.	45^0	20^0	53^0
3.	60^0	28^0	67^0

(c)

S.N.	$\angle$i	$\angle$r	$\angle$e
1.	30^0	30^0	20^0
2.	45^0	45^0	29^0
3.	60^0	60^0	36^0

(d)

S.N.	$\angle$i	$\angle$r	$\angle$e
1.	30^0	20^0	20^0
2.	45^0	29^0	29^0
3.	60^0	36^0	36^0

    (a) a   (b) b   (c) c   (b) d

(20) If n_v, n_r, n_b are the refractive indices of violet, red and blue light respectively, in a given medium then which of the following is true?

    (a) $n_v = n_b = n_r$ (b) $n_v > n_b > n_r$

    (c) $n_v > n_b < n_r$ (b) $n_v > n_r > n_b$

(21) $v_V = v_R = v_G$ are the velocities of violet, red and green lights respectively, passing through a prism after dispersion of white light. Which among the following is a correct relation?

(a) $v_V = v_R = v_G$ (b) $v_V < v_G = v_R$

(c) $v_V > v_R > v_G$ (b) $v_V < v_R = v_G$

Ans. *(1) (d) changing refractive index of atmospheric gases*

(2) (d) $\dfrac{2}{3}$ *(3) (b) refraction of light (4) (a) bends towards normal (5) (b) parallel (6) (b) bends away from normal (7) (b)* 3×10^8 *(8) (a)* $\angle i > \angle r$ *but* $\angle i = \angle e$ *(9) (c) passes without bending (10) (a)* $0°$ *(11) (c) the velocity of light changes (12) (b)* $40°$ *(13) (b) moves away from the slab (14) (b)* 2.4×10^8 *m/s (15) (a) Red*

(16) (b) $\dfrac{\sin 60^0}{\sin 45^0}$ *(17) (b)* $\angle i$ *and* $\angle e$ *(18) (b) No*

(19) (a) (20) (b) $n_v > n_b > n_r$ *(21) (b)* $v_V < v_G = v_R$

Q.2.1 Solve the following:

Formula:

Refractive index of second medium with respect to first medium,

$$_2n_1 = \frac{v_1}{v_2}$$

v_1 = velocity of light in first medium

v_2 = velocity of light in second medium

Also $_2n_1 = \dfrac{\sin i}{\sin r}$

i = angle of incidence

r = angle of refraction

*(1) The absolute refractive index of water is 1.36. What is the velocity of light in water? (velocity of light in vacuum is 3×10^8 m/s)

Ans. Given: $_wn_{vac} = 1.36$

$v_{vac} = 3 \times 10^8$ m/s

To find: $v_w = ?$

Formula: $_wn_{vac} = \dfrac{v_{vac}}{v_w}$

Solution: $1.36 = \dfrac{3 \times 10^8}{v_w}$

$$v_w = \frac{3 \times 10^8}{1.36}$$

$$v_w = 2.21 \times 10^8 \text{ m/s}$$

The velocity of light in water is 2.21×10^8 m/s

(2) Light travels with a velocity 1.5×10^8 m/s in a medium. On entering 2nd medium its velocity becomes 0.75×10^8 m/s. What is the refractive index of the 2nd medium with respect to the first medium.

Ans. Given: $v_1 = 1.5 \times 10^8$ m/s

$v_2 = 0.75 \times 10^8$ m/s

To find: $_2n_1 = ?$

Formula: $_2n_1 = \dfrac{v_1}{v_2}$

Solution: $_2n_1 = \dfrac{1.5 \times 10^8}{0.75 \times 10^8}$

$_2n_1 = 2$

Refractive index of 2nd medium with respect to 1st is 2.

*(3) If the speed of light in a medium is 1.5×10^8 m/s, what is the absolute refractive index of the medium?

Ans. Given: $v_m = 1.5 \times 10^8$ m/s

$v_{vac} = 3 \times 10^8$ m/s

To find: $_mn_{vac} = ?$

Formula: $_mn_{vac} = \dfrac{v_v}{v_m}$

Solution: $_mn_{vac} = \dfrac{3 \times 10^8}{1.5 \times 10^8}$

$_mn_{vac} = 2$

Absolute refractive index of the medium is 2.

*(4) If the absolute refractive indices of glass and water are 3/2 and 4/3 respectively, what is the refractive index of glass with respect to water?

Ans. Given: $_gn_v = \dfrac{3}{2} = \dfrac{v_v}{v_g}$

$_wn_v = \dfrac{4}{3} = \dfrac{v_v}{v_w}$

To find: $_gn_w = ?$

Formulae: $_gn_w = \dfrac{v_w}{v_g}$

Solution : $_gn_w = \dfrac{v_w}{v_g}$

$$= \frac{v_w}{v_g} \times \frac{v_v}{v_v}$$

$$= \frac{v_v}{v_g} \times \frac{v_w}{v_v}$$

$$= \frac{3}{2} \times \frac{3}{4}$$

$$_gn_w = \frac{9}{8}$$

Refractive index of glass with respect to water is $\dfrac{9}{8}$

*(5) If the refractive index of second medium with respect to first medium is $_2n_1$ and that of third medium with respect to second medium is $_3n_2$. What and how much is $_3n_1$? *(Can you tell?; Textbook page no. 75)*

Ans. Refractive index of 2nd medium w.r.t. 1st.

$$_2n_1 = \frac{v_1}{v_2} \quad ....(i)$$

Refractive index of 3rd medium w.r.t. 2nd.

$$_3n_2 = \frac{v_2}{v_3} \quad ....(ii)$$

Similarly,

$_3n_1$ = **refractive index of 3rd medium w.r.t. 1st.**

$$_3n_1 = \frac{v_1}{v_3} \times \frac{v_2}{v_2}$$

$$= \frac{v_2}{v_3} \times \frac{v_1}{v_2}$$

From (i) and (ii)

$$\boxed{_3n_1 = {_3n_2} \times {_2n_1}}$$

*(6) **If the angle of incidence and angle of emergence of a light ray falling on a glass slab are i and e respectively, then prove that, i = e.**
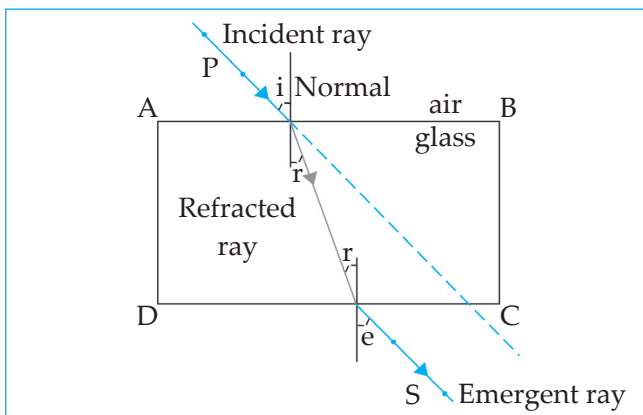
Ans.

Fig. 6.1 : Refraction of light passing through a glass slab

$$_2n_1 = \frac{1}{_1n_2}$$

1st medium be air

2nd medium be glass

$$_gn_a = \frac{1}{_an_g} \quad ....(i)$$

At surface AB

$$_gn_a = \frac{\sin i}{\sin r} \quad ....(ii)$$

At surface CD

$$_an_g = \frac{\sin r}{\sin e} \quad ....(iii)$$

Substituting (ii) and (iii) in (i)

$$\frac{\sin i}{\sin r} = \frac{\sin e}{\sin r}$$

$$\sin i = \sin e$$

$$\boxed{i = e}$$

NUMERICALS FOR PRACTICE

(1) The speed of light in a transparent medium is 2.5×10^8 m/s. Find the absolute refractive index of that medium. *(1.2)*

(2) The refractive index of benzene is $\frac{3}{2}$ and that of water is $\frac{4}{3}$. Find the refractive index of water with respect to benzene. $\left(\frac{8}{9}\right)$

(3) The refractive index of water is $\frac{4}{3}$ and speed of light in air is 3×10^8 m/s. Find the speed of light in water. *(2.25 × 10^8 m/s)*

(4) Solve and fill in the blanks

Sr. No.	Velocity of light in the first medium v_1	Velocity of light in the second medium v_2	Refractive Index $_2n_1$	Refractive Index $_1n_2$
(1)	3×10^8 m/s	1.2×10^8 m/s		
(2)		2.25×10^8 m/s	$\frac{4}{3}$	
(3)	2×10^8 m/s			1.5

[(1) 2.5, 0.4; (2) 3 × 10^8 m/s, 0.75; (3) 3 × 10^8 m/s, $\frac{2}{3}$ (0.67)]

Q.2.2. Define/write the laws:

(1) Refraction of light

Ans. The phenomenon of change in the direction of the light ray passing from one transparent medium to another obliquely is called refraction.

(2) Dispersion

Ans. The splitting of white light into its component colours is called dispersion.

(3) Spectrum

Ans. The band of coloured components of a light beam is called Spectrum.

(4) Angle of incidence

Ans. The angle made by an incident ray with the normal is called angle of incidence. It is denoted by '*i*'.

(5) Angle of refraction

Ans. The angle made by refracted ray with the normal is called as angle of refraction. It is denoted by '*r*'.

(6) Laws of refraction

Ans.

(i) The incident ray and the refracted ray are on the opposite sides of the normal at the point of incidence and all three lie in the same plane.

(ii)   For a given pair of media, the ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant.

If 'i' is the angle of incidence and 'r' is the angle of refraction, then $\dfrac{\sin i}{\sin r}$ = constant

This constant is called refractive index of a medium.

*(5)   Laws of reflection *(Can you recall?; Textbook page no.73)*

Ans.

(i)   The incident ray, reflected ray and the normal are all in the same plane.

(ii)   The incident ray and reflected ray are on opposite sides of the normal.

(iii)   The angle of incidence and angle of reflection are of equal measure.

Q.2.3. Write the short notes on:
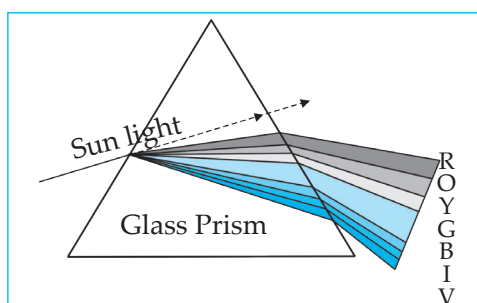
(1)   Dispersion of light

Ans.

Fig. 6.2 : Dispersion of light

(i)   The process of separation of light into its component colours while passing through a medium is called dispersion of light.

(ii)   Refractive index of a medium is different for different colours.

(iii)   When white light enters a single medium like glass, the angles of refraction are different for different colours.

(iv)   When white light from the sun through air, enters any refracting medium, it emerges as a spectrum of seven colours.

(v)   Sir Issac Newton was the first person to use a glass prism to obtain sun's spectrum.

(2)   Refractive index

Ans.

(i)   The ratio of sine of angle of incidence to the sine of angle of refraction is called refractive index.

$\therefore \ _1n_2 = \dfrac{\sin i}{\sin r}$

(ii)   The refractive index of the second medium with respect to the first medium is given by the ratio of the magnitude of velocity of light in the first medium to that in the second medium. It is represented as
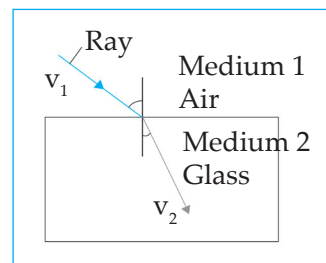

Fig. 6.3: Light ray going from medium 1 to medium 2

$$_2n_1 = \dfrac{\text{velocity of light in medium 1}}{\text{velocity of light in medium 2}}$$

$$\therefore \quad _2n_1 = \dfrac{v_1}{v_2}$$

(iii)   The refractive index depends upon the relative speed of propagation of light in different media.

(iv)   Refractive index has no unit.

(3)   Partial and Total internal reflection

Ans. *(For diagram; refer Fig. 6.8, Page No. 114)*

(i)   When light ray travels from denser medium to rarer, reflection takes place partially at the interface, this is called partial reflection.

(ii)   Angle of incidence (i) is smaller than the angle of refraction, (r). If 'i' increases gradually, then 'r' also increases as refractive index is a constant.

(iii)   The angle of incidence for which the angle of refraction is 90°, is called critical angle.

(iv)   When the angle of incidence in a denser medium is more than critical angle, the light reflects back into the denser medium. This is called total internal reflection.

(4)   Mirage or Have you seen a mirage which is an illusion of water on a hot road or desert. Explain.

Ans.

(i)   A mirage is observed on a hot day in the desert or road.

(ii)   The air near the hot road or desert surface is hot and hence rarer than the air above.

(iii)   As height increases, the refractive index also increases.

(iv)   The direction of light rays keeps changing due to refraction and appears to be coming from the image of the object on the ground.

(v)   This is called a mirage.

(5) **Rainbow formation or Prove that a rainbow is the combined effect of the refraction, dispersion and total internal reflection of light.**
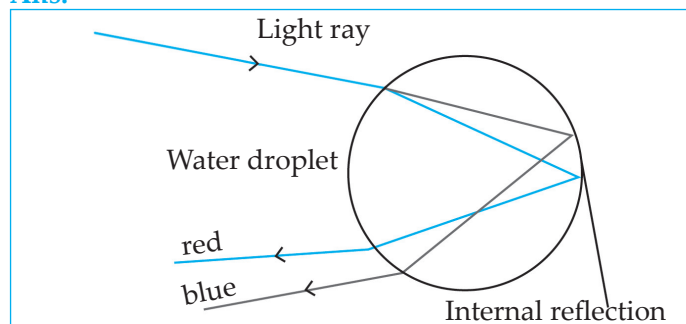
Ans.

Fig. 6.4: Rainbow formation

(i)   The beautiful phenomenon of the rainbow is a combination of different phenomena namely dispersion of light, internal reflection and refraction of light.

(ii)   The rainbow appears in the sky after a rain shower.

(iii)   The water droplets act as small prisms.

(iv)   When sunlight enters the water droplets present in the atmosphere, they refract and disperse the incident sunlight. That results in a spectrum.

(v)   Then the light rays get reflected internally inside the droplet and finally again get refracted.

(vi)   As a collective effect of all these phenomena, the seven coloured rainbow is observed.

(vii)   In the morning, rainbow can be seen towards west, while in the evening, it can be seen towards the East.

Q.2.4. Give scientific reasons

(1) **Stars twinkle at night.**

Ans.

(i)   Stars are self luminous and can be seen at night in the absence of sunlight.

(ii)   They appear to be point sources as they are at a very large distance from us.

(iii)   The apparent position of the star keeps changing a bit because of the motion of atmospheric air and changing air density and temperature.

(iv)   Because of this, refractive index of air keeps changing continuously.

(v)   So the position and brightness of the stars keeps changing and so the stars appear to be twinkling.

(2) **Planets do not twinkle.**

Ans.

(i)   Planets are much closer to us as compared to stars.

(ii)   They, therefore do not appear as point sources but appear as a collection of point sources.

(iii)   Changes in atmospheric refractive index changes the position as well as the brightness of individual point source, but the average position and total average brightness remains unchanged.

(iv)   As a result of this planets do not appear to twinkle.

(3) **We can see the sun even when it is little below the horizon.**

Ans.

(i)   By sunrise we mean the appearance of the sun above the horizon.

(ii)   When the Sun is somewhat below the horizon, its light rays are able to reach us along a curved path due to the refraction through Earth's atmosphere.

(iii)   Thus we see the Sun even before it emerges above the horizon.

(iv)   Samething happens at the time of sunset, we keep seeing the Sun for a short while even after it goes below horizon.

(4) **Red colour is used in danger signal.**

Ans.

(i)   In a visible light range, the wavelength of red light is maximum, i.e. 700 nm.

(ii)   The maximum scattering of light is for blue light and the least scattering of red light takes place.

(iii)   Thus, red light can travel to longer distance and can be visible from far off distance.

(iv)   Therefore, the danger signals are red coloured.

(5) **It is possible to enjoy a rainbow at fountain in any season.**

Ans.

(i)   The phenomenon of rainbow is a combined effect of dispersion, internal reflection and refraction.

(ii)   The rainbow appears in the sky after a rainfall.

(iii)   The water droplets of a fountain also act as small prisms as the rain drops.

(iv)   When the light rays enter these droplets, it first gets dispersed, then internally reflected and then refracted while coming out of the droplets. All these three processes together produce the rainbow.

*(6) **Will light travel through a glass slab with the same velocity as it travels in air?** *(Use your brain; Textbook page no. 74)*

Ans.

(i)   Refractive index depends on the velocity of light.

(ii)   As refractive index increases, velocity of light decreases.

(iii) Since refractive index of glass is greater than air, the velocity of light in glass is lesser than that in air.
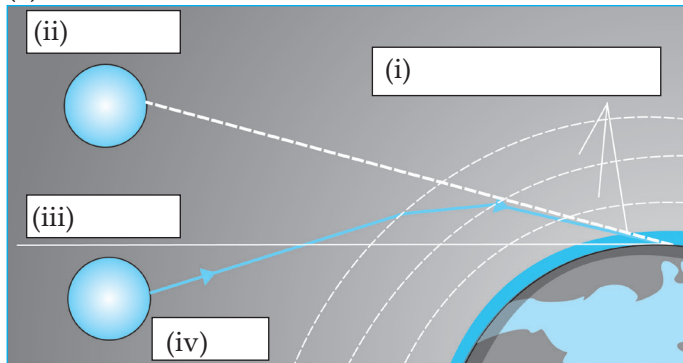
*(7) Will the velocity of light be same in all media?
(Use your brain; Textbook page no. 74)

Ans.

(i) Refractive index depends on the velocity of light.

(ii) Refractive index is different for different media.

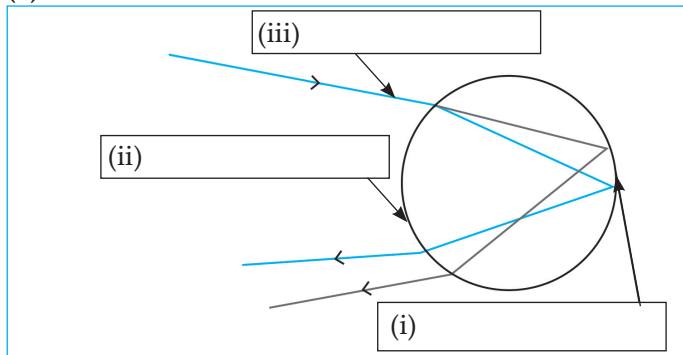(iii) Velocity of light will also be different for different media.

Q.2.5. Label the diagram.

(1)

Ans. (i) Atmospheric layers (ii) Apparent position
(iii) Horizon   (iv) Real position

(2)

Ans. (i) Internal Reflection (ii) Water droplet
(iii) Incident Sunlight

Q.3.1. Complete the following statements and explain.

*(1) The refractive index depends on the .... of light.

Ans. The refractive index depends upon the <u>relative speed of propagation</u> of light in different media. This is because light has different velocities in different media.

*(2) The change in .... of light rays while going from one medium to another is called refraction.

Ans. The change in the <u>direction</u> of light rays while going from one medium to another obliquely is called refraction.

Light travels along a straight line path in a transparent medium. But, it does not travel in the same direction in all media.

The direction of light rays change when it enters from one transparent to another as the velocity of light is different in different media.

(3) Light rays when travelling from air to water bends ....

Ans. Light rays when travelling from air to water bend <u>towards normal</u>.

When light rays travel from rarer medium to denser medium obliquely, it bend towards normal as the velocity of light decreases after entering into denser medium, i.e. water.

(4) Light rays when travelling obliquely from Benzene to Air bend ....

Ans. Light rays when travelling obliquely from Benzene to Air, bend <u>away from the normal</u>.

Generally, when light rays travel obliquely from denser medium to rarer medium, it bends away from the normal as the velocity increases after entering air.

Benzene is a denser medium, while air is the rarer medium. Velocity of light in benzene is less than that in air.

(5) The splitting of Sunlight into its component colours is called ....

Ans. The splitting of Sunlight into its component colours is called <u>dispersion</u>.

The band of coloured components of a light beam is called its spectrum. The various colours are Violet, Indigo, Blue, Green, Yellow, Orange and Red.

Q.3.2 Draw neat and labelled diagram for the following:

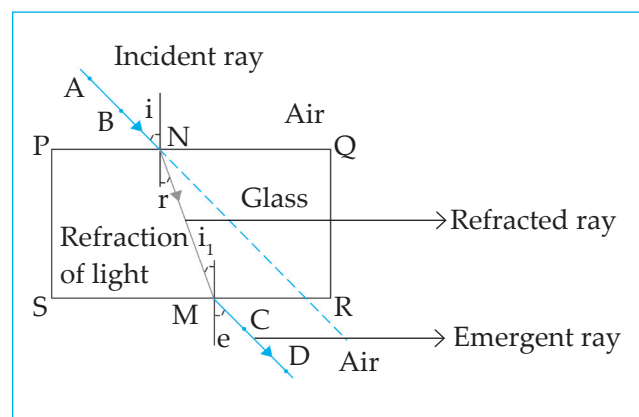**(1) Refraction of light passing through a glass slab.**

Fig. 6.5: Refraction of light passing through a glass slab

(2) Dispersion of light.

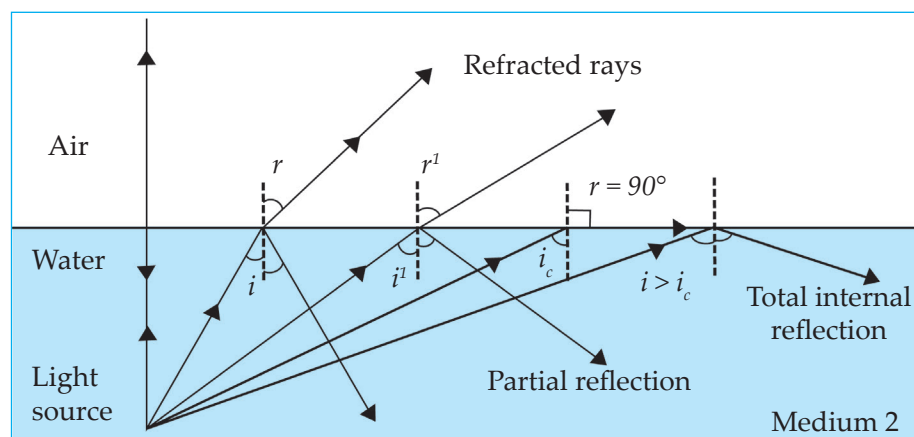**Ans.** *(For diagram, refer Fig. 6.2)*

(3)   Partial and total internal reflection.

Ans.

Fig. 6.6: Partial and total internal reflection

(4)   Rainbow formation.

Ans. *(For diagram, refer Fig. 6.4)*

Q.4.1. Read the following paragraph and answer the following questions.

(1) In, vacuum the velocity of light radiation with different wavelength is the same. But in a material medium, the velocity of different colour radiations is not the same and they travel with different paths. Due to this, the refractive index of the medium is different for different colours. If white beam of light is incident on a glass prism, the angle of refraction for different colours is different. When Sunlight is incident on a refracting surface, then it gets split into seven coloured spectrum and emerges out. The splitting of light into its component colours is called dispersion.

Sir Isaac Newton was the first to use a glass prism to obtain the spectrum of Sunlight. A glass prism is a transparent medium bounded by two plane surfaces inclined at an angle.

When white light is dispersed into seven colours by a prism, different colours of light bend through different angles with respect to incident ray. Out of these seven colours, red light bends the least, while violet light bends the most. So, the rays of each colour emerge along different paths and becomes distinct. Hence, we get spectrum of seven - different colours.

(i)   How do emergent rays appear?

Ans. The emergent rays appear as a band of colours called spectrum.

(ii)   Write the colours of the Spectrum?

Ans. Violet, Indigo, Blue, Green, Yellow, Orange and Red.

(iii)   What is dispersion?

Ans. The splitting of Sunlight or white light into its component colours is called dispersion of light.

(iv)   What is spectrum?

Ans. The band of coloured components of a light beam is called as Spectrum.

(v)   Which light deviates the least and which one deviates the most?

Ans. When light is incident on a surface of a glass prism, the red light deviates the least, while violet light deviates the most.

(2) The beautiful phenomenon of the rainbow is a combination of different phenomena - dispersion, internal reflection and refraction of light. The rainbow appears in the sky after a rainfall. The water droplets act as small prisms. When sunlight enters the water droplets present in the atmosphere, they refract and disperse the incident Sunlight. Then, they reflect internally inside the droplet and finally again refract it. As a collective effect of all the phenomena, the seven coloured rainbow is observed.

(i)   Which three major phenomena are responsible for rainbow?

Ans. The three major phenomena responsible for rainbow are dispersion, internal reflection and refraction of sunlight.

(ii)   How do refraction and dispersion take place?

Ans. When light rays of Sun enter the water droplets of atmosphere, the refraction of light occurs as the

medium changes from air to water. The direction of light rays also change and at the sametime, due to decrease in the velocity of light, the splitting of light rays result in dispersion.

(iii) **Give a diagrammatic representation of Rainbow Production.**

Ans. *(For diagram, refer Fig. 6.4)*

Q.4.2. Activity Activity / Application based Question:

(1) **Activity:**

(For diagram, refer Fig. 6.5)

(i) Keep a glass slab on a blank paper and draw its outline PQRS as shown in the figure.

(ii) Draw an inclined straight line on the side of PQ so that it intersects PQ at N. Pierce two pins vertically at two points A and B along the line.

(iii) Look at the pins A and B from the opposite side of the slab and pierce pins C and D vertically so that the images of A and B are in line with C and D.

(iv) Now remove the chip and the pins and draw a straight line going through points C and D so that it intersects SR at M.

(v) Join points M and N. Observe the incident ray AN and emergent ray MD.

Questions:

(a) **What is your observation about the emergent ray and incident ray?**

Ans. Incident ray and emergent ray lie parallel to each other.

*(2) **From incident white light how will you obtain white emergent light by making use of two prisms?** *(Use your brain; Textbook page no. 77)*
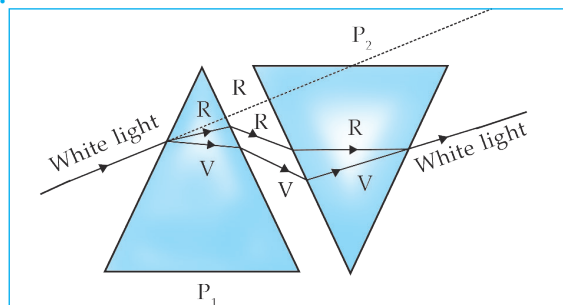
Ans.

Fig. 6.7: Dispersion of light

(i) Take a glass prism, Allow white light to fall on it. Obtain a spectrum.

(ii) Take a second identical glass prism. Place it parallel to the first prism in an upside down position with the first prism.

(iii) Allow the colours of the spectrum to pass through the second prism.

(iv) It is found then, that a beam of white light emerges from the other side of the second prism.

*(3) **You must have seen chandeliers having glass prism. The light from a tungsten bulb gets dispersed while passing through these prisms and we see coloured spectrum. If we use on LED light instead of tungsten bulb, will we be able to see the same effect?** *(Use your brain; Textbook page no. 77)*

Ans. Yes. We can see the same effect for LED light also. But the spectrum obtained is not continuous as in the case of sunlight.

(4) **Have you seen that objects beyond and above a holi fire appear to be shaking? Why does this happen?** *(Can you tell?; Textbook page no. 76)*. **or**

Objects beyond and above a holy fire appear to be shaking. Give scientific reasons.

Ans. Yes.

(i) The air near the holi flame is hotter than the air above, hence it is a rarer medium than the air above.

(ii) Because of this change of medium the refractive index keeps on changing as we go higher and higher above the flame and so the refraction of light also changes.

(iii) This gives a shaking effect to objects beyond and above holy fire.

(5) **(a) Complete the diagram.**

(b) **What is the effect on the velocity of light when it enters water?**

(c) **If the light was incident on the interface at an angle greater than critical angle; which phenomen on occurs?**

Ans. (a)
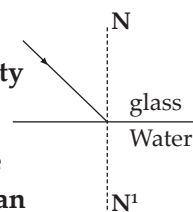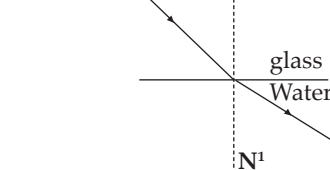
(b) When light enters water, its velocity increases.

(c) At an angle greater than critical angle, Total internal Reflection occurs.

(6) **(a) Complete the following diagram:**

(b) Name the colour that deviates the most and least

(c) Among orange and violet, which colour has highest velocity.

Ans. (a)

(b) Violet deviates the most and Red deviates the least.

(c) The velocity of orange is more than the velocity of violet.
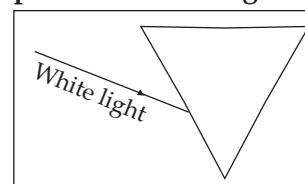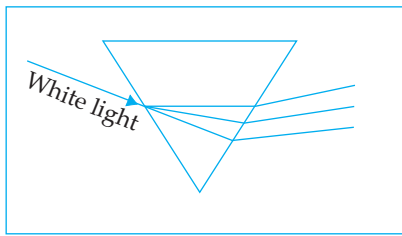
(7) **(a) Answer the following questions based on the concept of total internal reflection.**

(a) What is the angle of incidence called, when angle of refraction is 90^0?

(b) State any one phenomenon in nature which is based on total internal reflection.

(c) State any one condition required for total internal reflection.

Ans. (a) The angle of incidence is called as Critical angle.

(b) Mirage or Rainbow formation.

(c) Light should travel from denser medium to rarer medium.

OR

Angle of incidence should be greater than critical angle.

(8)
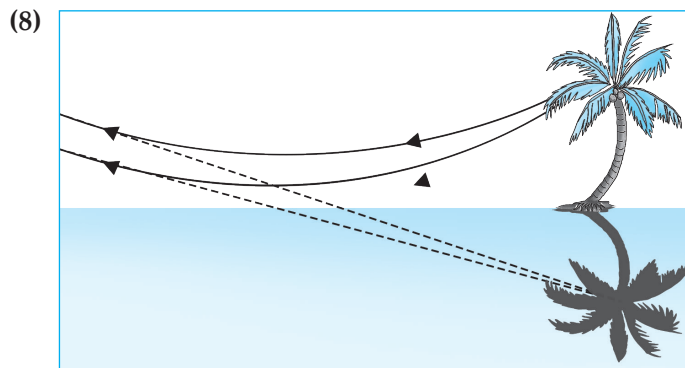
(a) Which phenomenon does the diagram show?

(b) Which law obeyed by light makes this phenomenon occur?

(c) Name one more phenomenon in nature where the above law is observed.

Ans. (a) Mirage

(b) Refraction of light or Total internal Reflection.

(c) Formation of Rainbow.

(9) **Answer the following questions from the diagram:**
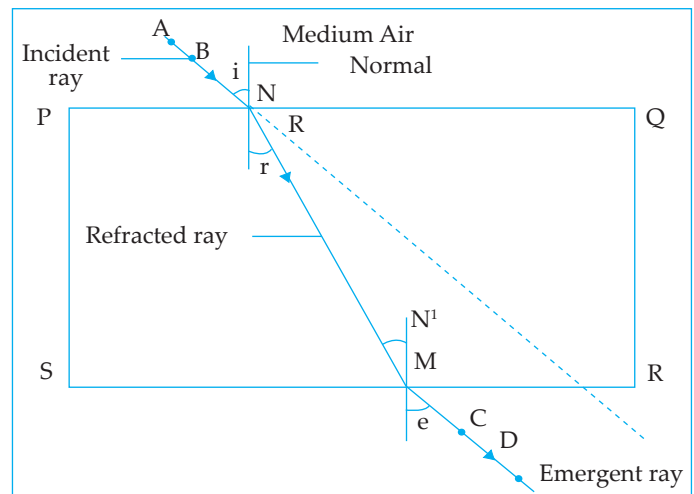
(a) How many times does the light undergo refraction?

(b) Which two angles are equal?

Ans. (a) The light undergoes refraction 2 times.

(b) angle of incidence (i) is equal to angle of emergence (e).

❖ ❖ ❖

ASSIGNMENT - 6

Time : 1 Hr.   **Marks : 20**

Q.1. (A) Attempt the following questions: **(3)**

(1)   Fill in the blanks and rewrite statement.

      (i) The wavelength of visible light range for human is ....

(2)   Find the odd one out:

      Brown, Blue, Green, Red

(3)   Complete the analogy.

      Diamond : Denser medium : : Air : ....

Q.1. (B) Choose and write the correct option: **(2)**

(1)   The velocity of light in air is .... m/s.

      (a) 3×10^{10} (b) 3×10^8 (c) 1.5×10^8 (d) 0.3×10^8

(2)   When light ray travels from denser medium to rarer, then it ....

      (a) bends towards the normal   (b) bends away from the normal

      (c) goes undeviated   (d) deviates randomly

Q.2. Answer the following: *(Any 2)*   **(4)**

(1)   Write short note on: Laws of refraction.

(2)   Give scientific reasons: "Red colour is used in danger signal."

(3)   Solve: If the speed of light in a medium is 1.5×10^8 m/s, what is the absolute refractive index of the medium?

Q.3. Answer the following: *(Any 2)*   **(6)**

(1)   Draw neat and labelled diagram for partial and total internal refraction.

(2)   Complete the following statement and explain.

      (i) The change in .... of light while going from one medium to another is called refraction.

(3)   If the angle of incidence and angle of emergence of a light ray falling on a glass slab are i and e respectively, prove that, i = e.

Q.4. Answer in detail. *(Any 1)*   **(5)**

(1)   With a neat labelled diagram explain Rainbow Formation.

(2)   (A) Define refraction

      (B) (i)   Complete the diagram.

           (ii)   What is the effect on the velocity of light when it enters water?

           (iii) If the light was incident on the interface at an angle greater than critical angle; which phenomenon occurs?

❖ ❖ ❖

CONCEPT MAP

(1)

Lenses

Concave lens (Diverging)

Convex lens (Converging)

Uses → Simple microscope

→ Compound microscope

→ Telescope Types → Refracting telescope

→ Reflecting telescope

→ Human Eye

Concave lens (Diverging)

Position of object

At Infinity → Image → At F_1

Between $2F_1$ & F_1 → Image → Between F_1 & O

Human Eye

Eye Defect

Myopia | Hypermetropia | Presbyopia

Unable to see distant objects

Unable to see nearby objects

In old-age, unable to see nearby objects

Corrected by → Concave lens

Corrected by → Convex lens

Corrected by → Convex lens

Convex lens (Converging)

Position of object

At Infinity → Image → At Focus (F_2)

At focus (F_1) → Image → At Infinity

Beyond $2F_1$ → Image → Between F_2 & $2F_2$

Between F_1 & $2F_1$ → Image → Between $2F_2$

At $2F_1$ → Image → At $2F_2$

Between F_1 & O → Image → On the same side as that of object

Points to Remember:

- A **lens** is a transparent medium bounded by **two surfaces**; out of which atleast one surface is spherical.

- A lens having both surfaces spherical,bulging outward, is a **convex lens** or **double convex lens**. It is **thicker** at the centre as compared to its edges. This lens can converge the light incident on it. So, it is a converging lens.

- A lens having both surfaces spherical,bulging inward, is a **concave lens** or **double concave lens**. It is **thinner** at the centre as compared to its edges. This lens can diverge the light incident on it. So, it is a diverging lens.

- **Double convex**, **plano – convex**, **concavo convex, positive meniscus, negative meniscus** are the types of convex lenses.

- Center of curvature (C): The centres of sphere whose parts form surfaces of the lenses are called centre of curvature of lenses. Each lens has two centre of curvature C_1 and C_2.

- Radius of curvature (R): The radii (R_1 and R_2) of sphere whose parts form surfaces of the lenses are called the **radii of curvature** of the lens.

- Principal axis: The imaginary straight line passing through the two centres of curvatures of lens (C) is called principal axis of the lens.

- Optical centre (O) :- The central point of a lens on the principal axis through which light rays pass without changing their path is called **optical centre**.

- Principal Focus (F): The point on the principal axis where all the incident rays are parallel to the principal axis actually meet or appear to meet after refraction from spherical lens is called **Principal focus** of a spherical lens. Every lens has **two** principal foci.

- Focal length (f) : The distance between the optical centre and the principal focus is called **focal length** of that lens.

- Images formed by spherical lenses can be studied with the help of ray diagrams. **Ray diagrams** are useful to study the position, relative size of the object and the image. It also helps to know the nature of the image formed by that lens.

- Following are the rules for obtaining images by **convex lens** :
  i) Rule 1: **If the incident ray is parallel to the principal axis, then the refracted ray passes through the principal focus (F).**
  ii) Rule 2: **If the incident ray is passing through the principal focus, then the refracted ray is parallel to the principal axis.**
  iii) Rule 3 : **If the incident ray of light passes through the optical centre of lens, it passes without changing its direction.**

- Position, relative size and nature of image formed by a convex lens for various positions of the object.

Sr. No.	Position of the object	Position of the image	Size of the image	Nature of the image
1	At Infinity	At Focus F_2	Highly diminished, Point - Sized	Real and inverted
2	Beyond $2F_1$	Between F_2 and $2F_2$	Smaller	Real and inverted
3	At $2F_1$	At $2F_2$	Same size	Real and inverted
4	Between F_1 and $2F_1$	Beyond $2F_2$	Larger	Real and inverted
5	At Focus F_1	At Infinity	Very Large	Real and inverted
6	Between O and F_1	On the same side of the lens as the object	Very Large	Virtual and erect

- Following are the rules for obtaining images by **Concave lens**.

  Rule 1 : When the incident ray is parallel to the principal axis, the refracted ray when extended backwards, passes through the principal focus.

  Rule 2: When the incident ray passes through the focus, the refracted ray is parallel to the principal axis.

  Rule 3: When the incident ray passes through optical centre, it passes undeviated.

- **Position, relative size and nature of image formed by a Concave lens for various positions of the object.**

Sr. No	Position of the object	Position of the image	Size of the image	Nature of the image
1	At Infinity	On the 1ˢᵗ Focus F_1	Point Image	Virtual and erect
2	Anywhere between optical centre O and Infinity	Between O and first focus F_1	Small	Virtual and erect

- Lens formula : The formula showing relation between distance of the object (u), the distance of the image (v) and the focal length (f) is called **lens formula**. $\dfrac{1}{v} - \dfrac{1}{u} = \dfrac{1}{f}$

- Linear magnification : Magnification is the ratio of height of the image (h_2) to the height of the object (h_1)

  $\text{Magnification} = \dfrac{\text{Height of Image}}{\text{Height of object}}$ $\therefore \ M = \dfrac{h_2}{h_1}$

- Magnification is also related to object distance (u) and Image distance (v).

  $\therefore \ \text{Magnification} = \dfrac{\text{Distance of Image}}{\text{Distance of object}}$ $\therefore \ M = \dfrac{v}{u}$

- Power of lens (P) : The capacity of a lens to converge or diverge incident rays is called its power (P). The power of a lens depends upon its focal length (f).

- If focal length is expressed in **metre**, the power of lens is expressed in **dioptre**. $\therefore \ P = \dfrac{1}{f(m)}$

- One dioptre is the power of a lens whose focal length is 1 metre.

  $\textbf{1 dioptre} = \dfrac{1}{\textbf{1 metre}}$

- Combination of lenses : If two lenses of focal lengths f_1 and f_2 are placed together then their combined focal length can be given by,

  $\dfrac{1}{f} = \dfrac{1}{f_1} + \dfrac{1}{f_2}$

- Combined power or power of combination of two lenses is given by, $\mathbf{P = P_1 + P_2}$

- Human eye and function of its lens :-

  (a) The outer most thin, transparent membrane of the human eye is called **cornea**.

  (b) Light enters the eye through it and maximum amount of incident light is refracted inside the eye at the outer surface of the cornea.

  (c) There is a dark, fleshy screen behind the cornea called the **Iris.**

  (d) There is a small hole of changing diameter at the centre of iris called the **pupil.** It controls the amount of light entering the eye.

  (e) If the light falling on eye is too bright it contracts and if the light falling on eye is too dim it widens.

  (f) Behind the pupil there is a double convex transparent crystalline lens, which provides small adjustment of the focal length to focus the image. This lens also creates real and inverted image of an object on the screen inside the eye.

  (g) The screen consist of light sensitive cells called **retina.**

  (h) These cells gets excited when light falls on them and they generate electric signals.

  (i) Signals are conveyed to the brain through **optic nerve.**

  (j) The brain thus analyses these signals and converts them in such a way that we perceive the objects as they actually are.

- The power of accommodation: The capacity of the eye lens to change its focal length as per need is known as **power of accommodation**.

- Myopia (near sightedness): The type of eye defect in which person **can see nearby objects** clearly but **cannot see distant objects** clearly is called **Myopia or nearsightedness**. Myopia can be corrected by using a spectacle of **concave lens** of suitable focal length. A concave lens with negative power is required for correcting myopia.

- Hypermetropia (longsightedness): The type of eye defect in which a person **can see distant objects** clearly but **cannot see nearby objects** clearly is called **Hypermetropia or farsightedness**. A convex lens with positive power is required for correcting Hypermetropia.

- Presbyopia (old age hypermetropia): The **power of accommodation** of eye usually **decreases** with increasing age. The nearpoint of aged people recedes and they find it difficult to see nearby objects comfortably and clearly without spectacle.

- **Uses** of concave lens: **Medical apparatus scanner**, **CD player**, **spectacles**, etc. use concave lens.

- **Uses** of convex lenses: Optical instruments like **Simple microscope**, **Compound microscope**, **Astronomical telescope**, etc. make use of convex lens.

- Persistence of vision: The sensation of the image lasts on the retina for $\frac{1}{16}$ th of a second even after the image is vanished from the eye. This effect is called **persistence of vision**. Motion pictures and TV work on this principle.

- Colour blindness: Some people cannot distinguish certain colours as they lack conical cells responding to certain colours. They can not even identify certain colours. These people are called 'colour blind' even though their eye sight is normal.

MASTER KEY QUESTION SET - 7

Q.1. (A) 1. Fill in the blanks:

(1)   The focal length of _____ lens is positive.

(2)   In hypermetropia, the image is formed _____ the retina.

(3)   The power of myopic eye is _____ .

(4)   Myopia can be corrected by using spectacle of _____ lens.

(5)   The _____ is the distance between optical centre and principal focus.

(6)   The ability of lens to converge or diverge light rays depends on _____ of the lens.

(7)   The power of convex lens with focal length 40 cm is _____ .

(8)   The lens with _____ power is used to correct farsightedness.

(9)   The distance of distinct vision for human eye is _____ cm.

(10) The impression of an image lasts on retina for _____ of second.

(11) The light enter the eye through _____ .

(12) An optical device used by watch repairers is _____ .

(13) The focal length of a healthy eye in relaxed position is _____ .

(14) The _____ cells are responsible for the perception of colours.

(15) The power of convex lens is 0.5D. Hence, its focal length is _____ .

(16) The image of the object at _____ is on the principal focus.

(17) The image formed by _____ is always virtual.

(18) The tendency of pupil to adjust the opening for light is called _____ .

(19) The diameter of human eyeball is _____ .

Ans. *(1) convex (2) behind (3) negative (4) concave (5) focal length (6) power (7) 2.5 D (8) positive (9) 25 (10) $\frac{1}{16}$ th (11) cornea (12) simple microscope (13) 2 cm (14) conical (15) 2 m (16) infinity (17) concave lens (18) adaptation (19) 2.4 cm*

Q.1. (A) 2. Find the odd word out:

(1)   Cornea, iris, pupil, cerebrum.

Ans. Cerebrum; it is a part of brain while others are the parts of human eye.

(2) Spectacle, microscope, torch, camera.

Ans. Torch; Concave lens is used in it while in others mainly convex lens is used.

(3) Longsightedness, myopia, short sightedness, near sightedness.

Ans. Longsightedness; it is corrected by convex lens while others are corrected by concave lens.

(4) Presbyopia, night blindness, myopia, hypermetropia.

Ans. Night blindness; it is a deficiency disease while others are eye defects.

(5) Compound microscope, astronomical telescope, simple microscope, flood light.

Ans. Flood light; It contains mirrors/reflectors while others contain lens.

Q.1. (A) 3. Complete the analogy:

(1) Convex lens: Converging :: Concave lens: ....

Ans. Diverging : Light rays parallel to the principal axis appear to be diverging from principal focus in concave lens.

(2) Object at $2F_1$: Image at $2F_2$ :: Object at F_1 : ....

Ans. Image at infinity : In convex lens when the object is at the focus, a very large, real and inverted image will be formed at infinity.

(3) Myopia : Concave lens :: Farsightedness : ....

Ans. Convex lens : Convex or converging lens is used to correct the Farsightedness.

(4) Concave lens : Negative focal length :: convex lens : ....

Ans. Positive focal length : Focal length of a convex lens is positive according to cartesian sign convention.

(5) Convex lens : Positive power :: Concave lens: ....

Ans. Negative power : The power of concave lens is negative as the power depends on focal length.

(6) Rod cells : Sensitive to dim light :: Cone cells: ....

Ans. Respond to colours : The conical cells respond to colour and give information about the colour of the object to the brain.

(7) Near point : 25cm :: Far point: ....

Ans. Infinity

Q.1. (A) 4. Match the columns:

(1)

Column A	Column B
(1) Microscope	(a) To observe celestial objects.
(2) Telescope	(b) Watch repairers.
(3) Simple microscope	(c) Correction of eye defect
	(d) To observe tissue

Ans. $(1 - d)$, $(2 - a)$, $(3 - b)$

(2)

Column A	Column B
(1) Persistence of vision	(a) 2.4 cm
(2) Distance of distinct vision	(b) $\frac{1}{16}^{th}$ of a second
(3) Diameter of eye ball	(c) 2 cm
(4) Focal length of healthy eye lens	(d) 25 cm

Ans. $(1 - b)$, $(2 - d)$, $(3 - a)$, $(4 - c)$

(3)

Mirror	Uses
(1) Plane mirror	(a) Rear view mirror
(2) Concave mirror	(b) At laughing gallery
(3) Convex mirror	(c) At a hair dresser
(4) Irregular curved mirror	(d) At a dentist

Ans. $(1 - c)$, $(2 - d)$, $(3 - a)$, $(4 - b)$

(4)

Column A	Column B
(1) Microscope	(a) Prism
(2) Telescope	(b) Spectacles having convex lenses
(3) Presbyopia	(c) To observe distant objects
(4) Dispersion of light	(d) Observation of plant and animal cells
	(e) Weakness of ciliary muscles

Ans. $(1 - d)$, $(2 - c)$, $(3 - e)$, $(4 - a)$

(5)

Column A	Column B
(1) Microscope	(a) Torches and headlights
(2) Telescope	(b) Observation of plant and animal cells
(3) Simple microscope	(c) To observe distant objects
(4) Concave mirror	(d) Watch repairers
	(e) Correction of eye defect

Ans. *(1 – b), (2 – c), (3 – d), (4 – a)*

*(6)

Column A	Column B	Column C
(1) Farsightedness	(a) Near by object can be seen clearly	(i) Bifocal lens
(2) Presbyopia	(b) Faraway object can be seen clearly	(ii) Concave lens
(3) Nearsightedness	(c) Problem of old age	(iii) Convex lens

Ans. *(1 – b – iii), (2 – c – i), (3 – a – ii)*

Q.1. (A) 5. State whether the following statements are 'True' of 'False'. If false; write the correct statement:

(1) A lens is an opaque object.

(2) Myopia can be corrected by using a spectacle of concave lens.

(3) Hypermetropia can be corrected by using a spectacle of convex lens.

(4) Cornea gives colour to the eye.

(5) The light is first and maximum refracted as it passes through eye lens.

(6) The perception of colours is concerned with cone cells.

(7) Auditory nerve take the impulse from eye to brain.

(8) Impression of an image lasts on the retina for $\frac{1}{10}$ th of a second.

(9) The focal length of a convex lens is positive.

(10) In the compound microscope, two concave lenses are used.

Ans. *(1) False. A Lens is a transparent object.*

(2) True (3) True. (4) False. Pigment in iris gives colour to the eye. (5) False. The light is first and maximum refracted as it passes through cornea. (6)True (7) False. Optic nerve takes the impulse from eye to brain. (8) False. Impression an the image lasts on the retina for $\frac{1}{16}$th of a second. (9) True (10) False. In compound microscope, two convex lenses are used.

Q.1. (A) 6. Answer the following in one sentence:

(1) If the object is at infinity from a convex lens, what would be its size?

Ans. If the object is at infinity, then the image will be highly diminished point image.

(2) Write the lens formula.

Ans. The lens formula is $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ where u - object distance, v - image distance and f is focal length.

(3) Name the types of telescopes.

Ans. Refracting telescope and reflecting telescope are the two types of telescopes.

(4) How is hypermetropia corrected?

Ans. Hypermetropia is corrected by using spectacles of convex lens of suitable focal length.

(5) How is myopia corrected?

Ans. Myopia is corrected by using spectacles of concave lens of suitable focal length.

(6) By which lens the matchstick can catch fire in the sunlight?

Ans. By using convex lens, a matchstick can catch fire in the sunlight.

(7) What is persistence of vision?

Ans. The impression of the image lasts on the retina for $\frac{1}{16}$ th of a second. The sensation on retina persists for a while. This is called persistence of vision.

(8) What is principal focus?

Ans. The point on the principal axis where all the incident rays parallel to the principal axis actually meet or appear to meet after refraction is called principal focus.

(9) What is focal length?

Ans. The distance between optical centre and principal focus of a lens is called focal length.

(10) What is the distance of distinct vision?

Ans. The minimum distance at which an object should be placed from a normal eye so that there won't be any strain on the eye is called distance of distinct vision. For normal human eye it is 25 cm.

(11) What do you mean by power of accommodation?

Ans. The capacity of the lens to adjust its focal length as per need is called its power of accommodation.

*(12) Why do we have to bring a small object near the eyes in order to see it clearly. *(Use your Brain Power; Textbook Page 89)*

Ans. If we bring small objects near the eyes, the angle subtended by the object at the eye becomes large which makes the eye to see the object clearly.

Q.1. (B) Choose and write the correct option:

(1) For the normal human eye, the distance of distinct vision is _____
(a) 15 cm   (b) 20 cm   (c) 25 m   (d) 25 cm

(2) The power of a convex lens of focal length 50 cm is _____ .
(a) 2 D   (b) 0.2 D   (c) 50 D   (d) 0.5 D

(3) The focal length of a concave lens with power -4 D is _____ .
(a) −0.5 m   (b) 0.5 m   (c) −0.25 m (d) 0.25 m

(4) If the incident ray passes through focus, then the refracted ray is _____ to the principal axis.
(a) parallel   (b) opposite
(c) perpendicular   (d) intersecting

(5) The image is formed on the _____ of the human eye.
(a) Cornea   (b) Retina
(c) Pupil   (d) Ciliary muscle

(6) If an object is placed between F_1 and $2F_1$ of a convex lens, then nature of the image formed is _____ .
(a) Real and inverted
(b) Real and diminished
(c) Virtual, erect
(d) Virtual, inverted

(7) In myopia, _____ objects can be seen clearly.
(a) distant   (b) nearby
(c) small   (d) big

(8) Longsightedness can be corrected by using _____ lens.
(a) cylindrical   (b) concave
(c) diverging   (d) converging

(9) Convex lens of power +5 D and concave lens with power -3 D are placed together, then the combined power is _____ .
(a) 5 D   (b) +3 D   (c) 2 D   (d) −2 D

(10) In simple microscope, _____ lens is used.
(a) Concave   (b) Cylindrical
(c) Diverging   (d) Convex

(11) The perception of dim light is concerned with _____ cells.
(a) Rod   (b) Cone
(c) Amoeboid   (d) Squamous

(12) The impression of an image lasts on the retina fo $\frac{1}{16}$th of a second, is called _____ .
(a) dispersion
(b) refraction
(c) persistence of vision
(d) internal reflection

(13) The second focal point is located at _____ of a human eye.
(a) Retina   (b) Optic nerve
(c) Cornea   (d) Pupil

(14) For a Convex lens, if the incident ray is parallel to the principle axis, then the refracted ray passes through the, _____ .
(a) Centre   (b) Pole
(c) Optical centre   (d) Principal focus

(15) Inside water, an air bubble behaves _____ .
(a) like a flat plate
(b) like a concave lens
(c) like a convex lens
(d) like a concave mirror

(16) To obtain an image of the same size as the object with the help of a convex lens, the object should be placed _____ .
(a) at infinity   (b) beyond F_1
(c) between F_1 and $2F_2$ (d) at $2F_1$

(17) At what distance should a watchmaker hold his lens from the watch?
(a) At the focal length
(b) At less than focal length
(c) At more than the focal length
(d) At zero distance

(18) When we enter a dark room, pupil of our eye ....

   (a) contracts   (b) expands

   (c) remains same   (d) none of these

Ans. *(1) (d) 25 cm; (2) (a) 2 D; (3) (c) –0.25 m; (4) (a) parallel ; (5) (b) retina (6) (a) Real and inverted ; (7) (b) nearby ; (8) (d) converging ; (9) (c) 2 D ; (10) (d) convex; (11) (a) Rod ; (12) (c) persistence of vision (13) (a) retina ; (14) (b) principal focus ; (15) (d) like a concave lens ; (16) (d) at 2F$_1$; (17) (b) At less than focal length (18) contracts*

Q.2.1. Solve the following:

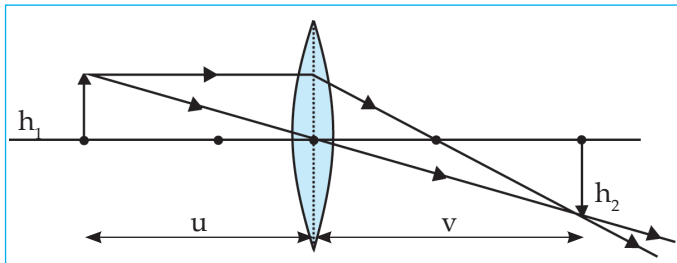Use the following ray diagrams and tips for solving the numericals.
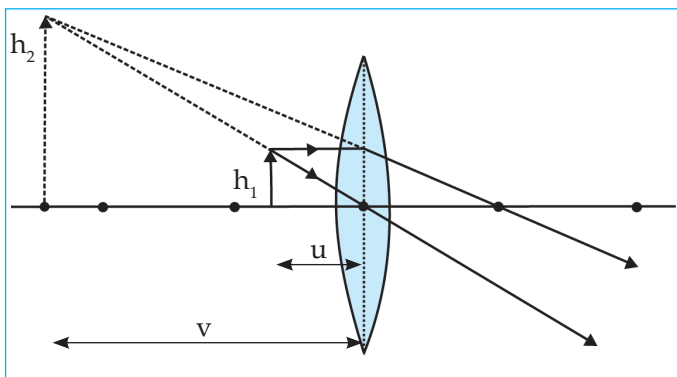

Fig 7.1

Fig 7.2

Tips:

(1) If h$_2$ is negative, then image is Real and Inverted

(2) If h$_2$ is positive, then image is Virtual and Erect

(3) h$_1$ greater than h$_2$, image is diminished

(4) h$_1$ smaller than h$_2$, image is magnified

(5) v is positive then image is on other side of lens.
v is negative then image is on same side of lens.

(6) f is +ve, it is convex lens, corrects Hypermetropia or Farsightedness

(7) f is -ve, it is concave lens, corrects Myopia or Near Sightedness.

Type: A

Problems based on the formulae:

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

v = image distance

u = object distance

f = focal length

(1) **An object is placed at a distance of 15 cm from a convex lens. If the focal length of the lens is 60 cm, find the image distance.**

Ans. **Given:** Object distance (u) = –15 cm

Focal length (f) = 60 cm

To find: Image distance (v) = ?

Formula: $\dfrac{1}{v} - \dfrac{1}{u} = \dfrac{1}{f}$

Solution: $\dfrac{1}{v} - \dfrac{1}{u} = \dfrac{1}{f}$

$\therefore \quad \dfrac{1}{v} = \dfrac{1}{f} + \dfrac{1}{u}$

$\therefore \quad \dfrac{1}{v} = \dfrac{1}{60} + \dfrac{1}{(-15)}$

$\therefore \quad \dfrac{1}{v} = \dfrac{1}{60} - \dfrac{1}{15}$

$\therefore \quad \dfrac{1}{v} = \dfrac{15 - 60}{900}$

$\therefore \quad \dfrac{1}{v} = \dfrac{-45}{900}$

$\therefore \quad \dfrac{1}{v} = \dfrac{-1}{20}$

$\therefore \quad v = -20 \text{ cm}$

> **The image of the object is formed at a distance of 20 cm on the same side of the lens.**

(2) **An object is placed at a distance of 10 cm from a convex lens of focal length 12 cm. Find the position and nature of the image.**

Ans. **Given:** Object distance (u) = –10 cm

Focal length (f) = 12 cm

To find: Image Position (v) = ?

Nature of image = ?

Formulae: $\dfrac{1}{v} - \dfrac{1}{u} = \dfrac{1}{f}$

Solution: $\dfrac{1}{v} - \dfrac{1}{u} = \dfrac{1}{f}$

$$\therefore \quad \frac{1}{v} = \frac{1}{f} + \frac{1}{u}$$

$$\therefore \quad \frac{1}{v} = \frac{1}{12} + \frac{1}{-10}$$

$$\therefore \quad \frac{1}{v} = \frac{1}{12} - \frac{1}{10}$$

$$\therefore \quad \frac{1}{v} = \frac{10 - 12}{12 \times 10}$$

$$\therefore \quad \frac{1}{v} = \frac{-2}{12 \times 10}$$

$$\therefore \quad \frac{1}{v} = \frac{-1}{60}$$

$$\therefore \quad v = -60 \text{ cm}$$

> The image is formed at a distance of 60 cm on the same side of the lens, it is a virtual and erect image.

*(3) An object kept 60 cm from a lens gives a virtual image 20 cm in front of the lens. What is the focal length of the lens? Is it a converging lens or diverging lens?

Ans. **Given:** Object distance (u) = –60 cm

Image distance (v) = –20 cm

To find: Focal length (f) = ?

Formulae: $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

Solution:

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\therefore \quad \frac{1}{f} = \frac{1}{-20} - \frac{1}{-60}$$

$$\therefore \quad \frac{1}{f} = \frac{-1}{20} + \frac{1}{60}$$

$$\therefore \quad \frac{1}{f} = \frac{-60 + 20}{20 \times 60}$$

$$\therefore \quad \frac{1}{f} = \frac{-40}{20 \times 60}$$

$$\therefore \quad \frac{1}{f} = \frac{-1}{30}$$

$$\therefore \quad f = -30 \text{ cm}$$

> **f = – 30cm, Since, f is –ve,**
> **Lens is concave i.e. diverging lens.**

Type: B

Problems based on the formulae:

$\dfrac{1}{v} - \dfrac{1}{u} = \dfrac{1}{f}$	v = distance of the image u = distance of the object f = focal length
$M = \dfrac{h_2}{h_1} = \dfrac{v}{u}$	M = magnification h_2 = height of image h_1 = height of object

(1) An object 6 cm tall is placed in front of a convex lens at a distance of 18 cm. If the image is formed at a distance of 9 cm on the other side of lens, find the height of the image.

Ans. **Given:** Height of the object (h_1) = 6 cm

Distance of the object (u) = –18 cm

Distance of the image (v) = 9 cm

To find: Height of the image (h_2) = ?

Formula: $M = \dfrac{h_2}{h_1} = \dfrac{v}{u}$

Solution:

$$h_2 = \frac{v \times h_1}{u}$$

$$\therefore \quad h_2 = \frac{9 \times 6}{-18}$$

$$\therefore \quad h_2 = \frac{6}{-2}$$

$$\therefore \quad h_2 = -3 \text{ cm}$$

> The height of the image is 3 cm and it is inverted.

*(2) An object is placed vertically at a distance of 20 cm from a convex lens. If the height of the object is 5 cm and the focal length of the lens is 10 cm, what will be the position, size and nature of the image? How much bigger will the image be as compared to the object?

Ans. **Given:** Height of the object (h_1) = 5 cm

Focal length (f) = 10 cm

Distance of the object (u) = –20 cm

To find: Image distance (v) = ?

Height of the image (h_2) = ?

Magnification (M) = ?

Formulae: (i) $\dfrac{1}{v} - \dfrac{1}{u} = \dfrac{1}{f}$

(ii) $\dfrac{h_2}{h_1} = \dfrac{v}{u}$

Solution:

(i) $\dfrac{1}{v} - \dfrac{1}{u} = \dfrac{1}{f}$

$\therefore \dfrac{1}{v} = \dfrac{1}{-20} + \dfrac{1}{10} = -\dfrac{1}{20} + \dfrac{1}{10}$

$\therefore \dfrac{1}{v} = \dfrac{10+20}{20 \times 10}$

$\therefore \dfrac{1}{v} = \dfrac{1\cancel{0}}{20\cancel{0}}$

$\therefore$ $\boxed{v = 20 \text{ cm}}$

(ii) $\dfrac{h_2}{h_1} = \dfrac{v}{u}$

$\therefore h_2 = \dfrac{v \times h_1}{u}$

$\therefore h_2 = \dfrac{20 \times 5}{-20}$

$\therefore$ $\boxed{h = -5 \text{ cm}}$

(iii) $M = \dfrac{v}{u} = \dfrac{20}{-20} = -1$

$\therefore$ $\boxed{M = -1}$

> The object and the image are of the same size. Image is real and inverted

*(3) 5 cm high object is placed at a distance of 25 cm from a converging lens of focal length 10 cm. Determine the position, size and type of the image.

Ans. **Given:** Height of the object (h_1) = 5 cm

Focal length (f) = 10 cm

Distance of the object (u) = –25 cm

To find: Image distance (v) = ?

Height of the image (h_2) = ?

Formula: $\dfrac{1}{v} - \dfrac{1}{u} = \dfrac{1}{f}$

Solution:

(i) $\dfrac{1}{v} - \dfrac{1}{u} = \dfrac{1}{f}$

$\therefore \dfrac{1}{v} = \dfrac{1}{f} + \dfrac{1}{u}$

$\therefore \dfrac{1}{v} = \dfrac{1}{10} + \dfrac{1}{-25}$

$\therefore \dfrac{1}{v} = \dfrac{1}{10} - \dfrac{1}{25}$

$\therefore \dfrac{1}{v} = \dfrac{25-10}{250}$

$\therefore \dfrac{1}{v} = \dfrac{15}{250}$

$\therefore \dfrac{1}{v} = \dfrac{3}{50}, \ v = \dfrac{50}{3} = 16.666$

$\therefore$ $\boxed{v = 16.7 \text{ cm}}$

(ii) $\dfrac{h_2}{h_1} = \dfrac{v}{u}$

$\therefore \dfrac{h_2}{5} = \dfrac{\frac{50}{3}}{-25}$

$\therefore h_2 = -\dfrac{50 \times 5}{3 \times 25} = \dfrac{-10}{3} = -3.333$

$\therefore$ $\boxed{h_2 = -3.3 \text{ cm}}$

> Position of image = 16.7 cm
>
> Size of the image = 3.3 cm
>
> Nature = Real and inverted

Type: C

Problems based on the formulae:

$P = \dfrac{1}{f \text{ (m)}}$ Dioptre

Note:

When we have numerical in power and focal length:

- Focal length should be in metre.
- Power should be in dioptre.

*(1) The focal length of a convex lens is 20 cm. What is the power?

Ans. **Given:** Focal length (f) = 20 cm = $\dfrac{20}{100}$ m

= 0.2 m

To find: Power of lens (P) = ?

Formula: $P = \dfrac{1}{f \text{ (m)}}$

Solution: $P = \dfrac{1}{f\,(m)}$

$\therefore \quad P = \dfrac{1}{0.2} = \dfrac{10}{2}$

$\therefore \quad P = 5\ D$

> **Power of lens is 5 dioptre.**

*(2) Doctor has prescribed a lens having power +1.5D. What will be the focal length of the lens? What is the type of the lens and what must be the defect of vision?

Ans. Given: Power of lens (P) = 1.5 D

To find: Focal length (f) = ?

Formula: $P = \dfrac{1}{f\,(m)}$

Solution: $P = \dfrac{1}{f\,(m)}$

$\therefore \quad f = \dfrac{1}{P}$

$\therefore \quad f = \dfrac{1}{1.5}$

$\therefore \quad f = \dfrac{10}{15}$

$\therefore \quad f = \dfrac{2}{3} = 0.67\ m$

> **Since f is +ve, lens used is convex, f = 0.67 m**
>
> **The defect is Hypermetropia (farsightedness)**

(3) Calculate the focal length of a corrective lens having power + 2.5 D.

Ans. Given: Power of lens (P) = 2.5 D

To find: Focal length (f) = ?

Formula: $P = \dfrac{1}{f\,(m)}$

Solution: $P = \dfrac{1}{f}$ dioptre

$\therefore \quad f = \dfrac{1}{P}$

$\therefore \quad f = \dfrac{1}{2.5}$

$\therefore \quad f = \dfrac{1 \times 10}{2.5 \times 10}$

$\therefore \quad f = \dfrac{10}{25} = \dfrac{2}{5}$

$\therefore$ | **f = 0.4 m** |

> **The focal length of the lens is 0.4 m.**

*(4) Three lenses having power 2, 2.5 and 1.7 D are kept touching in a row. What is the total power of the lens combination?

Ans. Given: $P_1 = 2\ D$

$\qquad\qquad P_2 = 2.5\ D$

$\qquad\qquad P_3 = 1.7\ D$

To find: P_{total} = ?

Formula: $P_{total} = P_1 + P_2 + P_3$

Solution: $P_{total} = P_1 + P_2 + P_3$

$\therefore \quad P_{total} = 2 + 2.5 + 1.7$

$\therefore \quad P_{total} = 6.2\ D$

> **Total Power of combination is 6.2 D.**

Q.2.2. Define the following:

(1) Centres of curvatures (C)

Ans. The centres of the spheres whose parts form surfaces of the lenses are called centres of curvature of the lens.

(2) Radii of curvatures (R)

Ans. The radii of the spheres whose parts form surfaces of the lenses are called radii of curvatures.

(3) Principal axis

Ans. The imaginary line passing through the centres of curvature is called principal axis.

(4) Optical centre (O)

Ans. The imaginary point on the lens through which the light ray passes undeviated is called optical centre.

(5) Principal Focus (F)

Ans. The point on the principal axis where all the incident rays parallel to the principal axis actually meet or appear to meet is called principal focus.

(6) Focal length (f)

Ans. The distance between optical centre and principal focus is called focal length of a lens.

(7) Convex lens

Ans. A lens having both the spherical surfaces bulging outward is a convex lens.

(8) Concave lens

Ans. A lens having both the spherical surfaces curved inwards is a concave lens.

(9) Real image

Ans. The image obtained when the refracted rays actually meet each other is called a real image.

(10) Virtual image

Ans. The image obtained when the refracted rays appear to meet is called a virtual image.

(11) Converging lens

Ans. The lens which converges the light incident on it is called converging lens.

(12) Diverging lens

Ans. The lens which diverges the light incident on it is called diverging lens.

(13) Lens

Ans. A lens is a transparent medium bounded by two surfaces, out of which at least one surface is spherical.

(14) Retina

Ans. The light sensitive screen in the human eye is called retina.

(15) Adaptation of pupil.

Ans. The tendency of the pupil to adjust the opening for light is called adaptation.

(16) Iris

Ans. The dark muscular diaphragm behind cornea is called iris.

(17) Pupil

Ans. The small opening of variable diameter at the centre of iris is called the pupil.

(18) Power of accommodation

Ans. The ability of the lens of adjusting focal length is known as power of accommodation.

(19) Distance of distinct vision

Ans. The minimum distance from the normal eye, at which the objects can be seen clearly and distinctly without any strain to the eye is known as the distance of distinct vision.

Q.2.3. Distinguish between:

*(1) Farsightedness and Nearsightedness.

Ans.

Farsightedness/ Hypermetropia	Nearsightedness/ Myopia
(i) Curvature of cornea and eye lens decreases	(i) Curvature of cornea and eye lens increases
(ii) Eyeball flattens slightly.	(ii) Eyeball elongates slightly.
(iii) Image of the nearby object falls behind the retina.	(iii) Image of the nearby object falls on the retina.
(iv) Image of the distant object falls on the retina.	(iv) Image of the distant object falls in front of the retina.
(v) This defect is corrected by using a spectacle of convex lens of suitable focal length.	(v) This defect is corrected by using a spectacle of concave lens of suitable focal length.

*(2) Concave lens and Convex lens.

Ans.

Concave lens	Convex lens
(i) It is also called as diverging lens.	(i) It is also called as converging lens.
(ii) This lens is thinner in the centre than at its edges.	(ii) This lens is thicker at the centre than at its edges.
(iii) The principal focus is virtual.	(iii) The principal focus is real as well as virtual.
(iv) The focal length is negative.	(iv) The focal length is positive.
(v) This lens is used to correct myopia.	(v) This lens can be used to correct hypermetropia.

(3) Real image and Virtual image.

Ans.

Real Image	Virtual Image
(i) When the refracted rays actually meet, the real image is formed.	(i) When the refracted rays appear to meet, the virtual image is formed.
(ii) Real image can be taken on the screen.	(ii) Virtual image can not be taken on the screen.
(iii) Real image is always inverted.	(iii) Virtual image is erect (upright).
(iv) In a ray diagram, real image is formed on opposite side of lens.	(iv) In a ray diagram, virtual image is formed on same side of lens.

Q.2.4. Give scientific reasons:

*(1)   Simple microscope is used for watch repairs.

Ans.

(i)   A magnifying glass works on the principle of simple microscope.

(ii)   When an object is placed within the focal length of a convex lens we get a virtual, erect and magnified image on the same side of the lens.

(iii)   This principle is used by the watch repairer to see the small parts more clearly. Hence, watchmakers use a magnifying glass while repairing wristwatches.

*(2)   We cannot clearly see an object kept at a distance less than 25 cm from the eye.

<center>**Or**</center>

If we bring an object closer than 25 cm from the eyes, why can we not see it clearly even though it subtends a bigger angle at the eye? *(Use your brain power; Textbook Page 89)*

Ans.

(i)   The minimum distance at which an object is placed from the normal eye so that it can be seen clearly without giving any strain on the eye is called the distance of the distinct vision.

(ii)   This distance is 25 cm for a normal human eye.

(iii)   If the object is placed at a distance less than 25 cm, ciliary muscles are unable to adjust the lens there is a strain on the eye and it cannot be seen clearly.

(iv)   Hence an object should be placed at 25 cm or more to have a clear and sharp image of it on the retina.

*(3)   One can sense colours only in bright light.

Ans.

(i)   The light sensitive screen of the eye called retina has two types of light sensitive cells.

(ii)   Rod cells are concerned with intensity of light and cone cells are responsible for the vision in presence of light.

(iii)   Cone cells are also concerned with colour perception. They do not respond to dim light or no light. Rod cell respond to faint light but conical cells do not.

(iv)   Cone cells can function only in bright light.

(v)   Hence, we can identify and differentiate colours in presence of light.

(4)   Convex lens is also called a converging lens.

Ans.

(i)   When light rays parallel to the principal axis are incident on a convex lens, they converge to a point on the principal axis.

(ii)   This point is called the principal focus.

(iii)   Light ray parallel to the principal axis falling on a convex lens come together, i.e. get focused at principal focus. So this type of lens is called a converging lens.

(5)   Concave lens is also called as diverging lens.

Ans.

(i)   Rays travelling parallel to the principal axis of a concave lens diverge after refraction in such a way that they appear to be coming out of a point on the principal axis.

(ii)   This point is called the principal focus of the concave lens.

(iii)   Light rays parallel to the principal axis falling on a concave lens go away from one another (diverge) after refraction. So, this type of lens is called diverging lens.

(6)   You can not enjoy watching a movie or television from a very short distance from the screen.

Ans.

(i)   If a person is very close to the screen, then the intensity of light falling on the eye is more.

(ii)   The ability of a normal eye or pupil to adjust the opening for light is called adaptation.

(iii)   As the light is bright, the pupil contracts and exposure in this condition for longer period of time can give an additional strain on the eye.

(iv)   Due to this, person can not enjoy watching movie or television program sitting close to the screen.

(7)   A concave lens is used to correct myopia.

Ans.

(i)   In Myopia, the curvature of the cornea and eye lens increases. Due to this, converging power of lens remains large.

(ii)   Also the eyeball elongates so that the distance between the lens and retina increases.

(iii) A concave lens of suitable focal length can create required divergence, hence, after convergence by eye lens sharp image of the distant object is formed on the retina and the defect is be corrected.

(8) Old people sometimes use bifocal glasses.

Ans.

(i) Few old people, suffer from both myopia and hypermetropia.

(ii) In such cases a bifocal lens is required to correct the defect. The upper part is concave lens to correct myopia and lower part is convex lens to correct hypermetropia.

(iii) The concave lens is useful for distant object vision and convex lens for nearby object vision.

(iv) Hence, old people sometimes use bifocal glasses.

(9) Hypermetropia can be corrected by using convex lens.

Ans.

(i) In hypermeteropia curvature of the cornea and eye lens decreases so that the converging power of the lens becomes less.

(ii) Due to the flattening of the eye–ball the distance between the lens and retina decreases.

(iii) This defect can be corrected by using a convex lens. This lens converges the incident rays which are further converged by retina to get a sharp image of nearby object on the retina.

(10) Why do we have to bring a small object near the eyes in order to see it clearly. *(Use your brain power; Textbook Page 89)*

Ans.

(i) The Apparent size of an object depends on the angle subtended by the object at the eye.

(ii) When the object is closes to the eye. The angle subtended is larger and it appears bigger, hence we have to bring a small object near eye.

Q.3.1. Answer the following questions:

(1) Which are the different types of lens?

Ans. In all, there are six different types of lenses, namely, bi-convex, plano-convex lens, Positive Meniscus, bi-concave lens, plano-concave lens and Negative Meniscus.

*(2) What is magnification? Write its formula.

<div align="center">Or</div>

What is the relation between h_1, h_2, u and v.

<div align="right">*(Use your brain power; Textbook Page 85)*</div>

Ans. The ratio of height of image (h_2) to the height of the object (h_1) is called Magnification (M).

$$\therefore \quad \text{Magnification} = \frac{\text{Height of the image}}{\text{Height of the object}}$$

$$\therefore \qquad M = \frac{h_2}{h_1} \qquad \qquad \text{... (i)}$$

Magnification can also be calculated by the ratio of the image distance (v) to the object distance (u).

$$\therefore \quad \text{Magnification} = \frac{\text{Image distance}}{\text{object distance}}$$

$$\therefore \qquad M = \frac{v}{u} \qquad \qquad \text{... (ii)}$$

From (i) and (ii),

$$\therefore \qquad M = \frac{h_2}{h_1} = \frac{v}{u}$$

(3) What is the Power of lens?

Ans.

(i) The capacity of a lens to converge or diverge incident rays is called its power (P).

(ii) The power of a lens depends on its focal length (f):

(iii) Power of lens is the reciprocal of focal length in meters.

$$\therefore \quad \text{Power of lens} = \frac{1}{\text{focal length (metre)}}$$

$$\therefore \quad P = \frac{1}{f \, (m)}$$

(4) What do you mean by combined focal length?

Ans. The reciprocal of combined focal length is equal to the sum of the reciprocals of focal lengths of number of all lenses placed together.

$$\therefore \quad \frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$$

where f - combined focal length,
f_1 - focal length of 1st lens,
f_2 - focal length of 2nd lens.

(5) What is the use of astronomical telescope?

Ans. Astronomical telescope is used to observe the celestial objects like stars and planets.

(6) Enlist the functions of Iris.

Ans. Functions of Iris are:

(i) To decide the size of the pupil.

(ii) To give colour to the human eye.

(7) Write the uses of concave lens.

Ans. The uses of concave lens are as follows:

(i) Concave lens are used to correct Myopia.

(ii) In Peep hole of the outside door.

(iii) In flash lights to magnify light produced by bulb.

(8) Write the uses of convex lens.
Ans.
(i) Watch repairers use simple microscope which has convex lens.

(ii) To correct hypermetropia, a spectacle of convex lens is used.

(iii) Astronomical telescope, compound microscope are the optical instruments where two convex lenses are used.

(9) What is persistence of vision?
Ans.
(i) We see an object because the eye lens creates its image on the retina.

(ii) The image is on the retina as long as the object is in front of us. The image disappears as soon as the object is taken away.

(iii) However, this is not instantaneous and the image remains imprinted on our retina for $\frac{1}{16}$th of a second after the object is removed.

(iv) The sensation on retina persists for a while. This is called persistence of vision.

(10) What is colour blindness?
Ans.
(i) Some people are unable to identify or distinguish certain colours due to the lack of cone cells in the retina.

(ii) This is a hereditary disorder and linked with X chromosomes.

(iii) This defect/disorder is called colour blindness and person is called colour blind.

(iv) It is mostly for the recognition of red and green colour.

*(11) What is the function of iris and the muscles connected to the lens in human eye?
Ans.
(i) An iris in human eye imparts colour to the eye.

(ii) The muscles connected to the lens in the human eye adjust the focal length of eye lens.

*(12) How do we perceive different colours? *(Can you tell; Textbook Page 91)*
Ans.
(i) The retina in our eyes is made up of many light sensitive cells.

(ii) These cells are shaped like a rod and like a cone.

(iii) The rod like cells respond to the intensity of light and give information about the brightness or dimness of the object to the brain.

(iv) The conical cells respond to the colour and give information about the colour of the object to the brain.

(v) Brain processes all the information received and we see the actual image of the object.

(vi) Thus conical cells are responsible for perceiving different colours.

*(13) What are real and virtual images? How will you find out whether an image is real or virtual? Can a virtual image be obtained on a screen? *(Can you Recall; Textbook Page 82)*
Ans.
(i) If the reflected or refracted rays from the lens actually meet at a point when light rays from the object are incident on it, then the image formed is Real and it can be seen on a screen.

If the reflected or refracted rays from the lens appear to meet at a point when light rays from the object are incident on it, then the image formed is called virtual.

(ii) If the images are inverted then they are real and if they are erect then they are virtual.

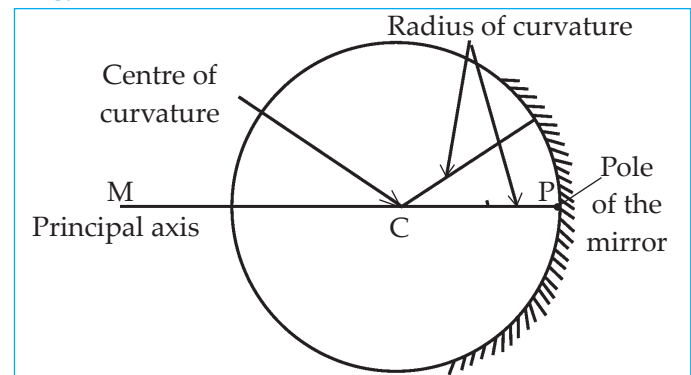(iii) Virtual images cannot be obtained on a screen.

*(14) Indicate the following terms related to spherical mirrors in figure: Poles, centre of curvature, radius of curvature, principal focus. *(Can you Recall; Textbook Page 80)*
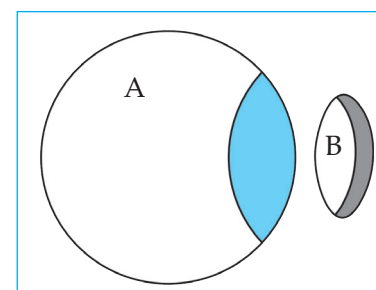**Ans.**

Fig 7.1

*(15) How are concave and convex mirrors constructed? *(Can you Recall; Textbook Page 80)*
Ans.

Fig 7.2

(i)   Generally, concave and convex mirror are spherical mirrors.

(ii) Spherical mirrors are parts of a hollow glass sphere like the part B in the figure.

(iii) The inner or outer surface of this part is coated with a shiny substance to produce spherical mirror.

Q.3.2. Draw well labelled diagrams for the following.

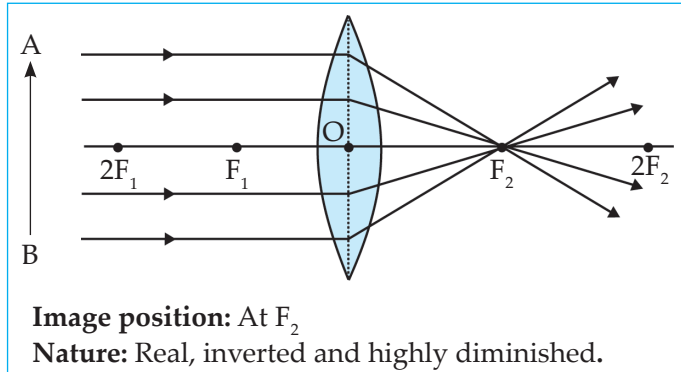**(1)   A ray diagram for object position at infinity for a convex lens or convergence of rays by convex lens.**

Image position: At F_2
Nature: Real, inverted and highly diminished.

Fig 7.3

*(2)   A ray diagram for object position beyond $2F_1$ for a convex lens.

Image position: Between F_2 and $2F_2$
Nature: Real, inverted and diminished.
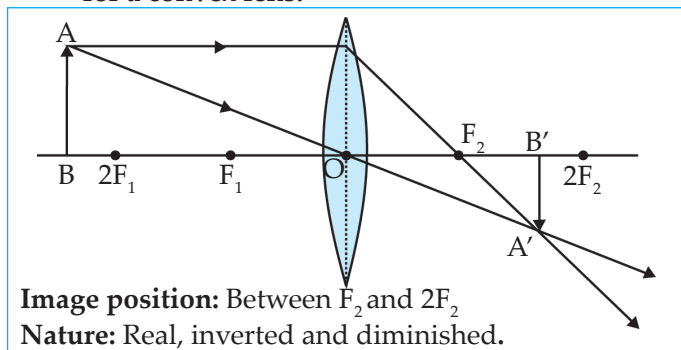
Fig 7.4

*(3)   At which position will you keep an object in front of a convex lens so as to get a real image of the same size as that of the object ? Draw a figure.
                    Or
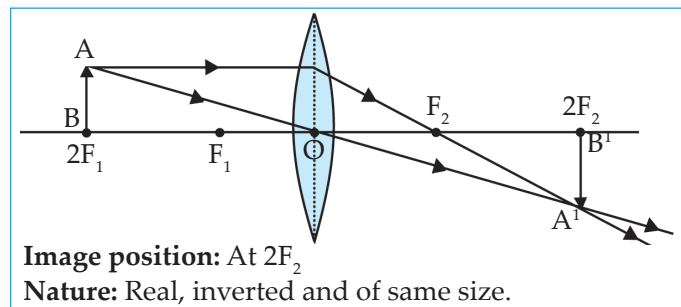**A ray diagram for object position at $2F_1$ for a convex lens.**

Image position: At $2F_2$
Nature: Real, inverted and of same size.

Fig 7.5

*(4)   A ray diagram for object position between $2F_1$ and F_1 for a convex lens.

Image position: Beyond $2F_2$
Nature: Real, inverted and magnified.
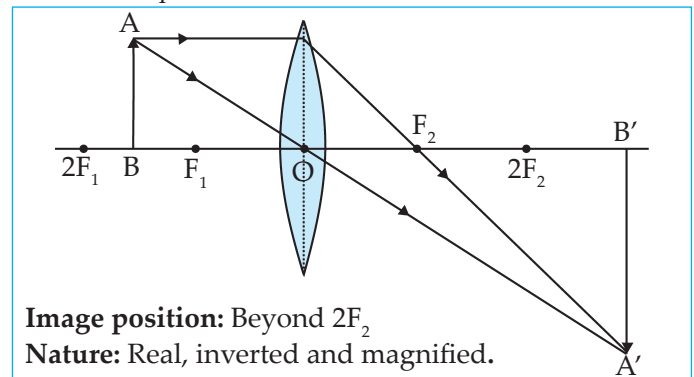
Fig 7.6

*(5)   A ray diagram for object positioned at F_1 for a convex lens.

Image position: At infinity
Nature: Real, inverted and highly magnified.
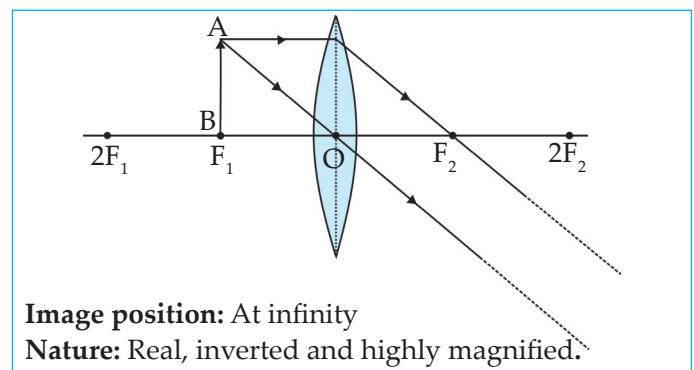
Fig 7.7

*(6)   A ray diagram for object position between F_1 and O for a convex lens.

Image position: On the same side of lens as the object.
Nature: Virtual, erect and magnified.
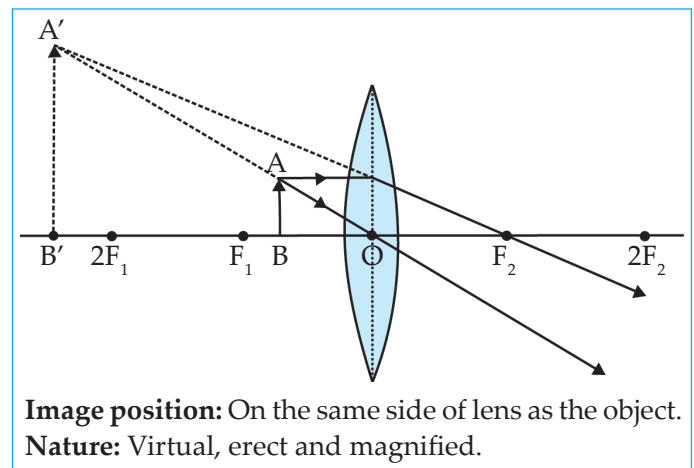
Fig 7.8

*(7)   Divergence of rays by concave lens.

Image position: At F_1
Nature: Virtual, erect, highly diminished
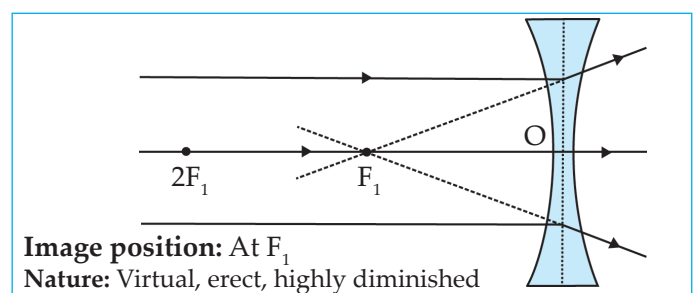
Fig 7.9

(8) **Ray diagrams showing images obtained by concave lens.**

Image position: On the same side of lens
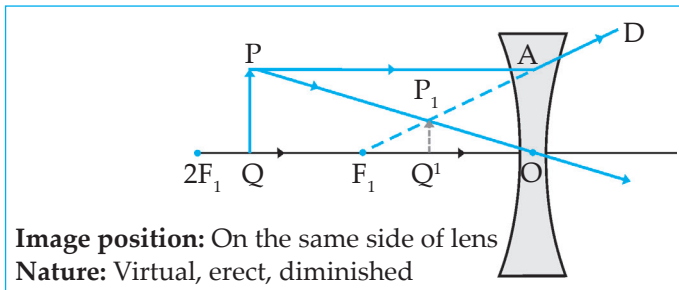**Nature:** Virtual, erect, diminished

Fig 7.10 Image formed by a concave lens

(9) **The structure of Human eye.**

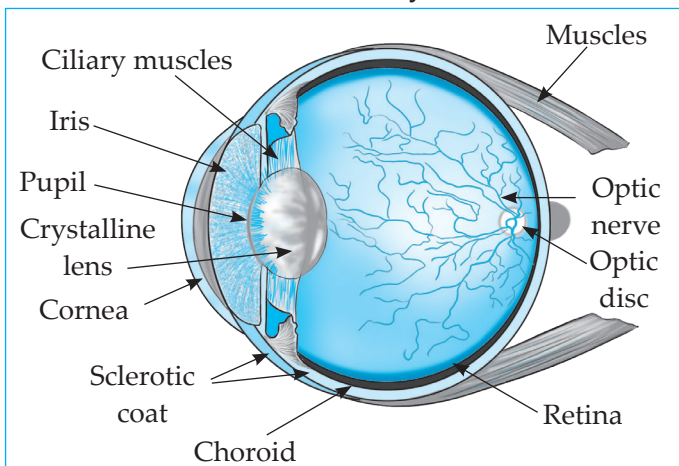*Fig 7.11 Structure of human eye*

(10) **The change in the shape of the lens while seeing distant and nearby objects.**
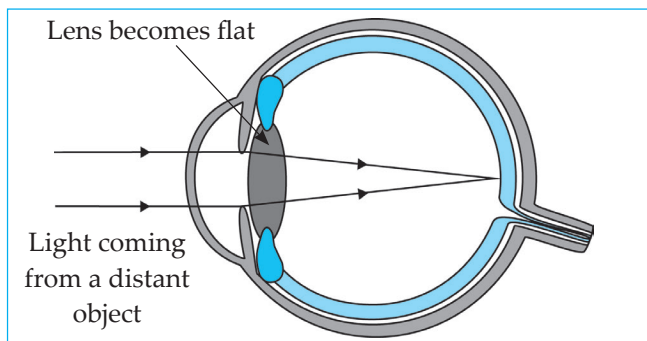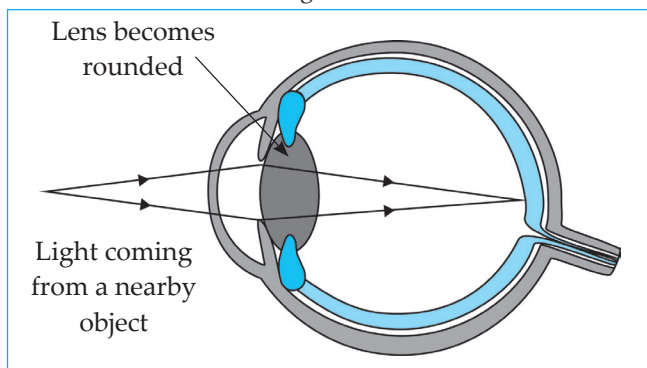

Fig 7.12a

Fig 7.12b

Q.4.1. Answer the following in brief.

*(1) **Draw a figure explaining various terms related to a lens.**
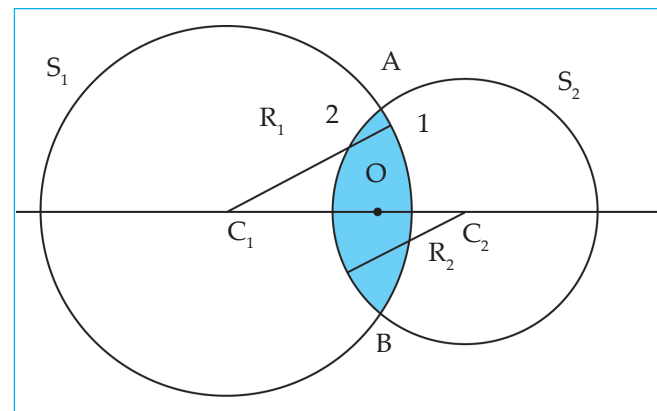
Ans. **Concepts related to lens:**

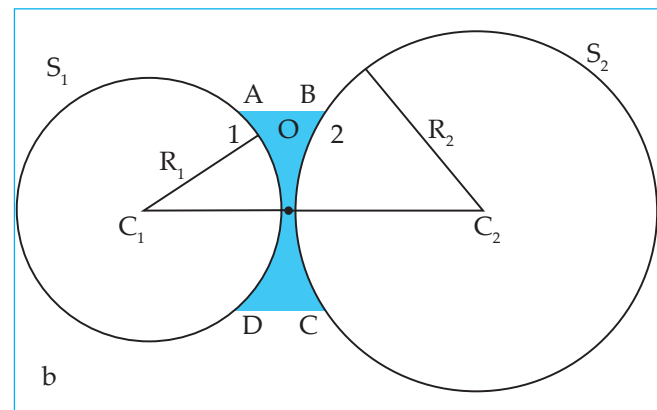*Fig 7.13a Cross section of convex lens*

Fig 7.13b Cross section of ccncave lens

(i) **Centre of curvature (C):** The centres of spheres whose parts form surfaces of the lenses are called centres of curvatures of the lenses. A lens with both surfaces spherical, has two centres of curvature C_1 and C_2.

(ii) **Radius of curvature (R):** The radii (R_1 and R_2) of the spheres whose parts form surfaces of the lenses are called the radii of curvature of the lens.

(iii) **Principal axis:** The imaginary line passing through both centres of curvature is called the principal axis of the lens.

(iv) **Optical centre (O):** The point inside a lens on the principal axis, through which light rays pass without changing their path is called the optical centre of a lens. In figure 7.14, rays P_1Q_1, P_2Q_2 passing through O are going along a straight line. Thus, O is the optical centre of the lens.
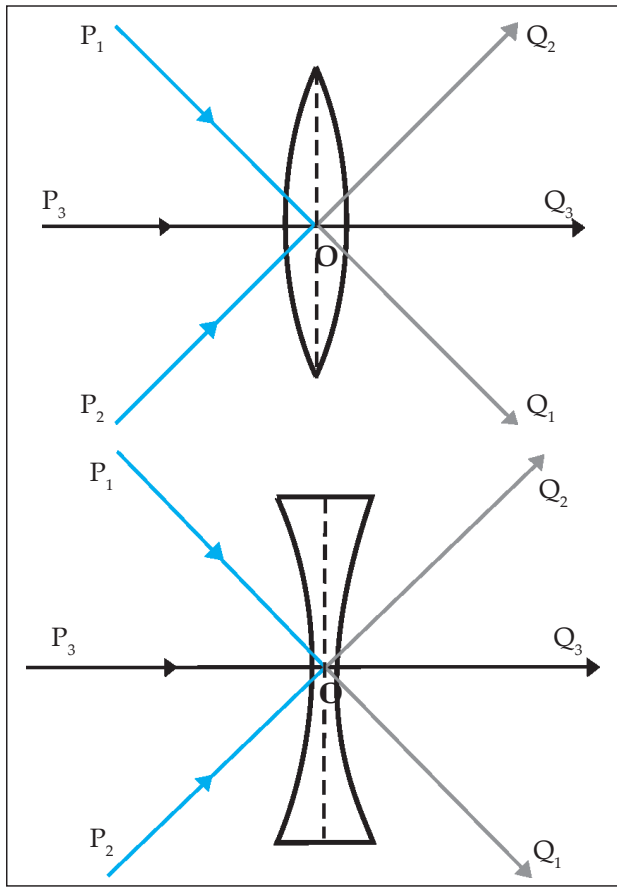
Fig 7.14 Optical centre of a lens

(v) **Principal focus (F):** When light rays parallel to the principal axis are incident on a convex lens, they converge to a point on the principal axis. This point is called the principal focus of the lens. As shown in figure 7.15a F_1 and F_2 are the principal foci of the convex lens.
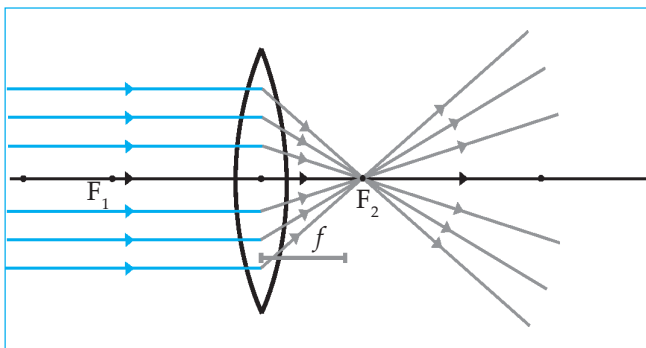

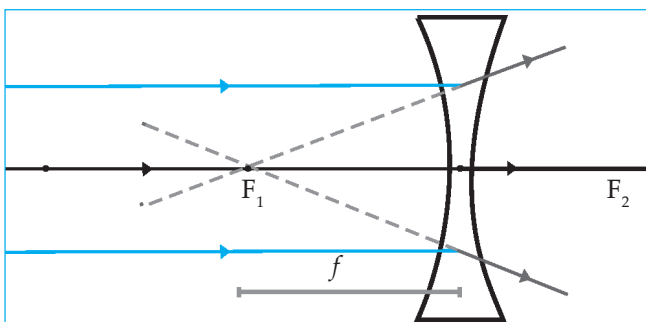*Fig 7.15 (a) Principal focus of a convex lens*

Fig 7.15 (b) Principal focus of concave lens

Light rays parallel to the principal axis falling on a convex lens come together, i.e. get focused at a point on the principal axis. So, this type of lens is called a converging lens.

Rays travelling parallel to the principal axis of a concave lens diverge after refraction in such a way that they appear to be coming out of a point on the principal axis. This point is called the principal focus of the concave lens. As shown in figure 7.15 (b) F_1 and F_2 are the principal foci of the concave lens.

Light rays parallel to the principal axis falling on a concave lens go away from one another (diverge) after refraction. So, this type of lens is called a diverging lens.

(vi) **Focal length (f):** The distance between the optical centre and principal focus of a lens is called its focal length.

(2) **Enlist the rules for drawing ray diagrams of convex lens.**

Ans. **Following are the rules for obtaining images by convex lens.**
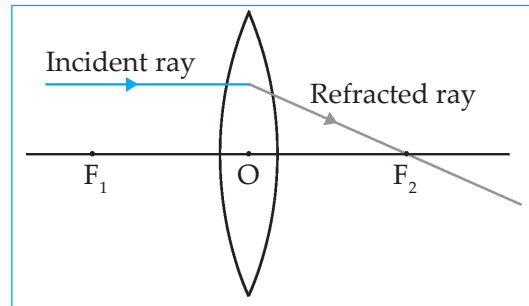

Fig 7.16

Rule (i): When the incident ray is parallel to the principal axis, the refracted ray passes through principal focus (F_2).
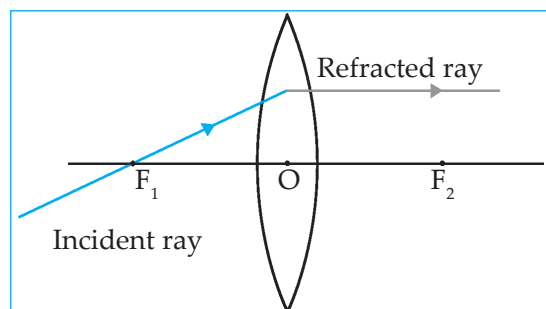

Fig 7.17

Rule (ii): When the incident ray passes through the principal focus (F_1), the refracted ray is parallel to the principal axis.
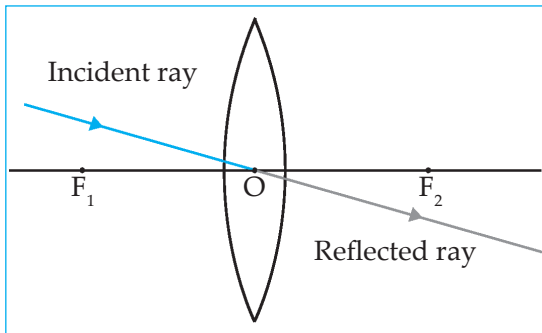
Fig 7.18

Rule (iiii): When the incident ray passes through the optical centre of the lens it passes without changing its direction.

*(3) **What is the Cartesian sign convention used for spherical mirrors?** *(Can you Recall; Textbook Page 84)*

Ans. According to the Cartesian sign convention, the pole of the mirror is taken as the origin. The principal axis is taken as the X–axis of the frame of reference. The sign conventions are as follows.
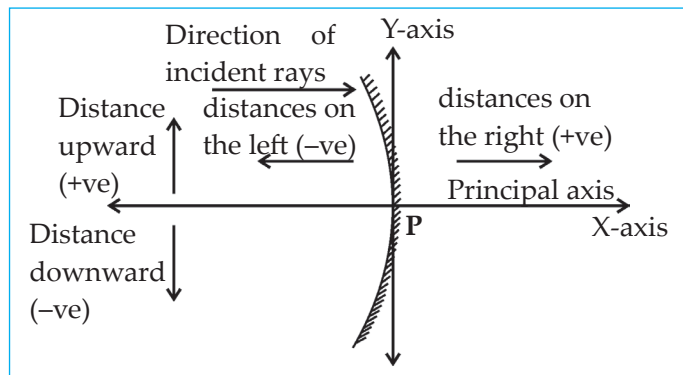

Fig 7.19

(i) The object is always kept on the left of the both mirrors. All distances parallel to the Principal axis are measured from the pole of the mirror.

(ii) All distances measured towards the right of the pole are taken to be positive, while those measured towards left are taken to be negative.

(iii) Distances measured vertically upwards from the principal axis are taken to be positive.

(iv) Distances measured vertically downwards from the principal axis are taken to be negative.

(v) The focal length of concave mirror is positive while that of a convex mirror is negative.

Q.4.2. Explain the following with the help of a diagram:

(1) Myopia or Nearsightedness
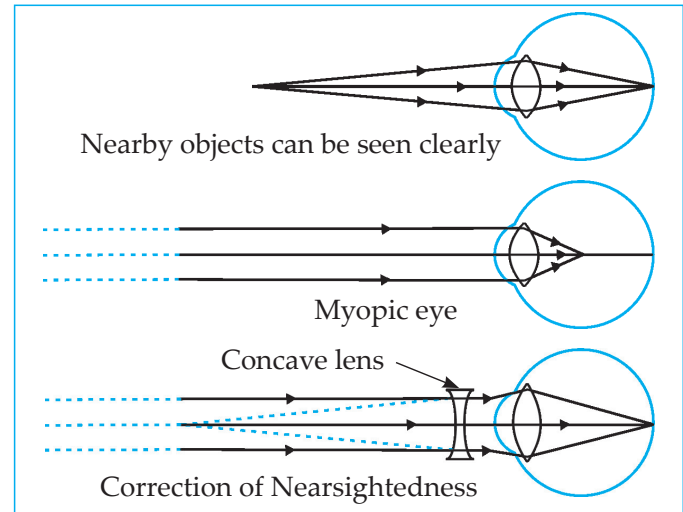
Fig 7.20 Nearsightedness

(i) Person having myopia can see nearby objects clearly but the distant objects appear indistinct.

(ii) In nearsightedness, the image of a distant object forms in front of the retina. There are two reasons for this defect.

(a) The curvature of the cornea and the eye lens increases, so that the converging power of the lens remains large.

(b) The eyeball elongates so that the distance between the lens and the retina increases.

(iii) This defect can be corrected by using spectacles with concave lens of proper focal length.

(iv) This lens diverges the incident rays and these diverged rays can be converged by the lens in the eye to form the image on the retina.

(2) Hypermetropia or Farsightedness
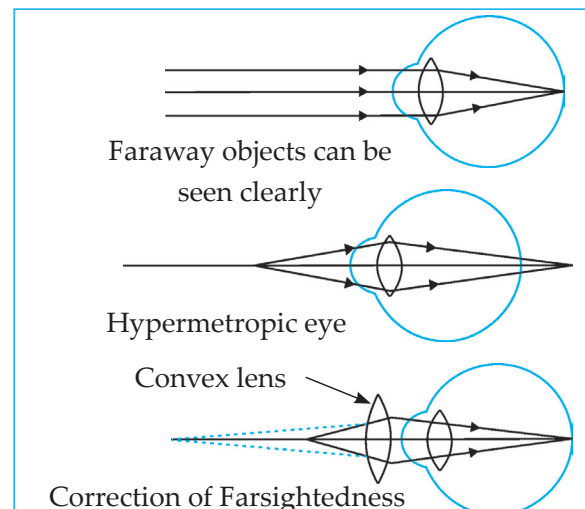
Fig 7.19 Farsightedness

(i)   In hypermetropia, a person can see distant objects clearly but cannot see nearby objects distinctly.

(ii)   The images of nearby objects are formed behind the retina. There are two reasons for farsightedness.

(a)   Curvature of the cornea and the eye lens decreases so that, the converging power of the lens becomes less.

(b)   Due to the flattening of the eyeball the distance between the lens and retina decreases.

(iii)   This defect can be corrected by using a convex lens with proper focal length. This lens converges the incident rays before they reach the lens.

(iv)   The lens then converges them to form the image on the retina.

(3)   Presbyopia

(i)   Presbyopia is an age related vision problem. The vision becomes blurred. Because of this old people cannot see nearby objects.

(ii)   Generally the focusing power of the eye lens decreases with age. The muscles near the lens loose their ability to change the focal length of the lens. The near point of the lens shifts farther from the eye.

(iii)   Presbyopia can be corrected by using spectacle of convex lens of suitable focal length.

(iv)   Sometimes people suffer from nearsightedness as well as farsightedness. In such a case, bifocal lenses are required to correct the defect.

(v)   In such lenses, the upper part is concave lens and corrects nearsightedness while the lower part is a convex lens which corrects the farsightedness.

(4)   Compound microscope
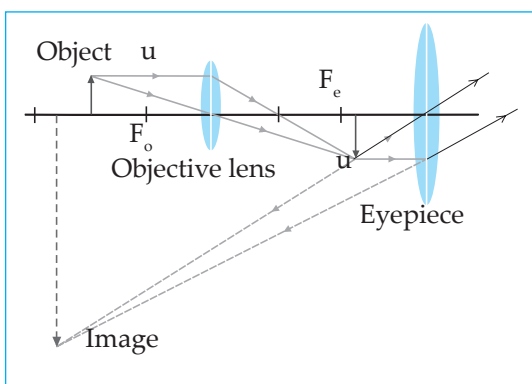
Fig 7.20

(i)   A compound microscope is made of two convex lenses objective and eye piece.

(ii)   The axes of both lenses are along the same line. The lenses are fitted inside a metallic tube in such a way that the distance between can be changed.

(iii)   The objective has smaller cross-section and smaller focal length. The eye piece has bigger cross section, its focal length is also larger than that of the objective.

(iv)   Higher magnification can be obtained by the combined effect of the two lenses.

(v)   The magnification occurs in two stages. The image formed by the first lens acts as the object for the second lens.

*(5) Explain the working of an astronomical telescope using refraction of light.

Ans.
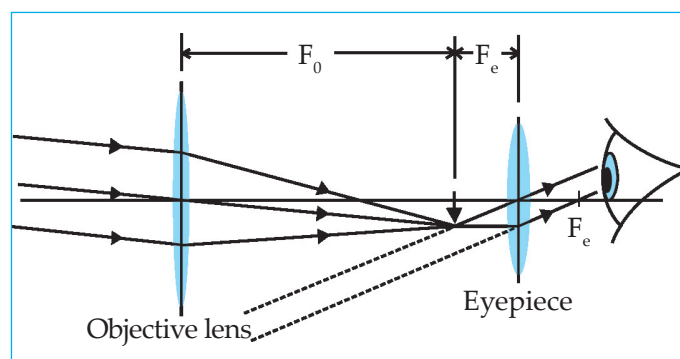
Fig 7.21

(i)   Telescope is used to see distant objects clearly in their magnified form. The telescopes used to observe astronomical sources like the stars and the planets are called astronomical telescopes.

(ii)   Objective lens has large diameter and larger focal length because of which maximum amount of light coming from the distant object can be collected.

(iii)   On the other hand the size of the eyepiece is smaller and its focal length is also less. Both the lenses are fitted inside a metallic tube in such a way that the distance between them can be changed.

(iv)   When rays of light enter the objective, they refract and give a real inverted and diminished image.

(v)   The eye–piece is so adjusted that the image becomes an object for the eyepiece and gives a

virtual, enlarged and inverted image w.r.t to object.

Q.4.3. Application Based Questions:

(1)   Answer the questions based on the following diagrams:
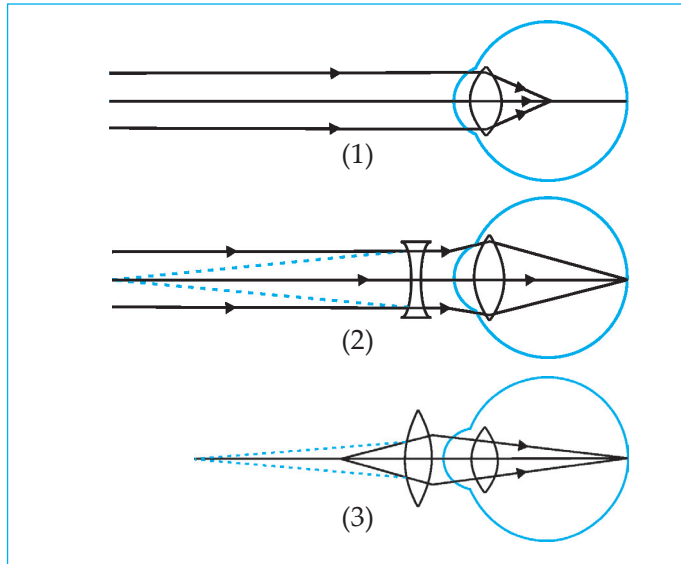
Fig 7.22

(a)   Name the defect shown in figure (1).

(b)   Give two reasons for this defect.

(c)   In which figure is the defect corrected, in figure (2) or (3)?

Ans.

(a)   Myopia.

(b)   (i)   The curvature of the cornea and the eye lens increases, so that the converging power of the lens remains large.

(ii)   The eyeball elongates so that the distance between the lens and the retina increases.

(c)   Figure (2)

(2)   Selwyn is 16 yr old and wears a spectacle having a power of +2 D. Answer the following questions:

(a)   Name the eye defect he has.

(b)   State two reasons why this defect is caused?

(c)   Compute the focal length of his lens.

(d)   Which lens is used by selwyn?

Ans.

(a)   Hypermetropia.

(b)   (i)   Curvature of the cornea and the eye lens decreases so that, the converging power of the lens becomes less..

(ii)   Due to the flattening of the eye ball the distance between the lens and retina decreases.

(c) $P = + 2D$

$f = \dfrac{1}{P} = \dfrac{1}{2}$

$= 0.5$ m

$\therefore$ focal length $= 0.5$ metre

(d)   Convex lens.

(3)   Vijay is 16 yr old and wears a spectacle having a power of -2D. Answer the following questions:

(a)   Name his eye defect.

(b)   State two reasons why this defect is caused?

(c)   Compute the focal length of his lens.

Ans.

(a)   Myopia.

(b)   (i)   The curvature of the cornea and the eye lens increases, so that the converging power of the lens remains large.

(ii)   The eyeball elongates so that the distance between the lens and the retina increases.

(c) $P = - 2D$

$f = \dfrac{1}{p}$

$= - \dfrac{1}{2}$

$= - 0.5$ m

$\therefore$ focal length $= - 0.5$ m

(4)   Ankit developed an eye defect at the age of 65 yrs and had to wear a lens of power +3D. Answer the following questions:

(a)   Name the eye defect.

(b)   State two reasons why this defect is caused?

(c)   Compute the focal length of his lens.

Ans.

(a)   Presbyopia.

(b)   The focusing power of the eye lens decreases with age. The muscles near the lens lose their ability to change the focal length of the lens. The near point of the lens shifts further than the eye.

(c) $P = + 3D$

$f = \dfrac{1}{p}$

$= \dfrac{1}{3}$

$= 0.33$ m

$\therefore$ focal length $= 0.33$ m

(5)
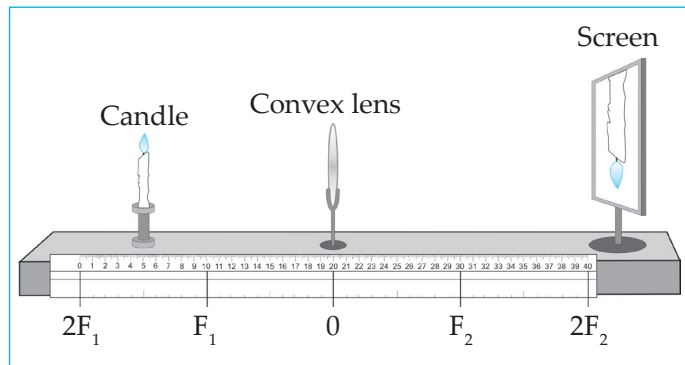
Fig 7.23

(a) What changes in the position of the candle should be made to obtain a virtual and enlarged image?

(b) What is nature of image formed if a concave lens is used instead of a convex lens?

(c) State any one point of difference between a real and virtual image.

Ans.

(a) To obtain a virtual and enlarged image, the candle (object) should be placed between F_1 and O.

(b) If a concave lens is used, the image will be virtual and erect.

(c) Real image and Virtual image

Real Image		Virtual Image	
(i)	When the refracted rays actually meet, the real image is formed.	(i)	When the refracted rays appear to meet, virtual image is formed.
(ii)	Real image can be taken on the screen.	(ii)	Virtual image can not be taken on the screen.
(iii)	Real image is always inverted.	(iii)	Virtual image is always erect (upright).

(iv)	In a ray diagram, real image is formed on opposite side of lens.	(iv)	In a ray diagram, virtual image is formed on same side of lens.

(5)
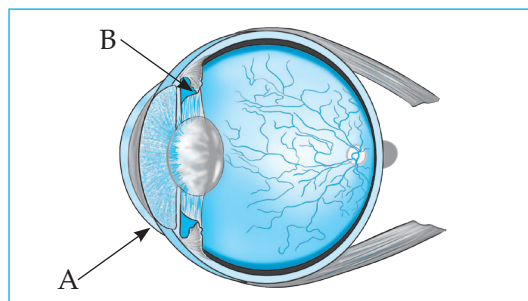
Fig 7.24

(i) Label A and B in the diagram.

(ii) Explain the functions of A.

Ans.

(i) A – Cornea, B – ciliary muscles.

(ii) Maximum refraction of light occurs on the cornea.

(5) Name of the two lenses A and B
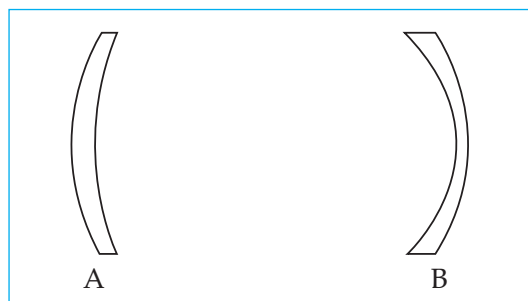
Fig 7.25

Ans. (i) Lens A – positive meniscus.

(ii) Lens B – negative meniscus.

❖ ❖ ❖

ASSIGNMENT - 7

Time : 1 Hr.   **Marks : 20**

Q.1. (A) Fill in the blanks: **(3)**

(1)   Myopia can be corrected by using spectacle of .... lens.

(2)   The tendency of pupil to adjust the opening for light is called ....

(3)   In simple microscope .... lens is used.

Q.1. (B) Choose and write the correct option: **(2)**

(1)   Farsightedness can be corrected by using .... lens.

(a) cylindrical   (b) concave   (c) diverging   (d) converging

(2)   The perception of dim light is concerned with .... cells.

(a) Rod   (b) Cone   (c) Amoeboid   (d) Squamous

Q.2. Answer the following: *(Any 2)*   **(4)**

(1)   An object is placed at a distance of 15 cm from a convex lens. If the focal length of the lens is 60 cm, find the image distance.

(2)   Give scientific reasons: "We cannot clearly see an object kept at a distance less than 25 cm from eye."

(3)   Distinguish between farsightedness and nearsightedness.

Q.3. Answer the following: *(Any 2)*   **(6)**

(1)   Draw a neat and labelled diagram of human eye.

(2)   A 5 cm high object is placed at a distance of 25 cm from a converging lens of focal length of 10 cm. Determine the position, size and type of the image.

(3)   Draw a neat and labelled ray diagram for convex lens.
(i) When object is beyond $2F_1$ (ii) When object is at infinity

Q.4. Answer the following: *(Any 1)*   **(5)**

(1)   Explain the working of an astronomical telescope using refraction of light.

(2)   Write a short note on (i) Hypermetropia.   (ii) Myopia

❖ ❖ ❖

8 Metallurgy

CONCEPT MAP

Elements

Types

Metals | **Metalloids** | **Non - metals**

Metalloids: e.g. Si, Ge, As

Non - metals: e.g. C, S, P

Properties → Physical, Chemical

occur as → **Ores**

occur in → Natural state e.g. Gold, Platinum

Ores → Extraction of metal → Concentration of ores

Processed for extraction:

- **Metals of high reactivity** → Electrolysis of molten ore → Pure metal → e.g. Na, Al, Mg
- **Metals of medium reactivity** → are present as → Carbonate ore / Sulphide ore (are reduced to oxides)
  - Carbonate ore → Calcination process
  - Sulphide ore → Roasting method
  - converted to → Oxide of metal → Reduction of metal oxide to metal → Purification of metal → e.g. Zn, Fe
- **Metals of low reactivity** → occur as → Sulphide ore → Heating → Metal → Refining → e.g. Cu, Hg

MASTER KEY QUESTION SET - 8

Q.1. (A) 1. Fill in the blanks and rewrite the complete statement :

(1) Elements that possess both the properties of metals and non metals are called ....

(2) .... and .... metals exist in liquid state at room temperature.

(3) The metallic lustre goes on .... due to exposure to atmospheric oxygen.

(4) The metals that produce a sound on striking on hard surface are said to be ....

(5) The ability of metals to be drawn into wires is called ....

(6) The alkali metals from group 1 such as Lithium, Sodium, and Potassium are very ....

(7) Metal tungsten has the highest melting point ....

(8) Non - metal bromine exists in ....

(9) .... is the hardest natural substance.

(152)

(10) Metals react with oxygen to form _____.

(11) The metals; aluminium, iron and zinc do not react with _____ but they react with _____ to form their oxides.

(12) Metals react with Nitric acid to form _____ .

(13) The arrangement of metals in the increasing or decreasing order of reactivity is called the _____ .

(14) _____ is a highly corrosive and fuming liquid.

(15) Non - metals are also called _____ .

(16) Non - metals combine with oxygen to form _____.

(17) The compounds formed from two units, namely cation and anion are called _____ .

(18) Ionic compounds are _____ in nature.

(19) The Science and Technology regarding the extraction of metals from ores and their purification for the use is called _____ .

(20) _____ is an ore of tin.

(21) A freshly prepared mixture of concentrated HCl and concentrated HNO_3 in the ratio of 3:1 is known as _____ .

(22) Aluminium is extracted from its ore _____ .

(23) The conversion of bauxite ore into alumina is done by a process called _____ .

(24) In _____ process carbonate ores are strongly heated.

(25) In _____ process sulphide ores are strongly heated.

(26) Metals such as _____, _____ and _____ do not react with water at all.

(27) Anodizing is a process of forming a thick layer of _____ .

(28) The impurities present in an ore are called as _____ .

(29) If one of the metal is mercury, then the alloy is known as _____ .

(30) Copper reacts with moist carbon dioxide in the air and slowly loses its shine to gain a green coat of _____ .

Ans. (*1) Metalliods (2) Mercury, Gallium (3) decreasing. (4) Sonorous (5) ductility (6) soft (7) 3422°C. (8) liquid state (9) Diamond (10) metal oxides (11) water, steam (12) Nitrate salts (13) reactivity series of metals (14) Aqua Regia (15) electronegative elements (16) acidic oxides (17) ionic compounds (18) crystalline (19) Metallurgy (20) Cassiterite*

(21) Aqua Regia (22) Bauxite (23) Bayer's process (24) Calcination (25) Roasting (26) gold, silver, copper (27) aluminium oxide (28) gangue (29) amalgam (30) copper carbonate.

Q1. (A) 2. Select the odd man out:

(1) Copper, Gallium, Gold, Silver.

Ans. Gallium: It is a metal in the liquid state and all others are in solid state.

(2) Silver, Gold, Platinum, Calcium

Ans. Calcium: Found in combined state, others are in free state.

(3) Water, Ammonia, Sodium chloride, Hydrogen chloride.

Ans. Sodium chloride: It is an ionic compound others are covalent compounds.

(4) K_2O, Na_2O, CaO, Al_2O_3.

Ans. Al_2O_3: Others are basic oxides Al_2O_3 is an amphoteric oxide.

(5) Malleability, Ductility, Brittleness, Lustre.

Ans. Brittleness: It is the property of non - metals, others are properties of metals.

(6) Graphite, Iodine, Silver, Phosphorous.

Ans. Silver: It is a metal, others are non metals.

(7) Sodium oxide, Zinc oxide, Potassium oxide, magnesium oxide.

Ans. Zinc oxide: It is an amphoteric oxide others are basic oxides.

(8) Steel, Iron, Copper, Tungsten.

Ans. Steel: It is an alloy, others are metals.

(9) Galvanizing, Tinning, Anodizing, Roasting.

Ans. Roasting: It is a process of metallurgy, Others are methods to prevent corrosion.

(10) Brass, Bronze, Steel, Antimony.

Ans. Antimony: It is a metalloid and others are alloys.

Q.1 (A) 3. Find out the correlation:

(1) Metal : Reducing agent : : Non - metal : _____

Ans. Oxidising agent - Metals are electron donors therefore metals are reducing agents. Non metals accept electrons and so nonmetals are oxidising agents.

(2) Brass : Copper and zinc : : Bronze : _____

Ans. Copper and Tin - Bronze is an alloy of copper and Tin.

(3) Aluminium : Bauxite : : Mercury : _____

Ans. Cinnabar - The ore of mercury is cinnavar

(4)   Cryolite : AlF$_3$.3NaF : : Fluorspar : ....

Ans. CaF$_2$ - Flurspar is calcium flouride.

(5)   Alumina : Al$_2$O$_3$: : Sodium aluminate : ....

Ans. NaAlO$_2$ - Sodium aluminate is an intermediate in the extraction of A1.

(6)   Coating of tin over metal : Tinning : : Coating of zinc over iron : ....

Ans. Galvanization - The process of applying a coating of zinc on Iron is called galvanisation.

Q.1   (A) 4. Match the columns:

*(1)

Substance		Property	
(1)	Potassium bromide	(a)	Combustible
(2)	Gold	(b)	Soluble in water
(3)	Sulphur	(c)	No chemical reaction
(4)	Neon	(d)	High ductility

Ans. *(1 – b), (2 – d), (3 – a), (4 – c)*

*(2)

Column A		Column B	
(1)	Bauxite	(a)	Mercury
(2)	Cassiterite	(b)	Aluminium
(3)	Cinnabar	(c)	Tin

Ans. *(1 – b), (2 – c), (3 – a)*

(3)

Column A		Column B	
(1)	React vigorously with cold water.	(a)	Silver and Copper
(2)	React with hot water	(b)	Iron and Zinc
(3)	React with steam	(c)	Calcium
(4)	React less vigorously with cold water	(d)	Sodium and Potassium
(5)	Do not react with water	(e)	Magnesium

Ans. *(1 – d), (2 – e), (3 – b), (4 – c), (5 – a)*

(4)

Column A		Column B	
(1)	Wilfley table method	(a)	SnO$_2$ and FeWO$_4$
(2)	Hydraulic separation method	(b)	CuFeS$_2$
(3)	Magnetic separation method	(c)	Ball mill
(4)	Froth Floatation method	(d)	Ore soaked in a solution
(5)	Leaching	(e)	Law of gravitation

Ans. *(1 – c), (2 – e), (3 – a), (4 – b), (5 – d)*

Q.1.   (A) 5. State whether the following statements are true or false, correct the false statements.

(1)   In the alloy, if one of the metals is mercury then, it is known as Amalgam.

(2)   In the process of 'Kalhaee' a metal is coated with Zinc to prevent its corrosion.

(3)   Nitric acid is a strong oxidizing agent.

(4)   Non - metals react with acids to give a salt and hydrogen gas.

(5)   The elements or compounds which occur naturally is earth's crust are known as minerals.

(6)   Ionic compounds have low melting points.

(7)   Alloys are resistant to corrosion.

(8)   Non - metals are good conductors of heat and electricity.

(9)   Metals gain electrons and become negatively charged ions.

(10)   Metal iron is more reactive than metal copper.

(11)   Non - metals combine with oxygen to form basic oxides.

(12)   The minerals from which the metal can be separated economically are called ores.

(13)   Stannic oxide (SnO$_2$) is magnetic and Ferrous tungstate (FeWO$_4$) is a non - magnetic ingredient.

(14)   Ore contains some impurities, these are called gangue.

(15)   The process of separating gangue from the ores is called concentration of ores.

(16)   The reactivity of metals increase down to reactivity series.

(17)   Electronic configuration of Aluminium is 2,8,2.

(18)   Cryolite (Na$_3$AlF$_6$) and Fluorspar (CaF$_2$) are used to increase the melting point of alumina.

(19)   Electrolysis is the method used to obtain pure metals from impure metals.

(20)   The process of converting sulphide ores into oxides by heating strongly in excess of air is called calcination.

(21)   Iodine is a lustrous metal.

Ans. *(1) True (2) False. In the process of 'Kalhaee' a metal is coated with Tin to prevent its corrosion (3) True (4) False. Metals react with acids to give a salt and hydrogen gas (5) True (6) False. Ionic compounds have high melting points (7) True (8) False. Non - metals are bad conductors of heat and electricity (9) False. Metals lose electrons and become positively charged ions (10) True (11) False. Non - metals combine with oxygen*

to form acidic oxide (12) True (13) False. Stannic oxide (SnO_2) is a non - magnetic and Ferrous tungstate ($FeWO_4$) is a magnetic ingredient (14) True (15) True (16) False. The reactivity of metals decreases down the reactivity series (17) False. Electronic configuration of Aluminium (2,8,3) (18) False. Cryolite (Na_3AlF_6) and Fluorspar (CaF_2) are used to lower the melting point of Alumina (19) True (20) False. The process of converting sulphide ores into oxides by heating strongly in air is called roasting (21) False. Iodine is a lustrous non-metal.

Q.1 (A) 6. Name the following :

*(1) Alloy of sodium with mercury.

Ans. Sodium amalgam.

*(2) Molecular formula of the common ore of aluminium.

Ans. $Al_2O_3.nH_2O$

*(3) The oxide that forms salt and water by reacting with both acid and base.

Ans. Aluminium oxide, Zinc oxide (All Amphoteric oxide)

*(4) The device used for grinding an ore.

Ans. Ball mill

*(5) The non - metal having electrical conductivity.

Ans. Graphite

*(6) The reagent that dissolves noble metals.

Ans. Aqua regia

*(7) An alloy of copper and zinc

Ans. Brass

*(8) A metal which does not react with cold water but reacts with steam.

Ans. Iron

*(9) The most lustrous substance.

Ans. Diamond

*(10) An ore of Mercury.

Ans. Cinnabar (HgS)

*(11) The process used for heating of carbonate ores.

Ans. Calcination

*(12) The metal which is the least reactive in the reactivity series.

Ans. Gold

*(13) The most reactive metal.

Ans. Potassium

*(14) Alloy of copper and tin.

Ans. Bronze

Q.1. (B). Choose and write the correct options.

(1) _____ is not a metalloid.
- (a) Silicon
- (b) Antimony
- (c) Germanium
- (d) Aluminium

(2) _____ has the highest melting point.
- (a) Tungsten
- (b) Copper
- (c) Iron
- (d) Zinc

(3) _____ is the most reactive metal.
- (a) Potassium
- (b) Magnesium
- (c) Calcium
- (d) Sodium

(4) _____ is the formula of cuprite.
- (a) Cu_2O
- (b) Cu_2S
- (c) $CuCO_3$
- (d) $CuCl_2$

(5) Cassiterite is an ore of _____
- (a) Copper
- (b) Silver
- (c) Calcium
- (d) Tin

(6) Metal oxides are generally _____ in nature.
- (a) Acidic
- (b) Basic
- (c) Neither acidic nor basic
- (d) Both acidic and basic

(7) _____ is a non metal which conducts electricity.
- (a) Diamond
- (b) Iodine
- (c) carbon
- (d) Graphite

(8) _____ is an oxide which is amphoteric.
- (a) Copper oxide
- (b) Magnesium dioxide
- (c) Zinc oxide
- (d) Calcium oxide

(9) The reactivity of metals with dil HCl in decreasing order is _____.
- (a) Mg >Zn > Al > Fe
- (b) Mg > Al > Zn > Fe
- (c) Fe >Zn > Al > Mg
- (d) Fe > Al > Zn > Mg

(10) Cinnabar is an ore of _____ .
- (a) Aluminium
- (b) Sodium
- (c) Iron
- (d) Mercury

(11) The main constituent of bauxite is _____ .
- (a) Al_2O_3
- (b) $Al_2(SO_4)_3$
- (c) $CaSO_4$
- (d) Na_3AlF_6

(12) Which method is used for the purification of more reactive metals?
- (a) Chemical reduction
- (b) Roasting
- (c) Calcination
- (d) Electrolytic reduction

(13) Substance used to decrease the melting point of alumina in Hall's process ....

    (a) $CuSO_4$ (b) Cryolite

    (c) Gypsum   (d) Limonite

(14) Galvanisation is a method of protecting iron from rusting by coating it with a thin layer of ....

    (a) Aluminium   (b) Tin

    (c) Silver   (d) Zinc

(15) Copper reacts with moist carbon - dioxide in air and slowly loses its shine to gain a green coat of ....

    (a) Copper oxide   (b) Iron oxide

    (c) Copper carbonate   (d) None of the above

(16) .... react with dil.HNO_3 to evolve hydrogen gas.

    (a) Iron and Copper

    (b) Manganese and Magnesium

    (c) Zinc and Manganese

    (d) Aluminium and Magnesium

(17) Silver articles become black on prolonged exposure to air. This is due to the formation of ....

    (a) Ag_3NO_3 (b) Ag_2O

    (c) Ag_2S (d) Ag_2S and Ag_3NO_3

(18) In Tinning a layer of molten .... is deposited on metals.

    (a) Zinc   (b) Iron

    (c) Tin   (d) Copper

Ans. *(1) (d) Aluminium (2) (a) Tungsten (3) (a) Potassium (4) (a) Cu_2O (5) (d) Tin (6) (b) basic (7) (d) Graphite (8) (c) Zinc oxide (9) (b) Mg > Al > Zn > Fe (10) (d) Mercury (11) (a) Al_2O_3 (12) (d) Electrolytic reduction (13) (b) Cryolite (14) (d) Zinc (15) (c) Copper carbonate (16) (b) Manganese and magnesium (17) (c) Ag_2S (18) (c) Tin.*

Q.2.1. Define the following :

*(1) Minerals

Ans. The compounds of metals that occur in nature along with the impurities are called minerals.

*(2) Ores

Ans. The minerals from which the metals can be separated economically are called ores.

*(3) Gangue

Ans. Ores contain metal compounds with some of the impurities like soil, sand, rocky substances etc. These impurities are called gangue.

*(4) Metallurgy

Ans. The Science and Technology regarding the extraction of metals from ores and their purification for the use is called metallurgy.

(5) Roasting

Ans. The process of conversion of sulphide ores into oxide by strongly heating in air is called roasting.

(6) Calcination

Ans. The process of conversion of carbonate ores into oxides by strongly heating in limited supply of air is called calcination.

(7) Reduction

Ans. The conversion of metal oxide into metal is called reduction.

(8) Galvanizing

Ans. Galvanizing is a process of giving a thin coating of zinc on iron or steel to protect them from corrosion.

(9) Electroplating

Ans. The process where a less reactive metal is coated on a more reactive metal using electrolysis is called electroplating.

(10) Anodization

Ans. The process where metals like copper and aluminium are coated with a thin and strong layer of their oxides by means of electrolysis is called anodizing.

(11) Tinning

Ans. The process of giving a protective coating of tin over other metals is called tinning.

(12) Alloy

Ans. The homogeneous mixture formed by mixing a metal with other metals or non - metals in certain proportion is called an alloy.

(13) Ionic compounds

Ans. The compounds formed from two units namely cation and an anion are called Ionic compounds.

(14) Hydraulic Separation method.

Ans. It is the process in which finely grounded (powdered) ore is washed with a stream of water. The lighter gangue particles are washed away in the stream of water whereas heavier mineral particles settle down at the bottom. It is based on the difference in the density of ore and impurities.

(15) Froth Floatation process

Ans. This process is used to concentrate some ores especially sulphide ores. In this process, the finely powdered ore is mixed with water and a suitable

oil, like pine oil. It is based on the principle that the mineral particles due to their hydrophobic property are wetted with oil, whereas gangue particles get wetted with water due to the hydrophilic property.

(16) Magnetic Separation

Ans. It is a process in which magnetic ore is separated from non - magnetic impurities with the help of electromagnetic machines.

(17) Patination of Copper

Ans. CO_2 in moist air reacts with the surface of copper vessel. Copper loses its lustre due to the formation of greenish layer of copper carbonate $CuCO_3$ on its surface. This is called Patination of copper.

**Q.2.2. Write chemical equation for the following events:**

*(1) Aluminium came in contact with air.

Ans. Aluminium combines with oxygen to form aluminium oxide.

$$4Al \quad + \quad 3O_2 \quad \rightarrow \quad 2\,Al_2O_3$$
*Aluminum   Oxygen   Aluminium Oxide*
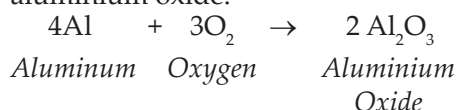
*(2) Iron filings are dropped in aqueous solution of copper sulphate.

Ans. When iron filings are dropped in aqueous solution of copper sulphate, iron displaces copper from the solution. The blue colour of copper sulphate solution fades out.

$$Fe \quad + \quad CuSO_4 \quad \rightarrow \quad FeSO_4 \quad + \quad Cu$$
Iron   Copper Sulphate   Iron Sulphate   Copper
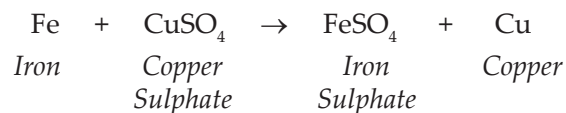
*(3) A reaction was brought about between ferric oxide and aluminium.

Ans. When Ferric oxide reacts with aluminium, aluminium oxide and iron are formed. This reaction is known as "Thermit Reaction".

$$Fe_2O_3 \quad + \quad 2Al \quad \rightarrow \quad 2Fe \quad + \quad Al_2O_3 + heat$$
Ferric Oxide   Aluminium   Iron   Aluminium Oxide
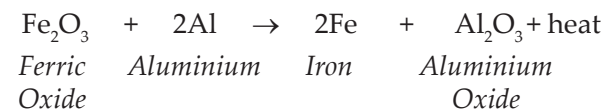
(4) Electrolysis of alumina is done.

Ans. Electrolysis of molten mixture of alumina is done in a steel tank. Electrode reaction

Anode reaction $2O^{2-} \rightarrow O_2 + 4e^-$ (Oxidation)

Cathode reaction $Al^{3+} + 3e^- \rightarrow Al$ (Reduction)

*(5) Zinc oxide is dissolved in dilute hydrochloric acid.

Ans. When zinc oxide dissolves in dilute hydrochloric acid, zinc chloride and water is formed.

$$ZnO \quad + \quad 2HCl \quad \rightarrow \quad ZnCl_2 \quad + \quad H_2O$$
Zinc Oxide   Hydrochloric Acid   Zinc Chloride   Water
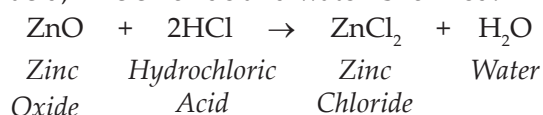
(6) When steam is passed over aluminium.

Ans. When steam is passed over aluminium, aluminium oxide and hydrogen gas are formed.

$$2Al_{(s)} \quad + \quad 3H_2O_{(g)} \quad \rightarrow \quad Al_2O_{3(s)} \quad + \quad 3H_{2(g)}$$
Aluminium   Steam   Aluminium oxide   Hydrogen
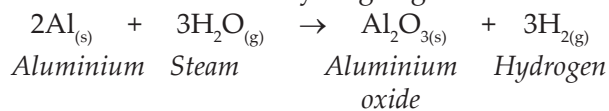
(7) Extraction of copper from its sulphide ore.

Ans. $$2Cu_2S \quad + \quad 3O_2 \quad \rightarrow \quad 2Cu_2O \quad + \quad 2SO_2\uparrow$$
Copper sulphide   Oxygen   Copper oxide   Sulphur dioxide

$$2Cu_2O \quad + \quad Cu_2S \quad \rightarrow \quad 6Cu \quad + \quad SO_2\uparrow$$
Copper oxide   Copper sulphide   Copper   Sulphur dioxide
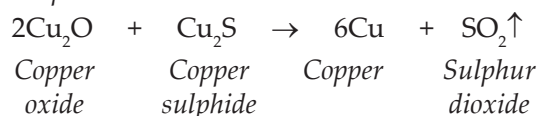
(8) When sodium oxide dissolves in water.

Ans. $$Na_2O_{(s)} \quad + \quad H_2O_{(l)} \quad \rightarrow \quad 2NaOH_{(aq)}$$
Sodium oxide   Water   Sodium hydroxide

(9) Copper reacts with concentrated nitric acid.

Ans.
$$Cu_{(s)} + 4HNO_{3(aq)} \rightarrow Cu(NO_3)_{2(aq)} + 2NO_{2(g)} + 2H_2O_{(l)}$$
Copper   conc. Nitric acid   Copper nitrate   Nitrogen dioxide   Water

(10) Copper reacts with dilute nitric acid

Ans. $$Cu_{(s)} \quad + \quad 8HNO_{3(aq)} \rightarrow Cu(NO_3)_{2(aq)} + 2NO_{(g)} + 4H_2O_{(l)}$$
Copper   Dilute nitri acid   Copper nitrate   Nitric Oxide   Water

(11) Aluminium oxide reacts with sodium hydroxide.

Ans.
$$Al_2O_3 . 2H_2O_{(s)} + 2NaOH_{(aq)} \rightarrow 2NaAlO_{2(aq)} + 3H_2O_{(l)}$$
Aluminium oxide   Sodium Hydroxide   Sodium aluminate   Water

Q.2.3 Answer the following in one or two sentences.

(1) Name the categories into which metals can be classified based on their reactivity.

Ans. Based on reactivity, metals can be classified into three groups:
(i) metals of high reactivity
(ii) metals of moderate reactivity
(iii) metals of low reactivity.

(2) Which metals are available in free state in nature?

Ans. Less reactive metals like gold, silver and copper are available in free state in nature.

(3) In what form are ores / minerals generally found in nature?

Ans. Generally, ores / minerals are found in the form of oxides, sulphides, carbonates and nitrates.

(4) Which impurities of bauxite ore are removed by Bayer's process?

Ans. Iron oxide (Fe_2O_3), silica (SiO_2) and titanium oxide

(TiO$_2$) are the impurities of bauxite ore which are removed by the Bayer's process.

**(5)   On what does the process of metallurgy depend?**

Ans. The process of metallurgy depends on i) the nature of the metal to be extracted ii) the type of impurity present in the ore.

(6)   What is concentration of ore?

Ans. The process of separating gangue from the ore is called concentration of ore.

(7)   Write the cathode reaction in electrolytic reduction of alumina.

Ans. Cathode reaction in electrolytic reduction of aluminium.

$$Al^{3+} + 3e^- \longrightarrow Al_{(l)}.$$
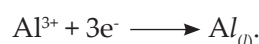
(8)   Name the two properties on which Froth floatation method is based.

Ans. The Froth floatation method is based on the two opposite properties, hydrophilic (getting wetted with water) and hydrophobic (getting wetted with oil) of the gangue particles and ore particles respectively.

**(9)   What is the principle of froth floatation process?**

Ans. The Froth floatation process is based on the principle of difference in wetting properties of the ore and the gangue particles with oil and water respectively.

(10)   What is the principle of magnetic separation method?

Ans. Magnetic separation method uses the principle of difference in the magnetic properties of the ore and the gangue.

(11)   Write an equation for the action of heat on aluminium hydroxide.

Ans. When aluminium hydroxide is heated upto 1000°C, it forms alumina and water.

$$2Al(OH)_3 \xrightarrow[\text{1000°C}]{\text{heat}} Al_2O_3 + 3H_2O.$$
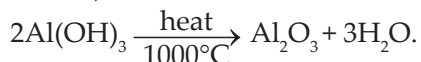
(12)   What is the purpose of roasting in metallurgy?

Ans. In metallurgy, the purpose of roasting is the conversion of Sulphide ore into oxide by strongly heating it in air.

(13)   What acts as cathode in electrolytic reduction of Al$_2$O$_3$?

Ans. Carbon (graphite) lining inside the Steel tank acts as a cathode in electrolytic reduction of Al$_2$O$_3$.

(14)   What works as a electrolyte in Hall's cell?

Ans. The mixture of molten Al$_2$O$_3$, Na$_3$AlF$_6$ and CaF$_2$ works as an electrolyte in Hall's cell.

(15)   What is reactivity series of metals?

Ans. The arrangement of metals in an increasing or decreasing order of reactivity is called reactivity series of metals.

(16)   What is the nature of the oxides of metals?

Ans. Oxides of metals are basic in nature.

(17)   In the extraction of aluminium, name the process of concentration of Bauxite.

Ans. The process used for concentration of Bauxite is leaching process using either Bayer's method or Hall's method. In both these methods, finally the concentrated alumina is obtained by calcination.

(18)   State the chemical composition of Bauxite.

Ans. In bauxite, Aluminium oxide (Al$_2$O$_3$.nH$_2$O) is 30% to 70% while the remaining portion is gangue made of silica,sand,iron oxide etc.

(19)   What do you mean by amphoteric oxides?

Ans. Those oxides of metals which show both acidic as well as basic behaviour in aqueous solution are called amphoteric oxides. e.g. Zinc oxide, Aluminium oxide are amphoteric oxides.

(20)   Why is hydrogen gas not liberated when metals (except Mn and Mg) are treated with HNO$_3$?

Ans. HNO$_3$, being a strong oxidizing agent, oxidises H$_2$ to water (H$_2$O), Hence, hydrogen gas is not liberated when metals are treated with HNO$_3$.

*(21)   What is the electronic definition of Oxidation and Reduction? *(Can you recall; Textbook Page no. 102)*

Ans: Definition in terms of electron transfer:

Oxidation means loss of electrons.

Reduction means gain of electrons.

*(22)   What are the moderately reactive metals? *(Can you tell; Textbook Page no. 104)*

Ans: The metals present in the middle of reactivity series are called as, moderately reactive metals e.g. Zinc, Iron, Lead, Tin, Copper.

*(23)   In which form do the moderately reactive metals occur in nature? *(Can you tell; Textbook Page no. 104)*

Ans: These metals are usually present as Sulphides or Carbonates in nature.

*(24)   What is meant by corrosion? *(Can you recall; Textbook Page no. 106)*

Ans: The degradation of materials due to reaction with the environment is called corrosion.

*(25)   Which measures would you suggest to stop the corrosion of metallic articles or not to allow the corrosion to start ? *(Can you recall; Textbook Page no. 106)*

Ans: Various methods are used to protect metals

from corrosion. To stop the corrosion of metallic articles; they should be kept isolated from a direct contact with air.

*(26) What is done so to prevent rusting of iron windows and iron doors of your house? *(Can you tell; Textbook Page no. 106)*

Ans: We can lower the rate of the process of rusting

of iron by applying a layer of paint, oil, grease or varnish on their surface. Thus, we can prevent rusting of iron windows and doors of our house.

*(27) Which method do we use when we want to study many things together and at the same time? *(Think about it; Textbook Page no. 93)*

Ans: We use classification method if we want to study many things together at the same time.

Q.2.4. Distinguish between:

(1) Metals and Non - metals. (based on physical properties).

Ans.

Metals	Non - metals
(i) Metals are solid at room temperature with the exception of mercury and gallium which are in liquid state at room temperature.	(i) Non - metals are either in solid or gaseous state with the exception of bromine which is in liquid state.
(ii) Metals have lustre in their pure state and can be polished to give a highly reflective surface.	(ii) Non - metals usually do not have lustre except iodine and diamond.
(iii) Metals are malleable, i.e they can be hammered into thin sheets.	(iii) Non - metals are not malleable.
(iv) Metals are ductile i.e they can be drawn into wires.	(iv) Non - metals are not ductile.
(v) Metals are good conductors of heat and electricity.	(v) Non - metals do not conduct heat and electricity except graphite as it is good conductor of electricity.
(vi) Metals have high density.	(vi) Non - metals have low densities.
(vii) Metals are sonorous.	(vii) Non - metals are not sonorous.
(viii) Metals are hard. Exceptions: Li, Na and K are soft metals and can be cut easily with a knife.	(viii) Non - metals are not hard. Exception: Diamond
(ix) Metals have high melting and boiling points. Exception: Na, K, Hg and Ga are having low melting and boiling points.	(ix) Non - metals have low melting and boiling points.

(2) Metals and Non - metals. (based on chemical properties)

Ans.

Metals	Non - metals
(i) Atoms of metals usually have 1, 2 or 3 electrons in their outermost orbit.	(i) Atoms of non - metals usually have 4, 5, 6 or 7 electrons in their outermost orbit.
(ii) Metals lose electrons from their outermost orbits to form positive ions.	(ii) Non - Metals gain electrons to form negative ions.
(iii) Metals are electropositive	(iii) Non - metals are electronegative.
(iv) Mostly metals form basic oxides.	(iv) Non - metals form acidic oxides.
(v) Metals are reducing agents.	(v) Non - Metals are oxidizing agents.
(vi) Metals displaces hydrogen from dilute acids and form the corresponding salts.	(vi) Non - metals generally do not react with dilute mineral acids.

(3)   Calcination and Roasting

Ans.

Calcination	Roasting
(i) The process by which carbonate ores are first converted into oxides is called calcination.	(i) The process by which sulphide ores are converted into oxides is called roasting.
(ii) In this process, the ore is strongly heated in a limited supply of air.	(ii) In this process, ore is strongly heated in air.
(iii) During calcination, CO_2 is evolved.	(iii) During roasting, SO_2 is evolved.
(iv) Example : $ZnCO_3 \rightarrow ZnO + CO_2\uparrow$	(iv) Example : $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$

(4)   Atoms and Ions

Ans.

Atoms	Ions
(i) An atom is electrically neutral.	(i) Ion is an atom or group of atoms which is either positively charged or negatively charged, formed due to loss or gain of electrons.
(ii) An atom has all the properties of the parent element.	(ii) An ion does not have properties of the parent element.
(iii) An atom may or may not have an independent existence.	(iii) An ion does not have an independent existence.
(iv) In an atom, the outermost orbit may be unstable. Eg. : Na (Sodium), (2, 8, 1) K (Potassium) (2, 8, 8, 1)	(iv) In an ion, the outermost orbit is stable. Eg.: Na^+ (sodium ion) (2, 8), K^+ (potassium ion) (2, 8, 8).

(5)   Cations and Anions

Ans.

Cations	Anions
(i) Cations are positively charged ions.	(i) Anions are negatively charged ions.
(ii) Generally, metals produce cations. Eg. : Na^+ (sodium ion), K^+ (potassium ion).	(ii) Generally non-metals produce anions. Eg. : Cl^- (chloride ion), Br^- (bromide ion).
(iii) During electrolysis, cations are discharged at the cathode.	(iii) During electrolysis, anions are discharged at the anode.

Q.2.5. Give Scientific Reasons:

*(1)   Lemon or tamarind is used for cleaning copper vessels turned greenish.

Ans.

(i)   Copper on exposure to moist air combines with carbon dioxide and a green coloured copper carbonate salt is formed, tarnishing the copper.

(ii)   Lime juice and tamarind contain citric acid and tartaric acid respectively.

(iii)   These acids react with copper carbonate forming water - soluble salts, which get washed off easily.

(iv)   Due to this, the tarnished copper becomes clean and regains its lustre.

(v)   Hence, lemon or tamarind is used for cleaning copper vessels turned greenish.

*(2)   Generally the ionic compounds have high melting points.

Ans.

(i)   Ionic compounds are formed when an atom of a combining metal element transfers its electrons to the atom of another non - metallic element.

(ii)   During this process, the atom of the combining metal after losing electrons, forms a positively charged ion called as cation and the atom of the combining non-metal after gaining electrons forms a negatively charged ion called as anion.

(iii) Thus ionic bonds are formed between the cations and anions during compound formation.

(iv) Due to the presence of cations and anions, there is a strong electrostatic attraction between the molecules.

(v) Hence to break these inter - molecular bonds a lot of energy is needed.

(vi) Hence ionic compounds have high melting points.

*(3) Sodium is always kept in kerosene.

Ans.

(i) Sodium is a highly reactive metal.

(ii) It reacts with the oxygen and moisture present in the air to form sodium hydroxide and hydrogen gas.

(iii) Hydrogen which is released, catches fire in presence of oxygen due to liberation of heat during this reaction.

(iv) Sodium does not react with kerosene and hence, it sinks in it.

(v) Thus, to prevent sodium from coming in contact with air, it is immersed in kerosene.

*(4) Pine oil is used in Froth floatation.

Ans. Froth floatation is a process to purify sulphide ores, in presence of pine oil.

The froth floatation method is based on the two opposite properties, hydrophilic and hydrophobic, of the particles. Here the particles of the metal sulphides, due to their hydrophobic property, get wetted mainly with pine oil, while due to the hydrophilic property the gangue particles get wetted with water.

Pressurized air is blown through the mixture and simultaneously mixture is agitated using an agitator, due to agitation particles of sulphide ore form a foam with pine oil. This foam rises to the surface of water and floats and can be easily separated.

*(5) Anodes need to be replaced from time to time during the electrolysis of alumina.

Ans.

(i) In extracting aluminium from aluminium oxide, the molten the electrolyte is a liquid mixture of cryolite (Na_3AlF_6) Fluorspar (CaF_2) and aluminium oxide. (alumina) (Al_2O_3).

(ii) The cathode and anodes are made of graphite.

(iii) During the electrolysis process, aluminium is deposited on the cathode on passing electric current.

(iv) Oxygen is liberated at the anode.

(v) Some of this oxygen reacts with the carbon in the graphite to form carbon - dioxide gas then slowly burning away the anodes.

(vi) Thus, the anodes need to be replaced from time to time during the electrolysis of alumina.

(6) Gold and silver are used to make jewellery.

Ans.

(i) Gold and silver are precious metals with attractive lustre.

(ii) They have low reactivity. They do not react with atmospheric oxygen, moisture, carbon dioxide.

(iii) They do not react with dilute acids.

(iv) These metals are malleable and ductile.

(v) Due to these properties gold and silver are used to make jewellery.

(7) Aluminium foils are used to wrap food items.

Ans. Aluminium foils are used to wrap food items because aluminium is highly malleable. It can be beaten into thin sheets. Moreover, it does not react with food.

(8) Aluminium oxide is called an amphoteric oxide.

Ans.

(i) An oxide which shows both acidic as well as basic properties is called an amphoteric oxide.

(ii) Metal oxides are usually basic in nature.

(iii) But some metal oxides like aluminium oxide, zinc oxide, etc. react both with acids as well as bases to produce salt and water.

(iv) Aluminium oxide shows both acidic as well as basic properties.

(v) Hence, aluminium oxide is called an amphoteric oxide.

(9) Carbonate and Sulphide ores are usually converted into oxides during the process of extraction.

Ans.

(i) Reduction of metal oxides is easier and economical than the reduction of carbonate and sulphide ores.

(ii) So, carbonate and sulphide ores are first converted to metal oxide and then further reduced to form metals.
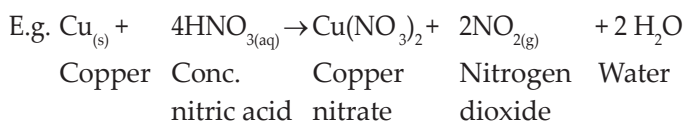
(10) Hydrogen gas is not evolved when metals like copper, zinc, iron, etc. react with dilute nitric acid.

Ans.

(i) Nitric acid is a strong oxidizing agent. It oxidizes hydrogen (H_2) to water.

(ii) Hence, it oxidizes completely to form any of the nitrogen oxide and water.

(iii) Hence, these metals do not produce H_2 gas when they react with concentrated and dilute HNO_3.

E.g. $Cu_{(s)} + 4HNO_{3(aq)} \rightarrow Cu(NO_3)_2 + 2NO_{2(g)} + 2H_2O$

    Copper Conc.   Copper   Nitrogen Water
           nitric acid nitrate   dioxide

Q.3.1. Explain the following:

*(1) When a copper coin is dipped in silver nitrate solution, a glitter appears on the coin after some time. Why does this happen? Write the chemical equation.

Ans. Copper being more reactive than silver, displaces silver from silver nitrate to form element silver and copper nitrate.

$$Cu_{(s)} + 2AgNO_{3(aq)} \rightarrow Cu(NO_3)_{2(aq)} + 2Ag_{(s)}$$

Copper Silver   Copper   Silver
*   nitrate   nitrate*
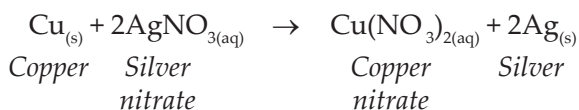
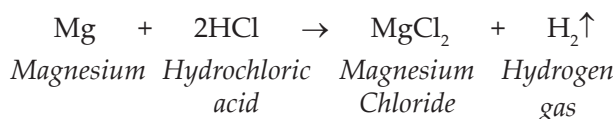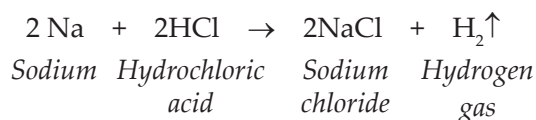The silver displaced gets coated on to the coin, hence coin gets the silver shine.

*(2) The electronic configuration of metal 'A' is 2,8,1. and that of metal 'B' is 2,8,2. Which of the two metals is more reactive? Write their reaction with dilute hydrochloric acid.

Ans. Metal 'A' Electronic configuration - (2,8,1),

Metal 'B' Electronic configuration - (2,8,2),

Metal 'A' loses its one electron and form positive ion. Metal 'B' also loses 2 electrons and forms positive ion; but metal 'A' is more reactive than metal 'B',as metal 'B' takes more energy to remove two electrons where as metal 'A' requires less energy to lose one electron.

Metal 'A' is sodium and metal 'B' is magnesium. Hence, sodium is more reactive than magnesium.

$2Na + 2HCl \rightarrow 2NaCl + H_2\uparrow$

Sodium Hydrochloric Sodium Hydrogen
*   acid   chloride   gas*

$Mg + 2HCl \rightarrow MgCl_2 + H_2\uparrow$

Magnesium Hydrochloric Magnesium Hydrogen
*   acid   Chloride   gas*

*(3) What are the physical properties of metals and Non - metals? *(Can you tell; Textbook Page no. 93)*

Ans. Physical properties of metals:

(i) Metals are in solid state except Mercury and Gallium which are in liquid state.

(ii) Metals are hard, have lustre and high melting and boiling points. They are ductile, malleable, good conductors of heat and electricity.

Physical properties of non - metals:

(i) Some non - metals are in solid state while some are in gaseous state.

(ii) They do not posses lustre. Non - metals are not hard, except diamond.

(iii) They have low melting and boiling points.

(iv) Not malleable and not ductile.

(v) Non - metals are bad conductors of heat and electricity, except graphite.

*(4) Write the electrode reaction for electrolysis of molten Magnesium chloride and Calcium chloride. *(Use your brain power; Textbook Page no. 103)*

Ans.

(i) For Magnesium chloride

$Mg^{2+} + 2e^- \rightarrow Mg$ (magnesium metal at the cathode)

$2Cl^- - 2e^- \rightarrow Cl_2$ (chlorine gas at the anode).

Magnesium ions gain electrons (reduction) to form magnesium atoms. Chloride ions lose electrons (oxidation) to form chlorine atoms.

The overall reaction is

$MgCl_{2\,(l)} \rightarrow Mg_{(s)} + Cl_{2\,(g)} \uparrow$

(ii) For Calcium chloride

$Ca^2 + 2e^- \rightarrow Ca$ (calcium metal at the cathode)

$2Cl^- - 2e^- \rightarrow Cl_2$ (chlorine gas at the anode)

Calcium ions gain electrons (reduction) to form calcium atoms. Chloride ions lose electrons (oxidation) to form chlorine atoms.

Overall reaction is

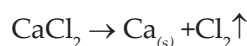$CaCl_2 \rightarrow Ca_{(s)} + Cl_2\uparrow$

*(5) Why do silver articles turn blackish while copper vessels turn greenish on keeping in air for a long time? *(Think about it; Textbook Page no. 106)*

Ans.

(i) On exposure to air, Silver articles turn blackish

after sometime because of the layer of silver sulphide (Ag_2S) formed by the reaction of silver with hydrogen sulphide in the air.

(ii) Carbon dioxide in moist air reacts with the surface of copper vessel and these copper vessels turn greenish because of the formation of copper carbonate ($CuCO_3$) on its surface.

*(6) Why do pure gold and platinum always glitter? *(Think about it; Textbook Page no. 106)*

Ans.

(i) Gold and Platinum occur in free state.

(ii) They are noble metals, hence they are least reactive.

(iii) They are not affected by air, water and other natural factors.

(iv) Hence, pure gold and platinum always glitter.

*(7) Can we permanently prevent the rusting of an iron article by applying a layer of paint on its surface? *(Use your brain power; Textbook Page no. 107)*

Ans.

(i) No, we cannot protect the articles permanently from rusting by painting on them.

(ii) The method of painting is suitable for short time.

(iii) If there is a scratch on the paint on the surface of the article and if a small surface of the metal comes in contact with air, the process of rusting starts below the layer of the paint.

*(8) Divide the metals Cu, Zn, Ca, Mg, Fe, Na, Li into three groups, namely reactive metals, moderately reactive metals and less reactive metals.

Ans.

Reactive metals	Moderately reactive	Less reactive
Na	Mg	Cu
Li	Zn	
Ca	Fe	

*(9) In the reaction between chlorine and HBr a transformation of HBr into Br_2 takes place. Can this transformation be called oxidation? Which is the oxidant that brings about this oxidation. *(Use your brain power; Textbook Page no. 98)*

Ans. When chlorine reacts with hydrobromic acid, bromine is formed.

$$Cl_{2(g)} + 2HBr_{(aq)} \rightarrow 2HCl_{(aq)} + Br_2.$$
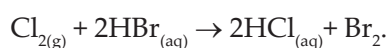
Yes, this transformation is called as oxidation, as hydrobromic acid loses hydrogen. In this reaction Cl_2 is the oxidizing agent.

*(10) Have you seen the following things?

Old iron bars of buildings, copper vessels not cleaned for long time, silver ornaments or idols exposed to air for long time, old abandoned vehicles fit to be thrown away. *(Can you recall; Textbook Page no. 106)*

Ans.

Blackened silver vessel

Rusted shackles

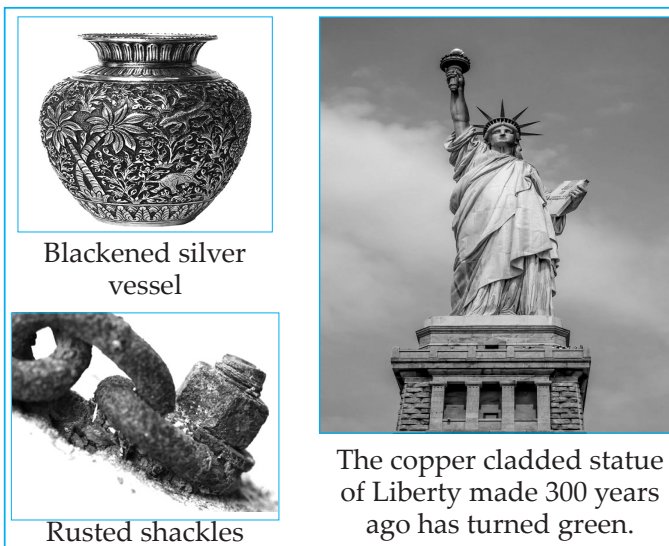The copper cladded statue of Liberty made 300 years ago has turned green.

Fig 8.1: Effects of Corrosion

(i) After keeping for a long time in air or in open when these above things come in contact with air and water, it reacts with it and a layer is formed above its, surface. They get corroded.

(ii) Iron bars - They get rusted as coating of Iron oxide ($Fe_2O_3 \cdot H_2O$) is formed.

Copper vessels - They react with CO_2 in moist air and a coating of copper carbonate ($CuCO_3$) is formed.

Silver Ornaments - They react with H_2S in air and a layer of silver sulphide (Ag_2S) is formed.

Old abandoned vehicles - They are rusted and coating of Iron oxide ($Fe_2O_3 \cdot H_2O$) is formed.

(11) An ore on treatment with dilute hydrochloric acid produces brisk effervescence. What type of ore is this?

What steps will be required to obtain metal from the enriched ore?

Ans. The ore is carbonate ore.

Steps required to obtain the metal:

(i) Calcination: Carbonate ore is heated in limited supply of air and oxide is obtained.

$$ZnCO_{3(s)} \xrightarrow{\Delta} ZnO_{(s)} + CO_2 \uparrow$$
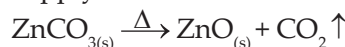
(ii) Reduction with Carbon: Metal oxide is heated with carbon.

$$ZnO_{(s)} + C \rightarrow Zn + CO \uparrow$$

(12) **A metal 'X' acquires a green colour coating on outer surface on exposure to air.**

(i) **Identify the metal 'X' and name the process responsible for this change.**

(ii) **Name and write chemical formula of the green coating formed on the metal.**

(iii) **List two important methods to prevent the process.**

Ans.

(i)   The metal is copper. The process is corrosion.

(ii)   Copper carbonate ($CuCO_3$)

(iii)   (a) It should be coated with tin.

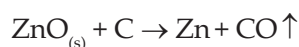   (b) It should be mixed with other metals to form alloys.

(13) **How is the method of extraction of metals high up in the reactivity series different from that for metals in the middle? Why the same process cannot be applied for them? Explain by giving equation, the extraction of sodium.**

Ans.

(i)   Metals high up in the series are obtained by electrolytic reduction because these metals are strong reducing agents and therefore cannot be obtained by chemical reduction.

(ii)   Metals in the middle of series are less reactive and can be obtained by chemical reduction. The same process can not be obtained by chemical reduction. Extraction of sodium is done by electrolysis of molten Sodium chloride.

$$2NaCl \xrightarrow{\text{electrolysis}} 2Na_{(s)} + Cl_2\uparrow$$
(Molten)
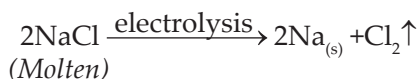
*(14) **What are the various alloys used in daily life? Where are those used?** *(Collect Information; Textbook Page 108)*

Ans.

(i)   Brass and Bronze are the two alloys which we use in our daily life.

(ii)   Brass is an alloy of copper and zinc and Bronze is an alloy of copper and tin.

(iii)   Brass is used for decorative articles and for making musical instruments.

(iv)   Bronze is used for making medals, sculptures, statues cooking utensils and coins.

*(15) **What are the properties that the alloy used for minting coins should have?** *(Collect Information; Textbook Page 108)*

Ans. Alloys used for minting coins should be ductile and malleable.

*Q.3.2. Draw a neat and labelled diagram.

(1)   **Magnetic separation method**
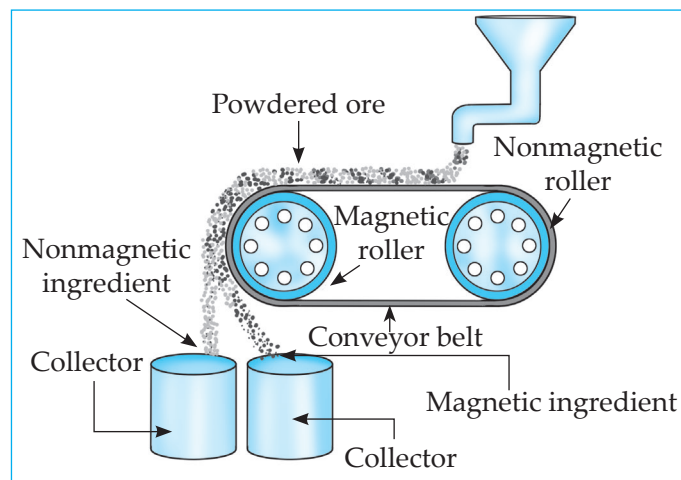
Ans.

Fig 8.2: Magnetic separations

(2)   **Froth floatation method.**
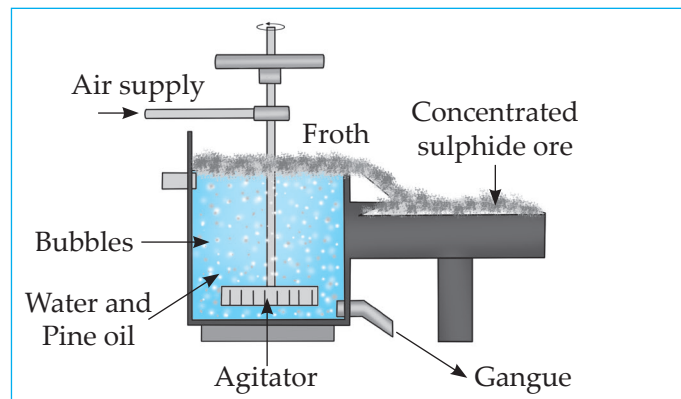
Ans.

Fig 8.3: Froth floatation method

(3)   **Electrolytic reduction of alumina**
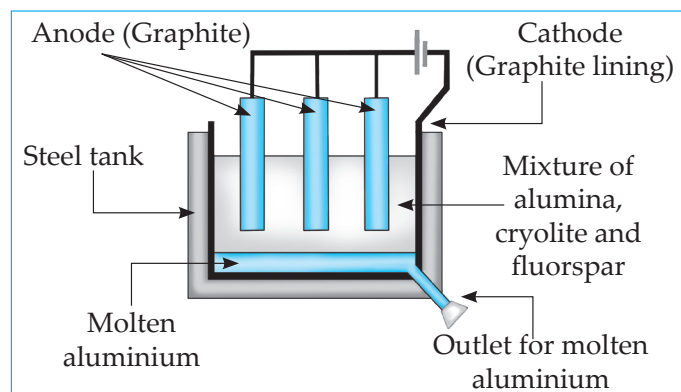
Ans.
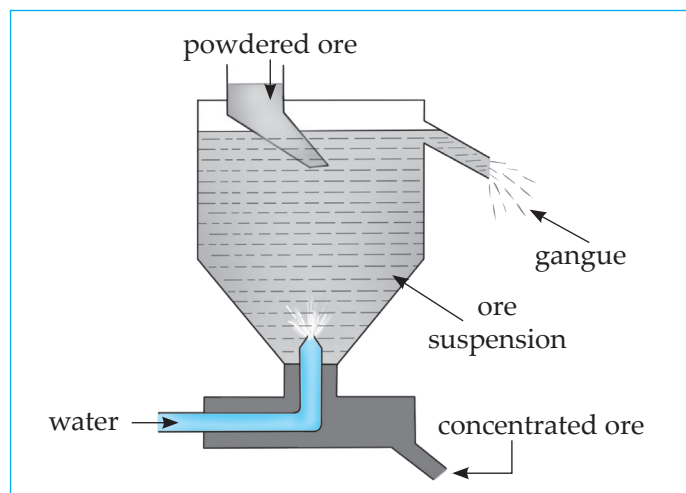

Fig 8.4: Extraction of aluminium

(4) **Hydraulic separation method.**

Ans.

Fig 8.5: Hydraulic separation

Q.3.3. **Complete the following statement using every given options.**

During the extraction of aluminium ⎯⎯⎯⎯⎯⎯

(1) **Ingredients and gangue in bauxite.**

Ans. Aluminium is extracted from its ore Bauxite $(Al_2O_3.nH_2O)$.

Bauxite contins 30% to 70% of Al_2O_3 and remaining part is gangue. It is made up of sand,silica,iron oxide etc. Silica (SiO_2), ferric oxide (Fe_2O_3) and titanium oxide (TiO_2) are the impurities present in bauxite.

(2) **Use of leaching during the concentration of ore.**

Ans.

(i) Leaching is a method in which ore is soaked in a certain solution for a long time.

(ii) The ore dissolves in that solution due to a specific chemical reaction.

(iii) The gangue does not react and therefore does not dissolve in that solution.

(iv) During the concentration of ore, separation of impurities is done by leaching process using either Bayer's method or Hall's method.

(3) **Chemical reaction of transformation of bauxite into alumina by Hall's process.**

Ans.

(i) In the Hall's process, the ore is powdered and then leached by heating with aqueous sodium carbonate to form water soluble sodium aluminate.

(ii) Then the insoluble impurities are filtered out.

(iii) The filtrate is warmed and neutralised by passing carbon dioxide gas through it.

(iv) This results in the precipitation of aluminium hydroxide.

(v) $Al_2O_3.2H_2O_{(s)} + Na_2CO_{3(aq)} \rightarrow 2NaAlO_{2(aq)} + CO_{2(g)} + 2H_2O_{(l)}$

(vi) $2NaAlO_{2(aq)} + 3H_2O_{(l)} + CO_{2(g)} \rightarrow 2Al(OH)_3 \downarrow + Na_2CO_3$

(vii) The precipitate of $Al(OH)_3$ obtained in Hall's process is filtered, washed, dried and then calcinated by heating at 1000°C to obtain alumina.

(viii) $2Al(OH)_3 \rightarrow Al_2O_3 + 3H_2O$.

(4) **Heating the aluminium ore with concentrated caustic soda.**

Ans. Aluminium oxide being amphoteric in nature, it reacts with the concentrated solution of sodium hydroxide (caustic soda) at 140°C to 150°C under high pressure for 2 to 8 hours in a digester to form water soluble sodium aluminate.

$$Al_2O_3.2H_2O_{(s)} + 2NaOH_{(aq)} \rightarrow 2NaAlO_{2\,(aq)} + 3H_2O_{(l)}$$

Aluminium oxide   *Sodium hydroxide*   *Sodium aluminate*   *Water*
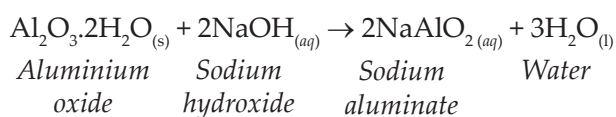
Q.3.4. **(1) Study the diagram and answer the questions:**
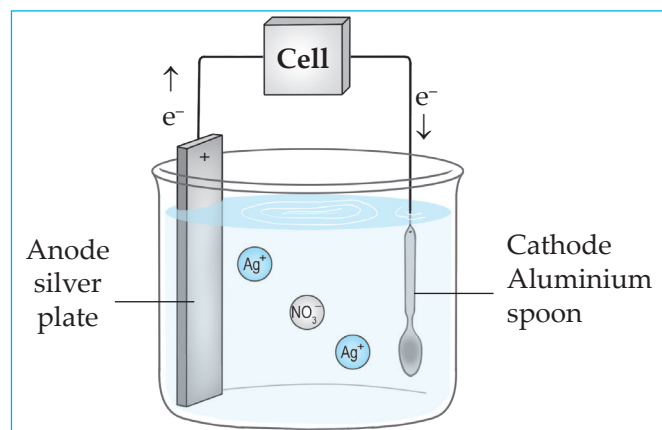
Fig 8.6: Electroplating

(a) **What does the diagram represent?**

Ans. The above diagram represents the process of Electroplating of Silver.

(b) **What can you say about the reactivity of metals at anode and cathode.**

Ans. The reactivity of metal at anode is less than the reactivity of metal at cathode.

(c) **Write the reactions occuring at cathode and anode.**

Ans. The electrode reaction are as follows:

Anode reaction - $Ag \rightarrow Ag^+ + e^-$

Cathode reaction - $Ag^+ + e^- \rightarrow Ag$
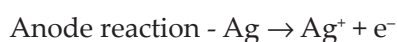
(2) Refer the following diagram which shows reaction of a metal with water and answer the following questions.

(a) Name two metals which do not react in the above experiment.

Ans. The two metals which do not react in the above experiment are Gold (Au) and Platinum (Pt.)

(b) What are the properties of the gas produced in the above experiment?

Ans. The properties of hydrogen gas are as follows:

(i) It is colourless, odourless and tasteless gas.

(ii) It is lighter than air.

(iii) It is insoluble in water.

(iv) It is combustible gas but does not support combustion.

(v) Hydrogen burns with a pop sound in oxygen with a pale blue flame forming water.

(c) Write a balanced chemical equation for the reaction of any one metal in the above process.

Ans. When Aluminium metal reacts with steam it forms Aluminium oxide and hydrogen gas.

$$2Al_{(s)} + 3H_2O_{(g)} \rightarrow Al_2O_{3(s)} + 3H_{2(g)}$$
Aluminium   Water   Aluminium   Hydrogen
                              oxide

Q.4.1. Read the passage and answer the following question:

(1) Anodising is a process of forming a thick oxide layer of aluminium. Aluminium develops a thin oxide layer when exposed to air. This aluminium oxide coat makes it resistant to further corrosion. The resistance can be improved by making the oxide layer thicker. In this technique aluminium article is used as an anode. Electrolyte used is dilute sulphuric acid. The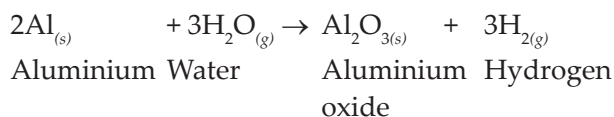 anode reaction results in formation of a black coloured thin film of aluminium oxide on the surface of anode. By putting appropriate dyes in the electrolytic bath coloured surface with decorative finish can be achieved. Kitchen articles like anodised pressure cooker, anodised pans and also frames of sliding windows are the applications of anodising techniques.

(a) How can we make an aluminium article resistant to corrosion?

Ans. If an aluminium article is coated with aluminium oxide, it becomes resistant to the corrosion.

(b) Name the technique used to coat the aluminium article.

Ans. The technique used is 'Anodising'.

(c) Name the anode and electrolyte used in this technique.

Ans. The aluminium article to be coated is used as anode, while dilute sulphuric acid is used as an electrolyte in this technique.

(d) How can we use this technique to obtain articles for decorative purpose?

Ans. By adding appropriate dyes in the electrolytic bath, we can obtain decorative finish for the articles which can be used for decorative purpose.

(e) Name any two articles commonly used in day to day life obtained by using this technique.

Ans. Anodised pressure cookers, pans and sliding windows are some articles used in day to day life.

Q.4.2. Answer in brief.

(1) State any four properties of Ionic compounds.

Ans.

(i) Ionic compounds are solids and are hard due to strong force of attraction between positive and negative ions.

(ii) They are generally brittle and break into pieces when pressure is applied.

(iii) Ionic compounds have high melting and boiling points, as a considerable amount of energy is required to break the strong inter molecular forces of attraction.

(iv) They are generally soluble in water and insoluble in solvents such as kerosene, petrol etc.

(v) Ionic compounds do not conduct electricity in solid state, due to their rigid structure. They conduct electricity in molten state or in solution in solvent like water.

(2) Describe Bayer's Process.

Ans.

(i) During extraction of aluminium from bauxite, the bauxite ore is concentrated by Bayer's Process.

(ii) During concentration, bauxite is converted into alumina.

(iii) Crude bauxite contains impurities like iron oxide and silica which are removed during Bayer's process.

(iv) The ore is first ground in a ball mill. Then it is leached by heating it with concentrated caustic

soda solution under high pressure for 2 to 8 hours at 140 °C to 150 °C in a tank called digester.

(v) Aluminium oxide (Al_2O_3) being amphoteric dissolves in aqueous NaOH to form water soluble Sodium aluminate ($NaAlO_2$).

$Al_2O_3.2H_2O_{(s)} + 2NaOH_{(aq)} \rightarrow 2NaAlO_{2\,(aq)} + 3H_2O_{(l)}$
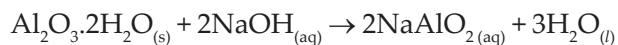
(vi) The impurities like Fe_2O_3 do not dissolve in aqueous NaOH and are removed by filteration.

(vii) Silica from the gangue dissolves in aqueous NaOH forming water soluble sodium silicate

(viii) Sodium aluminate is diluted and cooled to 50°C and hydrolyzed to give aluminium hydroxide as precipitate.

$NaAlO_2 + 2H_2O \rightarrow NaOH + Al(OH)_3$
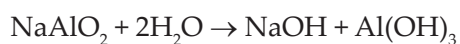
The precipitate of $Al(OH)_3$ obtained is filtered, washed,dried and then calcinated by heating at 1000°c to obtain alumina.

$2Al(OH)_3 \rightarrow Al_2O_3 + 3H_2O.$
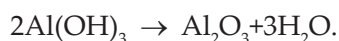
(3)   Describe Hall's Process.

Ans. *Refer to answer Q.3.3 (3)*

(4)   Describe the process of electrolytic reduction of Alumina with the help of a diagram.

Ans. *(For diagram, refer fig 8.4)*

(i) During the process of electrolytic reduction of aluminium, a molten mixture of pure alumina (m.p. is > 2000 °C) is electrolysed in a steel tank.

(ii) This tank is lined inside with carbon graphite which acts as cathode and a set of graphite rods dipped in the molten electrolyte acts as anode.

(iii) Cryolite (Na_3AlF_6) and Fluorspar (CaF_2) are also added to the mixture to lower the melting point to about 1000 °C. Current is passed through the electrolyte and aluminium is formed at the cathode.

(iv) The molten aluminium sinks to the bottom of the tank as it is heavier from there it is removed periodically.

(v) Oxygen is liberated at the anode.

(vi) The reaction occuring at the cathode and anode are:

Cathode reaction: $Al^{3+} + 3e^- \rightarrow Al_{(l)}$ (Reduction)

Anode reaction: $2O^{2-} + 4e^- \rightarrow O_2 + 4e^-$ (Oxidation)
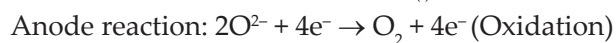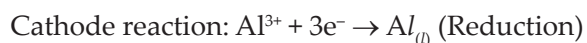
(vii) The oxygen liberated reacts with the carbon anode to form carbon dioxide gas.

(viii) As a result of this oxidation, carbon anode have to be replaced at intervals.

(5)   How can corrosion of metals be prevented?

Ans. Corrosion of metals can be prevented by coating the metal with something which does not react with moisture and oxygen.

(i) To fix a layer of any substance on the metal surface so that the contact of the metal with moisture and oxygen in the air is prevented and no reaction would occur between them.

(ii) Metals can be coated with paints , oils, grease or varnish.

(iii) Another method of preventing corrosion is done by coating a corrosive metal with a non - corrosive metal.

This can be done by following methods:

(a) Galvanizing : It is done by coating the metal with a thin coating of Zinc on iron or steel.

(b) Tinning is a process where a layer of molten tin is coated over another metal e.g. copper, brass, etc.

(c) Electroplating :

In this method, a less reactive metal is coated on a more reactive metal by electrolysis. e.g. silver plated spoon.

(d) Alloying :

A homogeneous mixture of a metal with other metals or non-metals in certain proportion is called an alloy. This prevents corrosion.

(e) Anodizing :

It is done to prevent corrosion of aluminium. Aluminium is coated with a strong film of its oxide electrically.

Fig 8.7: Anodization

(6)   Describe the separation methods which are based on gravitation.

Ans. Separation method based on gravitation - The heavy particles of ores can be easily separated from the light particles of gangue by the

gravitational method. The processes to carry out this separation are as follows:

(i) **Wilfley table method:**

(a)   In this method of separation, the Wilfley table is made by fixing narrow and thin wooden riffles on inclined surface.
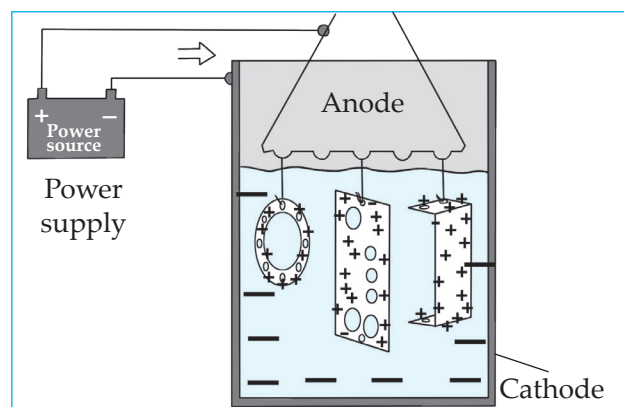
(b)   The table is kept vibrating continuously.

(c)   Powdered ore obtained from lumps of the ore using ball mill is poured on the table and a stream of water is also released from the upper side.

(d)   As a result, the lighter gangue particles are carried away along with the flowing water, while the heavier particles in which proportion of minerals is more and proportion of gangue is less, are blocked by wooden riffles and get collected on the slits between them.

(ii) **Hydraulic separation method:**

(a)   The hydraulic separation method is based on the working of a mill.

(b)   There is a tapering vessel similar to that used in a grinding mill.

(c)   It opens in a tank-like container that is tapering on the lower side.

(d)   The tank has an outlet for water on the upper side and a water inlet on the lower side.

(e)   Finely ground ore is released in the tank.

(f)   A forceful jet of water is introduced in the tank from the lower side.

(g)   Gangue particles are lighter and therefore they flow out along with the water jet from the outlet on the upper side of the tank and get collected separately.

(h)   At the same time the heavy particles of the ore are collected at the bottom from the lower side of the tank.

(i)   In short, this method is based on the law of gravitation, wherein particles of the same size are separated by their weight with the help of water. *(For diagram, refer fig 8.5)*

(7) **Describe some general methods for the concentration of ore.**

Ans.

(i) **Magnetic Separation method:**

(a)   This method requires an electromagnetic machine.

(b)   The main parts of this machine are two types of iron rollers and the conveyor belt moving continuously around them.

(c)   One of the rollers is nonmagnetic while the other is electromagnetic.

(d)   The conveyor belt moving around the rollers is (non magnetic) made up of leather or brass.

(e)   The powdered ore is poured on the conveyor belt near the nonmagnetic roller.

(f)   Two collector vessels are placed below the magnetic roller.

(g)   The particles of the nonmagnetic part in the ore are not attracted towards the magnetic roller.

(h)   Therefore, they are carried further along the belt and fall in the collector vessel placed away from the magnetic roller.

(i)   At the same time, the particles of the magnetic ingredients of the ore stick to the magnetic roller and therefore fall in the collector vessel near the magnetic roller.

(j)   In this way the magnetic and nonmagnetic ingredients in the ore can be separated depending on their magnetic nature.

        For example, cassiterite is a tin ore.

(k)   It contains mainly the nonmagnetic ingredient stannic oxide (SnO_2) and the magnetic ingredient ferrous tungstate ($FeWO_4$).

(l)   These are separated by the electromagnetic method.

        (For diagram, refer fig 8.2)

(ii) **Froth floatation method:**

(a)   The froth floatation method is based on the two opposite properties, hydrophilic and hydrophobic, of the particles.

(b)   Here the particles of the metal sulphides, due to their hydrophobic property, get wetted mainly with oil, while due to the hydrophilic property the gangue particles get wetted with water.

(c)   By using these properties certain ores are concentrated by froth floatation method.

(d)   In this method, the finely ground ore is put into a big tank containing ample amount of water.

(e)   Certain vegetable oil such as pine oil, eucalyptus oil, is added in the water for the formation of froth.

(f)   Pressurised air is blown through the water.

(g)   There is an agitator rotating around its axis in the centre of the floatation tank. The agitator is used as per the requirement. Bubbles are formed due to the blown air.

(h) Due to agitation, a foam is formed from oil, water and air bubbles together. Due to the agitating. This foam rises to the surface of water and floats. That is why this method is called froth floatation process.

(i) Particles of certain sulphide ore float with the foam on water as they preferentially get wetted by the oil. For example, this method is used for the concentration of zinc blend (ZnS) and copper pyrite (CuFeS$_2$)

(For diagram, refer fig 8.3)

(iii) Leaching:

(a) The first step in the extraction of the metals like aluminium, gold silver from their ores is the method of leaching.

(b) In this method the ore is soaked in a certain solution for long time.

(c) The ore dissolves in that solution due to a specific chemical reaction.

(d) The gangue does not react and therefore does not dissolve in that solution.

(e) So it can be separated. For example, concentration of bauxite, the aluminium ore is done by leaching method.

(f) Here, bauxite is soaked in aqueous NaOH or aqueous Na$_2$CO$_3$ which dissolves the main ingredient alumina in it.

Q.4.3. Solve the following questions:

(1) **Redraw the given diagram and label the parts. Complete the paragraph with the words given in the bracket:**

(magnetic roller, particles of the magnetic ingredients, away, near, conveyor belt, nonmagnetic part)

Ans.
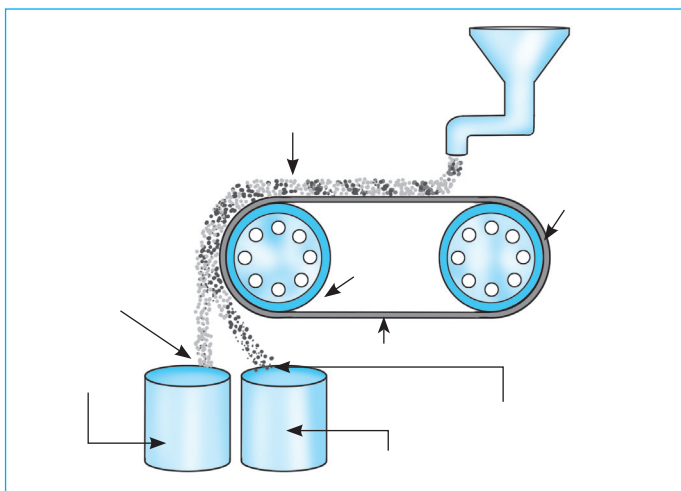
Ans. *For labelled diagram Refer to fig 8.2*

The powdered ore is poured on the **conveyor belt** near the nonmagnetic roller. Two collector vessels are placed below the magnetic roller. The particles of the **nonmagnetic part** in the ore are not attracted towards the **magnetic roller**. Therefore, they are carried further along the belt and fall in the collector vessel placed **away** from the magnetic roller. At the same time the **particles of the magnetic ingredients** of the ore stick to the magnetic roller and therefore fall in the collector vessel **near** the magnetic roller.

(2) **Redraw the given diagram and label it correctly. Answer the questions given below.** *(For diagram refer Q.4.3 (1))*

Ans. *For labelled diagram Refer to fig 8.2*

(a) What does the above diagram indicates?

Ans. The above diagram indicates the process of Magnetic separation method of concentration of ores.

(b) Name an ore which is concentrated by this method and also write the two ingredients with molecular formulae, present in this ore.

Ans. The ore which is concentrated by this method is cassiterite.

Cassiterite is a ore. It contains mainly the nonmagnetic ingredient stannic oxide (SnO$_2$) and the Magnetic ingredient ferrous tungstate (FeWo$_4$).

(3) **Redraw the given diagram and label the parts. Complete the paragraph with the words given in the bracket:**

(gangue particles, hydrophobic, oil, water, metal sulphides, hydrophillic)
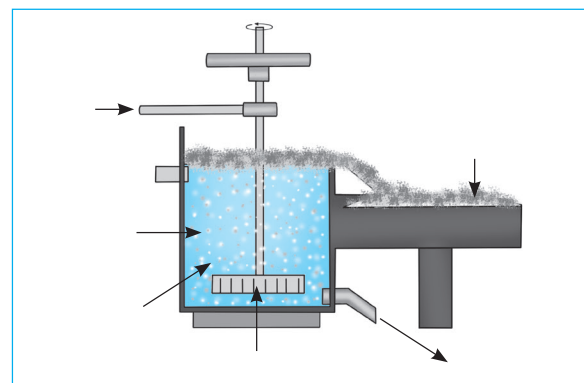
Ans. *For labelled diagram Refer to fig 8.3*

The froth floatation method is based on the two opposite properties, **hydrophilic** and **hydrophobic**, of the particles. Here the particles

of the **metal sulphides**, due to their hydrophobic property, get wetted mainly with **oil**, while due to the hydrophilic property the **gangue particles** get wetted with **water**. By using these properties certain ores are concentrated by froth floatation method.

(4) **Redraw the given diagram and label it correctly. Answer the questions given below:** *(For diagram refer Q.4.3 (3))*

Ans. *For labelled diagram Refer to fig 8.3*

(a) What does the above diagram indicates?

Ans. The above diagram indicates the process of Froth floatation method of concentration of ores.

(b) Name two ores along with their molecular formula which are concentrated by this method.

Ans. The two ores concentrated by this method are

(i) Zinc blende - Zns (ii) Copper pyrite - $CuFeS_2$.

(c) What is the use of pine oil in this process?

Ans. The use of pine oil in this process is as follows:

(i) Pine oil is hydrophobic in nature and also it attracts the particles of sulphide ore.

(ii) Thus the particles of sulphide ore get wetted by pine oil.

(iii) Due to air supply and agitation, pine oil forms a froth which floats on the surface of water. Thus the particles of sulphide ore are separated from water.

(iv) The gangue particles get wetted by water and are removed from the bottom.

(5) **Redraw the given diagram and label the parts. Complete the paragraph with the words given in the bracket:**

(heavy particles, Gangue particles, bottom, lower, lighter, upper)
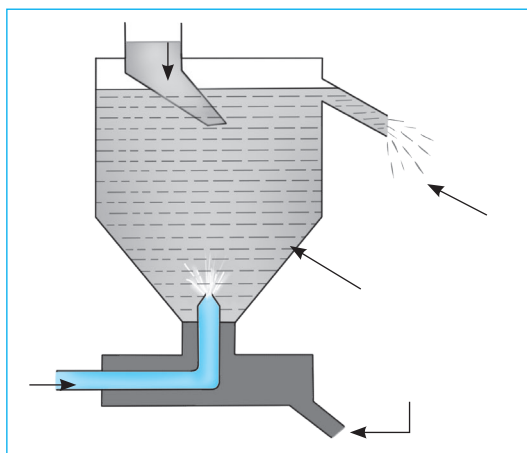
Ans. *For labelled diagram Refer to fig 8.5*

In hydraulic separation method, the finely ground ore is released in the tank. A forceful jet of water is introduced in the tank from the **lower** side. **Gangue particles** are **lighter** and therefore they flow out along with the water jet from the outlet on the **upper** side of the tank and get collected separately. At the same time the **heavy particles** of the ore are collected at the bottom from the lower side of the tank.

(6) **Redraw the given diagram and label it correctly. Answer the questions given below:** *(For diagram refer Q.4.3 (5))*

Ans. *For labelled diagram Refer to fig 8.5*

(a) What does the above diagram indicates?

Ans. The above diagram indicates the process of Hydraulic separation method of concentration of ores.

(b) Explain the law on which this method is based.

Ans. This method is based on the law of gravitation, where in particles of the same size are separated by their weight with the help of water.

(7) **Redraw the given diagram and label the parts. Completer the paragraph with the words given in the bracket:**

(heavier, ball mill, lighter, slits, inclined, stream of water, vibrating)
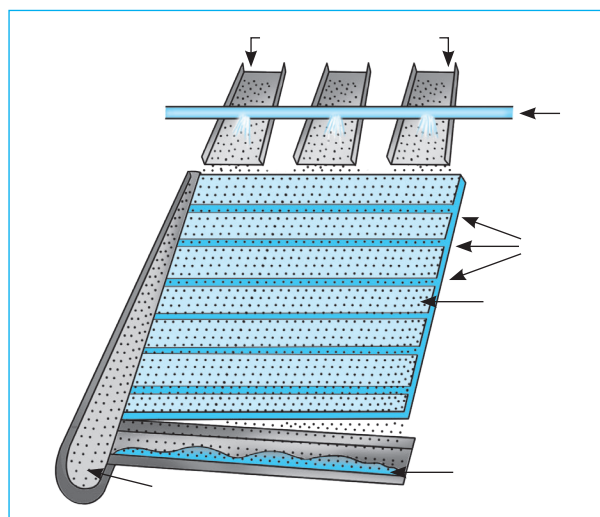
Ans. *For labelled diagram Refer to fig 8.8*

In the method of separation, Wilfley table is made by fixing narrow and thin wooden riffles on **inclined** surface. The table is kept **vibrating** continuously. Powdered ore obtained from lumps of the ore using **ball mill** is poured on the table, a **stream of water** is also released from the upper side. As a result, the **lighter** gangue particles are carried away along with the flowing water, while the **heavier** particles in which proportion

of minerals is more and proportion of gangue is less, are blocked by the wooden riffles and get collected on the **slits** between them.

(8) **Redraw the given diagram and label it correctly. Answer the questions given below:** *(For diagram refer Q.4.3 (7))*

Ans. *For labelled diagram Refer to fig 8.8*

(a) What does the above diagram indicates?

Ans. The above diagram indicates the process of Wifley table method of concentration of ores.

(b) What is the result of gangue particles and ore particles in this process.

Ans. The result of this process is that the lighter gangue particles are carried away along with the flowing water, while the heavier particles of ore are blocked by the wooden riffles and get collected on the slits between them.

(9) **Answer the questions based on the given diagram.**

Label the diagram and answer the given questions.
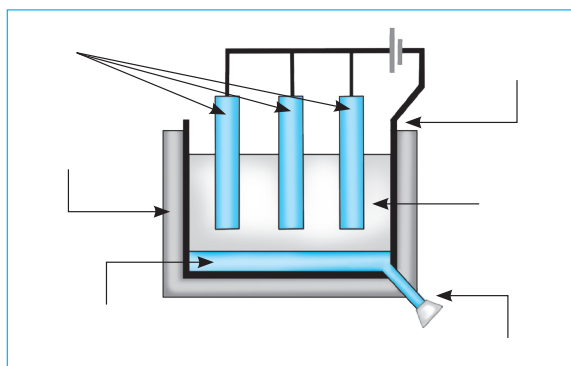
Ans. *For labelled diagram Refer to fig 8.4*

(a) What is the importance of cryolite and fluorspar?

Ans. Cryolite (Na_3AIF_6) and fluorspar (CaF_2) are added in the mixture to lower its melting point upto $1000\ ^0C$.

(b) Write the anode and cathode reactions.

Ans. Anode reaction : $2O^{2-} \rightarrow O_2 + 4e^-$ (Oxidation)

Cathode reaction : $Al^{3+}\ 3e^- \rightarrow Al_{(l)}$ (Reduction)

(10) **Redraw the given diagram and label it correctly. Answer the questions given below:** *(For diagram refer Q.4.3 (9))*

Ans. *For labelled diagram Refer to fig 8.4*

(a) What does the above diagram indicate?

Ans. The above diagram indicates the process of Electrolytic reduction of alumina in Extraction of aluminium.

(b) In the above process, name the two compounds along with their molecular formula which are added in the mixture to lower its melting point.

Ans. The two compounds cryolite (Na_3AIF_6) and Fluorspar (CaF_2) are added in the mixture to lower its melting point up to $1000\ ^0C$

(c) Give the cathode and anode reactions?

Ans. The electrode reactions are as shown below.

Anode reaction : $2O^{2^-} \rightarrow O_2 + 4e^-$ (Oxidation)

Cathode reaction : $Al^{3+} + 3e^- \rightarrow Al_{(l)}$ (Reduction)

❖ ❖ ❖

ASSIGNMENT - 8

Time : 1 Hr.	**Marks : 20**

Q.1. (A) Answer the following questions: (3)

(1)   Fill in the blank:

(i)   The metals that produce a sound on striking on hard surface are said to be _____ .

(2)   Find the odd man out:

(i) K_2O, Na_2O, CaO, Al_2O_3

(3)   Find out the correlation

Brass : Copper and Zinc :: Bronze : _____

Q.1. (B) Choose and write the correct options: (2)

(1)   _____ has the highest melting point.

(a) Copper   (b) Iron   (c) Tungsten   (d) Zinc

(2)   Cinnabar is an ore of _____

(a) Aluminium   (b) Sodium   (c) Iron   (d) Mercury

Q.2. Answer the following: *(Any 2)* (4)

(1)   Distinguish between metals and non-metals.

(2)   Write the balanced chemical equation for the reaction.

When copper reacts with concentracted nitric acid.

(3)   How can corrosion of metals be prevented?

Q.3. Answer the following: *(Any 2)* (6)

(1)   Describe Bayer's Process.

(2)   The electronic configuration of metal 'A' is (2, 8, 1), and that of metal 'B' is (2, 8, 2). Which of these two metals is more reactive? Write their reaction with dilute hydrochloric acid.

(3)   Explain magnetic separation method.

Q.4. Answer the following: *(Any 1)* (5)

(1)   Give scientific reasons:

(i)   Lemon or tamarind is used for cleaning copper vessels turned greenish.

(ii) Gold and silver are used to make jewellery.

(2)   Explain electrolytic reduction of Alumina with the help of a diagram.

❖ ❖ ❖

9 Carbon Compounds

CONCEPT MAP

Living things → Substances in Nature → Non living → are → Inorganic (may or may not contain carbon)

Substances in Nature are Organic (all containing carbon)

Living things are Organic

Inorganic can be converted to Organic

Organic are Hydrocarbons

Non living are Inorganic

Inorganic containing carbon → CO, CO_2, Na_2CO_3, $NaHCO_3$, Air

Inorganic not containing carbon → not containing carbon, O_2, Fe, sand, water.

Hydrocarbons → Straight chain and branched chain

Hydrocarbons → Closed chain or Cyclic or Ring compounds

Straight chain and branched chain are classified as → Saturated / Unsaturated

Saturated → Shading (Alkanes) (– C –) e.g. Ethane (C_2H_6)

Unsaturated → (Alkenes) (– C = C –) e.g. Ethene (C_2H_4)

Unsaturated → (Alkynes) (– C ≡ C –) e.g. Ethyne (C_2H_2) (H– C ≡ C –H)

Saturated → Undergo substitution reaction

Unsaturated → Undergo addition reaction

Closed chain or Cyclic or Ring compounds are classified as → Alicyclic hydrocarbon e.g. Cyclohexane (C_6H_{12}) / Aromatic hydrocarbon e.g. Benzene (C_6H_6)

MASTER KEY QUESTION SET - 9

Q.1 (A) 1. Fill in the blanks and rewrite the completed sentence

(1) The essential element in all the organic compounds is ....

(2) The organic compounds having double or triple bonds in them are termed as ....

(3) The chemical bonds in carbon compounds do not produce ....

(4) The chemical bond formed by sharing of two valence electrons between the two atoms is called ....

(5) .... are known as parent organic compounds.

(6) Saturated hydrocarbons have .... bonds only.

(7) The general formula for alkanes is ....

(8) Hydrocarbons necessarily contain .... and ....

(9)   Covalent compounds are generally soluble in .... solvents.

(10) The molecular masses of carbon compounds range upto ....

(11) The property of carbon atom to form strong covalent bond with itself and results in formation of big molecules, is called ....

(12) Being .... one carbon atom can form bonds with four other atoms.

(13) Hydrocarbons having identical molecular formula but different structures are called ....

(14) The molecular formula of cyclohexane is ....

(15) .... is a cyclic unsaturated hydrocarbon.

(16) The functional group $\overset{O}{\underset{-C-}{\|}}$ is called ....

(17) Difference between successive members of homologous series is ....

(18) Ethanol gets oxidized by alkaline Potassium permanganate to form ....

(19) The reaction in which the place of one type of atom/ group in a reactant is taken by another atom/ group of atoms is called ....

(20) Ethanoic acid is commonly called ....

(21) Ethanol is also called .... or ....

(22) During winter in cold countries ethanoic acid freezes at room temperature itself and looks like ice. Therefore, it is named ....

(23) The giant carbon molecules formed from hundreds and thousands of atoms are called ....

(24) A macro molecule formed by regular repetition of a small unit is called ....

(25) Boiling point of ethanol is .... and freezing point is ....

(26) Molecular formula for the homologous series of alkynes is ....

(27) The IUPAC name of the salt is Sodium ethanoate while its common name is ....

Ans. *(1) Carbon (2) Unsaturated hydrocarbon (3) ions (4) Covalent bond (5) Hydrocarbons (6) single (7) C_nH_{2n+2} (8) Hydrogen and Carbon (9) organic (10) 10^{12} (11) Catenation (12) tetravalent (13) isomers*

(14) C_6H_{12} (15) Benzene (16) Ketone (17) $^-CH_2$ (18) ethanoic acid (19) substitution reaction (20) Acetic acid (21) alcohol or sprit (22) glacial acetic acid (23) macromolecules (24) polymer (25) 78°C, –114°C (26) C_nH_{2n-2} (27) sodium acetate

Q.1 (A) 2. Match the columns:

(1)

Column A	Column B
(1) Benzene	(a) CH_3COOH
(2) Sodium ethoxide	(b) C_6H_{12}
(3) Acetic acid	(c) C_6H_6
(4) Cyclohexane	(d) CH_3CH_2ONa

Ans. *(1 – c), (2 – d), (3 – a), (4 – b)*

*(2)

Column A	Column B
(1) C_2H_6	(a) Unsaturated hydrocarbon
(2) C_2H_2	(b) Molecular formula of an alcohol
(3) C_2H_5OH	(c) Saturated hydrocarbon
(4) C_3H_6	(d) Triple bond

Ans. *(1 – c), (2 – d), (3 – b), (4 – a)*

(3)

Column A Name of the Compound	Column B Structural Formula
(1) Ethyl alcohol	(a) $CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_3$
(2) Acetone	(b) $CH_3\text{-}CH_2\text{-}CH_2\text{-}OH$
(3) Propionic acid	(c) $CH_3-\overset{\overset{O}{\|}}{C}-CH_3$
(4) Ethyne	(d) $CH_3\text{-}CH_2\text{-}C\overset{O}{\underset{OH}{\diagup}}$
(5) Propanol	(e) $CH_3\text{-}CH_2OH$
(6) Butane	(f) $CH \equiv CH$

Ans. *(1 – e), (2 – c), (3 – d), (4 – f), (5 – b), (6 – a)*

(4)

Column A Name of Polymer	Column B Constituent monomer
(1) Polyethylene	(a) $CF_2 = CF_2$
(2) Polystyrene	(b) $CH_3 – CH=CH_2$
(3) Polyvinyl chloride (PVC)	(c) $CH_2 = CH – C \equiv N$
(4) Polyacrylo nitrile	(d) $Cl – CH = CH_2$
(5) Teflon	(e) $CH_2 = CH_2$
(6) Polypropylene	(f) $C_6H_5 – CH = CH_2$

Ans. *(1 – e), (2 – f), (3 – d), (4 – c), (5 – a), (6 – b)*

(5)	Column A	Column B
	(1) $CH_3COOH + CH_3 - CH_2 - OH \xrightarrow[\text{Catalyst}]{\text{Acid}} CH_3 - COO - CH_2 - CH_3 + H_2O$	(a) Addition Reaction
	(2) $CH_2= CH_2 + H_2 \xrightarrow{\text{Ni}} CH_3 - CH_3$	(b) Substitution reaction
	(3) $CH_4 + Cl_2 \xrightarrow{\text{Sunlight}} CH_3Cl + HCl$	(c) Neutralisation reaction
	(4) $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$	(d) Esterification reaction

Ans. *(1 – d), (2 – a), (3 – b), (4 – c)*

Q.1. (A) 3. State whether the following statements are true or false. If false, rewrite the correct statements:

(1) Saturated hydrocarbons burn with smoky flame.

(2) The essential element in all the organic compounds is carbon.

(3) Generally, most of the carbon compounds are found to be good conductors of electricity.

(4) Two pairs of electrons are shared between two nitrogen atoms to form a nitrogen molecule.

(5) Ethanoic acid reacts with a base like sodium hydroxide to form sodium ethanoate and water.

(6) When Unsaturated carbon compounds burn, they give a clean oxidizing flame with lots of black carbon.

(7) CH_3-CH_2-CH_2Br is 1- bromo propane.

(8) Carbon is tetravalent and it can undergo catenation.

(9) $CH_3 - CH_2 - \overset{\overset{O}{\|}}{C} - OH$ is propanone.

(10) Covalent compounds have high melting and boiling points.

(11) Monomer of protein is alpha amino acids.

(12) The atom of the element which is substitute for hydrogen is referred as hetero atoms.

Ans. *(1) False. Saturated hydrocarbon burns with non-smoky flame. (2) True (3) False. Generally most of the carbon compounds are found to be bad conductor of electricity. (4) False. Three pairs of electron are shared between two nitrogen atoms to form a Nitrogen molecule. (5) True (6) False. When unsaturated carbon compounds burn, they give yellow flame with lots of black carbon. (7) True (8) True (9) False. It's a propanoic acid (10) False. Covalent compounds have low melting and boiling points (11) True (12) True.*

*Q.1. (A) 4. Write the IUPAC names of the following structural formula

(1) $CH_3 – CH_2 – CH_2 – CH_3$

(2) $CH_3 – CH – OH –CH_3$

(3) $CH_3 – CH_2 – COOH$

(4) $CH_3 – CH_2 – NH_2$

(5) $CH_3 – CHO$

(6) $CH_3 –CO – CH_2 – CH_3$

Ans. *(1) Butane (2) Propanol or Propan-1-ol (3) Propan-1-oic acid (4) Ethan-1-amine (5) ethanal (6) butan - 2 - one*

Q.1. (A) 5. Identify the type of the following reaction of carbon compounds.   **Ans.**

*(1) CH_3-CH_2-CH_2-OH $\rightarrow$ CH_3-CH_2-$COOH$ $\rightarrow$ Oxidation reaction

*(2) CH_3-CH_2-$CH_2 + 5O_2$ $\rightarrow$ $3CO_2 + 4H_2O$ $\rightarrow$ Combustion reaction

*(3) CH_3-$CH = CH - CH_3 + Br_2$ $\rightarrow$ CH_3-$CHBr - CHBr-CH_3$ $\rightarrow$ Addition reaction

*(4) CH_3-$CH_3 + Cl_2$ $\rightarrow$ CH_3-CH_2-$Cl + HCl$ $\rightarrow$ Substitution reaction

*(5) CH_3-CH_2-CH_2-CH_2-OH $\rightarrow$ CH_3-$CH_2 – CH = CH_2 + H_2O$ $\rightarrow$ Dehydration reaction

*(6) CH_3-CH_2-$COOH + NaOH$ $\rightarrow$ CH_3-CH_2-$COONa + H_2O$ $\rightarrow$ Neutralization reaction

*(7) CH_3-$COOH + CH_3$-OH $\rightarrow$ CH_3-$COOCH_3 + H_2O$ $\rightarrow$ Esterification reaction

(8) $CH_3COOC_2H_5 + NaOH$ $\rightarrow$ $CH_3COONa + C_2H_5OH$ $\rightarrow$ Saponification reaction

(9) $CH_2 = CH_2 + Br_2$ $\rightarrow$ $Br–CH_2–CH_2–Br$ $\rightarrow$ Addition reaction

(10) $2CH_3OH + 3O_2$ $\rightarrow$ $2CO_2 + 4H_2O$ $\rightarrow$ Combustion reaction

(11) $CH_3CH_2OH + 2[O]$ $\rightarrow$ $CH_3COOH + H_2O$ $\rightarrow$ Oxidation reaction

Q.1. **(A) 6. Answer the following questions in one sentences:**

(1) Name the five things which contain carbon essentially.

Ans. Food, clothes, medicines, books, wooden table etc.

(2) How can carbon become stable?

Ans. Carbon becomes stable by sharing four electrons with atoms of other elements or carbon itself.

(3) Which organic compounds are named as alkanol in IUPAC system?

Ans. The alcohol with functional group –OH are named as alkanol in IUPAC system.

(4) What is glacial acetic acid?

Ans. Acetic acid or ethanoic acid when frozen below 17°C (290 K) solidifies to an ice-like mass, which is known as glacial acetic acid.

(5) What is covalent bond?

Ans. The chemical bond formed by sharing of two valence electrons between the two atoms is called covalent bond.

(6) What are isomers?

Ans. Compounds having different structural formula but having the same molecular formula are called isomers.

(7) What is a functional group?

Ans. The atom or group of atoms present in the molecule which determine characteristic properties of an organic compound is called the functional group.

*(8) What are the types of compounds? (Can you *recall; Textbook Page no. 110)*

Ans. Organic and Inorganic compounds.

*(9) Objects in everyday uses such as foodstuff, fibers, paper, medicines, wood, fuels are made of various compounds.
Which constituent elements are common in these compounds? *(Can you recall; Textbook Page no. 110)*

Ans. All these materials are made up of organic compounds and the constituent element common in their compounds is carbon.

*(10) To which group in the periodic table does the element carbon belong? Write down the electronic configuration of carbon and deduce the valency of carbon. *(Can you recall; Textbook Page no. 110)*

Ans. Carbon belongs to group 14 of the Periodic table. Its atomic number is 6. Electronic configuration is (2, 4) and valency of carbon is 4.

*(11) What is meant by a chemical bond? *(Can you tell; Textbook Page no. 110)*

Ans. A chemical bond is an attraction between atoms, ions or molecules that enables the formation of chemical compounds.

*(12) What is the number of chemical bonds that an atom of an element forms called? *(Can you tell; Textbook Page no. 110)*

Ans. The number of chemical bonds that an atom of an element forms is called its valency.

*(13) What are the two important types of chemical bond? *(Can you tell; Textbook Page no. 110)*

Ans. The two important types of chemical bond are Ionic or Electrovalent bond and Covalent bond.

*(14) With which bond C atom in CO_2 is bonded to each of the O atoms? *(Use your brain power; Textbook Page no. 112)*

Ans. As carbon and oxygen share the valence electrons and fulfill their valency, the bond formed is covalent bond.

*(15) Molecular formula of propane is C_3H_8. From the Molecular formula draw its structural formula. *(Use your brain power; Textbook Page no. 115)*

Ans. Structural formula : C_3H_8.

$$H - \overset{\overset{\displaystyle H}{|}}{C} - \overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}} - \overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}} - H$$
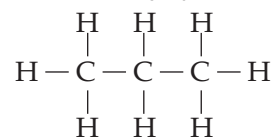
*(16) Propane (C_3H_8) is one of the combustible component of LPG. Write down the reaction for propane (C_3H_8). **(**Use your brain power; Textbook page no 123)*

Ans. $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O + \text{heat} + \text{light}$

*(17) Which is the component of biogas that makes it useful as fuel. *(Can you recall; Textbook Page no 123)*

Ans. Methane present in biogas makes it useful as fuel.

*(18) Which product is formed by the combustion of elemental carbon? *(Can you recall; Textbook Page no 123)*

Ans. Carbon dioxide and water are formed by the combustion of elemental carbon.

*(19) Is the biogas combustion reaction endothermic or exothermic *(Can you recall; Textbook Page no 123**)**

Ans. It is an exothermic reaction.

*(20) Which one of ethanoic acid and hydrochloric acid is stronger? *(Use your brain power; Textbook Page no 129)*

Ans. Hydrochloric acid is stronger than ethanoic acid (acetic acid).

*(21)   Which indicator paper out of blue litmus paper and pH paper is useful to distinguish between ethanoic acid and hydrochloric acid? *(Use your brain power; Textbook Page no 129)*

Ans. pH paper is useful to distinguish between the ethanoic acid and hydrochloric acid.

*(22) When fat is heated with sodium hydroxide solution, soap and glycerin are formed. Which functional groups might be present in fat and glycerin? *(Use your brain; Textbook page no 131)*

**Ans.** Ester –COO group, Alcohol- OH, and (–COOH) carboxyl functional groups, are present in fat and glycerin.

*(23) What are the chemical names of the nutrients that we get from the food stuff, namely cereals, pulses and meat? *(Can you tell; Textbook page no 131)*

Ans. Carbohydrates, fats and proteins

*(24) What are the chemical substances that make cloth, furniture, and elastic objects? *(Can you tell; Textbook page no 131)*

Ans. Manmade fibres, elastomers.

(25) Hydrogen peroxide decomposes on its own by the following reaction. *(Use your brain power; Textbook Page no. 113)*

$H – O – O – H \rightarrow 2H\text{-}O – H + O_2$
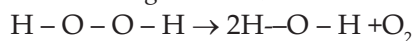
From this, what will be your inference about the strength of O – O, Covalent bond.

Ans. The strength of O - O, Covalent bond is weaker.

*(26) Tell from the above example whether oxygen has catenation power or not? *(Use your brain power; Textbook page no. 113)*

Ans. No, oxygen shows catenation property only in the formation of ozone.

(27) What is the full from of PET?

Ans. PET - Poly ethylene terephthalate.

(28) Give uses of the following polymer's.
  (a) polyethylene   (b) polystyrene
  (c) polyvinyl chloride   (d) polyacrylo nitrile

Ans. (a) polyethylene : It is used to make carry bags, and sports wear
  (b) polystyrene : It is used to make thermocol articles.
  (c) polyvinyl chloride : It is used to produce P.V.C. pipes, door mats, tubes and bags in hospital kits.
  (d) polyacrylo nitrile : It is used in producing winter clothing and blankets.

Q.1. **(B) Choose and write the correct option.**

(1) The fundamental organic compounds are also known as _____ compounds.
  (a) parent   (b) father
  (c) mother   (d) daughter

(2) A functional group mainly determines the _____ properties.
  (a) physical   (b) chemical
  (c) both   (d) none of the above

(3) The _____ hydrocarbon is also called marsh gas.
  (a) ethane   (b) propane
  (c) methane   (d) butane

(4) Ethane with the molecular formula C_2H_6 has _____ covalent bonds.
  (a) six   (b) seven   (c) eight   (d) nine

(5) What are the products obtained on complete combustion of hydrocarbons? _____
  (a) $CO + H_2O$ (b) $CO_2 + H_2$
  (c) $CO_2 + H_2O$ (d) $CO + H_2$

(6) The functional group of alcohol is _____ .
  (a) –COOH (b) –OH (c) $H-\overset{\overset{O}{\|}}{C}$ (d) $-\overset{\overset{O}{\|}}{C}-$

(7) Ethanol is used as an additive to increase the efficiency of petrol such a fuel is called _____
  (a) ethanol   (b) cananol
  (c) gashol   (d) methanol

(8) After the formation of four Covalent bonds, Carbon attains the electronic configuration of _____.
  (a) Helium   (b) Neon
  (c) Argon   (d) Krypton

(9) Diamond and graphite have the same _____.
  (a) chemical properties
  (b) degree of hardness
  (c) electrical conductivity
  (d) physical forms

(10) The reaction in which two molecules react to form a single product is known as _____ reaction.
  (a) substitution   (b) addition
  (c) hydrogenation   (d) polymerisation

(11) IUPAC name of $CH_3\text{-}CH_3$ is _____
  (a) ethene   (b) ethane
  (c) ethyne   (d) ethylene

(12) A saturated hydrocarbon will have suffix _____
  (a) –ene   (b) –yne   (c) –ane   (d) –one

(13) The valency of carbon is _____

(a) 2   (b) 3   (c) 4   (d) 6

(14) _____ is a natural macromolecule.

(a) Polythene   (b) Monosaccharide's

(c) Polysaccharides   (d) Disaccharides

(15) Gas evolved during fermentation _____

(a) O_2 (b) CO   (c) H_2 (d) CO_2

(16) A small unit that repeats regularly to form a polymer.

(a) Macromolecule   (b) Polysaccharides

(c) Monomer   (d) Dinomer

(17) Monomer of polythene is _____

(a) $CH \equiv CH$ (b) $CH_2=CH_2$

(c) $CH_3\text{-}CH_3$ (d) $C_2H_5 - C_2H_5$

(18) _____ are used for making fragrance and flavouring agents

(a) Ethers   (b)   Ethanol

(c) Ester   (d)   Ethanoic acid

(19) _____ is used in nonstick cookware.

(a) PVC   (b) Teflon

(c) Polystyrene   (d) Polypropylene

Ans. *(1) (a) parent   (2) (b) chemical (3) (c) methane (4) (b) seven (5) (c) CO_2+H_2O (6) (b)–OH (7) (c) gashol (8) (b) neon (9) (a) chemical properties (10) (b) addition (11) (b) ethane (12) (c) -ane (13) (c) 4 (14) (c) polysaccharides (15) (d) CO_2 (16) (c) monomer (17) (b) $CH_2=CH_2$ (18) (c) Ester (19) (b) Teflon*

Q.2.1. Define the following:

*(1) Structural isomerism

Ans. The phenomenon in which compounds have different structural formulae but have the same molecular formula is called structural isomerism.

e.g. Structural formula of compound C_4H_{10}
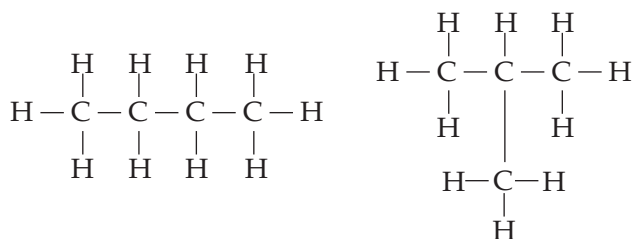
*(2) Covalent bond

Ans. The chemical bond formed by sharing of two valence electrons between the two atoms is called covalent bond.

e.g. Covalent bond is formed between oxygen and each of the hydrogen in a water molecule (H_2O).

Each of the covalent bonds contains two electrons – one from a hydrogen atom and one from the oxygen atom. Both atoms share the electrons.

*(3) Hetero atom in a carbon compound

Ans. The atoms of the elements, substitute one or more hydrogen atoms in the hydrocarbon chain and thereby, the tetravalency of carbon is satisfied. The atom of the element which is substitute for hydrogen is referred as hetero atom.

e.g. CH_3OH. In this example, one hydrogen atom in methane CH_4 is replaced by –OH group. OH is a functional group. So, OH is a heteroatom.

*(4) Functional group

Ans. The hetero atom or group of hetero atoms, present in a compound due to which the compound acquires specific chemical properties irrespective of the length and nature of the carbon chain in it, are called as functional group. e.g. alcohol group (-OH). Any hydrocarbon that has – OH substituent. e.g. methanol (CH_3OH)
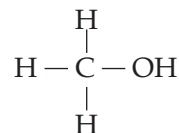
*(5) Alkane

Ans. Alkanes are chemical compounds that consist of carbon and hydrogen atoms, so they are also called hydrocarbons, the chemical structure of alkanes only consists of single covalent bonds. As they contain only single bonds, and because of that each carbon atom is saturated with hydrogen atoms. Alkanes are, therefore referred to as saturated hydrocarbons.

e.g.:Methane   Ethane   Pentane
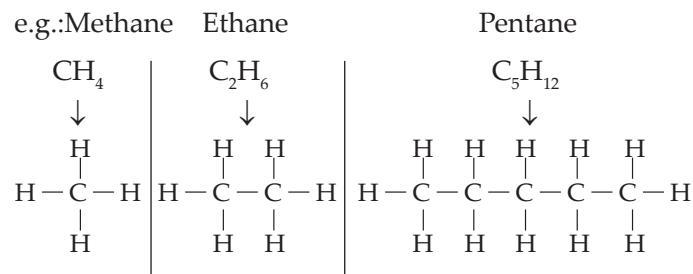
*(6) Unsaturated hydrocarbons

Ans. Hydrocarbons in which carbon atoms are linked to each other by double or triple bonds are known as unsaturated hydrocarbons.

e.g. Ethene; (C_2H_4),   Ethyne; (C_2H_2)

$$H-\overset{\downarrow}{C}=\overset{\downarrow}{C}-H \qquad H-C\equiv C-H$$
$$\underset{H}{|}\quad\underset{H}{|}$$
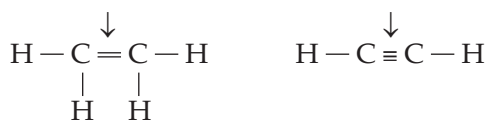
*(7) Homopolymer

Ans. When the polymers are formed by repetition of single monomer.

These are called homopolymer. e.g. Polyvinyl Chloride (PVC)

into starch, cellulose, laminarin and glucans.

Synthesis of polyethylene is as follows:

$$\underset{H}{\overset{H}{\diagdown}}C=C\underset{H}{\overset{H}{\diagup}}+\underset{H}{\overset{H}{\diagdown}}C=C\underset{H}{\overset{H}{\diagup}}+\underset{H}{\overset{H}{\diagdown}}C=C\underset{H}{\overset{H}{\diagup}}+... \xrightarrow{\text{Polymerisation}} \left[\begin{array}{cccccc} H & H & H & H & H & H \\ | & | & | & | & | & | \\ C{-}C{-}C{-}C{-}C{-}C \\ | & | & | & | & | & | \\ H & H & H & H & H & H \end{array}\right]_n$$

ethylene monomer   Polyethylene
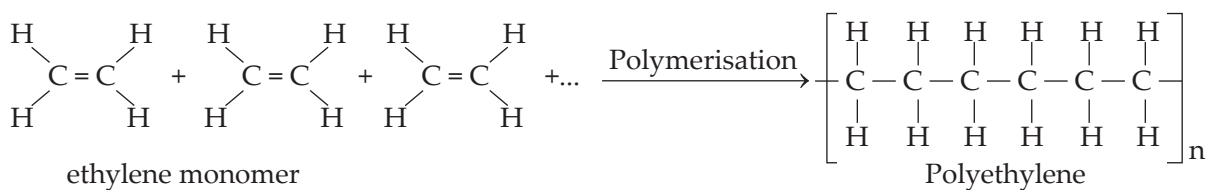
*(9) Reduction:

Ans. Reduction is the type of reaction in which loss of oxygen and gain of hydrogen occurs or in terms of electron transfer, we can define reduction reactions are the type of reactions where gain of electrons takes place.

e.g: $CH_3CHO \rightarrow CH_3CH_2OH$
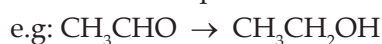
       ⌐————— Reduction by gain of hydrogen

*(10) Oxidant:

Ans. Substances that can give oxygen to other substances are called oxidants or oxidizing agents. e.g. Potassium permanganate or potassium dichromate are commonly used as oxidizing agents.

(11) Catenation

Ans. Carbon has a unique ability to form strong covalent bonds with other carbon atoms, this results in formation of big molecules. This property of carbon is called Catenation power.

(12) Structural Isomerism

Ans. The phenomenon in which compounds having different structural formulae but have the same molecular formula is called Structural Isomerism.

(13) Homologous series

Ans. The series of compounds formed by joining the

*(8) Monomer

Ans. A macromolecule formed by regular repetition of a small unit is called polymer. The small unit that repeats regularly to form a polymer is called monomer e.g. Vinyl chloride polymerizes into polyvinyl chloride of PVC. Glucose polymerises

same functional group in the place of a particular hydrogen atom in the chains having sequentially increasing length is called Homologous Series.

(14) Addition reaction

Ans. When a carbon compound combines with another compound to form a product that contains all the atoms in both the reactants is called as Addition Reaction.

(15) Substitution reaction

Ans. The reaction in which the place of one type of atom or group in a reactant is taken by another atom or group of atoms is called Substitution Reaction.

For example $CH_4 + Cl_2 \xrightarrow{\text{Sunlight}} CH_3\text{-}Cl + HCl$

(16) Aliphatic compounds

Ans. A group of hydrocarbons that contains carbon atoms joined together in straight chains, branched chains or simple rings.

(17) Aromatic Compounds

Ans. A cyclic compound containing at least one benzene ring and characterized by the presence of alternating double bonds within the ring. e.g. Benzene – C_6H_6

Q.2.2 Differentiate between:

(1)   Saturated and unsaturated Hydrocarbons.

Ans.

Saturated Hydrocarbons	Unsaturated Hydrocarbons
(i) They have C-C single bonds.	(i) They have C-C double or triple bonds.
(ii) These compounds are chemically less reactive.	(ii) These compounds are more reactive.
(iii) Substitution reaction is the characteristic property of these hydrocarbons.	(iii) Addition reaction is the characteristic property of these hydrocarbons.
(iv) The general formula is C_nH_{2n+2}	(iv) The general formula is C_nH_{2n-2} or C_nH_{2n}
(v) e.g. Methane CH_4. $H-\overset{\displaystyle H}{\underset{\displaystyle H}{\overset{\mid}{\underset{\mid}{C}}}}-H$	(v) e.g. ethene C_2H_4. $H_2C = CH_2$ ethyne C_2H_2. $HC \equiv CH$

(2)   Alkanes and Alkenes

Ans.

Alkanes	Alkenes
(i) Hydrocarbons containing carbon to carbon single bonds (C-C) only are called alkanes or Paraffins.	(i) The hydrocarbons which contain carbon to carbon double bonds (C=C) are called Alkenes or Olefins.
(ii) Their general formula is C_nH_{2n+2}	(ii) Their general formula is C_nH_{2n}
(iii) They are chemically less reactive.	(iii) They are chemically more reactive.
(iv) They undergo substitution reaction.	(iv) They undergo addition reaction.
(v) e.g. ethane – C_2H_6. $H-\overset{\displaystyle H}{\underset{\displaystyle H}{\overset{\mid}{\underset{\mid}{C}}}}-\overset{\displaystyle H}{\underset{\displaystyle H}{\overset{\mid}{\underset{\mid}{C}}}}-H$	(v) e.g. ethene C_2H_4. $\overset{\displaystyle H}{\underset{\displaystyle H}{\overset{\mid}{\underset{\mid}{C}}}} = \overset{\displaystyle H}{\underset{\displaystyle H}{\overset{\mid}{\underset{\mid}{C}}}}$

(3)   Alkenes and Alkynes.

Ans.

Alkenes	Alkynes
(i) The hydrocarbons which contain carbon to carbon double bonds (C = C) are called alkenes.	(i) The hydrocarbons which contain carbon to carbon triple bonds (C ≡ C) are called alkynes.
(ii) Their general formula is C_nH_{2n}	(ii) Their general formula is C_nH_{2n-2}
(iii) e.g. ethene C_2H_4. $\overset{\displaystyle H}{\underset{\displaystyle H}{\overset{\mid}{\underset{\mid}{C}}}} = \overset{\displaystyle H}{\underset{\displaystyle H}{\overset{\mid}{\underset{\mid}{C}}}}$	(iii) e.g. ethyne C_2H_2. $HC \equiv CH$.

(4)   Covalent compounds and Ionic compounds.

Ans.

Covalent compounds	Ionic compounds
(i) These compounds are formed due to sharing of electrons.	(i) These compounds are formed due to transfer of electrons.
(ii) They exist as solid, liquid and gases.	(ii) They exist as solids.
(iii) Covalent compounds have low melting and boiling points.	(iii) Ionic compounds have high melting and boiling points.
(iv) They are generally insoluble in water.	(iv) They are mostly soluble in water.
(v) They do not conduct electricity in molten or in aqueous solution.	(v) They conduct electricity in molten state and in aqueous solution.
(vi) e.g. Methane (CH_4), ethane (C_2H_6).	(vi) e.g. Sodium Chloride (NaCl). Potassium Chloride (KCl)

(5)   Ethanol and Ethanoic acid (Physical properties)

Ans.

Ethanol	Ethanoic Acid
(i) It has a specific smell.	(i) It has vinegar like smell.
(ii) It has a burning taste.	(ii) It is sour to taste.
(iii) It does not freeze in winters.	(iii) It freezes in winters.
(iv) Boiling point is 78°C.	(iv) Boiling point is 118°C.

(6)   Ethanol and Ethanoic acid (Chemical Properties)

Ans.

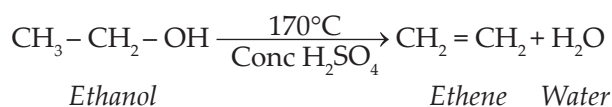| Ethanol	Ethanoic acid
(i) It does not react with $NaHCO_3$.	(i) It evolves CO_2 with $NaHCO_3$.
(ii) It burns with a blue flame.	(ii) It does not burn with a blue flame.
(iii) It does not affect blue litmus.	(iii) It turns blue litmus red.

Q.2.3 Answer the following questions:

(1)   Why are carbon and its compounds used as fuels for most application?

Ans. Carbon and its compounds undergo combustion to produce heat, the amount of heat released can be handled and used, so that they can be used as fuels for most application.

(2)   How is ethene prepared from ethanol? Give the reaction involved in it.

Ans. When ethanol is heated at the temperature 170°C with excess amount of concentrated sulphuric acid, one molecule of water is removed from its molecule to form ethene, an unsaturated compound.

$$CH_3 - CH_2 - OH \xrightarrow[\text{Conc } H_2SO_4]{170°C} CH_2 = CH_2 + H_2O$$

Ethanol   *Ethene   Water*

(3)   State the physical properties of ethanoic acid.

Ans. Physical properties of ethanoic acid are:

(i)   Ethanoic acid is a colourless liquid.

(ii)   Boiling point of ethanoic acid is 118°C.

(iii) Melting point of ethanoic acid is 17°C.

(iv)   Ethanoic acid is commonly called as acetic acid and the frozen ethanoic acid is called glacial acetic acid.

(4)   State the number of bonds essentially present between carbon and carbon in alkenes and alkynes.

Ans. In alkenes, at least one carbon is linked to another carbon by a double bond and in alkynes at least one carbon is linked to another carbon by a triple bond.

*Q.2.4   Give Scientific reasons:

(1)   Covalent compounds have low melting and boiling points.

Ans.

(i)   When substances melt or boil, bonds between the molecules are broken due to heat supplied.

(ii)   In covalent compounds, the bonds between two or more molecules are weak.

(iii) Hence, intermolecular bonds in covalent compounds are broken easily due to which they have low melting and boiling points.

(2)   Carbon can form a large number of compounds.

Ans.

(i)   Atomic number of carbon is 6 and its electronic configuration is (2,4).

(ii)   An atom of carbon has four valence electrons. It can share these electrons with other carbon atoms and also with hydrogen, oxygen, nitrogen, sulphur etc.

(iii) Carbon also shows the property of catenation. By virtue of this property, it can form a variety of chain and ring structures, with different shapes, sizes and molecular mass.

(iv)   Thus, carbon can form a large number of compounds.

(3)   Graphite is a good conductor of electricity.

Ans.

(i)   Graphite is an crystalline allotrope of carbon.

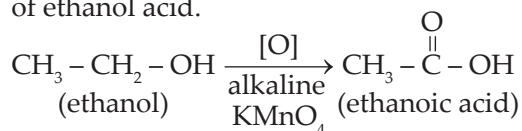(ii)   In its structure, each carbon is attached to three other carbon atoms, forming a hexagonal planar structure.

(iii)   These hexagonal rings form layer on one another. Thus, in graphite many free electrons move throughout the entire layers.

(iv)   These free electrons help in conduction of electricity.

(v)   Hence, graphite is a good conductor of electricity.

(4)   **Many hydrocarbons are used as fuels in day to day life.**

Ans.

(i)   Hydrocarbons are compounds consisting of carbon and hydrogen and they are easily combustible

(ii)   When they burn in air, large amount of heat is evolved with the formation of carbon dioxide.

(iii)   Due to evolution of heat on combustion, many hydrocarbons are used as fuels in day to day life.

(5)   **Conversion of ethanol to ethanoic acid an oxidation reaction**

Ans.

(i)   Addition of oxygen or removal of hydrogen or loss of electrons is known as oxidation.

(ii)   Ethanol gets oxidised by alkaline potassium permangnate to form ethanoic acid.

(iii)   The following equation will explain conversion of ethanol acid.

$$CH_3 - CH_2 - OH \xrightarrow[\substack{\text{alkaline} \\ \text{KMnO}_4}]{[O]} CH_3 - \overset{\overset{O}{\|}}{C} - OH$$
(ethanol)   (ethanoic acid)

2 Hydrogen atoms are replaced by one Oxygen atom, therefore it is an oxidation reaction.

(6)   **Vegetable oils are healthy as compared to vegetable ghee.**

Ans.

(i)   Vegetable oils which contain unsaturated fatty acids are good for health as they do not increase cholesterol.

(ii)   Vegetable ghee contains saturated fatty acids which are harmful, they increase cholesterol and increase lipids in blood.

(iii)   Hence, vegetable oils are healthy as compared to vegetable ghee.

*Q.2.5. Answer the following questions:

(1)   **Draw an electron dot structure of the following molecules. (without showing the circles).**

     (a) Methane   (b) Ethene

     (c) Methanol   (d) Water

Ans.

(a)   Methane - molecular formula - CH_4
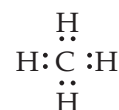
(b)   Ethene - molecular formula - C_2H_4
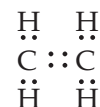
(c)   Methanol - molecular formula - CH_3OH
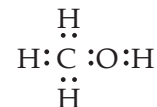
(d)   Water - molecular formula - H_2O
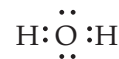
(2)   **Draw all possible structural formula of compounds from their molecular formula given below.**

     (A) C_3H_8 (B) C_4H_{10} (C) C_3H_4

Ans.

(A) $C_3H_8 \rightarrow$ Propane

2D - formula	3D - formula
(C_3H_8)	(C_3H_8)
(C_3H_8)	(C_3H_8) (C_3H_8)

(B) $C_4H_{10} \rightarrow$ Butane

C_4H_{10}	C_4H_{10}

(C) $C_3H_4 \rightarrow$ Propyne

*(3) **Write structural formulae for the following IUPAC names.**

(i) **Pent - 2 - one - Molecular formula- $C_5H_{10}O$**
Structural formula

$$H - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{}{\overset{\overset{O}{\|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - H$$
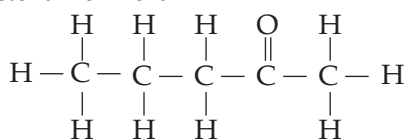
(ii) **2 - Chlorobutane : Molecular formula C_4H_9Cl**
Structural formula

$$H - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{Cl}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - H$$
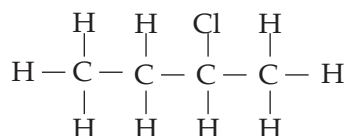
(iii) **Propan - 2 - ol : Molecular formula- C_3H_7OH**
Structural formula

$$H - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{OH}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - H$$

(iv) **Methanol : Molecular formula- CH_3OH**
Structural formula

$$H - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - OH$$
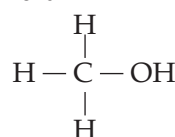
(v) **Butanoic acid : Molecular formula- $C_4H_8O_2$ or $CH_3CH_2CH_2 COOH$**
Structural formula

$$H - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{}{\overset{\overset{O}{\|}}{C}} - O - H$$
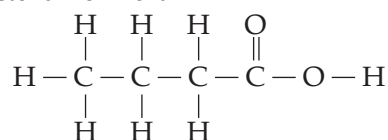
(vi) **1- bromopropane : Molecular formula - C_3H_7Br**
Structural formula

$$H - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - Br$$
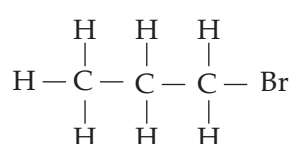
(vii) **Ethanamine: Molecular formula $C_2H_5NH_2$**
Structural formula

$$H - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - N \overset{\diagup H}{\diagdown H}$$
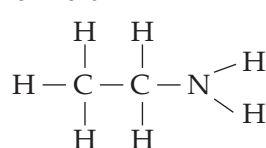
(viii) **Butanone: Molecular formula C_4H_8O**
Structural formula

$$H - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{}{\overset{\overset{H}{|}}{\underset{\underset{O}{\|}}{C}}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - H$$
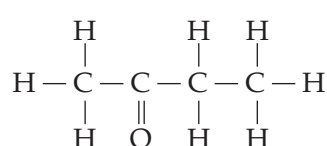
(ix) **Methanol. Molecular formula CH_2O**
Structural formula

$$H - \overset{\overset{O}{\|}}{C} - H$$
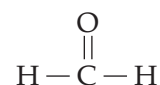
*(4) **Draw all possible structural formulae having molecular formula C_6H_{14}. Give names to all the isomers. Which difficulties were faced by you while naming?** *(Use your brain power; Textbook Page No. 121)*

Ans. Molecular formula is C_6H_{14} Its Hexane.

Having 5 isomers.

(i)
$$H - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - H$$
n- Hexane
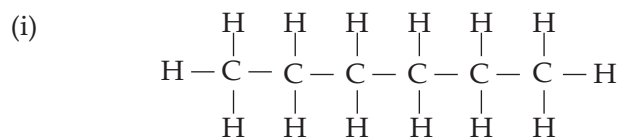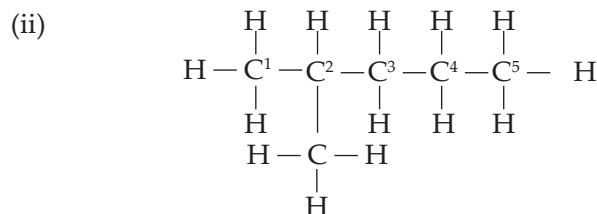
(ii)
$$H - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C^1}} - \underset{}{\overset{\overset{H}{|}}{C^2}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C^3}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C^4}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C^5}} - H$$
$$\underset{\underset{H}{|}}{H - C - H}$$
Iso- hexane or 2 methyl pentane

(iii)
$$H - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C^1}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C^2}} - \underset{}{\overset{\overset{H}{|}}{C^3}} - \un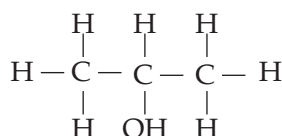derset{\underset{H}{|}}{\overset{\overset{H}{|}}{C^4}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C^5}} - H$$
$$\underset{\underset{H}{|}}{H - C - H}$$
3- methyl pentane
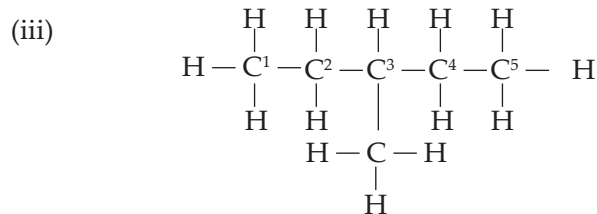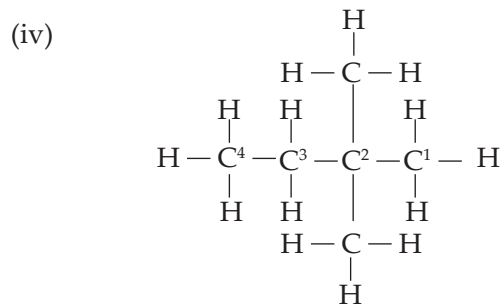
(iv)
$$\overset{\overset{H}{|}}{\underset{\underset{}{|}}{H - C - H}}$$
$$H - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C^4}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C^3}} - \underset{}{\overset{\overset{|}{C^2}}{}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C^1}} - H$$
$$\underset{\underset{H}{|}}{H - C - H}$$
2, 2 – dimethyl butane or neohexane
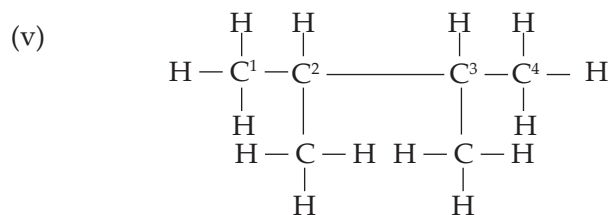
(v)
$$H - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C^1}} - \underset{}{\overset{\overset{H}{|}}{C^2}} - - - - \underset{}{\overset{\overset{H}{|}}{C^3}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C^4}} - H$$
$$\underset{\underset{H}{|}}{H - C - H} \quad \underset{\underset{H}{|}}{H - C - H}$$
2, 3 dimethyl butane

The difficulty faced by us is naming the isomer. As the number of carbon atoms increases number

of isomers will also increase and their common name creates confusion.

*(5) **The molecular formula of sulphur is S_8 in which eight sulphur atoms are bonded to each other to form a ring. Draw an electron – dot structure of S_8 without showing circles.** *(Use your brain power; Textbook Page no. 112)*

Ans.

Electron - dot structure
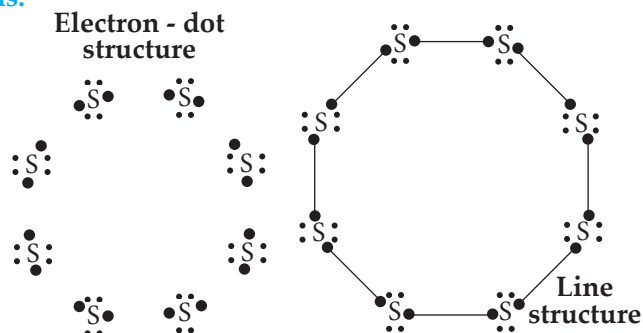
Line structure

*(6) **Draw electron dot structure of cyclohexane** *(Use your brain power; Textbook Page no. 116)*

Ans. Molecular formula is C_6H_{12}
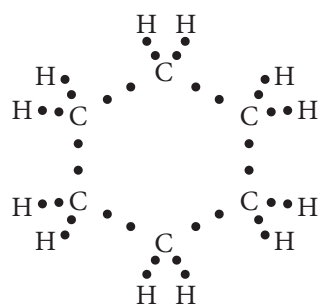
(7) **The proportion of carbon atoms in ethanol (C_2H_5OH) and naphthalene $(C_{10}H_8)$**

Ans.

Compound	The number of carbon atoms
Ethanol	2
Naphthalene	10

(8) **How is the transformation of ethanol into ethanoic acid an oxidation reaction?**

Ans. Ethanol gets oxidised by alkaline potassium permanganate to form ethanoic acid. Potassium permanganate is an oxidizing agent which is the source of oxygen. Addition of oxygen is oxidation.

$$CH_2 - CH_2 - OH \xrightarrow[\text{alkaline KMnO}_4]{\text{(O)}} CH_3 - \overset{\displaystyle O}{\overset{\|}{C}} - OH$$

ethanoic acid
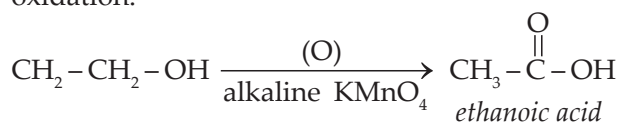
Q.2.6. Answer the following questions:

***(1)** **By how many $-CH_2-$ (methylene) units do the formulae and the first two members of homologous series of alkane, methane (CH_4) and ethane (C_2H_6) differ? Similarly, by how many $-CH_2-$ Units do the neighbouring members ethane (C_2H_6) and propane (C_3H_8) differ from each other?** *(Use your brain power; Textbook Page no. 119)*

Ans. Methane and ethane differ by one – CH_2- unit. Also in ethane and propane differ by one – CH_2- unit.

*(2) **How many methylene units are extra in the formula of the fourth member than the third members of the homologous series of alcohols?** *(Use your brain power; Textbook Page no. 119)*

Ans. There is only one extra unit of methylene $(-CH_2-)$ in the formula of the fourth member than the third member of the homologous series of alcohol.

*(3) **How many methylene units are less in the formula of the second member than the third member of two homologous series of alkenes?** *(Use your brain power; Textbook Page no. 119)*

Ans. One unit of methylene $(-CH_2-)$ is less in the formula of the second member than the third member of the homologous series of alkenes.

*(4) **Atomic number of Chlorine is 17. What is the number of electrons in the valence shell of Chlorine?** *(Use your brain power; Textbook Page no. 112)*

Ans. Atomic Number of Chlorine is 17, Electronic configuration in 2, 8, 7. Therefore, number of electrons in valence shell is 7.

*(5) **Inspect the molecular formulae of the members of Alkenes.**

Do you find any relationship in the number of carbon atoms and the number of hydrogen atoms in the molecular formulae *(Use your brain power; Textbook page no. 120)*

Ans. In the Alkene series, First member is ethene where molecular formula is C_2H_4, Next is propene C_3H_6, then 1- Butene – C_4H_8. We can see from the molecular formula that if number of carbon atoms increases by '1', then number of hydrogen atoms increases by '2'

*(6) **If the number of carbon atoms in the molecular formulae of alkenes is denoted by 'n' what will be the number of hydrogen atom?** *(Use your brain power; Textbook page no. 120)*

Ans. General formula of alkenes is C_nH_{2n}. When the value of n = 2, then the number of hydrogen atoms will be 2n = 2 × 2 = 4. Or if n = 3, then the hydrogen atoms will be 2n = 2 × 3 = 6
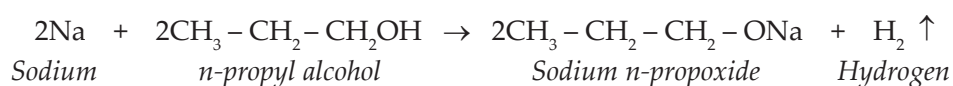
*(7) **What causes the existence of very large number of carbon compounds?**

Ans.

(i) Carbon is the only element that can form so many different compounds because each carbon atom can form four chemical bonds with other atoms.

(ii) Having the atomic number 6, every carbon atom has a total of six electrons. The carbon atom's four valence electrons can be shared by other atom, forming covalent bonds, gives them the ability to form long carbon – to – carbon chain, they can even join "head – to – tail" to make rings of carbon atoms.

(iii) Carbon atoms can share not only a single electron with another atom to form a single bond, but it can also share two or three electrons, forming double or triple bond.

(iv) This makes a huge number of different possible molecules. Hence, carbon forms large number of compounds, because of all these properties.

*(8) **What is meant by vinegar and gashol? What are their uses?**

Ans.

(i) Vinegar: Ethanoic acid is most commonly known as acetic acid. Its dilute solution in water (5-8 %) is known as vinegar.

(ii) Uses: Vinegar is used as a cooking ingredient, as a preservative in pickles, food storage, vinegar is also used for fermentation and also in medicinal field.

(iii) Gashol: Ethanol is a clean fuel. Therefore, it is used as an additive to increase the efficiency of petrol. Such a fuel is called gashol.

(iv) Uses: It is used as a fuel.

*(9) **What is a catalyst? Write any one reaction which is brought about by use of a catalyst.**

Ans. Catalyst: A substance which increases the rate of reaction without causing any disturbance is called a catalyst.

Vegetable oils are converted into vanaspati ghee by passing hydrogen in presence of nickel as catalyst.

$$\text{Vegetable oil} + H_2 \xrightarrow{\text{Ni}} \text{vanaspati ghee}$$

$$H - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} = \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \xrightarrow[\text{Pt/Ni}]{H_2} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} -$$

(10) **State some of the physical properties of covalent compounds.**

Ans. Some physical properties of covalent compounds are i) They have low melting and boiling points. ii) They are generally insoluble in water but soluble in other organic solvents iii) They are poor conductors of heat and electricity.

(11) **Explain by writing a reaction, what will happen when pieces of sodium metal are put in n- propyl alcohol.**

Ans. When pieces of sodium metal are put in n-propyl alcohol, hydrogen is liberated and sodium n-propoxide salt is formed.

$$\underset{Sodium}{2Na} + \underset{n\text{-propyl alcohol}}{2CH_3 - CH_2 - CH_2OH} \rightarrow \underset{Sodium\ n\text{-propoxide}}{2CH_3 - CH_2 - CH_2 - ONa} + \underset{Hydrogen}{H_2 \uparrow}$$

(12) **Explain by writing a reaction, which product will be formed on heating n - butyl alcohol with concentrated sulphuric acid.**

Ans. When n - butyl alcohol is heated at the temperature 170°C with excess amount of concentrated sulphuric acid, one molecule of water is removed from its molecule to form butene, an unsaturated compound.

$$CH_3 - CH_2 - CH_2 - CH_2OH \xrightarrow[\text{Conc } H_2SO_4]{170°C} \underset{Butene}{CH_3 - CH_2 - CH = CH_2} + H_2O$$

Here concentrated sulphuric acid acts as a dehydrating agent.

Q.3.1. Answer the following questions:

*(1) Write down structural formula of the first four members and the various homologous series formed by making use of the functional groups. *(Use your brain power; Textbook page 120)*

Ans. First four members of Alkanes and Alcohols.

Alkanes	Formula of Alcohol	Common Name	IUPAC Name
CH_4 Methane	CH_3OH	Methyl alcohol	Methanol
C_2H_6 Ethane	C_2H_5OH	Ethyl alcohol	Ethanol
C_3H_8 Propane	C_3H_7OH	n-propyl alcohol	1- Propanol
C_4H_{10} Butane	C_4H_9OH	n-butyl alcohol	1- Butanol

Alkyl Halides

Molecular formula	Structural Formula	Common Name	IUPAC Name
CH_3Cl	CH_3Cl	Methyl chloride	Chloro methane
C_2H_5Cl	CH_3CH_2Cl	Ethyl chloride	Chloro ethane
C_3H_7Cl	$CH_3CH_2CH_2Cl$	n-propyl chloride	1- Chloropropane
C_4H_9Cl	$CH_3CH_2CH_2CH_2Cl$	n-Butyl chloride	1- Chlorobutane

Aldehydes

Molecular formula	Structural Formula	Common Name	IUPAC Name
HCHO	$H-\overset{\overset{O}{\|\|}}{C}-H$	Formaldehyde	Methanal
CH_3CHO	$CH_3-\overset{\overset{O}{\|\|}}{C}-H$	Acetaldehyde	Ethanal
CH_3-CH_2-CHO	$H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{\overset{O}{\|\|}}{C}\diagdown H$	Propionaldehyde	Propanal
$CH_3CH_2CH_2CHO$	$H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{\overset{O}{\|\|}}{C}-H$	Butyraldehyde	Butanal

Ketones

Molecular formula	Structural Formula	Common Name	IUPAC Name
$CH_3CO\,CH_3$	$H-\overset{H}{\underset{H}{C}}-\overset{\overset{O}{\|\|}}{C}-\overset{H}{\underset{H}{C}}-H$	Acetone	Propanone
$CH_3CO\,C_2H_5$	$H-\overset{H}{\underset{H}{C}}-\overset{\overset{O}{\|\|}}{C}-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-H$	Ethyl methyl Ketone	Butanone
$C_2H_5CO\,C_2H_5$	$H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{\overset{O}{\|\|}}{C}-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-H$	diethyl ketone	Pentan-3-one
$CH_3CO\,CH_2CH_2\,CH_3$	$H-\overset{H}{\underset{H}{C}}-\overset{\overset{O}{\|\|}}{C}-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-H$	Methyl-n-propyl ketone	2- pentanone

Carboxylic Acids

Molecular formula	Structural Formula	Common Name	IUPAC Name
HCO OH	$\overset{\displaystyle O}{\overset{\|\|}{H-C-OH}}$	Formic acid	Methanoic acid
$CH_3CO\ OH$	$H-\overset{\displaystyle H}{\underset{\displaystyle H}{C}}-\overset{\displaystyle O}{\underset{\displaystyle O-H}{C}}$	Acetic acid	Ethanoic acid
$CH_3CH_2\ COOH$	$H-\overset{\displaystyle H}{\underset{\displaystyle H}{C}}-\overset{\displaystyle H}{\underset{\displaystyle H}{C}}-\overset{\displaystyle O}{C}-O-H$	Propionic acid	Propanoic acid
$CH_3CH_2\ CH_2COOH$	$H-\overset{\displaystyle H}{\underset{\displaystyle H}{C}}-\overset{\displaystyle H}{\underset{\displaystyle H}{C}}-\overset{\displaystyle H}{\underset{\displaystyle H}{C}}-\overset{\displaystyle O}{C}-O-H$	Butyric acid	Butanoic acid

Same way students can write with Alkenes and Alkynes.

*(2) **General formula and the homologous series of alkanes is C_nH_{2n+2}. Write down the molecular formula of the 8th and 12th member using this.** *(Use your brain power; Textbook page 120)*

Ans. General formula of alkanes is C_nH_{2n+2}

Molecular formula of 8th member n=8

$C_8H_{2\times8+2}$ = $\boxed{C_8H_{18}}$
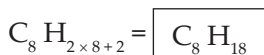
Molecular formula of 12th member

i.e n = 12.

$C_{12}H_{2\times12+2}$ = $\boxed{C_{12}H_{26}}$
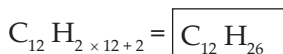
*(3) **Draw three structural formulae having molecular formula C_5H_{12}.** *(Use your brain power Textbook page 121)*

Ans. Molecular formula = C_5H_{12}.

i.
$H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-H$ Or $CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_3$

ii.
$H-\overset{H}{\underset{\underset{\displaystyle H-\overset{H}{\underset{H}{C}}-H}{H}}{C}}-\overset{H}{\underset{}{C}}-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-H$ Or $\overset{}{\underset{\displaystyle CH_3}{CH_3\text{-}CH\text{-}CH_2\text{-}CH_3}}$

iii.
$H-\overset{\overset{\displaystyle H}{\overset{\displaystyle |}{H-\overset{\displaystyle H}{\underset{\displaystyle H}{C}}-H}}}{\underset{\underset{\displaystyle H-\overset{\displaystyle H}{\underset{\displaystyle H}{C}}-H}{\displaystyle H}}{C}}-\overset{H}{\underset{H}{C}}-H$ Or $CH_3-\overset{\displaystyle CH_3}{\underset{\displaystyle CH_3}{C}}-CH_3$
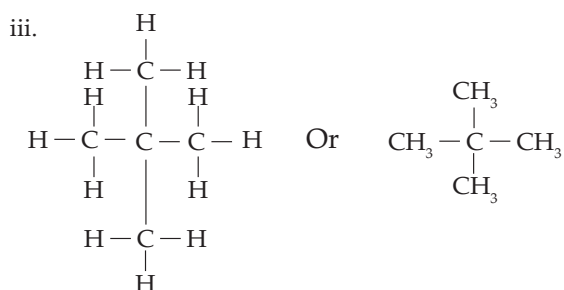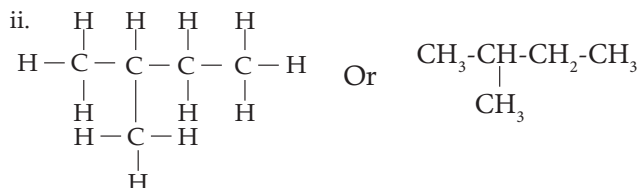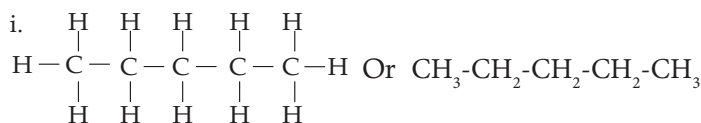
*(4) **Give the names n-pentane, and Neo-pentane to the above structural formulae.**

(Use the same logic as used in the names of the isomeric butanes for their purpose). *(Use your brain power; Textbook page 121)*

Ans. In –the above question

(i) Structure is n-pentane

(ii) Structure is i-pentane or isopentane

(iii) Structure is Neopentane.

There are two isomers of Butane(C_4H_{10}). n-Butane and isobutane.

$H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-H$ Or $CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_3$
  n - butane

$H-\overset{H}{\underset{\underset{\displaystyle H-\overset{\displaystyle H}{\underset{\displaystyle H}{C}}-H}{H}}{C}}-\overset{H}{\underset{}{C}}-\overset{H}{\underset{H}{C}}-H$ Or $\overset{}{\underset{\displaystyle CH_3}{CH_3\text{-}CH\text{-}CH_3}}$
  Isobutane
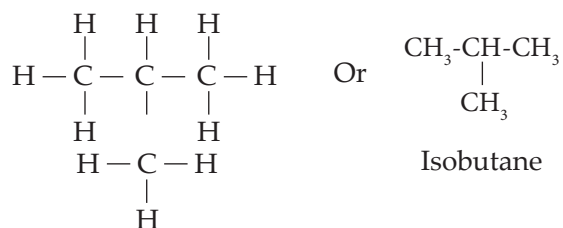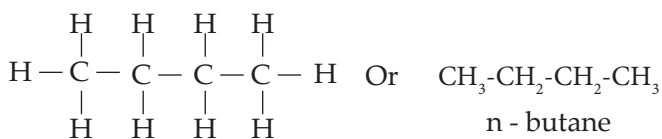
*(5) **Molecular formula of chlorine is Cl_2. Draw an electron dot and line structure of a chlorine molecule.** *(Use your brain power; Textbook Page no. 112)*

Ans. Molecular formula Cl_2

Electron-dot Structure → outermost shell of chlorine contain 7 electrons.

Line Structure – Cl + Cl → Cl_2 or Cl – Cl

*(6) **The molecular formula of water is H_2O. Draw electron-dot and line structure of this triatomic molecule. (use dots for electron of oxygen atom and cross for electrons of hydrogen atom)** *(Use your brain power; Textbook Page no. 112)*

Ans. Molecular formula of water is H_2O

Electron dot structure:

Hydrogen Oxygen Hydrogen   Water
atom   atom   atom   molecule

Line structure:

$$H — O — H$$

*(7) **The molecular formula of Ammonia is NH_3. Draw electron dot structure and line structure of ammonia molecule.** *(Use your brain power; Textbook Page no. 112)*

Ans. Molecular formula of Ammonia is NH_3.

Atomic number of Nitrogen is 7.

Electronic configuration : (2, 5)

Its valency is 3, which will be satisfied by three hydrogen atoms.

Electron – dot structure

Line Structure:

$$H — N — H$$
$$|$$
$$H$$

Ammonia molecule

*(8) **The molecular formula of carbon-dioxide is CO_2 – Draw the electron dot structure (without showing circle) and line structure of CO_2** *(Use your brain power; Textbook Page no. 112)*

Ans. Molecular formula and Carbon dioxide is CO_2

Atomic number of carbon = 6;

Electronic configuration = (2, 4)

Atomic number of oxygen = 8;

Electronic configuration (2, 6)

Electron – dot structure.

Oxygen   *Carbon*   *Oxygen*   *CO_2 - Compound*
atom   *atom*   *atom*

Line Structure: $O = C = O$

*(9) **In the Chlorination, substitution reaction of propane, two isomeric products containing one chlorine atom are obtained. Draw their structural formula and give their IUPAC names.** *(use your brain power; Text book page no. 126)*

Ans.

$$2CH_3\ CH_2\ CH_3 + Cl_2 \rightarrow CH_3CH_2\text{-}CH_2Cl + CH_3\text{-}CH\ Cl\text{-}CH_3$$
$$\qquad\qquad\qquad\qquad (45\%)\qquad\qquad ((55\%)$$

Structural formula and two isomers

1- Chloropropane   2- Chloropropane

**Q.3.2. Complete the given tables:*

(1) **Complete the table by writing their IUPAC names** *(Complete the table; Textbook Page No. 123)*

Sr. No.	Common Name	Structural Formula	IUPAC Name
(1)	Ethylene	$CH_2 = CH_2$	ethene
(2)	Acetylene	$HC \equiv CH$	ethyne
(3)	Acetic acid	$CH_3 \text{-} COOH$	ethanoic acid
(4)	Methyl alcohol	$CH_3 \text{-} OH$	methanol
(5)	Ethyl alcohol	$CH_3 \text{-} CH_2 \text{-} OH$	ethanol
(6)	Acetaldehyde	$CH_3 \text{-} CHO$	ethanal
(7)	Propionaldehyde	$CH_3 \text{-} CO \text{-} CH_3$	propanone or propan – 2 – one
(8)	Ethyl methyl ketone	$CH_3 \text{-} CO \text{-} CH_2 \text{-} CH_3$	butanone or butan – 2 – one
(9)	Ethyl amine	$CH_3 \text{-} CH_2 \text{-} NH_2$	ethanamine or 1 – Aminoethane
(10)	n- propyl chloride	$CH_3 \text{-} CH \text{-} CH_2 \text{-} Cl$	1 – chloropropane

(2) **Fill in the gaps in the table a, b and c of homologous series.**

(a) Homologous Series of Alkanes

Name	Molecular formula	Condensed Structural formula	Number of carbon atoms	Number of $-CH_2-$ units	Boiling point ^0C
Methane	CH_4	CH_4	1	1	- 162
Ethane	C_2H_6	CH_3-CH_3	2	2	- 88.5
Propane	C_3H_8	$CH_3-CH_2-CH_3$	3	3	- 42
Butane	C_4H_{10}	$CH_3-CH_2-CH_2-CH_3$	4	4	0
Pentane	C_5H_{12}	$CH_3-CH_2-CH_2-CH_2-CH_3$	5	5	36
Hexane	C_6H_{14}	$CH_3-CH_2-CH_2-CH_2-CH_2-CH_3$	6	6	69

(b) Homologous Series of Alcohols

Name	Molecular formula	Condensed Structural formula	Number of carbon atoms	Number of $-CH_2-$ units	Boiling point ^0C
Methanol	CH_4O	CH_3-OH	1	1	63
Ethanol	C_2H_6O	CH_3-CH_2-OH	2	2	78
Propanol	C_3H_8O	$CH_3-CH_2-CH_2-OH$	3	3	97
Butanol	$C_4H_{10}O$	$CH_3-CH_2-CH_2-CH_2-OH$	4	4	118

(c) Homologous Series of Alkenes

Name	Molecular formula	Condensed Structural formula	Number of carbon atoms	Number of $-CH_2-$ units	Boiling point ^0C
Ethene	C_2H_4	$CH_2=CH_2$	2	0	- 102
Propene	C_3H_6	$CH_3-CH=CH_2$	3	1	- 48
l-Butene	C_4H_8	$CH_3-CH_2-CH=CH_2$	4	2	- 6.5
l-Pentene	C_5H_{10}	$CH_3-CH_2-CH_2-CH=CH_2$	5	3	30

(3) **Which of the substances do contain a multiple bond?**

Name	Molecular formula	Number of C = C double bonds	Will it decolourize I_2?
Stearic acid	$C_{17}H_{35}COOH$	No double bonds	yes / no ✓
Oleic acid	$C_{17}H_{33}COOH$	2 double bonds	✓ yes / no
Plamitic acid	$C_{15}H_{31}COOH$	No double bonds	yes / no ✓
Linoleic acid	$C_{17}H_{31}COOH$	2 double bonds	✓ yes / no

*Q.3.3. Answer the questions based on the reaction.

(1) Observe the given reaction and answer the questions given below.
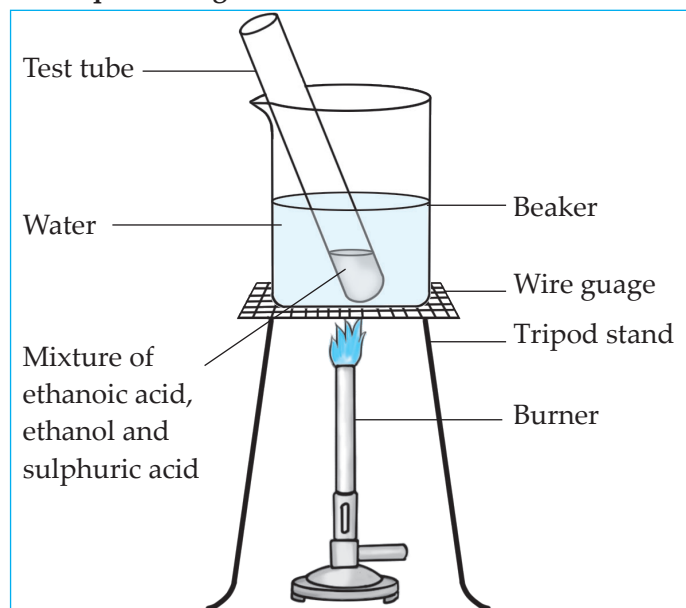

(i) What reaction is shown in the above diagram? Name the reactant and products.

(ii) Name the chemical equation.

(iii) What is the special characteristic of the group that is formed in this reaction?

Ans.

(i) Reaction - Esterification

Reactant - Ethanoic acid and ethanol in presence of concentrated sulphuric acid as catalyst.

Products - Ethyl ethanoate (ester) and water.

(ii) Chemical equation.

$$CH_3COOH + C_2H_5OH \rightarrow CH_3COO - C_2H_5 + H_2O$$

Ethanoic   Ethanol   Ethyl ethanate   Water

acid   (ester)

(iii) The special characteristic of esters is that they have sweet odour and hence used for making fragrances and flavouring agents.

(2) Answer the questions based on the reaction. Observe the given reaction and answer the questions given below.
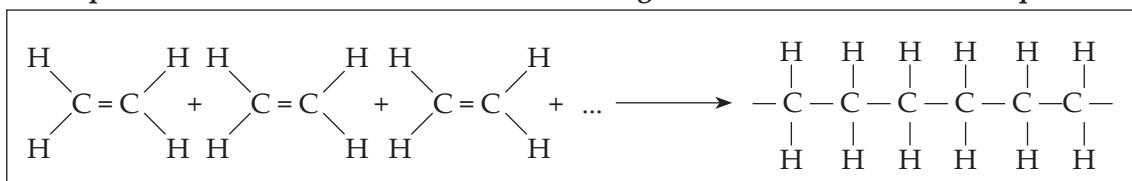
(i) What type of reaction is it? Define it.

(ii) Name the reactant and the products.

(iii) What are the uses of the product / products?

Ans.

(i) It is a Polymerization reaction. The reaction by which monomer molecules are converted into a polymer is called polymerization. In the above polymerization reaction, ethylene (monomer) molecules are converted into polyethylene (polymer).

(ii) The reactant is ethylene (monomer) and the product is polyethylene (polymer).

(iii) The uses of the product polyethylene is for making carry bags and sportswear.

Q.4.1. Answer the following questions:

*(1) Give any four functional groups containing oxygen as the heteroatom in it. Write name and structural formula and one example each.

Ans.

Functional group				
Hetero atom	Name	Structural formula	Condensed Structural formula	Example
Oxygen	(1) Alcohol	$- O - H$	$- OH$	Ethyl alcohol C_2H_5-OH
Oxygen	(2) Aldehyde	$\overset{O}{\overset{\|\|}{- C - H}}$	$- CHO$	Acetaldehyde $\overset{O}{\overset{\|\|}{CH_3 - C - H}}$
Oxygen	(3) Ketone	$\overset{O}{\overset{\|\|}{- C -}}$	$- CO-$	Propanone $\overset{O}{\overset{\|\|}{CH_3 - C - CH_3}}$
Oxygen	(4) Carboxylic acid	$\overset{O}{\overset{\|\|}{- C - O - H}}$	$- COOH$	Acetic Acid CH_3COOH

*(2) **Give names of three functional groups containing three different heteroatoms, write names and structural formulae and one example each.**
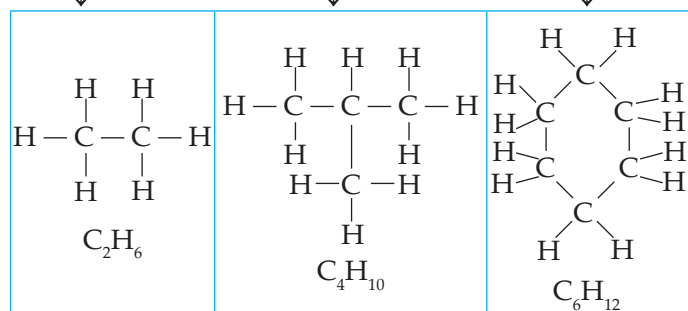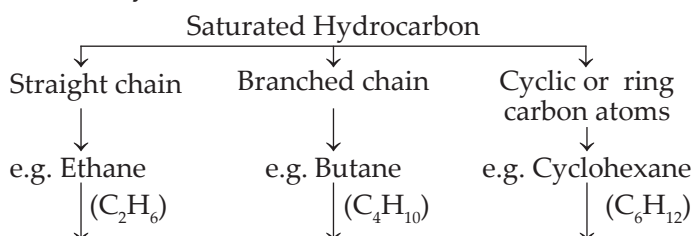
Ans.

Functional group				
Hetero atom	**Name**	**Structural formula**	**Condensed Structural formula**	**Example**
Halogen (Chlorine, Bromine, Iodine)	Halo (chloro, bromo, iodo)	$-X$ ($-Cl$, $-Br$, $-I$)	$-X$ ($-Cl$, $-Br$, $-I$)	Ethyl Chloride or chloro ethane C_2H_5-Cl
Oxygen	Ketone	$\overset{\textstyle O}{\underset{\textstyle }{\overset{\|}{-C-}}}$	$-CO-$	Propanone $CH_3-\overset{O}{\overset{\|}{C}}-CH_3$
Nitrogen	Amines	$\underset{\textstyle H}{-N-H}$	$-NH_2$	Methyl amine $H-\underset{\underset{\textstyle H}{\|}}{\overset{\overset{\textstyle H}{\|}}{C}}-\underset{\textstyle H}{N}-H$

*(3) **Saturated hydrocarbons are classified into three types. Write these names giving one example each.**

Ans. Saturated hydrocarbons in which the carbon atoms are linked to each other only by single bonds (C – C) are known as saturated hydrocarbons.

They are classified into:

Saturated Hydrocarbon

Straight chain	Branched chain	Cyclic or ring carbon atoms
e.g. Ethane (C_2H_6)	e.g. Butane (C_4H_{10})	e.g. Cyclohexane (C_6H_{12})

*(4) **Give names of three natural polymers. Write the place of their occurrence and name of monomers from which they are formed.**

Ans. A macromolecule formed at regular repetition of a small unit is called polymer. The small unit that repeats itself regularly to form a polymer is called monomer. Most of the structure of living things are composed of natural polymers.

Polymer	Name of the monomer	Occurence
Polysaccharide	Glucose	Starch and Cellulose
Proteins	Alpha amino acids	Muscles, hair, enzyme, skin, egg.
DNA	Nucleotide (base- deoxy ribose phosphate)	Chromosomes of animals

(5) **With the help of an example explain what is meant by homologous series.**

Ans.

(i) You have seen that chains of different length are formed by joining the carbon atoms to each other. Moreover you have also seen that a functional group can take place of hydrogen atom on these chains.

(ii) As a result, large number of compounds are formed having same functional group but different length of carbon chain. For example, there are many compounds such as CH_3-OH, CH_3-CH_2-OH, CH_3-CH_2-CH_2-OH, CH_3-CH_2-CH_2-CH_2-OH which contain alcohol as the functional group.

(iii) Though the length of the carbon chain in them is different, their chemical properties are very much similar due to the presence of the same functional group in them.

(iv) The series of compounds formed by joining the same functional group in the place of a particular

hydrogen atom on the chains having sequentially increasing length is called homologous series.
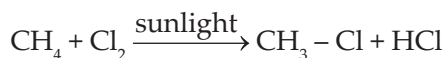
(v)   There are different homologous series in accordance with the functional group. For example, homologous series of alcohols, homologous series of carboxylic acids, homologous series of aldehydes, etc.

(vi)   All the members of the homologous series are homologues of each other. Homologous series of alkanes is:

CH_4 Methane C_2H_6 Ethane

C_3H_8 Propane C_4H_{10} Butane

(6)   Explain with an example what is meant by substitution and addition reactions.

Ans.

(i)   The reaction in which the place of one type of atom or group of atoms in a reactant is taken by another atom or group of atoms is called Substitution reaction.

$$CH_4 + Cl_2 \xrightarrow{\text{sunlight}} CH_3 - Cl + HCl$$

$$CH_3Cl + Cl_2 \xrightarrow{\text{sunlight}} CH_2Cl_2 + HCl$$

$$CH_2Cl_2 + Cl_2 \xrightarrow{\text{sunlight}} CHCl_3 + HCl$$

$$CHCl_3 + Cl_2 \xrightarrow{\text{sunlight}} CCl_4 + HCl$$

(ii)   When a carbon compound combines with another compound to form a product that contains all the atoms in both the reactants, it is called an addition reaction. For example - When ethene is heated with bromine, bromine gets added to ethene to form ethylene dibromide.

Ethene   Bromine

Ethylene dibromide
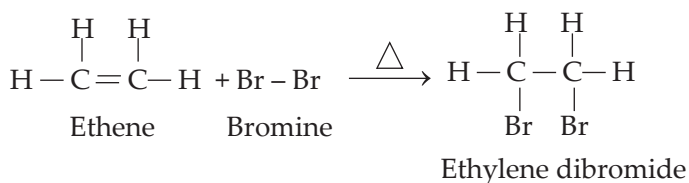
(7)   What are macromolecules? Explain Natural and manmade macromolecule.

Ans.

(i)   The number of the known carbon compounds is as large as about 10 million and the range of their molecular masses is as large as 10^1-10^{12}-

(ii)   The giant carbon molecules formed from hundreds or thousands of atoms are called macromolecules.

**Natural macromolecules:** (i) The natural macromolecules namely polysaccharides, proteins and nucleic acids are the supporting pillars of the living world. (ii) We get food, clothing and shelter from polysaccharides, namely starch and cellulose. (iii) Proteins constitute a large part of the bodies of animals and also are responsible for their movement and various physiological processes. (iv) Nucleic acids control the heredity at molecular level. Rubber is another type of natural macromolecule.

Man-made macromolecule: (i) Today manmade macromolecules are in use in every walk of life. (ii) Manmade fibres which have strength along the length similar to natural fibres cotton, wool and silk (iii) Elastomers which have the elastic property of rubber, plastics from which innumerable types of articles, sheets, pipes are made. (iv) All these are examples of manmade macromolecules.
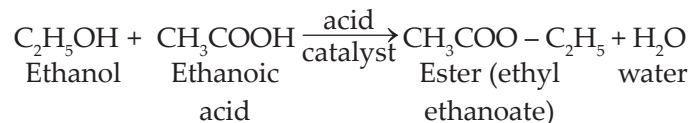
(8)   What is esterification and give its uses?

Ans.

(i)   Esterification is the reaction in which esters are formed by reaction between carboxylic acid and an alcohol in the presence of concentrated sulphuric acid
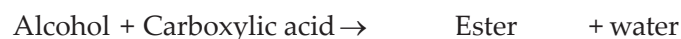
Alcohol + Carboxylic acid $\rightarrow$ Ester   + water

For e.g. Ethanoic acid reacts with ethanol in the presence of an acid catalyst and ester, ethyl ethanoate is formed.

$$C_2H_5OH + CH_3COOH \xrightarrow[\text{catalyst}]{\text{acid}} CH_3COO - C_2H_5 + H_2O$$

Ethanol   Ethanoic   Ester (ethyl   water

acid   ethanoate)

(ii)   Uses: They are used for making fragrances and flavouring agents. e.g.: flavouring in ice-cream and sweets.

(9)   What is saponification?

Ans.

(i)   Saponification is the process of making soap molecule from the chemical reaction in which fatty esters are hydrolysed in basic conditions.

(ii)   This process converts fats and oils via basic reaction medium to salts of fatty acids.

(iii)   When an ester is reacted with the alkali sodium hydroxide, the corresponding alcohol and carboxylic acid (in the form of its sodium salt) are obtained back. This reaction is called saponification reaction as it is used for preparation of soap from fats.

Ester + Sodium hydroxide $\rightarrow$ Sodium Carboxylate + Alcohol
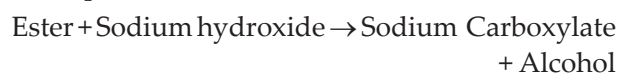
Q.4.2. Study the diagram and answer the following questions:

(1)
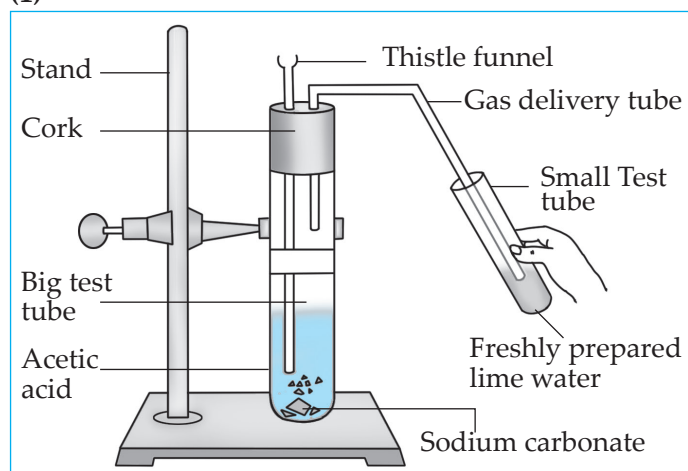
(i) Which acid is present in the big test tube?

(ii) What is the observation and conclusion of this experiment?

(iii) Explain neutralization reaction of this acid with a base.

Ans.

(i) Acetic acid (ethanoic acid) is present in the big test tube.

(ii) **Observation :** Acetic acid (ethanoic acid) reacts wtih basic salt namely, sodium carbonate and a gas with effervescence is given out. This gas, when passed through lime water in the small test tube, turns lime water milky.

Conclusion : Acetic acid (ethanoic acid) reacts with basic salt namely, Sodium carbonate, to form a salt named sodium ethanoate, water and carbon dioxide gas.

$$2CH_3COOH_{(aq)} + Na_2CO_{3(s)} \rightarrow 2CH_3COONa_{(aq)} + H_2O_{(I)} + CO_{2(g)}$$

Acetic acid   Sodium   Sodium   Water   Carbon
            carbonate   ethanoate   dioxide

This carbon dioxide gas reacts with lime water Ca $(OH)_2$ in the small test tube and forms a white colour precipitate of calcium carbonate due to which lime water turns milky.

$$CO_{2(g)} + Ca(OH)_{2(aq)} \rightarrow H_2O + CaCO_3\downarrow$$

Carbon   Lime   Water   Calcium
dioxide   Water   carbonate
                                  (water)

(iii) The neutralization reaction of this acid with a base to form salt and water.

$$CH_3COOH + NaOH \rightarrow CH_3COONa_{(aq)} + H_2O_{(I)}$$
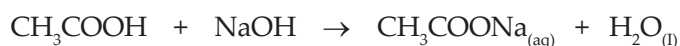
(2) Observe the apparatus and chemicals given below and answer the following questions:

Apparatus : Test tube, beakers, burner etc.

Chemicals : Glacial ethanoic acid, ethanol, concentrated Sulphuric acid etc.

(a) Which reaction will you study using above apparatus and chemicals? Draw a neat labelled diagram for the experimental set up.

(b) How will you identify that the reaction has occurred?

(c) Write chemical equation involved in this experiment.

(For fig. see pg. 172 Q.3.3(1))

Ans.

(i) We will be able to study the esterification reaction. Substances having ester as the functional group are formed by the reaction between a carboxylic acid and an alcohol.

(ii) 1 ml of ethanol is mixed with 1 ml of glacial ethanoic acid in a test tube and a few drops of concentrated sulphuric acid is added to this mixture. This tube is heated using hot water bath for five minutes. This mixture is powered into 20-0 ml of water in a breaker. If we get a sweet odour the reaction is complete, as the esters have sweet odour.

(iii) Ethanoic acid reacts with ethanol in the presence of an acid catalyst and ester, ethyl ethanoate is formed.

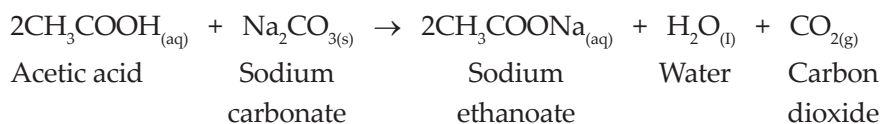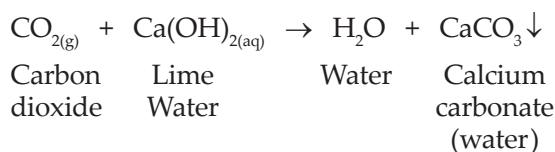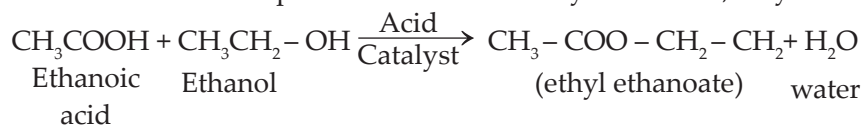$$CH_3COOH + CH_3CH_2-OH \xrightarrow[\text{Catalyst}]{\text{Acid}} CH_3-COO-CH_2-CH_2+ H_2O$$

     Ethanoic   Ethanol   (ethyl ethanoate)   water
      acid

❖ ❖ ❖

ASSIGNMENT - 9

Time : 1 Hr.   **Marks : 20**

Q.1. (A) Fill in the blanks: (3)

(1)   Hydrocarbons having identical molecular formula but different structures are called _____ .

(2)   Ethanoic acid is commonly known as _____ .

(3)   A macromolecule formed by regular repetition of a small unit is called _____ .

Q.1. (B) Choose and write the correct option: (2)

(1)   What are the products obtained on complete combustion of hydrocarbons? _____

(a) $CO + H_2O$ (b) $CO_2 + H_2$ (c) $CO_2 + H_2O$ (d) $CO + H_2$

(2)   Ethanol is used as an additive to increase the efficiency of petrol. Such a fuel is called _____

(a) Ethanol   (b) Cananol   (c) Gasohol   (d) Methanol

Q.2 Answer the following: *(Any 2)*   (4)

(1)   Why acetic acid is called glacial acetic acid?

(2)   Give IUPAC names for the given compounds

(a)
```
      H    H    H
      |    |    |
H  —  C —  C  = C
      |    |    |
      H    H    H
```
(b)
```
      H    H   OH    H
      |    |    |    |
H  —  C —  C —  C  —  C  — H
      |    |    |    |
      H    H    H    H
```

(3)   Differentiate between natural and man-made macromolecules.

Q.3 Answer the following: *(Any 2)*   (6)

(1)   Draw electron dot structure of (i) CO_2 (ii) H_2O

(2)   Detergents are superior to soaps - Give scientific reasons.

(3)   Write short notes on (i) Structural Isomerism   (ii) Covalent bonds.

Q.4 Answer the following: *(Any 1)*   (5)

(1)   Explain with example: (i) Substitution reaction   (ii) Addition reaction

(2)   Classify saturated compounds. Give 1 example of each.

❖ ❖ ❖

10 Space Missions

🔦 *Points to Remember:*

- The universe consists of vast emptiness called **space** with unknown boundaries. It comprises of millions of **galaxies** which are **cluster of Stars.**

- **Astronomy** is a branch of Science which deals with the study of all the **Celestial or Heavenly bodies** in this Universe. Unlike other sciences, astronomy is an **observational** Science.

- The advancement of technology, specially space technology, has taken a huge step in the last part of **20th century.** Hence, space travel got a boost.

- Thousands of **artificial satellites** are revolving around the earth in specific orbits. This enables man to know and understand more about the **Solar system.**

- Space mission is broadly classified into two types:
    - **Launching an artificial satellite in the orbit around the earth for research and various other useful applications.**
    - **Sending spacecrafts to outer space to observe objects closely and to understand them.**

- Russian **Yuri Gagarin** was the first to **go into the space** and **revolve** around the **Earth.**

    In **1969, Neil Armstrong** was the **1st** man to land on the surface of the **Moon.**

- In **1984, Rakesh Sharma,** was the **first Indian** to orbit the earth.

- **Sunita Williams** and **Kalpana Chawla** of Indian origin also participated in space exploration through missions organized by **NASA.**

- Due to space explorations, the world has becomes a **universal or global village.**

- **Moon** is the **natural satellite** of the earth. **Jupiter** has maximum, i.e. **69** natural satellites.

- Artificial satellite is a **man-made object** that revolves regularly around a planet or earth in a fixed orbit.

- The **first** artificial satellite 'Sputnik' was launched in space by **Russia in 1957.**

- There are different types of artificial satellites; they are : **Weather satellites, Communication satellites, Broadcast satellites, Navigational satellites, Military satellites** and **Earth Observation Satellites.**

- All artificial satellites **do not** revolve around the Earth in the same orbit.

- The satellite takes **24 hours** to orbit around the earth if its height from the surface of the earth is **35780 km.**
    - The specific velocity given to a satellite in a tangential direction to the orbit so that it starts revolving around earth is called as critical velocity (v_c).
    - The orbit of a satellite at a height greater than or equal to 35780 km above earth's surface is called High earth orbit.
    - The orbit of a satellite at a height between 2000 km and 35780 km above earth's surface is called Medium earth orbit.
    - The orbit of a satellite at a height between 180 km and 2000 km above earth's surface is called Low earth orbit.
    - Satellite launch vehicles are used to place satellites in their specific orbits.
    - Geosynchronous satellites revolve in an orbit parallel to the equator and have a time of revolution of 24 hours.
    - Polar satellites revolve in elliptical orbits passing over polar regions and revolve in 2 to 24 hours.

- The Moon is the **closest** celestial object around the Earth. Hence, the earlier explorations were towards Moon only.

- The **second closest** celestial body is **Mars**. The Mars expeditions were very tough. **ISRO** launched a space Mangalyaan Shuttle to Mars in **Nov. 2013** and in **Sept. 2014**, it got placed in the orbit of Mars and started functioning.

- **Vikram Sarabhai** is known as the father of the Indian space programme. The first Indian artificial satellite **'Aryabhatta'** was launched in **1963** under his efforts.

- There are many other explorations carried on other planets which were successful. Some **space shuttles** moved around those planets and some landed on them.

- In the space due to explorations, some **man-made** objects revolve around the earth. In **2016**, it was noticed that nearly **2 crore** objects having length of more than 1 cm are revolving around the earth. This is called **space waste** or **space garbage.** The worldwide efforts are now underway to manage these space debris.

MASTER KEY QUESTION SET - 10

Q.1. (A) 1. Fill in the blanks and rewrite the statement:

(1) The man made devices that revolve around the earth, like any other planet are called _____ .

*(2) If height of orbit of a satellite from earth's surface is increased, the tangential velocity of the satellite will _____ .

*(3) The initial velocity (during launching) of the Mangalyaan must be greater than _____ of the earth.

(4) The presence of _____ on the Moon was predicted by the space shuttle _____ .

(5) India's first successful inter-planetary mission was _____ .

(6) The first man to travel in space through a spacecraft was _____ .

(7) In 1969, the first person who landed on the Moon was _____ .

(8) The first Indian _____ travelled around the earth in a Russian spacecraft in 1984.

(9) Due to _____ , the world has become a global village.

(10) In 1957, Russia launched a satellite named _____ .

(11) The launching of a satellite is based on _____ third law of motion.

(12) The nearest celestial object from the earth is _____ .

(13) The Father of Indian space exploration programme is _____ .

(14) The nearest planet to earth is _____ .

(15) In India, ISRO is headquatered at _____ .

(16) The earth takes almost _____ hours to rotate about itself.

(17) The first satellite launched by India was named as _____ .

(18) The earth takes almost _____ days to revolve around the Sun.

(19) The planet Jupiter has _____ satellites.

(20) _____ are the Broadcast satellites of India.

Ans. *(1) Artificial satellite (2) decrease (3) escape velocity (4) water, Chandrayaan 1 (5) Mangalyaan (6) Y. Gagarin (7) N. Armstrong (8) Rakesh Sharma (9) Space exploration (expedition) (10) Sputnik (11) Newton's (12) Moon (13) Vikram Sarabhai (14) Mars (15) Bengaluru (16) 24 (17) Aryabhatta (18) 365 (19) 69 (20) INSAT.*

Q.1. (A) 2. Find the odd man out:

(1) Yuri Gagarin, Neil Armstrong, Rakesh Sharma, Vikram Sarabhai

Ans. Vikram Sarabhai - He was a scientist while others were astronauts.

(2) Moon, Sputnik, INSAT, Mars

Ans. Mars - It is a planet while others are satellites of earth.

(3) INSAT, GSAT, IRS, PSLV

Ans. PSLV - It is a satellite launch vehicle while others are satellites.

(4) H.E.O, L.E.O, M.E.O, GSLV

Ans. GSLV - It is a satellite launch vehicle while others are earth orbits.

Q.1. (A) 3. Complete the analogy:

(1) USSR: Yuri Gagarin :: India : _____

Ans. Rakesh Sharma: The first person to go in space from USSR was Yuri Gagarin, whereas the 1st Indian to go in space was Rakesh Sharma.

(2)   PSLV : Polar Satellite Launch Vehicle : : GSLV : ....

Ans. Geosynchronous Satellite Launch Vehicle : PSLV stands for Polar Satellite Launch Vehicle whereas GSLV stands for Geosynchronous 'Satellite Launch Vehicle.

(3)   2000 km to 35780 km : M.E.O : : 180 km to 2000 km : ....

Ans. (LEO) : If the height of the satellite orbit above earth's surface is in between 2000 km and 35780 km, the orbits are called Medium Earth Orbits, (MEO), Whereas if the height of the satellite orbit above the earth's surface is in between 180 km and 2000 km, the orbit are called Low Earth Orbits, (LEO)

(4)   Moon : Chandrayan - 1 : : Mars : ....

Ans. Mangalyan : In 2008, ISRO successfully launched Chandrayan I and placed it into an orbit around the moon, while the spacecraft made by ISRO in November 2013 was placed into orbit around Mars.

Q.1. (A) 4. Match the columns:

(1)

Column A	Column B
(1) INSAT	(a) Polar Satellite Launch Vehicle
(2) GSAT	(b) Indian National Satellite
(3) GSLV	(c) Geo synchronous Satellite
(4) PSLV	(d) Geo synchronous Satellite Launch vehicle

Ans. *(1 - b), (2 − c), (3 - d), (4 - a)*

(2)

Column A	Column B
(1) Weather satellite	(a) Information of the area on protection point
(2) Communication satellite	(b) To decide accurate latitude and longitude
(3) Navigational satellite	(c) Communicate various places through waves
(4) Military satellite	(d) To predict weather forecast

Ans. *(1- d), (2 − c), (3 - b), (4 - a)*

(3)

Column A	Column B
(1) Neil Armstrong	(a) The first man in space
(2) Yuri Gagarin	(b) The father of Indian Space Research
(3) Rakesh Sharma	(c) The first man on Moon
(4) Vikram Sarabhai	(d) The first Indian in space

Ans. *(1 – c), (2 − a), (3 - d), (4 − b)*

(4)

Column A	Column B
(1) Gravitational Constant	(a) 6×10^{24} kg
(2) Gravitational acceleration	(b) 6.4×10^6 m
(3) Mass of the earth	(c) 9.8 m/s^2
(4) Radius of the earth	(d) 6.67×10^{-11} Nm^2/kg^2

Ans. *(1 – d), (2 − c), (3 – a), (4 − b)*

Q.1. (A) 5. State whether the following statements are 'True' or 'False'. Correct the false statements:

*(1)   If a spacecraft has to be sent away from the influence of Earth`s gravitational field, its velocity must be less than the escape velocity.

(2)   INSAT is an educational satellite.

*(3)   The escape velocity on the Moon is less than that on the Earth.

*(4)   A satellite needs a specific velocity to revolve in specific orbit.

*(5)   If the height of the orbit of a satellite increases, its velocity must also increase.

(6)   All artificial satellites revolve in similar orbits around earth.

(7)   ISS and Hubble revolve in L.E.O.

Ans. *(1) False. The escape velocity is responsible to launch a rocket in space which can overcome the earth's gravitational force. Hence, its velocity should be more than the escape velocity. (2) False. EDUSAT is the satellite used in the field of education. (3) True. As the gravitational force of attraction on the moon is 1/6th of the Earth, hence, less escape velocity is required to overcome the gravitational force. (4) True. (5) False. If height increases, the velocity decreases. (6) False. All artificial satellites do not revolve in similar orbits around earth. (7) True*

Q.1.   (A) 6. Name the following:

(1)   Indian origin female astronauts who travelled by NASA satellite.

Ans.   Sunita Williams and Kalpana Chawla

(2)   Satellite designed by the student of COEP in Pune.

Ans.   Swayam

(3)   In 2008, the ISRO launched space shuttle.

Ans.   Chandrayan 1

(4)   First Satellite launched by India.

Ans.   Aryabhatta

(5)   Value of gravitational constant.

Ans. $6.67 \times 10^{-11} \ Nm^2/kg^2$

(6)   Orbit of a satellite between 180 km. to 2000 km from Earth's surface.

Ans.   Low Earth Orbit

(7)   Energy on which satellites work.

Ans.   Solar energy

(8)   Satellite which appears stationary with respect to Earth, revolving parallel to the equator.

Ans.   Geosynchronous satellite

(9)   Orbits in which satellites complete one revolution in 2 to 24 hours.

Ans.   Polar Orbits

(10)   The velocity required for launching a remote sensing satellite.

Ans.   Escape velocity

(11)   Indian satellite working for monitoring and management of natural resources and disaster management.

Ans.   IRS Satellite

Q.1.   (A) 7. Answer the following in one sentence:

(1)   What is an artificial satellite?

Ans.   A man made object that revolves around the Earth or any other planet in a fixed orbit is called artificial satellite.

(2)   Which planet in our solar system has maximum satellites?

Ans.   Jupiter has maximum satellites, i.e. 69.

(3)   What is the name of the first Indian satellite?

Ans.   The first Indian Satellite is named as 'Aryabhatta'.

(4)   Who is called the father of Indian Space programme ?

Ans.   Vikram Sarabhai is called the father of Indian Space programme.

(5)   Name two female astronauts of Indian Origin?

Ans.   Two female astronauts of Indian origin are Sunita Williams and Kalpana Chawla.

(6)   What are the applications of geo-stationary satellite?

Ans.   Geo-stationary satellites are used for weather report, telephone, television, Radio, broadcasting and telecommunication.

Q.1 (A) 8. Write the full forms of the following:

(1)   INSAT : Indian National Satellite

(2)   GSAT : Geosynchronous Satellite

(3)   IRNSS : lndian Regional Navigation Satellite System

(4)   GSLV : Geosynchronous   Satellite   Launch Vehicle

(5)   PSLV   : Polar Satellite Launch Vehicle

(6)   ISRO   : Indian Space Research Organisation

(7)   NASA : National   Aeronautics   and   Space Administration

Q.1.   (B) Choose and Re-write with the correct option:

(1)   Which of the following is the communication satellite of India?

   (a) INSAT   (b) EDUSAT

   (c) Astrosat   (d) Resourusat–1

(2)   'Launching of a rocket' is based on Newton's _____ law of motion.

   (a) first   (b) second   (c) third   (d) fourth

(3)   _____ planet has maximum number of satellites.

   (a) Earth   (b) Jupiter   (c) Mars   (d) Saturn

(4)   Which of the following is a satellite launch vehicle?

   (a) PSLV   (b) IRS   (c) INSAT (d) GSAT

(5)   _____ is known as Pioneer of Indian space Programme.

   (a) Neil Armstrong   (b) Yuri Gagarin

   (c) Rakesh Sharma   (d) Vikram Sarabhai

(6) .... is a High Earth Orbit (HEO) satellite?
- (a) Navigational satellite
- (b) Geosynchronous
- (c) International Space Station
- (d) SPUTNIK

(7) Which of the following is Low Earth Orbit (LEO) statlite?
- (a) Navigational satellite
- (b) Geostationary satellite
- (c) International Space Station
- (d) All of the above

(8) To use a satellite for communication or meteorology, what type of orbit will be best suited?
- (a) Circular orbit
- (b) Geosynchronous orbit
- (c) Elliptical orbit   (d) Polar orbit

(9) Two satellites revolving in a LEO and geo-synchronous orbit have speed x and y respectively. Which of the following relation is correct?
- (a) $x > y$ (b) $x < y$
- (c) $x = y$ (d) None of the above

(10) Which is the best suited orbit for a remote sensing satellite?
- (a) Geosynchronous orbit
- (b) Elliptical orbit   (c) Circular orbit
- (d) Sun synchronous Polar orbit

Ans. *(1) (a) INSAT (2) (c) third (3) (b) Jupiter (4) (a) PSLV (5) (d) Vikram Sarabhai (6) (b) Geosynchronous orbit (7) (c) International Space Station (8) (b) Geosynchronous orbit (9) (a) x > y (10) (a) Geosynchronous orbit*

Q.2.1. Solve the following:

> **Type: A**
> **Escape velocity:**
> $$v_{esc} = \sqrt{\frac{2GM}{R}}$$
> **for earth: v_{esc} = 11.2 km/s.**

*(1) If mass of a planet is eight times the mass of the earth and its radius is twice the radius of the earth, what will be the escape velocity for that planet?

Ans. Given: $M_p = 8 M_e$
$R_p = 2 R_e$

To find: $v_{e(p)}$ = ?

Formula: $v_e = \sqrt{\frac{2GM}{R}}$

Solution:

(a) For earth,
$$v_e = \sqrt{\frac{2GM_e}{R_e}} = 11.2 \text{ km/s} \quad \text{...(i)}$$

(b) For the planet given,
$$v_c = \sqrt{\frac{2GM_p}{R_p}} \quad \text{...(ii)}$$
$$= \sqrt{\frac{2G8M_e}{2R_e}} \quad \because (M_p = 8 M_e, R_p = 2R_e)$$
$$= \sqrt{\frac{8}{2} \times \frac{2GM_e}{R_e}}$$
$$= \sqrt{4 \times \frac{2GM_e}{R_e}}$$
$$= 2 \times \sqrt{\frac{2GM_e}{R_e}} \quad \text{...[from (i)]}$$
$$= 2 \times 11.2$$
$$= 22.4 \text{ km/s}$$

∴ **The escape velocity for that planet will be 22.4 km/s.**

> **Type: B**
> **Orbital velocity:**
> $$v = \sqrt{\frac{GM}{R+h}}$$
> $$v = \frac{2\pi r}{T}$$
> **Note: At height h from surface**
> $$v = \frac{2\pi (R+h)}{T}$$

*(1) Suppose the orbit of a satellite is exactly 35780 km above the earth's surface. Determine the tangential velocity of the satellite.

Ans. Given: h = 35780 km = 35780000m
$R = 6.4 \times 10^6$ m = 6400000m
$M = 6 \times 10^{24}$ kg
$G = 6.67 \times 10^{-11}$ Nm²/kg²

To find: v = ?

Formula: $v = \sqrt{\frac{GM}{R+h}}$

Solution: $v = \sqrt{\frac{6.67 \times 10^{-11} \times 6 \times 10^{24}}{(35780000 + 6400000)}}$

$$= \sqrt{\frac{40.02 \times 10^{13}}{42180000}}$$

$$= \sqrt{\frac{40.02 \times 10^{13}}{42.18 \times 10^6}}$$

$$= \sqrt{\frac{40}{42} \times 10^7}$$

$$= \sqrt{0.95 \times 10^7}$$

$$= \sqrt{9.5 \times 10^6}$$

$$= 3.08 \times 10^3 \text{ m/s or } 3.08 \text{ km/s}$$

∴ **Tangential velocity will be 3.08 km/s.**

*(2) In the previous example, how much time the satellite will take to complete one revolution around the earth?

Ans. **Given:**   v = 3.08 km/s

h = 35780 km

R = 6400 km

To find: T = ?

Formula: $v = \dfrac{2\pi r}{T}$

Solution: $v = \dfrac{2\pi r}{T}$

$T = \dfrac{2\pi r}{v}$

$T = \dfrac{2\pi}{v}(R + h)$

$T = 2 \times \dfrac{3.14}{3.08} \times (6400 + 35780)$

$= 2 \times \dfrac{3.1}{3.1} \times 42180$

$= 2 \times 42.18 \times 10^3$

$= 2 \times 43 \times 10^3$

$= 86 \times 10^3 \text{ s or } 86000 \text{ s}$

Also, $T = \dfrac{86000}{3600}$ hrs = 23.89 hrs = 23 hrs 54 mins

∴ **Satellite will take 23 Hrs. 54 mins to complete one revolution.**

*(3) How much time a satellite in an orbit at height 35780 km above earth's surface would take, if the mass of the earth would have been four times its original mass?

Ans. Method 1

Given: h = 35780 km

v = 3.08 km/s

M = 4 M

R = 6400 km

To find: T = ?

Formulae: $v = \sqrt{\dfrac{GM}{R + h}}$, $v = \dfrac{2\pi r \,(R + h)}{T}$

Solution: $v = \sqrt{\dfrac{GM}{R + h}}$

let v_n be the new velocity,

$v_n = \sqrt{\dfrac{GM_n}{R + h}}$

$v_n = \sqrt{\dfrac{G \times 4M}{R + h}}$

$v_n = \sqrt{\dfrac{4 \times GM}{R + h}}$

$v_n = 2 \times \sqrt{\dfrac{GM}{R + h}}$

$v_n = 2v$ ...(i)

Also, $v_n = 2\pi \dfrac{(R + h)}{T_n}$

$T_n = \dfrac{2\pi\,(R + h)}{v_n}$

$T_n = \dfrac{2\pi\,(R + h)}{2v}$ ...from equation (i)

$T_n = \dfrac{3.14}{3.08} \times (35780 + 6400)$

$T_n = \dfrac{3.1}{3.1} \times 42180$

$T_n = 42180 \text{ s}$ or $T_n = \dfrac{42180}{3600} = 11.71 \text{ hrs.} \sim 12 \text{ hrs.}$

∴ **Time take will be ~ 12 hrs.**

*(3) How much time a satellite in an orbit at height 35780 km above earth`s surface would take, if the mass of the earth would have been four times its original mass?

Ans. Method 2

Given: New Mass of Earth (M) = 4 × (6 × 10²⁴) kg

= 24 × 10²⁴ kg.

Altitude of the satellite (h)   = 35780 km

= 35780 × 10³ m.

To find: Time required for revolution (T) = ?

Formulae: $v = \sqrt{\dfrac{GM}{R+h}}$

$T = \dfrac{2\pi\,(R+h)}{v}$

Solution: $v \quad = \sqrt{\dfrac{GM}{R + h}}$

∴ $v = \sqrt{\dfrac{6.67 \times 10^{-11} \times 24 \times 10^{24}}{6.4 \times 10^6 + 35780 \times 10^3}}$

$\therefore \quad v = \sqrt{37.95 \times 10^6}$

$v = 6.160$ km/s.

$T = \dfrac{2\pi\,(R+h)}{v}$

$= \dfrac{2 \times 3.14 \times 6400 + 35780}{6.16}$

$T = \dfrac{2 \times 3.14 \times 42180}{6.16}$

$= 43001.68$ sec

$T = 11.94$ hr $\sim$ 12 hours

> $\therefore$ **The satellite will take approximately 12 hours to revolve around earth.**

*(4) **If the height of a satellite completing one revolution around the earth in T seconds is h_1 meter, then what would be the height of a satellite taking $2\sqrt{2}$ T. seconds for one revolution?**

Ans. **Given:** Height of 1ˢᵗ satellite = h_1

Time of rev. of 1ˢᵗ satellite = T

Time of rev. of 2ⁿᵈ satellite = $2\sqrt{2}$ T

To find: Height of 2ⁿᵈ satellite (h_2) = ?

Formulae: $\dfrac{T^2}{r^3} = k,\ \dfrac{2\pi\,(R+h)}{T}$

Solution: Case (i) Time = T, $r = R + h_1$

$\dfrac{T^2}{(R+h_1)^3} = k$ \qquad (i)

Case (ii) Time = $2\sqrt{2}$ T

$r = R + h_2$

$\dfrac{8T^2}{(R+h_2)^3} = k$ \qquad (ii)

From (i) and (ii)

$\dfrac{T^2}{(R+h_1)^3} \diagdown\!=\!\diagup \dfrac{8T^2}{(R+h_2)^3}$ (by cross multiplying)

$(R+h_2)^3 = 8\,(R+h_1)^3$

Taking cube root on both sides,

$\sqrt[3]{\left(R+h_2\right)^3} = \sqrt[3]{8\,(R+h_1)^3}$

$R + h_2 = 2\,(R + h_1)$

$R + h_2 = 2R + 2h_1$

$h_2 = 2R + 2h_1 - R$

$h_2 = R + 2h_1$

> $\therefore$ **Height of the 2ⁿᵈ satellite will be $R + 2h_1$**

Q.2.2. Define the following:

(1) **Geo-stationary satellite**

Ans. If the satellite is revolving in an orbit parallel to the equator, the time of revolution of the Earth around itself and that of the satellite to revolve around the Earth is the same. Thus the satellite will appear to be stationary with respect to the Earth. This satellite is called Geo-stationary satellite.

(2) **High Earth Orbits**

Ans. If the height of the satellite's orbit above the Earth's surface is greater than or equal to 35780 km, the orbit is called High Earth Orbits.

(3) **Medium Earth Orbits**

Ans. If the height of the satellite's orbit above the Earth's surface is in between 2000 km to 35780 km, the orbits are called Medium Earth Orbits.

(4) **Low Earth Orbits**

Ans. The height of the satellite orbit above the earth surface is in between 180 km and 2000 km are called Low Earth Orbits.

(5) **Polar Orbit**

Ans. In order to observe and study polar regions, geo-stationary satellites have limitations. Hence, elliptical medium earth orbits passing over the polar regions are used. They are called Polar Orbits.

(6) **Critical Velocity (v_c)**

Ans. The specific velocity given to a satellite in a tangential direction to the orbit, so that it starts revolving around earth is called as critical velocity (v_c).

(7) **Satellite Launch vehicle**

Ans. The space vehicles which are used to place satellites in their specific orbits are called Satellite Launch vehicles.

Q.2.3. Write short notes:

(1) **Space Exploration**

Ans.

(i) In the second half of the 20th century, there was tremendous development in technology, especially space technology. Hence, space shuttles were developed and launched in the space.

(ii) More than thousands of artificial satellites now are revolving around the Earth in various orbits.

(iii) Space Exploration helps to observe and study the various aspects of our solar system and the universe outside the solar system.

(iv)   The collective effect of space exploration can be seen in the development of communication technology, weather forecasting and many other fields where artificial satellites are playing a very important role in the world today.

(v)   Space explorations are basically of two types, a) Satellite revolving around the Earth which study and observe various things happening on or around earth and sending information to the earth. b) Sending satellite outside our solar system to know more about the universe.

(2)   Artificial Satellite

Ans.

(i)   A man-made object which revolves around the Earth in a definite orbit is called artificial satellite of the earth.

(ii)   Sputnik was the first artificial satellite launched in 1957.

(iii)   Today, there are more than thousands of artificial satellites revolving around the earth.

(iv)   These satellites use solar energy for their functioning.

(v)   Satellites are used for various purposes, like weather, communication, broadcasting etc.

(vi)   Aryabhatta was the first Indian satellite.

(3)   Lunar expeditions
Ans.
(i)   Moon is the natural celestial body nearest to the Earth.

(ii)   It is our natural satellite. Therefore, initial explorations were always caused on the moon.

(iii)   Soviet Union, USA, European countries, China, Japan and now India carried out such expeditions towards the moon.

(iv)   Russia had sent series of space shuttles called Luno on the moon.

(v)   From 1962 to 1972, USA carried out expedition to Moon.

(vi)   In 1969, Neil Armstrong was the first man who landed on Moon.

(4)   Mars expeditions

Ans.

(i)   The planet nearest to the Earth is 'Mars'.

(ii)   Many countries had sent space shuttles towards Mars for various purposes.

(iii)   Mars expeditions are very tough and nearly 50% of the expeditions have failed.

(iv)   ISRO has made an expedition towards Mars, a success. In Nov, 2013 a space shuttle was launched towards Mars and in Sept 2014, valuable informations were gathered about Mars.

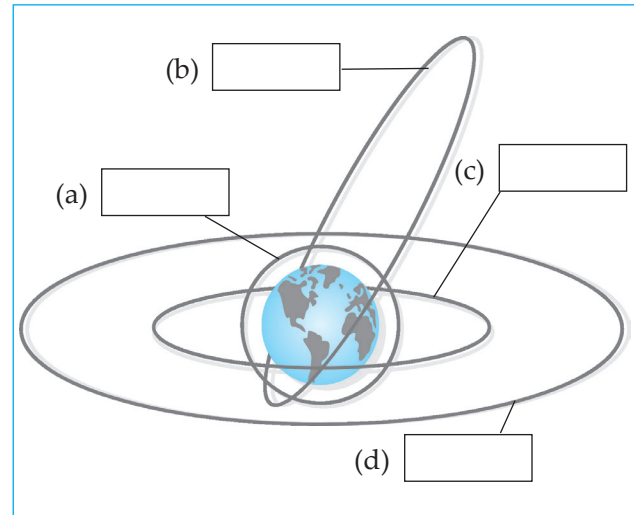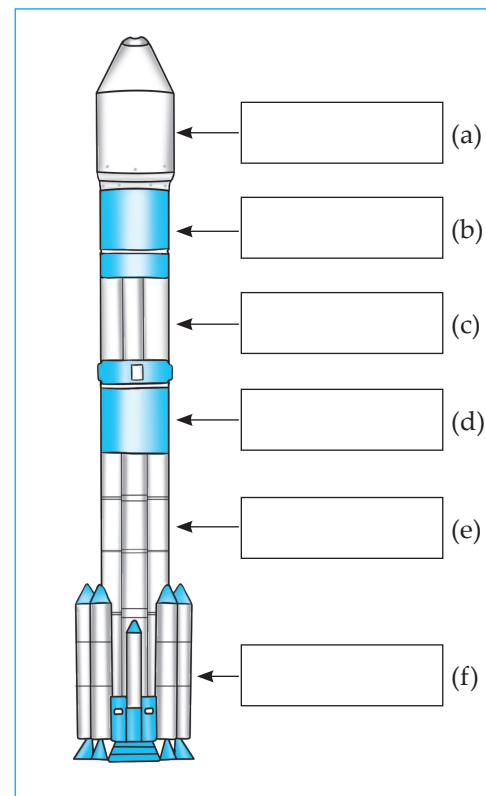**Q.2.4. Label the diagram:**

(1)   Orbits of satellites

Fig 10.1 : Orbits of Satellites

Ans. (a) LEO (b) MEO (c) MEO (d) HEO

(2)   Structure of PSLV made by ISRO

Ans. (a) Place for satellite (b) Fourth stage using liquid fuel (c) Third stage using solid fuel (d) Second stage using liquid fuel (e) First stage using solid fuel (f) Engine using solid fuel which provides the initial thrust

Q.2.5. Answer the following:

(1) What are the applications of geo-stationary satellite?

Ans. Geo-stationary satellites are used for weather report, telephone, television, Radio, broadcasting and telecommunication.

(2) What is space debris ? How this debris is managed?

Ans.

(i) In addition to artificial satellites some other objects also revolve around the earth. They include non-functional parts of satellites, detached parts of launcher, pieces due to collision of satellites.

(ii) This debris can be harmful to the artificial satellites. They can collide with the satellites or space crafts and damage them. Soon it will be very difficult to launch new space crafts.

(iii) How is it managed.

(3) Explain escape velocity. Write the value of escape velocity of earth?

Ans.

(i) The velocity required to overcome the Earth's gravitational force and move the objects in space is called escape velocity.

(ii) The escape velocity for the Earth is 11.2 km/s.

*(4) Why are geo-stationary satellites not useful for studies of polar regions?

Ans.

(i) Geo-stationary satellites have orbits parallel to the equator and hence the observation of polar regions is not carried out properly.

(ii) For this purpose, elliptical medium earth orbits passing over polar regions are used.

*(5) Which types of telescopes are orbiting around the earth? Why it is necessary to put them in space? *(Can you tell; Textbook Page no. 135)*

Ans.

(i) The different types of telescopes orbiting around the earth are optical telescopes (Hubble), X ray telescope (Chandra), etc.
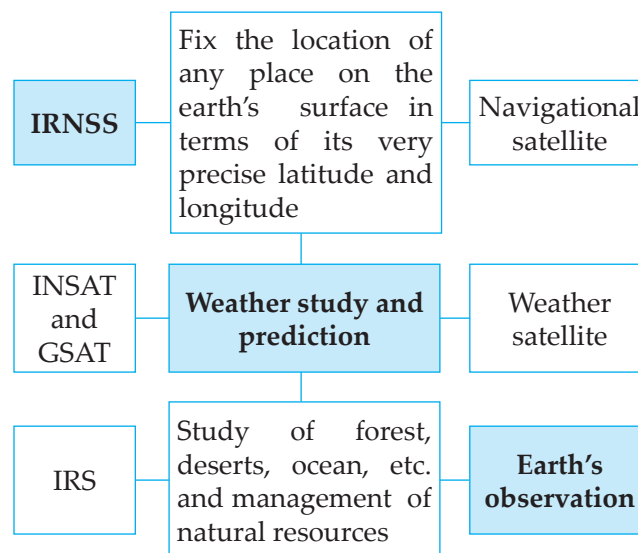
(ii) These telescopes are placed in space because

    (a) Some of the light coming from heavenly bodies is absorbed by earth's atmosphere.

    (b) The position of image is disturbed due to changes in pressure and turbulence in atmosphere.

    (c) Optical telescopes cannot be used during the day due to sunlight.

    (d) During night, city lights and cloudy weather causes difficulty in observations.

(6) How are satellites launched in an orbit?

Ans. The satellites are taken to the desired orbits using a satellite launcher. The satellite is then given a specific velocity, called critical velocity (v_C) in a tangential direction.

*(7) Complete the following table:

IRNSS	Fix the location of any place on the earth's surface in terms of its very precise latitude and longitude	Navigational satellite
INSAT and GSAT	**Weather study and prediction**	Weather satellite
IRS	Study of forest, deserts, ocean, etc. and management of natural resources	**Earth's observation**

*(8) What is difference between space and sky? *(Can you recall; Textbook page no 135)*

Ans.

(i) Space: The region between the celestial bodies which have different gases and dust particles is called space. There are many stars, planets, galaxies present in the space.

(ii) Sky: On a cloudless night, if we observe up above the earth, from an open ground, we can see stars twinkling on a dark background. What we see beyond the earth's atmosphere with our naked eyes which appears like a ceiling is called the sky.

*(9) What are different components of Solar System?

Ans. Our Solar system comprises of Sun, Moon, Planets, dwarf planets, Comets, Meteors, etc.

*(10) What is meant by Satellite?

Ans. An astronomical object in space that orbits or circles around the earth or planet is called satellite.

*(11) How many natural satellites does the earth have?

Ans. The Moon is the only natural satellite of the Earth.

*(12) Where does the signal in your cell phone come from?

Ans. Mobile receives its signals from communication (mobile) towers on the earth which are in the vicinity.

*(13) **Where from do mobile towers receive the signals?**

Ans. Mobile towers receive the signals through various communication satellites like INSAT, GSAT series of satellites.

*(14) **Where does the signal to your TV set come from?**

Ans. TV sets receive signals from various broadcasting satellites which revolve around the earth.

*(15) **You may have seen photographs showing the position of monsoon clouds over the country, in the newspaper. How are these images obtained?**

Ans. They are obtained with the help of weather satellites like INSAT and GSAT.

(16) **The broadcast signals that originate from a radio station are sent to an artificial satellite for redistribution to other locations. Name the orbit where such satellites should be placed and the launch vehicle used.**

Ans. The satellite should be placed in High Earth Orbit (HEO). The launch vehicle used is GSLV.

(17) **What is the range from the Earth's surface, where an artificial satellite, to detect a precise latitude and longitude of a place, should revolve?**

Ans. 2000 km. to 35780 km.

(18) **An artificial satellite is at a height of 35780 km. from the Earth's surface. What is the period of revolution of this satellite?**

Ans. Since the orbit is at a height of 35780 km. from the Earth's surface, its period of revolution is 24 hrs.

(19) **Satellites need a specific velocity to revolve in specific orbits. Justify whether true of false.**

Ans. True.

(i) The specific velocity given to a satellite in tangential direction i.e. the critical velocity is given as $v_c = \sqrt{\dfrac{GM}{R+h}}$

(ii) Since the gravitational constant (G), mass of Earth (M) and the radius of Earth (R) is constant, the critical velocity depends on the height of the satellite from the Earth's surface. Thus satellites need a specific velocity to revolve in specific orbits.

*Q.3. Answer the following:

(1) **Calculate the minimum velocity required by spacecraft to escape the earth's gravitational force.**

Ans.

(i) Space launch vehicles are used for the launching

artificial satellites which overcome the earth's gravitational force and move into space.

(ii) The velocity of an object should be more than the escape velocity, only then the object can be launched into space.

$$v_{esc} = \sqrt{\frac{2GM}{R}}$$

G - Gravitational constant = 6.67×10^{-11} Nm²/kg²

M - Mass of the planet (earth) = 6×10^{24} kg

R - Radius of the earth = 6.4×10^6 m

$\therefore$ $v = \sqrt{\dfrac{2GM}{R}}$

$v = \sqrt{\dfrac{2 \times 6.67 \times 10^{-11} \times 6 \times 10^{24}}{6.4 \times 10^6}}$

$v = 11.18 \times 10^3$ m/s = 11.18 km/s.

Hence, the escape velocity for earth is 11.18 km/s.

The satellite launch vehicle should have velocity more than or at least 11.2 km/s.

(2) **Derive the formula for critical velocity (v_c).**

Ans. If a satellite of mass 'm' is revolving around the earth in an orbit of height 'h' with speed 'v_c', then centripetal force $F = \dfrac{mv_c^2}{r}$ will act on it.

Here, 'r' is the orbital radius of the satellite from the centre of the earth.

This centripetal force is provided by the gravitational force of the earth.

Therefore, centripetal force = gravitational force between the Earth and the satellite.

$$\frac{mv_c^2}{R+h} = \frac{GMm}{(R+h)^2}$$

$$v_c^2 = \frac{GM}{R+h}$$

Taking square root on both sides,
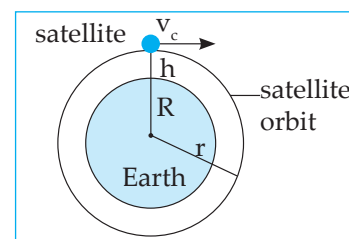
$$v_c = \sqrt{\frac{GM}{R+h}}$$

Fig 10.2: Orbit of an artificial satellite

*(3) **What is meant by the 'orbit' of a satellite? On what basis and how are the orbits of artificial satellites classified?**

Ans.

(i) The particular path that a satellite follows to revolve around the earth is known as its orbit. Different artificial satellites revolve in different orbits around the earth.

(ii) The orbits of artificial satellites are classified on the basis of following factors -

(a) Height of the orbit above the Earth's surface.

(b) The shape of the orbit (i.e. circular or elliptical)

(c) Whether it is parallel to the equator or makes a particular angle with the equator.

(iii) According to the altitude, the orbits are classified as follows:

(a) High Earth Orbits: Height 35780 km or higher above the Earth's surface.

(b) Medium Earth Orbits: Height 2000 km to 35780 km above the Earth's surface.

(c) Low Earth Orbits: Height 180 km to 2000 km, above the Earth's surface.

*(4) Why is it beneficial to use Satellite Launch Vehicles made of more than one stage?

Ans.

(i) Satellite Launch Vehicle uses a special type of fuel in huge amounts.

(ii) Hence, the maximum weight of the launcher is due to the fuel.

(iii) Due to this, different stages of fuels are made so that as the fuel gets utilized, the weight of the satellite launch vehicle can gradually reduce.

(iv) As the fuel in the 1st step is burnt, that part get automatically detached from the launcher. Due to this, the satellite launch vehicle can acquire more velocity.

(v) Thus, ultimately escape velocity is achieved and satellite can be launched successfully.

Q.4. Answer in detail:

*(1) What is meant by satellite launch vehicles? Explain a satellite launch vehicle developed by ISRO with the help of a schematic diagram.

Ans.

(i) Satellite launch vehicles are used, to place the satellites in their specific orbits. The functioning of the satellite launch vehicle is based on the Newton's third law of motion.

(ii) The launch vehicle uses specific type of fuel.

(iii) The gas produced due to combustion of the fuel expands due to its high temperature and is expelled forcefully through the nozzles at the rear of the launch vehicle.

(iv) As a reaction of this, a thrust acts on the vehicle, which drives the vehicle high into the space.

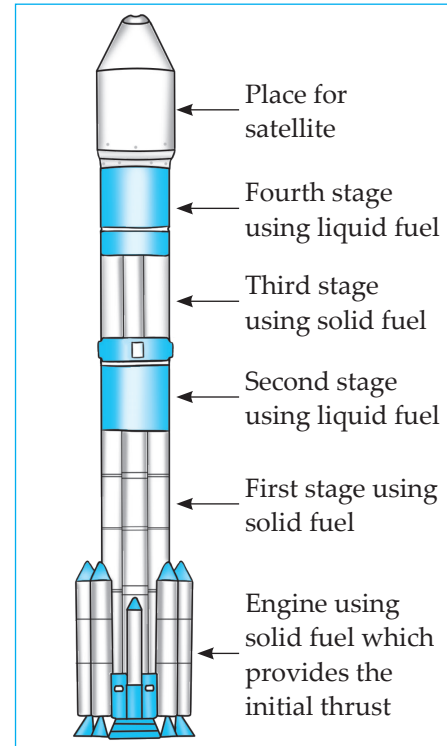(v) The structure of the launch vehicle is decided by the weight of the satellite and the type of satellite orbit.

Fig 10.3 : Structure of PSLV made by ISRO

(vi) The fuel forms a major portion of the total weight of the launch vehicle.

(vii) To overcome this problem, launch vehicles with more than one stages are used. Due to this, the weight of the vehicle can be reduced step by step, after its launching.

(viii) For example, consider a launch vehicle having two stages.

For launching the vehicle, the fuel and engine in the first stage are used. This imparts a specific velocity to the vehicle and takes it to a certain height.

(ix) Once the fuel in this first stage is exhausted, the empty fuel tank and the engine are detached from the main body of the vehicle and fall either into a sea or on an unpopulated land.

(x) As the fuel in the first stage is exhausted, the fuel in the second stage is ignited.

(xi) Since, the vehicle now contains only one stage, the weight has now been reduced and the vehicle can move with higher speed. Almost all vehicles are made of either two or more stages.

(xii) As an example, Polar Satellite Launch Vehicle (PSLV)

❖ ❖ ❖

ASSIGNMENT - 10

Time : 1 Hr.	Marks : 20

Q.1. (A) Answer the following questions. (3)

(1)   Fill in the blanks and rewrite the statement.

The nearest planet to earth is _____ .

(2)   Find the odd one out.

INSAT, GSAT, IRS, PSLV

(3)   Complete the analogy.

2000 km to 35780 km : M.E.O : : 180 km to 2000 km : _____

Q.1. (B) Choose and write the correct option: (2)

(1)   Launching of rocket is based on Newton's _____ law of motion.

(a) first   (b) second   (c) third   (d) fourth

(2)   _____ is known as Pioneer of Indian Space Programme.

(a) Neil Armstrong   (b) Yuri Gagarin   (c) Rakesh Sharma   (d) Vikram Sarabhai
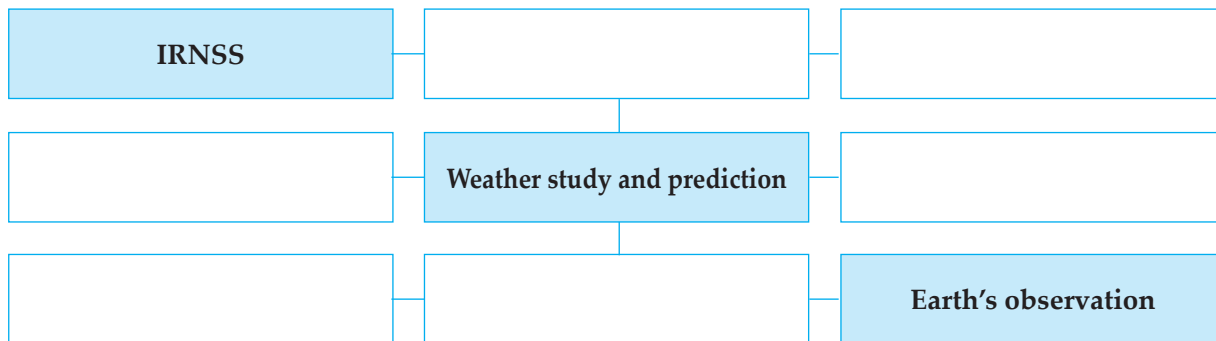
Q.2. Answer the following: (Any 2) (4)

(1)   Write short note on: Artificial satellite.

(2)   What is the difference between space and sky.

(3)   Define (a) High Earth orbits (b) Low Earth orbits

Q.3. Answer the following: (Any 2) (6)

(1)   How are satellites classified based on their functions?

(2)   Complete the following table.

IRNSS		
	Weather study and prediction	
		Earth's observation

(3)   How much time a satellite in an orbit at height 35780 km above Earth's Surface would take, if the mass of earth would have been four times its original mass?

Q.4. Answer in detail: (Any 1) (5)

(1)   Derive the formula for escape velocity.

(2)   What are Satellite Launch Vehicles? Explain a Satellite Launch Vehicle developed by ISRO with the help of schematic diagram.

❖ ❖ ❖

MODEL ACTIVITY SHEET

Time : 2 Hrs.   **Marks : 40**

Q.1. (A) Solve the following questions.   **(5)**

(1) If the height of the orbit of a satellite from the earth surface is increased, the tangential velocity of the satellite will ‒‒‒‒‒‒‒‒‒‒‒ .

(2) The conversion of Ferrous Sulphate to Ferric Sulphate is ‒‒‒‒‒‒‒‒‒‒‒ reaction.

(3) Write the proper answer in the box: $H = \boxed{} \times R \times t$.

(4) What is the odd one out from:
Fuse wire, bad conductor, rubber gloves, generator.

(5) During transformation of liquid phase to solid phase; the latent heat is ‒‒‒‒‒‒‒‒‒‒‒ .

Q.1. (B) Choose the correct alternative and rewrite the sentence: **(5)**

(1) The force of gravitation between two bodies in the Universe does not depend on ‒‒‒‒‒‒‒‒‒ .

(a) the distance between them   (c) the sum of their masses

(b) the product of their masses   (d) the gravitational constant

(2) Which of the following is a Dobereinei's triad?

(a) Ne, Ca, Na   (b) H_2, N_2, O_2 (c) Li, Na, K   (d) Na, Br, Ar

(3) When electric current is passed through a bulb, the bulb gives light because of ‒‒‒‒‒‒‒‒‒ .

(a) electric effect of current   (c) glowing effect of current

(b) heating effect of current   (d) lighting effect of current

(4) Which of the following has the highest heat capacity.

(a) Water   (b) Air   (c) Soil   (d) None of the above

(5) The part of the lens through which the ray of light passes without suffering deviation is called ‒‒‒‒‒‒‒ .

(a) Focus   (b) Optical centre   (c) Centre of curvature   (d) Pole

Q.2. Solve the following questions: *(Any 5)*   **(10)**

(1) Complete the following table.

IRNSS		
	Weather study and predict	

(2) Write the IUPAC names of the following structural formulae.

(a) $CH_3 – CH_2 – COOH$ (b) $CH_3 – CO – CH_2 – CH_3$

(3) Explain the terms: (a) Ores   (b) Gangue

(4) Distinguish between: Farsightedness and Nearsightedness.

(5) The absolute refractive index of water is 1.36. What is the velocity of light in water? (velocity of light in vaccum is 3×10^8 m/s).

(6) What is meant by latent heat? How will the state of matter transform if latent heat is given off.

(7) Give scientific reasons: Tungsten metal is used to make a solenoid type coil in an electric bulb.

Q.3. Solve the following questions: *(Any 5)*   **(15)**

(1) The gravitation force between two objects is F. How will this force change when:
(a) Distance between them is reduced to half.
(b) The mass of each object is quadrupled.

(2) What is the cause of non - metallic character of elements? What is the expected trend in the variation of non - metallic character of element from left to right in a period?

(3)	Some examples of redox reaction are as follows:
 (a)	Identify the reductants and oxidants from them:

$$2H_2S + SO_2 \rightarrow 3S\downarrow + 2H_2O$$

$$MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2\uparrow$$

 (b)	If oxidation means losing electrons, what is meant by reduction?

 (c)	Write the reaction of formation of Fe^{2+} by reduction Fe^{3+} by making use of the symbol (e^-).

(4)	An electron enters a magnetic field at right angle to the field direction.

 (a)	State the rule to find the direction of force acting on the electron.

 (b)	What will be the direction of force acting on the electron in the above case?
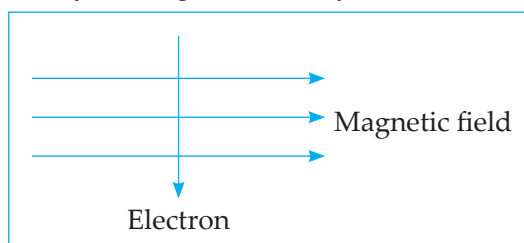
(5)	Observe the following graph. Considering the change in volume of water as its temperature is raised from 0°C, discuss the difference in the behaviour of water and other substances. What is this behaviour of water called?
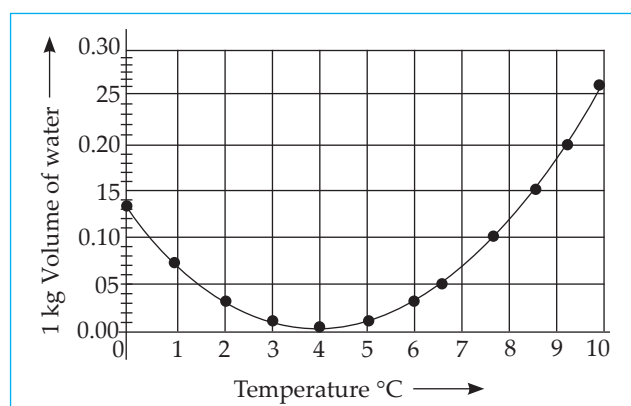
(6)	Prove the statement: A rainbow is the combined effect of the refraction, dispersion and total internal reflection of light.

(7)	What is meant by Satellite launch vehicles? Explain a Satellite launch vehicle developed by ISRO with the help of a schematic diagram.

Q.4. Solve the following questions: *(Any 1)*	**(5)**

(1)	Most of the children of a school in a village bring parantha and pickle in their tiffin in school. These children do not share their food with anyone. Some children bring chapati, fruits, salad, curd, vegetable. Those children share their food with each other.

 (a)	Which acid is present in curd and vinegar used in pickles?

 (b)	What class of compounds should be present in our diet?

 (c)	Which group of children bring healthy food? Give two benefits of this food.

 (d)	Which group of children bring unhealthy food? Give two harmful effects.

 (e)	Which group of children have better value system and why?

(2)	An element is placed in 2nd group and 3rd period of the periodic table, burns in presence of oxygen to form a basic oxide.

 (a)	Identify the element.

 (b)	Write the electronic configuration.

 (c)	Write the balanced equation when it burns in the presence of air.

 (d)	Write the balanced equation when this oxide is dissolved in water.

 (e)	Draw the electron dot structure for the formation of this oxide.

❖ ❖ ❖