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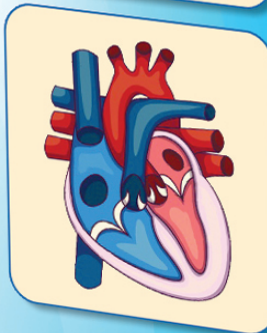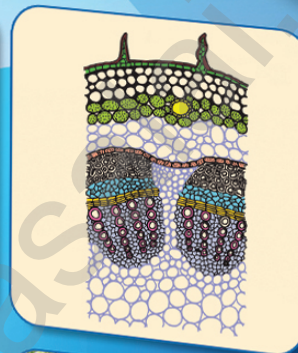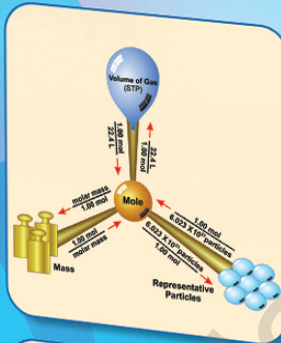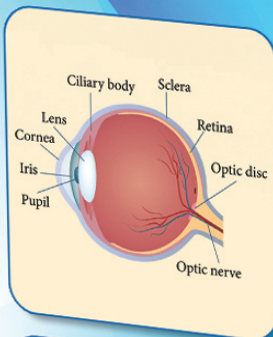# SCIENCE
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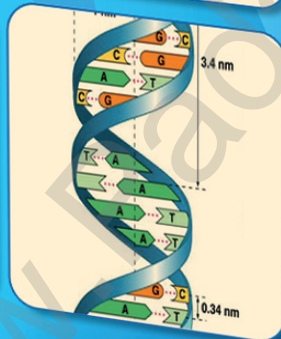
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A WORD

WITH THE READER

The **Mercy Science** for class X has been prepared in accordance with the new textbook brought out by the Government of Tamil Nadu. The questions at the end of each lesson in the text have been answered. **Public Examination Question Papers are provided (with answers).**

In Physics, the physical phenomena, the fundamental aspects in electronics, optics, electricity and other topics have been explained in detail.

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This book has been created with the goals of accessibility and student engagement. Teachers and students will find this book offer a strong introduction to Biology in an accesible formating. In Biology, in order to develop the skills of students, diagrams and labelling have been done.

Our aim is to kindle the scientific temper and scientific attitude of students in addition to preparing them for the public examination.

This **"Student Companion"** would not be possible if not for the tremendous contributions of the expert and well experienced authors and the meticulous pruning by the reviewing team.

We express our sincere thanks to authors **A.E. Mohamed Sheriff, K. Sampath, M.Anbu** and **J. Shankar** for pruning the entire work meticulously. We appeal to the teachers and students to offer their valuable suggestions and criticism for further enrichment of this book.

- **Publisher**

Physics

1. Laws of Motion

Important Formulae

1	Weight	$W = mg$
2	Force	$F = m \times a$
3	Torque	$\tau = F \times d$
4	Principle of moment 's	$F_1 d_1 = F_2 \times d_2$
5	Impulse	$J = F \times t$
6	Newton's universal law of gravitational force	$F = \dfrac{GMm}{r^2}$
7	Acceleration due to gravity	$g = \dfrac{GM}{R^2}$
8	Apparent weight : i. When lift is moving upwards ii. When lift is moving downwards	$R = m(g+a)$ $R = m(g-a)$
9	Apparent weight : i. When lift is at rest ii. When lift is falling down freely	$R = mg$ $R = O$
10	Linear Momentum	$P = mv$
11	Moment of couple	$M = F \times S$
12	Mass of Earth	$M = \dfrac{gR^2}{G}$
13	Conservation of linear momentum	$m_1 v_1 + m_2 v_2 = m_1 u_1 + m_2 u_2$
14	Moment of couple = Force $\times$ perpendicular distance between line of action of forces.	$\boxed{M = F \times s}$
15	Weight = Mass $\times$ acceleration due to gravity	$\boxed{W = m \times g}$
16	Acceleration	$a = \dfrac{v-u}{t}$
17	Parallel force acting in force same direction	$F_{net} = F_2 + F_1$
18	Parallel unequal forces are acting in opposite directions	$F_{net} = F_2 - F_1$ (OR) $F = F_2 - F_1$

Bookback Questions & Answers

I.   Choose the correct answer

1.   Inertia of a body depends on   **(April-24)**
     a)   weight of the object
     b)   acceleration due to gravity of the planet
     c)   mass of the object   d)   Both a & b
     Ans : c) mass of the object

2.   Impulse is equal to   **(PTA - 1)**
     a)   rate of change of momentum   b)   rate of force and time
     c)   change of momentum   d)   rate of change of mass
     Ans : c) change of momentum

3.   Newton's III law is applicable
     a)   for a body is at rest   b)   for a body in motion
     c)   both a & b   d)   only for bodies with equal masses
     Ans : c) both a & b

4.   Plotting a graph for momentum on the Y-axis and time on X-axis, slope of momentum - time graph gives
     a)   Impulsive force   b) Acceleration   c) Force   d) Rate of force
     Ans : c) Force

5.   In which of the following sport the turning of effect of force is used
     a)   swimming   b) tennis   c) cycling   d) hockey
     Ans : c) cycling

6.   The unit of 'g' is m s^{-2}. It can also be expressed as
     a)   cms^{-1} b) Nkg^{-1} c) Nm^{2}kg^{-1} d) cm^{2}s^{-2}
     Ans : b) Nkg^{-1}

7.   One kilogram force equals to
     a)   9.8 dyne   b) 9.8×10^4 N   c) 98×10^4 dyne   d) 980 dyne
     Ans : c) 98×10^4 dyne

8.   The mass of a body is measured on planet Earth as M kg. When it is taken to a planet of radius half that of the Earth then its value will be _____ kg.
     a)   4 M   b) 2M   c) M/4   d) M
     Ans : d) M

9.   If the Earth shrinks to 50% of its real radius its mass remaining the same, the weight of a body on the Earth will
     a)   decrease by 50%   b)   increase by 50%
     c)   decrease by 25%   d)   increase by 300%
     Ans : d) increase by 300%

10. To project the rockets which of the following principle(s) is /(are) required?

(Dept, Sep.-21,22, July-23)

   a) Newton's third law of motion   b) Newton's law of gravitation

   c) law of conservation of linear momentum   d) both a and c

Ans : d) both a and c

II. Fill in the blanks

1. To produce a displacement _____ is required.

   Ans : force

2. Passengers lean forward when sudden brake is applied in a moving vehicle. This can be explained by _____.

   Ans : inertia of motion

3. By convention, the clockwise moments are taken as _____ and the anticlockwise moments are taken as _____.

   Ans : negative, positive

4. _____ is used to change the speed of car.

   Ans : Torque or Gear

5. A man of mass 100 kg has a weight of _____ at the surface of the Earth.

   Ans : Weight = m × g = 100 × 9.8 N = 980 N

III. State whether the following statements are true or false. Correct the statement if it is false

1. The linear momentum of a system of particles is always **conserved.**

   Ans : False

   Correct statement : The linear momentum of a system of particles is always **conserved if no external force acts on it.**

2. Apparent weight of a person is **always** equal to his actual weight.

   Ans : False

   Correct statement : Apparent weight of a person is **not always** equal to his actual weight.

3. Weight of a body is **greater** at the equator and **less** at the polar region.

   Ans : False

   Correct statement : Weight of a body is **minimum** at the equator. It is **maximum** at the poles.

4. Turning a nut with a spanner having a **short** handle is so easy than one with a **long** handle.

   Ans : False

   Correct statement : Turning a nut with a spanner having a **long** handle is easier than one with a **short** handle.

5. There is no gravity in the orbiting space station around the Earth. So the astronauts feel weightlessness.

   Ans : False

   Correct statement : Astronauts fall freely around the earth due to their **huge orbital velocity.**

IV.   Match the following   (PTA - 1)

	Column I	Column II
a.	Newton's I law	propulsion of a rocket
b.	Newton's II law	Stable equilibrium of a body
c.	Newton's III law	Law of force
d	Law of conservation of Linear momentum	Flying nature of bird

Ans :		Column I	Column II
	a.	Newton's I law	Stable equilibrium of a body
	b.	Newton's II law	Law of force
	c.	Newton's III law	Flying nature of bird
	d	Law of conservation of Linear momentum	propulsion of a rocket

V.   Assertion & Reasoning. Mark the correct choice as

a)   If both the assertion and the reason are true and the reason is the correct explanation of assertion.

b)   If both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.

c)   Assertion is true, but the reason is false.

d)   Assertion is false, but the reason is true.

1.   **Assertion :**   The sum of the clockwise moments is equal to the sum of the anticlockwise moments.

     Reason   :   The principle of conservation of momentum is valid if the external force on the system is zero.

                 Ans : b) Both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.

2.   **Assertion :**   The value of 'g' decreases as height and depth increases from the surface of the Earth.

     Reason   :   'g' depends on the mass of the object and the Earth.

                 Ans : c) Assertion is true, but the reason is false.

VI.   Answer briefly

1.   **Define inertia. Give its classification.**   (Sep.-22, April - 23)

     ★   The inherent property of a body to resist any change in its state of rest or the state **of uniform motion,** unless it is influenced upon by an external unbalanced force is known an **interia.**

     Classification of inertia :

     1.   Inertia of rest   2.   Inertia of motion   3.   Inertia of direction.

2.   **Classify the types of forces based on their application.**   (Sep.-22)

     Like parallel forces :

     ★   Two or more forces of equal or unequal magnitude acting along the same direction, parallel to each other are called like parallel forces.

     Unlike parallel forces :

     ★   If two or more equal forces or unequal forces act along opposite directions parallel to each other, then they are called unlike parallel forces.

3. **If a 5 N and a 15 N forces are acting opposite to one another. Find the resultant force and the direction of action of the resultant force.**

   Data :

   $F_1 = 5N$ $F_2 = 15N$ $R = ?$

   Solution :

   $$R = F_1 + (-F_2)$$
   $$R = F_1 - F_2$$
   $$R = 5 - 15$$

   ∴ Resultant force = −10N.

   Resultant force of −10N is acting in the direction of 15N.

4. **Differentiate mass and weight.**   **(May-22)**

	Mass	Weight
1	It is the quantity of matter contained in the body.	It is the gravitational force exerted on a body due to the Earth's gravity alone.
2	Its SI unit is kilogram (kg)	Its SI unit is newton (N)
3	Mass is a scalar quantity.	Weight is a vector quantity.
4	Mass is measured by using **physical balance.**	Weight can be measured by using **spring balance.**

5. **Define moment of a couple.**

   Moment of a couple :

   ★ Rotating effect of a couple is known as moment of a couple.
   ★ Moment of a couple = Force × perpendicular distance between the lines of action of forces.
     M = F × S.

6. **State the principle of moments.**

   ★ The principle of moments states that when a number of like or unlike parallel forces act on a rigid body and the body is in equilibrium, then the algebraic sum of the moments in the clockwise direction is equal to the algebraic sum of the moments in the anticlock wise direction.

     Moment in clockwise direction = moment in anticlockwise direction

     $F_1 \times d_1 = F_2 \times d_2$

7. **State Newton's second law.**   **(Dept., May-22)**

   ★ The force acting on a body is directly proportional to the rate of change of linear momentum of the body and the change in momentum takes place in the direction of the force.

     F = m × a

8. **Why a spanner with a long handle is preferred to tighten screws in heavy vehicles?**

   ★ A spanner with a long handle gives high torque with less force.
   ★ So tightening screws in heavy vehicles is easier with using a long handle spanner.
     $\tau = F \times d$

9. **While catching a cricket ball the fielder lowers his hands backwards. Why?**
   ★ In cricket, a fielder pulls back his hands while catching the ball.
   ★ He experiences a smaller force for a longer interval of time, to catch the ball resulting in a lesser impulse on his hands.

10. **How does an astronaut float in a space shuttle?**
   ★ An astronaut floats in a space shuttle because both are in the state of weightlesness.
   ★ Both are experiencing equal acceleration towards Earth as free fall bodies. Astronauts are not floating but are falling freely.

VII. Solve the given problems.

1. **Two bodies have a mass ratio of 3 : 4 The force applied on the bigger mass produces an acceleration of 12 ms^{-2}. What could be the acceleration of the other body, if the same force acts on it.**

   Data :

   Mass ratio of two bodies is   = 3 : 4

   Mass of smaller body m_1 = 3kg

   Mass of bigger body m_2 = 4 kg

   Acceleration due to force applied by bigger body a_2 = 12 ms^{-2}

   ∴ Acceleration due to the same force on the small body a_1 = ?

   Solution :

   According to Newton's Second Law of Motion

   $$F = m \times a$$
   $$F_1 = m_1 a_1 \text{ and } F_2 = m_2 a_2$$
   $$F_1 = 3 a_1 \text{ and } F_2 = 4 \times 12$$
   $$F_2 = 48N$$

   As the forces are equal

   $$F_1 = F_2$$
   $$3a_1 = 48$$
   $$\therefore a_1 = \frac{48}{3}$$
   $$\therefore \mathbf{a_1 = 16ms^{-2}}$$

   So acceleration due to the same force on the smaller body $\mathbf{a_1 = 16ms^{-2}}$.

2. **A ball of mass 1 kg moving with a speed of 10 ms^{-1} rebounds after a perfect elastic collision with the floor. Calculate the change in linear momentum of the ball.**

   Data :

   Mass of the ball m   = 1kg

   Initial velocity u   = 10ms^{-1}

   Final velocity v   = -10ms^{-1}

   ∴ Change in linear momentum   = m(v – u) = mv – mu.

Solution :

Momentum before collision	=	mu
	=	1×10
	=	10kg ms^{-1}
Momentum after collision	=	mv
	=	$-(1 \times 10)$
	=	-10kg m^{-1}
$\therefore$ Change in momentum	=	mv – mu
	=	$-10 - 10$
	=	**-20 kgms^{-1}.**

3. **A mechanic unscrews a nut by applying a force of 140 N with a spanner of length 40 cm. What should be the length of the spanner if a force of 40 N is applied to unscrew the same nut?**

   Data :

Force F_1	=	140N
Length L_1	=	$40\text{cm} = 40 \times 10^{-2}\text{m}$
Force F_2	=	40N
Length L_2	=	?

   Solution :

   $$F_1 \times L_1 = F_2 \times L_2$$

   Length of the spanner

   $$L_2 = \frac{F_1 \times L_1}{F_2}$$

   $$L_2 = \frac{140 \times 40 \times 10^{-2}}{40}$$

   $$\mathbf{L_2 = 140 \times 10^{-2} \text{ (or) } 1.4m.}$$

4. **The ratio of masses of two planets is 2 : 3 and the ratio of their radii is 4 : 7 Find the ratio of their accelerations due to gravity.**

   Data :

   The ratio of masses of two bodies is $m_1 : m_2$

   i.e. 2 : 3

Mass of the smaller body	m_1	=	2 kg
Mass of the bigger body	m_2	=	3 kg
Radius of the smaller body	R_1	=	4 km
Radius of the bigger body	R_2	=	7 km
	i.e. $R_1 : R_2$	=	4 : 7

   $\therefore$ ratio of their accelerations due to gravity $\quad g_1 : g_2 \quad = \quad$?

Solution :

We know that, acceleration due to gravity is

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

$$g_1 = \frac{GM_1}{R_1^2} \text{ and } g_2 = \frac{GM_2}{R_2^2}$$

$$\therefore \frac{g_1}{g_2} = \frac{\dfrac{GM_1}{R_1^2}}{\dfrac{GM_2}{R_2^2}} = \frac{M_1}{R_1^2} \times \frac{R_2^2}{M_2}$$

$$\frac{g_1}{g_2} = \left(\frac{M_1}{M_2}\right)\left(\frac{R_2}{R_1}\right)^2$$

$$\frac{g_1}{g_2} = \left(\frac{2}{3}\right)\left(\frac{7}{4}\right)^2$$

$$\frac{g_1}{g_2} = \left(\frac{2}{3}\right) \times \frac{7}{4} \times \frac{7}{4} = \frac{49}{24}$$

∴ **ratio of** $g_1 : g_2$ = **49 : 24.**

VIII. Answer in detail

1. What are the types of inertia? Give an example for each type.(PTA - 3, Sep.-22, April-24)

Inertia of rest :

★ The resistance of a body to change its state of rest is called intertia of rest.

E.g. : When you vigorously shake the branches of a tree, some of the leaves and fruits are detached and they fall down.

Intertia of motion :

★ The resistance of a body to change its state of motion is called inertia of motion.

E.g. : An athlete runs some distance before jumping. Because this will help him jump longer and higher.

Inertia of direction :

★ The resistance of a body to change its direction of motion is called inertia of direction.

E.g. : When you make a sharp turn while driving a car, you tend to lean sideways.

2. State Newton's laws of motion? (Sep.-21,22)

i) Newton's First Law :

★ Every body continues to be in its state of rest or the state of uniform motion along a straight line unless it is acted upon by some external force.

ii) Newton's Second Law of Motion :

★ The force acting on a body is directly proportional to the rate of change of linear momentum of the body and the change in momentum takes place in the direction of the force. This law helps us to measure the amount of force. So, it is also called as 'law of force'.

iii) Newton's Third Law of Motion :

★ Newton's third law states that 'for every action, there is an equal and opposite reaction. They always act on two different bodies.'

3. **Deduce the equation of a force using Newton's second law of motion.**   (April-23)

Newton's Second Law of Motion :

★ The force acting on a body is directly proportional to the rate of change of linear momentum of the body and the change in momentum takes place in the direction of the force. Let 'm' be the mass of a moving body, moving along a straight line with an initial speed u.

★ After a time interval of 't', the velocity of the body changes to 'v' due to the impact of an unbalanced external force F.

Initial momentum of the body

$$P_i = mu$$

Final momentum of the body

$$P_f = mv$$

Change in momentum $\triangle p$ $= P_f - P_i$

$$= mv - mu$$

By Newton's Second law of motion,

Force, F α rate of change of momentum.

F α Change in momentum / time

F α (mv - mu) / t

$$F = \frac{km(v-u)}{t}$$

Here, k is the proportionality constant,

$$k = 1 \text{ in all systems of units}$$

$$\text{Hence } F = \frac{m(v-u)}{t}$$

Since, acceleration = Change in velocity / time

$$a = \frac{(v-u)}{t}$$

Hence, we have

$$F = m \times a$$

Force = mass × acceleration.

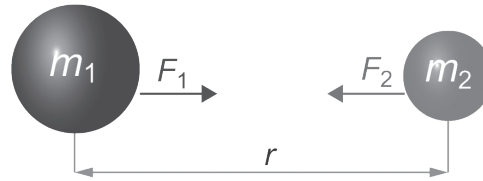4. **State and prove the law of conservation of linear momentum.**   (Dept.)

The principle of conservation of linear momentum :

★ There is no change in the linear momentum of a system of bodies as long as no net external force acts on them. Let us prove the law of conservation of linear momentum with the following illustration.
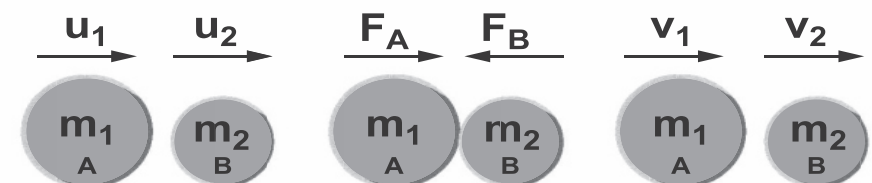
Conservation of linear momentum

Proof :

Gravitational force between two masses

★   Let two bodies A and B having masses m_1 and m_2 move with initial velocity u_1 and u_2 in a straight line.

★   Let the velocity of the first body be higher than that of the second body. i.e. $u_1 > u_2$

★   During an interval of time t seconds, they tend to have a collision. After the impact, both of them, move along the same straight line with a velocity v_1 and v_2 respectively.

Force on body B due to A,

$$F_B = \frac{m_2(v_2 - u_2)}{t}$$

Force on body A due to B,

$$F_A = \frac{m_1(v_1 - u_1)}{t}$$

By Newton's III Law of motion,

Action force   =   Reaction force

$$F_A = -F_B$$

$$\frac{m_1(v_1 - u_1)}{t} = \frac{-m_2(v_2 - u_2)}{t}$$

$$m_1 v_1 - m_1 u_1 = -m_2 v_2 + m_2 u_2$$

$$m_1 v_1 + m_2 v_2 = m_1 u_1 + m_2 u_2 \qquad \boxed{1}$$

★   The above equation confirms that in the absence of an external force, the algebraic sum of the momentum after collision is numerically equal to the algebraic sum of the momentum before collision. Hence the law of conservation linear momentum is proved.

5.   **Describe rocket propulsion.**   **(PTA - 4, Sep.-20,22)**

★   Propulsion of rockets is based on the law of conservation of linear momentum as well as Newton's III law of motion.

★   Rockets are filled with a fuel (either liquid or solid) in the propellant tank.

★   When the rocket is fired, this fuel is burnt and a hot gas is ejected with high speed from the back nozzle producing a huge momentum.

★   To balance this momentum, an equal and opposite reaction force is produced which makes the rocket project forward.

★   While in motion, the mass of the rocket gradually decreases until the fuel is completely burnt out. Since there is no net external force acting on it, the linear momentum of the system is conserved.

★   The mass of the rocket decreases by altitude that results in Trb gradual increase in the velocity of the rocket.

★   At one stage, it reaches a velocity which is sufficient to just escape from the gravitational pull of the Earth. This velocity is called escape velocity.

6. **State the universal law of gravitation and derive its mathematical expression.(July-23)**

Newton's Universal law of Gravitation :

★ This law states that every particle of matter in this universe attracts every other particle with a force. This force is directly proportional to the product of their masses and inversely proportional to the square of the distance between the centers of these masses. The direction of the force acts along the line joining the masses. Let m1 and m2 be the masses of two bodies A and B placed at r metres apart in space.

Force $F \propto m_1 \times m_2$

$$F \propto \frac{1}{r^2}$$

On combining the above two expressions

$$F \propto \frac{m_1 \times m_2}{r^2}$$

$$\therefore F = \frac{Gm_1 m_2}{r^2} \qquad (1)$$

★ Where G is the universal gravitational constant. Its value in SI Unit is 6.674×10^{-11} Nm^2kg^{-2}.

7. **Give the applications of universal law of gravitation.**

Application of Newton's law of gravitation:

★ Dimensions of the heavenly bodies can be measured using the gravitation law. Mass of the Earth, radius of the Earth, acceleration due to gravity, etc. can be calculated with a higher accuracy. It helps in discovering new stars and planets.

★ One of the irregularities in the motion of stars is called 'wobble' which leads to the disturbance in the motion of a planet nearby. In this condition the mass of the star can be calculated using the law of gravitation.

★ Helps to explain germination of roots. It is due to the property of geotropism which is the property of a root responding to the gravity.

★ Helps to predict the path of the astronomical bodies.

IX. **HOT Questions.**

1. **Two blocks of masses 8 kg and 2 kg respectively lie on a smooth horizontal surface in contact with one other. They are pushed by a horizontally applied force of 15 N. Calculate the force exerted on the 2 kg mass.**

Data :

Mass of block 1, m_1 = 8 kg

Mass of block 2, m_2 = 2 kg

Total mass, m = $m_1 + m_2$

                           m = 8 + 2

                           m = 10kg

        Force, F_1 = 15N

Force exerted on 2 kg, F_2 = ?

Solution :

$$\text{Force, } F_1 = \text{mass} \times \text{acceleration}$$
$$F_1 = ma$$
$$F_1 = 10 \times a$$
$$a = \frac{F_1}{10} = \frac{15}{10} = 1.5 \text{ ms}^{-2}$$

Force exerted on m_2 (2kg) is,

$$F_2 = m_2 \times a$$
$$F_2 = 2 \times 1.5$$
$$\mathbf{F_2 = 3N.}$$

2. **A heavy truck and a bike are moving with the same kinetic energy. If the mass of the truck is four times that of the bike, then calculate the ratio of their momenta. (Ratio of momenta = 2:1)**

Data :

$$\text{Kinetic energy of the truck} = \frac{1}{2}m_t v_t^2$$

$$\text{Kinetic energy of the bike} = \frac{1}{2}m_b v_b^2$$

$$\text{Kinetic energy of the truck} = \text{Kinetic energy of the bike}$$

$$\frac{1}{2}m_t v_t^2 = \frac{1}{2}m_b v_b^2 \qquad (1)$$

Also, $\qquad\qquad m_t = 4m_b \qquad\qquad (2)$

Substituting (2) in (1)

$$\frac{1}{2}(4) m_b V_t^2 = \frac{1}{2}m_b V_b^2$$

$$4v_t^2 = v_b^2$$

$$\therefore v_t = \frac{1}{2}v_b \qquad (3)$$

$\therefore$ Ratio of the momenta, i.e.. $m_t v_t : m_b v_b$?

Solution :

$$\frac{P_{truck}}{P_{bike}} = \frac{m_t v_t}{m_b v_b}$$

$$\frac{P_{truck}}{P_{bike}} = \frac{4m_b}{m_b v_b} \cdot \frac{1}{2}v_b$$

$$\frac{P_{truck}}{P_{bike}} = \frac{4}{2}$$

$$\frac{P_{truck}}{P_{bike}} = \frac{2}{1}$$

$$\therefore \frac{P_{truck}}{P_{bike}} = \frac{2}{1} \textbf{ (or) } \frac{P_{truck}}{P_{bike}} = \frac{1}{2} \textbf{ = 1 : 2.}$$

3. **"Wearing helmet and fastening the seat belt is highly recommended for safe journey"**
   Justify your answer using Newton's laws of motion.

   ★ During the motion of car and two wheelers, when the brakes are applied, the vehicles slow down but our body tends to continue in the same state of motion due to inertia. So this causes injury to passengers. Hence they are advised to wear a helmet and the seat belt.

PTA & Exam Questions (interior)

I. Choose the correct answer

1. F be the force between the two bodies placed at a certain distance. If the distance between them is doubled, then the gravitational force F will be _____.   **(PTA-5)**

   a) 2 F   b) F/2   c) F/4   d) 4F

   Ans : c) F/4

2. The force required to produce an acceleration of 1 cm s^{-2} on a body of mass 1 g is _____.   **(PTA-6)**

   a) 1 N   b) 10   c) 10^2 dyne   d) 1 dyne

   Ans : d) 1 dyne

V. Assertion and Reason

1. **Understand the assertion statement and the reason given and choose the correct choice.**   **(PTA - 2)**

   Assertion : When a person swims he pushes the water using the hands backwards and the water pushes the person in the forward direction.

   Reason : For every action there is an equal and opposite reaction.

   a) Both the assertion and the reason are true and the reason is the correct explanation of the assertion.

   b) Both the assertion and the reason are true, the reason is not the correct explanation of the assertion.

   c) Assertion is true but the reason is false.

   d) Both the assertion and the reason are false.

   Ans : a) Both the assertion and the reason are true and the reason is the correct explanation of the assertion.

VII. Give short answers

1. **Why do the apples weigh more at poles than at equator?**   **(PTA - 3)**

   ➢ Weight of a body varies from one place to another place on the earth.

   ➢ Since it depends on the acceleration due to gravity of the earth (g) weight of a body is **more at the poles than at the equatorial region.**

   ➢ So the apples weigh more at poles than at equator.

2. **Write a short notes on gears.**   **(Sep.-20)**

   ➢ A gear is a **circular wheel** with teeth around its rim.

   ➢ It helps to change the **speed of rotation** of a wheel by **changing the torque** and helps to transmit power.

VIII. Give long answers

1.   i)   **Shock absorbers are used in luxury buses. Why?**   **(PTA - 2)**

   ➤   Luxury buses are filted with springs and shock absorbers to reduce jerk while moving on uneven roads. For the comfort purpose, shock obsorbers are used to absorb (or) damp the shock (or) unwanted oscillation of the bus due to damaged roads.

   ii)   **Name the law of motion used in flying of birds. Give another example for the same law.**   **(PTA - 2)**

   Newton III law of motion :

   ➤   Rocket propulsion

   Another example :

   ➤   When a person swims, he pushes the water using the hands backwards (Action) and the water pushes the swimmer in the forward direction (Reaction)

   iii)   **A weight of a man is 686 N on the surface of the earth. Calculate the weight of the same person on moon. ('g' value of a moon is 1.625 ms^{-2})**   **(PTA - 2)**

   Solution :

Accleration due to gravity

$$g = 9.8 \text{ ms}^{-2}$$
$$\text{Weight (w)} = 686 \text{ N}$$
$$\text{gravity (g)} = 9.8 \text{ ms}^{-2}$$
$$\text{Formula} = w = m \times g$$
$$m = \frac{w}{g}$$
$$m = \frac{686}{9.8}$$
$$m = 70 \text{ kg}$$

Acceleration due to gravity surface of the Moon $= 1.625 \text{ ms}^{-2}$

$$\therefore w = m \times g$$
$$w = 70 \times 1.625$$
$$\mathbf{w = 113.75N}$$

2.   **A body of mass m is initially moving with a velocity u. When a force F acts on the body it picks up velocity v in t second so that the acceleration is produced. Using this data derive the relation between the force, mass and acceleration.**   **(PTA - 5)**

   Solution :

   Newton Second law :

   ➤   Force acting on a body is directly proportional to the rate of change of linear momentum of the body and the change in momentum takes place in the direction of the force.

   It is also called as "Law of force"

   Initial momentum of the body $P_i = mu$

   Final momentum of the body $P_f = mv$

$\therefore$ change in momentum : $\triangle p = P_f - P_i$

$\triangle p = mv - mu$

By Newton's second Law of motion.

$F \propto \dfrac{\text{Change in momentum}}{\text{time}}$

$F \propto \dfrac{mv - mu}{t}$

$F = \dfrac{Km(v - u)}{t}$

K - Proportionality constant K $= 1$

$F = \dfrac{m(v-u)}{t}$ $\dfrac{v-u}{t} = a$

Since acceleration

$a = \dfrac{v-u}{t}$ $\boxed{F = m \times a}$

Force = mass × acceleration.

IX. Analogy

1. Opening a door; Moment of force,   **(PTA - 4)**
   Opening a water tap: _____
   Ans : Moment of a couple

2. Pushing a bus by a group of people; Like a parallel forces   **(PTA - 4)**
   Tug of war   : _____
   Ans : Unlike parallel force

XI. Numerical problems

1. **Calculate the velocity of a moving body of mass 5 kg whose linear momentum is 2 kg ms^{-1}.**   **(Dept.)**

   Solution :

   Linear momentum $= 2 \text{ kg ms}^{-1}$

   Mass $= 5 \text{ kg}$

   Velocity $= ?$

   Linear momentum $= \text{Mass} \times \text{Velocity}$

   Velocity $= \dfrac{\text{Linear momentum}}{\text{Mass}}$

   $V = \dfrac{2}{5}$

   $\mathbf{V = 0.4 \text{ ms}^{-1}}$

2. **A lift is moving downwards with an acceleration of 1.8 ms^{-2}, What is the apparent weight realised by a man of mass 50 kg?**   **(PTA - 1)**

   Solution :

   Acceleration $= 1.8 \text{ ms}^{-2}$

   Mass $= 50 \text{ kg}$

   Gravity (g) $= 9.8 \text{ ms}^{-2}$

   Apparent weight R $= ?$

   $\boxed{\text{Formula; } R = m(g - a)}$

   $R = 50 [9.8 - 1.8]$

   $R = 50 \times 8$

   $\mathbf{R = 400N.}$

3. **A force of 5 N applied on a body produces an acceleration 5 cm s^{-2}. Calculate the mass of the body.** (PTA - 5)

Solution :

$$\text{Force (F)} = 5N$$

$$\text{acceleration (a)} = 5\,\text{cms}^{-2} = 0.05\,\text{ms}^{-2}$$

$$\text{Mass (m)} = ?$$

Newton II Law : $\boxed{F = ma}$

$$m = \frac{F}{a}$$

$$m = \frac{5}{0.05} \times \frac{100}{100}$$

$$m = \frac{\cancel{500}^{100}}{\cancel{5}_1}$$

m = 100 kg.

4. **At what height from the centre of the earth's surface, the acceleration due to gravity will be 1/4th of its value on the surface of the earth.** (PTA - 6)

Data :

Height from the centre of the Earth,

$$R' = R + h$$

The acceleration due to gravity at that height,

$$g' = g/4$$

Solution :

$$g = \frac{GM}{R^2}, \; g' = \frac{GM}{R'^2}$$

$$\frac{g}{g'} = \left(\frac{R'}{R}\right)^2 = \left(\frac{R+h}{R}\right)^2 = \left(1 + \frac{h}{R}\right)^2$$

$$4 = \left(1 + \frac{h}{R}\right)^2$$

$$2 = 1 + \frac{h}{R} \text{ or } h = R. \; R' = 2R$$

$$\therefore R^1 = R + h$$

$$R^1 = R + R$$

R = 2R

From the centre of the Earth, the object is placed at twice the radius of the earth.

2. Optics

Important Formulae

1	Magnification	$\Rightarrow m = \dfrac{h_1}{h}$ (or) $m = \dfrac{v}{u}$
2	Power of Lens	$P = \dfrac{1}{f}$
3	Lens Maker's formula	$\dfrac{1}{f} = (\mu - 1)\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right)$
4	Lens formula	$\dfrac{1}{f} = \dfrac{1}{V} - \dfrac{1}{u}$
5	Refractive index	$\mu = \dfrac{Ca}{Cm}$
6	Snell's law	$\Rightarrow \dfrac{\sin i}{\sin r} = \dfrac{\mu_2}{\mu_1}$
7	Myopia, Focal length of required concave lens	$\Rightarrow f = \dfrac{xy}{x - y}$
8	Velocity of light	$c = v\lambda$
9	Rayleigh's scattering law	$S \propto \dfrac{1}{\lambda^4}$
10	Hypermeteropia	$f = \dfrac{dD}{d - D}$
11	Myopia Focal length of the concave lens	$f = \dfrac{xy}{x - y}$
12	Hypermetropia Focal length of the convex lens	$f = \dfrac{dD}{d - D}$

Bookback Questions & Answers

I. Choose the correct answer

1. The refractive index of four substances A, B, C and D are 1.31, 1.43, 1.33, 2.4 respectively. The speed of light is maximum in

   a) A   b) B   c) C   d) D

   Ans : a) A

2. Where should an object be placed so that a real and inverted image of same size is obtained by a convex lens   **(May-22)**

   a) f   b) 2f   c) infinity   d) between f and 2f

   Ans : b) 2f

3. A small bulb is placed at the principal focus of a convex lens. When the bulb is switched on, the lens will produce   **(PTA - 3)**

   a) a convergent beam of light   b) a divergent beam of light

   c) a parallel beam of light   d) a coloured beam of light

   Ans : c) a parallel beam of light

4. Magnification of a convex lens is   **(April-23)**
   a) Positive   b) negative
   c) either positive or negative   d) zero
   Ans : c) either positive or negative

5. A convex lens forms a real, diminished point sized image at focus. Then the position of the object is at
   a) focus   b) infinity   c) at 2f   d) between f and 2f
   Ans : b) infinity

6. Power of a lens is –4D, then its focal length is
   a) 4m   b) –40m   c) –0.25 m   d) –2.5 m
   Ans : c) –0.25 m

7. In a myopic eye, the image of the object is formed
   a) behind the retina   b) on the retina
   c) in front of the retina   d) on the blind spot
   Ans : c) in front of the retina

8. The eye defect 'presbyopia' can be corrected by   **(PTA - 2, Sep.-20)**
   a) convex lens   b) concave lens   c) convex mirror   d) Bi focal lenses
   Ans : d) Bi focal lenses

9. Which of the following lenses would you prefer to use while reading small letters found in a dictionary?
   a) A convex lens of focal length 5 cm   b) A concave lens of focal length 5 cm
   c) A convex lens of focal length 10 cm   d) A concave lens of focal length 10 cm
   Ans : a) A convex lens of focal length 5 cm

10. If V_B, V_G, V_R be the velocity of blue, green and red light respectively in a glass prism, then which of the following statement gives the correct relation?
    a) $V_B = V_G = V_R$ b) $V_B > V_G > V_R$ c) $V_B < V_G < V_R$ d) $V_B < V_G > V_R$
    Ans : c) $V_B < V_G < V_R$

II. Fill in the blanks

1. The path of the light is called as _____.
   Ans : ray of light

2. The refractive index of a transparent medium is always greater than _____.
   Ans : one

3. If the energy of incident beam and the scattered beam are same, then the scattering of light is called as _____ scattering.
   Ans : elastic

4. According to Rayleigh's scattering law, the amount of scattering of light is inversely proportional to the fourth power of its _____.
   Ans : wave length

5. Amount of light entering into the eye is controlled by _____.
   Ans : Iris

III. Say True or False. If false correct it

1. Velocity of light is **greater** in denser medium than in **rarer** medium.

    Ans : False

    Correct statement : Velocity of light is greater in **rarer** medium than in a **denser** medium.

2. The power of lens depends on the focal length of the lens.

    Ans : True

3. Increase in the converging power of eye lens causes **'hypermetropia'.**

    Ans : False

    Correct statement : Decrease in the converging power of eye lens causes **'Myopia'.**

4. The **convex** lens always gives a small virtual image.

    Ans : False

    Correct statement : The **concave** lens always gives a small virtual image.

IV. Match the following

	Column I		Column II
1	Retina	a	Path way of light
2	Pupil	b	Far point comes closer
3	Ciliary muscles	c	near point moves away
4	Myopia	d	Screen of the eye
5	Hypermetropia	e	Power of accommodation

Ans :		Column I		Column II
	1	Retina	a	Screen of the eye
	2	Pupil	b	Path way of light
	3	Ciliary muscles	c	Power of accommodation
	4	Myopia	d	Far point comes closer
	5	Hypermetropia	e	near point moves away

V. Assertion and reasoning type. Mark the correct choice as

a) If both assertion and reason are true and reason is the correct explanation of assertion.

b) If both assertion and reason are true but reason is not the correct explanation of assertion.

c) Assertion is true but reason is false.

d) Assertion is false but reason is true.

1. **Assertion :** If the refractive index of the medium is high (denser medium) the velocity of the light in that medium will be small

    Reason   : Refractive index of the medium is inversely proportional to the velocity of the light.

    Ans : a) If both assertion and reason are true and reason is the correct explanation of assertion.

2. **Assertion :** Myopia is due to the increase in the converging power of eye lens.

    Reason   : Myopia can be corrected with the help of concave lens.

         Ans : b) If both assertion and reason are true but reason is not the correct explanation of assertion.

VI. Answer Briefly

1. What is refractive index?

★ The ratio of speed of light in vacuum to the speed of light in a medium is defined as the refractive index of that medium.
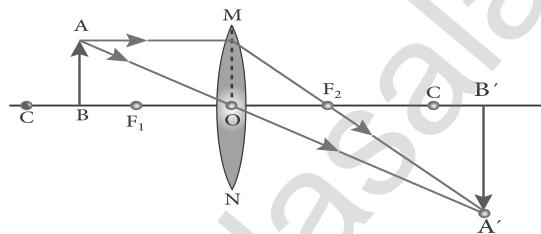
$$\mu = \frac{c}{v}$$

2. State Snell's law.   (Sep.-22)

★ The ratio of the sine of the angle of incidence and sine of the angle of refraction is equal to the ratio of refractive indices of the two media.

$$\frac{\sin i}{\sin r} = \frac{\mu_2}{\mu_1}$$

3. Draw a ray diagram to show the image formed by a convex lens when the object is placed between F and 2F.   (Dept., July-23)

Object placed between F and C

4. Define dispersion of light.   (April-24)

★ When a beam of white light or composite light is refracted through any transparent media such as glass or water, it is split into its component colours. This phenomenon is called as dispersion of light.

5. State Rayleigh's law of scattering.   (PTA - 3, July-23)

★ Rayleigh's law of scattering states that the amount of scattering is inversely proportional to the fourth power of the wavelength. This is called as Rayleigh scattering law.

Amount of scattering $\propto \dfrac{1}{\lambda^4}$

6. Differentiate convex lens and concave lens.   (PTA - 3)

	Convex Lens	Concave Lens
1	A convex lens is thicker in the middle than at edges.	A concave lens is thinner in the middle than at edges.
2	It is converging.	It is diverging.
3	It produces real images.	It produces a virtual image.
4	It is used to treat *hyper meteropia.*	It is used to treat *myopia.*

7. What is power of accommodation of eye?

★ The ability of the eye lens to focus nearby as well as the distant objects is called power of accommodation of eye.

8. **What are the causes of '*Myopia*'?**
   ★ *Myopia*, also known as short sightedness, occurs due to the lengthening of eye ball.
   ★ Nearby objects can be seen clearly but distant objects cannot be seen clearly.
   ★ The focal length of the eye lens is reduced or the distance between the eye lens and retina increases.
   ★ Due to this, the images of distant objects are formed before the retina.

9. **Why does the sky appear blue in colour?**　　　　　　　**(PTA - 1, April - 23)**
   ★ When sunlight passes through the atmosphere, the blue colour (shorter wavelength) is scattered to a greater extent than the red colour (longer wavelength). This scattering causes the sky to appear blue in colour.

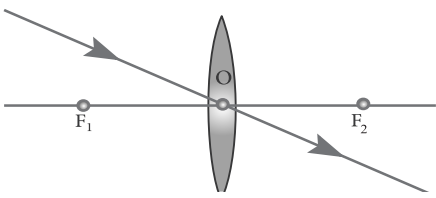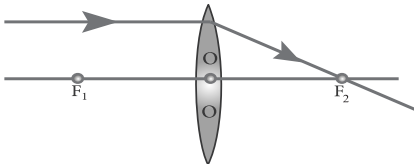10. **Why are traffic signals red in colour?**　　　　　　　**(PTA - 4, April-24)**
    ★ Red has the longest wavelength.
    ★ It is mostly scattered by atmospheric particles. As a result whether it is fog or smoke - red light passes comparatively easily through them.
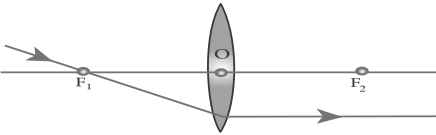
VII. Give the answer in detail

1. **List any five properties of light.**　　　　　　　　　　**(May-22)**
   ★ Light is a form of energy Light always travels along a straight line.
   ★ Light does not need any medium for its propagation. It can even travel through vacuum.
   ★ The speed of light in vaccum or air is $c = 3 \times 10^8 ms^{-1}$.
   ★ Different coloured light has different wavelength and frequency.

2. **Explain the rules for obtaining images formed by a convex lens with the help of ray diagram.**

Rule : 1	When a ray of light strikes the convex lens obliquely at its optical centre, it continues to follow its path without any deviation.	**Rays passing through the optical centre**
Rule : 2	When rays parallel to the principal axis strike a convex lens, the refracted rays are converged to (convex lens) or appear to diverge from the principal focus.	**Rays passing parallel to the optic axis**
Rule : 3	When a ray passing through (convex lens) or directed towards the principal focus strikes a convex lens, the refracted ray will be parallel to the principal axis.	**Rays passing through or directed towards the principal focus**

3. **Differentiate the eye defects: Myopia and Hypermetropia.** (PTA-6, Sep.-21, 22, April-23)

	Myopia	Hypermetropia
1	Myopia is short sightedness.	It is long sightedness.
2	It is due to the lengthening of the eye ball	It is due to the shortening of the eye ball.
3	Near by object can be seen clearly.	Distant object can be seen clearly.
4	With this defect, distant objects cannot be seen clearly.	With this defect, nearby objects cannot be seen clearly.
5	The focal length of the eye lens is reduced.	The focal length of eye lens is increased.
6	The far point will not be at infinity.	The near point will not be at 25 cm.
7	The far point has come closer.	The near point has moved further.
8	The images of distant objects are formed before the retina.	The images of nearby objects are formed behind the retina.
9	It can be corrected by using a concave lens.	It can be corrected by using a convex lens.
10	This defect is known as myopia.	This defect is known as *hypermetropia*.

4. **Explain the construction and working of a 'Compound Microscope'.**

Construction:

★ Compound microscope is used to view or deduce the tiny objects. A compound microscope consists of two convex lenses. The lens with the shorter focal length is placed near the object, and is called as 'objective lens' or 'objective piece'.

★ The lens with larger focal length and larger aperture placed near the observer's eye is called as 'eye lens' or 'eye piece'. Both the lenses are fixed in a narrow tube with adjustable provision.
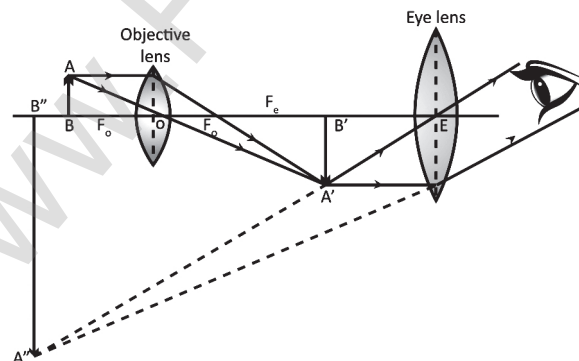
Image formation in compound microscope

Working :

★ The object (AB) is placed at a distance slightly greater than the focal length of the objective lens (u>Fo). A real, inverted and magnified image (A^1B^1) is formed at the other side of the objective lens. This image behaves as the object for the eye lens.

★ The position of the eye lens is adjusted in such a way, that the image (A^1B^1) falls within the principal focus of the eye piece. This eye piece forms a virtual, enlarged and erect image ($A^{11}B^{11}$) on the same side of the object.

VIII. Numerical Problems

1. **An object is placed at a distance 20cm from a convex lens of focal length 10cm. Find the image distance and nature of the image.**

    Data :

    Distance of an object   u   =   20cm

    Focal length of convex lensf   =   10 cm

    Image distance   v   =   ?

    Nature of the image   =   ?

    Solution :

    If the object is placed on the left side of the lens, then f = 10 cm, u = -20cm.

    $$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

    $$\frac{1}{v} = \frac{1}{f} + \frac{1}{u}$$

    $$\frac{1}{v} = \frac{1}{10} + \frac{1}{(-20)}$$

    $$\frac{1}{v} = \frac{1}{10} - \frac{1}{20}$$

    $$\frac{1}{v} = \frac{20-10}{200} = \frac{10}{200}$$

    $$\frac{1}{v} = \frac{1}{20}$$

    $$\mathbf{v = 20\ cm}$$

    (-ve sign indicates the inverted image)

2. **An object of height 3cm is placed at 10cm from a concave lens of focal length 15cm. Find the size of the image.**

    Data :

    Object distance   u   =   −10cm

    [Object is placed on the left side]

    Focal length   f   =   −15 cm

    Let image distance   v   =   ?

    Height of the object   h   =   3 cm

    Solution :

    We know

    $$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

    $$\frac{1}{v} = \frac{1}{f} + \frac{1}{u}$$

    $$\frac{1}{v} = \frac{1}{-15} + \frac{1}{-10}$$

    $$\frac{1}{v} = \frac{-10-15}{150}$$

$$\frac{1}{v} = \frac{-25}{150} = \frac{-1}{6}$$

$$\therefore V = -6cm$$

Distance of image $V = -6cm.$

$$\text{Magnification m} = \frac{\text{Distance of the image}}{\text{Distance of the object}}$$

$$m = \frac{v}{u}$$

$$m = \frac{6}{10}$$

$$m = 0.6$$

$$\text{And Magnification m} = \frac{h^1}{h} = \frac{\text{height of the image}}{\text{height of the object}}$$

$$m = \frac{h^1}{h}$$

$$0.6 = \frac{h^1}{3}$$

$$\therefore h^1 = 0.6 \times 3$$

$$h^1 = 1.8$$

$$\therefore \text{ Size of the image, } \quad \mathbf{h^1} = \mathbf{1.8cm.}$$

IX. Higher order thinking (HOT) questions.

1. While doing an experiment for the determination of focal length of a convex lens, Raja Suddenly dropped the lens. It got broken into two halves along the axis. If he continues his experiment with the same lens, (a) can he get the image? (b) Is there any change in the focal length?

★ Yes, he can get the image.

★ The focal length of the lens will be doubled.

2. The eyes of the nocturnal birds like owl are havivg a large cornea and a large pupil. How does it help them?

★ The large pupil opens wider and allows the maximum amount of light to enter the eye in the dark.

★ Their lens is large and situated near the retina. This also allows a lot of light to register on the retina. The retina contains two types of light - sensing cells and cones. Cones are responsible for the coloured vision and allow required bright, focussed light.

PTA & Exam Questions & Answers
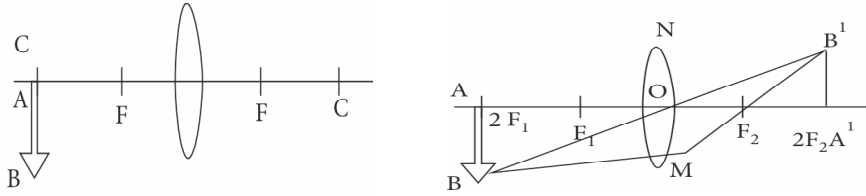
I. Choose the correct answers

1. The scattered light in Raman scattering contains _____ lines.   **(PTA - 5)**

   a) Rayleigh's   b) stokes   c) Antistokes   d) all the above
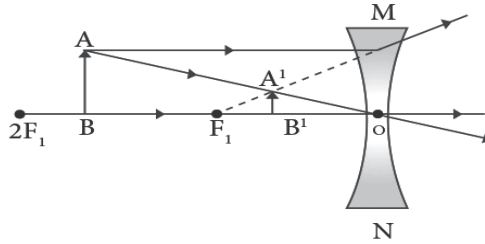
   Ans : d) all the above

VII. Give short answers

1. An object AB is placed at the centre of curvature C of the convex lens as shown in the picture. Complete the ray diagram. **(PTA - 1)**

2. Complete the ray diagram of a concave lens. **(PTA - 6)**

3. In common What is the value of least distance of distinct vision of a human? **(PTA - 6)**
➤ In common, the value of least distance of distinct vision of a human is 25 cm.

4. Write any two applications of concave lens. **(Sep.-21)**
➤ Concave lenses are used as eye lens of "Galilean Telescope".
➤ They are used in wide angle spy hole in doors.
➤ They are used to correct the defect of vision called "Myopia".

5. What are the uses of Simple micro scope? **(Sep.-20)**

Simple microscopes are used,
➤ By watch repairers and jewellers
➤ to read small letters clearly
➤ To observe parts of flower, insects etc.
➤ To observe finger prints in forensic science.

7. List the advantages of Telescopes. **(PTA - 3)**
➤ Elaborate view of the Galaxies, Planets, stars and other heavenly bodies is possible.
➤ Camera can be attached for taking photograph of the celestial objects.
➤ Telescope can be used even with the low intensity of light.

5. What are the uses of convex lens ? **(April -24)**
➤ Convex lenses are used as camera lenses.
➤ They are used as magnifying lenses.
➤ They are used in making microscope, telescope and slide projectors.
➤ They are used to correct the defect of vision called hypermetropia.

6. What is the least count of travelling microscope? **(April-24)**
➤ A travelling microscope is one of the best instrument for measuring very small length with high degree of accuracy at the order of 0.01mm.
➤ It works based on the principle of vernier.
➤ Its least count is 0.01 mm.

VII. Long answers

1. **A student in a class room can read text book but he / she can't see the letters on the black board distinctly. Write the name of his / her eye defect and what is the cause? Suggest a remedy.** (PTA - 1)

   Name of the defect - Myopia

   ➤ It is also known as short sightedness.

   ➤ It occurs due to the lengthening of eye ball.

   ➤ Nearby object can be seen clearly but distant object cannot be seen clearly.

   Remedy :

   ➤ This defect can be corrected using a concave lens.

2. i) **Draw the ray diagram of image formation in simple microscopes.** (PTA - 2)
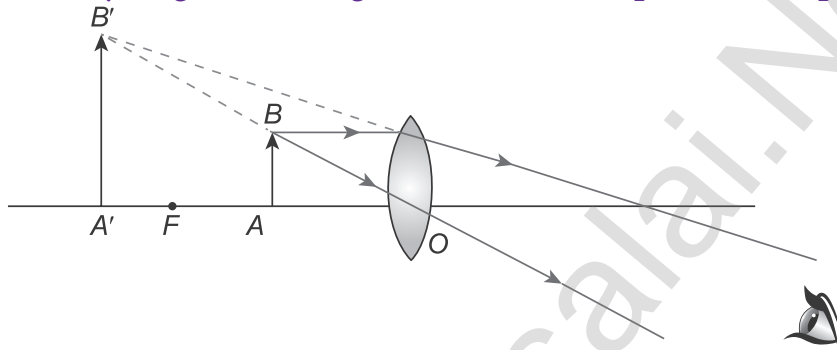
   Image formation in simple microscope

   ii) **Find the position and write the nature and size of the image form.**

   Nature :

   ➤ Simple microscope has a convex lens of short focal length. It is held near the eye to get an enlarged image of small objects.

   Position :

   ➤ Let an object (AB) be placed at a point within the principal focus (U < f) of the convex lens, the observer eye is placed just behind the lens.

   ➤ As per this position the convex lens produces an erect, virtual and enlarged image (A′B′)

   Size :

   ➤ The image formed is of the same size of the object and the distance is equal to the least distance of distinct vision (D). For normal Human eye (D = 25 cm)

XI. Numerical problems

1. **A beam of light passing through a diverging lens of focal length 0.3 m appears to be focused at a distance 0.2 m behind the lens. Find the position of the object.** (Sep.-20)

   Solution :

   $$f = -3.0$$
   $$v = 0.2m$$

   Formula $\dfrac{1}{f} = \dfrac{1}{v} - \dfrac{1}{u}$

$$\frac{1}{u} = \frac{1}{v} - \frac{1}{f}$$

$$\frac{1}{u} = \frac{1}{-0.2} - \frac{1}{-0.3}$$

$$\frac{1}{u} = \frac{-10}{6}$$

$$u = \frac{-6}{10}$$

$$u = -0.6 \text{ m}$$

2. **The power of a lens is –2D. Find the focal length of the lens.**   (PTA - 4)

    Solution :

    $$P = \frac{1}{f} \text{ or } f = \frac{1}{P}$$

    $$f = \frac{1}{-2} = -0.5m$$

    $$f = -0.5 \text{ m}$$

3. **A person with myopia can see objects placed at a distance of 4m. If he wants to see objects at a distance of 20m, what should be the focal length and power of the concave lens he must wear ?**   (May-22, Sep.-22)

    Data :

    $x = 4m, \ y = 20m,$

    focal length f = ?

    Power of the correction lens = ?

    Solution :

    We know

    Focal length of the correction lens is

    $$f = \boxed{f = \frac{xy}{x-y}}$$

    $$f = \frac{4 \times 20}{4-20} = \frac{80}{-16}$$

    $$f = -5m$$

    Power of the correction lens

    $$P = \frac{1}{f} = -\frac{1}{5}$$

    $$\mathbf{P = -0.2D.}$$

4. **An object of height 3 cm is placed at 10 cm from a convex lens which produces an image at 20 cm from it optical centre. Calculate the magnification and height of the image produced.**   **(PTA - 5)**

Solution :

$$h = 3 \text{ cm (Height)}$$

$$\text{Object distance (u)} = 10 \text{ cm}$$

$$\text{Image distance (v)} = 20 \text{ cm}$$

$$\text{Magnification } m = \frac{v}{u}$$

$$m = \frac{2\cancel{0}}{1\cancel{0}}$$

$$m = 2$$

ii) Height of the image

$$\text{Magnification} = m = \frac{h^1}{h}$$

$$h^1 = h \times 2$$

$$h^1 = 3 \times 2$$

$$\mathbf{h^1 = 6 \text{ cm.}}$$

5. **Calculate the frequency of visible light having wavelength 3000A° travelling in vacuum.**   **(PTA-5)**

Solution :

$$\text{Wave length } \lambda = 3000 \text{A}°$$

$$\boxed{\therefore 1\text{A}° = 10^{-10} \text{m}}$$

$$= 3000 \times 10^{-10}$$

$$\text{Velocity of light} = 3 \times 10^8 \text{ ms}^{-1}$$

$$\text{Frequency } (\upsilon) = \frac{\text{Velocity (v)}}{\text{Wave length } (\lambda)}$$

$$\upsilon = \frac{3 \times 10^8}{3000 \times 10^{-10}}$$

$$\upsilon = \frac{1 \times 10^8}{1000 \times 10^{-10}}$$

$$\upsilon = \frac{1 \times 10^8 \times 10^{10}}{1000}$$

$$\upsilon = \frac{1 \times 10^{18}}{10^3}$$

$$= \frac{1 \times 10^{15} \times 10^3}{10^3}$$

$$\mathbf{\text{Frequency (u)} = 10^5 \text{ hertz}}$$

CHEMISTRY

7. Atoms and Molecules

Important Formulae

1. Volume at S.T.P   =   One mole of any gas occupies 22.4 litre or 22,400ml. at STP.

2. Number of moles   =   Mass / atomic mass

3. Number of mole   = $\dfrac{\text{Mass}}{\text{Molecular Mass}}$

4. Number of mole   = $\dfrac{\text{Number of atom}}{6.023 \times 10^{23}}$

5. Number of mole   = $\dfrac{\text{Number of molecules}}{6.023 \times 10^{23}}$

                      =   Volume at S.T.P. /22.4.

6. Mass % of an element in a compound = $\dfrac{\text{Mass of that element in the compound}}{\text{Molecular mass of the compound}} \times 100$

7. Average atomic mass of an element = Mass of 1st isotopes × % abundance of 1st Isotope + (Mass of 2nd isotope × % abundance of 2nd Isotope)

   Atomic mass expressed in gram is called gram atomic mass.

   H $\rightarrow$ 1g   O $\rightarrow$ 16g   C $\rightarrow$ 12g   Cl $\rightarrow$ 35.5 g   N $\rightarrow$ 14g   S $\rightarrow$ 32 g

1. Monoatomic   -   Metals and noble gases.

2. Diatomic   -   Hydrogen H_2

                             Nitrogen N_2

                             Oxygen O_2

3. Triatomic   -   ozone O_3

4. Polyatomic   -   Phosphorus P_4

5. Atomicity   - $\dfrac{\text{Molecular mass}}{\text{Atomic mass}}$

6. Molar volume of gas at STP - 22.4 litre at STP. (or) 22.400 ml.

7. No. of mole   - $\dfrac{\text{Given volume of gas at STP}}{\text{Molar volume at STP}}$

Bookback Questions & Answers

I.   Choose the best answer

1. Which of the following has the smallest mass?
   a) 6.023×10^{23} atoms of He   b) 1 atom of He
   c) 2 g of He   d) 1 mole atoms of He

   Ans : b) 1 atom of He

2. Which of the following is a triatomic molecule?   **(Dept., PTA - 1)**

    a) Glucose   b) Helium   c) Carbon dioxide d) Hydrogen

    Ans : c) Carbon dioxide

3. The volume occupied by 4.4 g of CO_2 at S.T.P

    a) 22.4 litre   b) 2.24 litre   c) 0.24 litre   d) 0.1 litre

    Ans : b) 2.24 litre

4. Mass of 1 mole of Nitrogen atom is

    a) 28 amu   b) 14 amu   c) 28 g   d) 14 g

    Ans : d) 14 g

5. Which of the following represents 1 amu?

    a) Mass of a C – 12 atom   b) Mass of a hydrogen atom

    c) $1/12^{th}$ of the mass of a C – 12 atom   d) Mass of O – 16 atom

    Ans : c) $\dfrac{1}{12^{th}}$ of the mass of a C – 12 atom

6. Which of the following statements is incorrect?

    a) 12 gram of C – 12 contains Avogadro's number of atoms

    b) One mole of oxygen gas contains Avogadro's number of molecules

    c) One mole of hydrogen gas contains Avogadro's number of atoms

    d) One mole of electrons stands for 6.023×10^{23} electrons

    Ans : c) One mole of hydrogen gas contains Avogadro's number of atoms

7. The volume occupied by 1 mole of a diatomic gas at S.T.P is

    a) 11.2 litre   b) 5.6 litre   c) 22.4 litre   d) 44.8 litre

    Ans : c) 22.4 litre

8. In the nucleus of $_{20}Ca^{40}$, there are

    a)   20 protons and 40 neutrons   b)   20 protons and 20 neutrons

    c)   20 protons and 40 electrons   d)   40 protons and 20 electrons

    Ans : b) 20 protons and 20 neutrons

9. The gram molecular mass of oxygen molecule is   **(Sep.-22)**

    a) 16 g   b) 18 g   c) 32 g   d) 17 g

    Ans : c) 32 g

10. 1 mole of any substance contains _____ molecules.   **(April-24)**

    a) 6.023×10^{23} b) 6.023×10^{-23} c) 3.0115×10^{23} d) 12.046×10^{23}

    Ans : a) 6.023×10^{23}

II.   Fill in the blanks

1. Atoms of different elements having _____ mass number, but _____ atomic numbers are called isobars.

    Ans : same, different

2. Atoms of one element can be transmuted into atoms of other element by _____.

    Ans : artificial transmutation   **(PTA - 4)**

3.   The sum of the numbers of protons and neutrons of an atom is called its _____.
     Ans : mass number

4.   Relative atomic mass is otherwise known as _____.
     Ans : standard atomic weight

5.   The average atomic mass of hydrogen is _____ amu.
     Ans : 1.008

6.   If a molecule is made of similar kind of atoms, then it is called _____ atomic molecule.
     Ans : homo   **(PTA - 6)**

7.   The number of atoms present in a molecule is called its _____.   **(PTA - 4)**
     Ans : atomicity

8.   One mole of any gas occupies _____ ml at S.T.P.
     Ans : 22,400

9.   Atomicity of phosphorous is _____.
     Ans : four

III.   Match the following

1	8 g of O_2	4 moles
2	4 g of H_2	0.25 moles
3	52 g of He	2 moles
4	112 g of N_2	0.5 moles
5	35.5 g of Cl_2	13 moles

Ans :

1	8 g of O_2	1	0.25 moles
2	4 g of H_2	2	2 moles
3	52 g of He	3	13 moles
4	112 g of N_2	4	4 moles
5	35.5 g of Cl_2	5	0.5 moles

IV.   State whether True or False (If false give the correct statement)

1.   Two elements sometimes can form more than one compound.
     Ans : True

2.   Noble gases are **Diatomic.**
     Ans : False
     Correct statement : Noble gases are **mono atomic**.

3.   The gram atomic mass of an element has no **unit.**
     Ans : False
     Correct statement : The gram atomic mass of an element is expressed in **grams.**

4. 1 mole of Gold and Silver contain same number of atoms.

Ans : True

5. Molar mass of CO_2 is **42g.**

Ans : False

Correct statement : Molar mass of CO_2 is **44g.**

V. Assertion and Reason: Answer the following questions using the data given below:

i) A and R are correct, R explains A.

ii) A is correct, R is wrong.

iii) A is wrong, R is correct.

iv) A and R are correct, R doesn't explain A.

1. **Assertion :** The Relative Atomic mass of aluminium is 27.

   Reason : An atom of aluminium is 27 times heavier than 1/12th of the mass of the C – 12 atom.

   Ans : iv) A and R are correct, R doesn't explain A.

2. **Assertion :** The Relative Molecular Mass of Chlorine is 35.5 a.m.u.   **(PTA - 3)**

   Reason : The natural abundance of Chlorine isotopes are not equal.

   Ans : iii) A is wrong, R is correct.

VI. Short answer questions

1. **Define : Relative atomic mass.**   **(PTA-3, Sep.-22, July-23)**

   ★ Relative atomic mass of an element is defined as the ratio between the average mass of its isotopes to the $\frac{1}{12}$th part of the mass of a carbon - 12 atom.

   ★ It is denoted as A_r.

   ★ It is otherwise called "Standard Atomic Weight".

   $$\text{Relative Mass} = \frac{\text{Average mass of the isotopes of the element}}{\frac{1}{12}\text{th of the mass of one carbon - 12 atom}}$$

2. **Write the different types of isotopes of oxygen and its percentage abundance.**

   ★ Oxygen exists as a mixture of three stable isotopes in nature as shown in the following table.

Isotope	Mass (amu)	% abundance
$_8O^{16}$	15.9949	99.757
$_8O^{17}$	16.9991	0.038
$_8O^{18}$	17.9992	0.205

3. **Define : Atomicity.**   **(May-22, Sep.-21,22, April-23)**

   ★ The number of atoms present in the molecule is called atomicity.

   E.g. : Hydrogen → H_2 atomicity - 2

        Ozone → P3 atomicity - 3

4. **Give any two examples for hetero diatomic molecules.**   **(Sep.-22)**

 ★ CO (Carbon monoxide) and HCl (Hydrogen choloride).

5. **What is Molar volume of a gas?**

 ★ Molar volume of a gas is the volume occupied by one mole of any gas at S.T.P. (Standard Temperature and Pressure). One mole of any gas occupies 22.4 litres or 22,400 ml at S.T.P.

6. **Find the percentage of nitrogen in ammonia.**   **(PTA - 1)**

  Atomic mass of Nitrogen = 14g

  Atomic mass of Hydrogen = 1g

 ★ Molecular mass of ammonia = Mass of (1 atom of nitrogen and 3 atoms of hydrogen)

$$= 14 + (3 \times 1)$$

$$= 17g$$

$$\% \text{ of Nitrogen} = \frac{\text{Mass of nitrogen}}{\text{Molecular mass of ammonia}} \times 100$$

$$= \frac{14}{17} \times 100$$

$$= \mathbf{82.35\%.}$$

VII. Long answer questions

1. **Calculate the number of water molecules present in one drop of water which weighs 0.18 g.**

  Gram molecular mass of water (H_2O) = 2 + 16 = 18g

$$\text{Number of molecules} = \frac{\text{Avogadro Number} \times \text{Given mass}}{\text{Gram molecular mass}}$$

$$= \frac{6.023 \times 10^{23} \times 0.18}{18}$$

$$= 6.023 \times 10^{21}. \text{ mole}$$

$$(\text{or})$$

$$0.06023 \times 10^{23} \text{ molecules}$$

2. **$N_2 + 3 H_2 \rightarrow 2 NH_3$**

  (The atomic mass of nitrogen is 14, and that of hydrogen is 1)

  1 mole of nitrogen (_____g) + 3 moles of hydrogen (_____ g) $\rightarrow$

  2 moles of ammonia (_____ g).

  $N_2 + 3H_2 \longrightarrow 2NH_3$
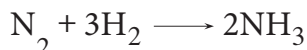
  The atomic mass of nitrogen is 14

  The atomic mass of hydrogen is 1

  The molar mass of ammonia (NH_3) is 17

  1 mole of nitrogen (2 atoms ie. $2 \times 14 = 28g$)

  + 3 moles of hydrogen (3×2 atoms i.e. $6 \times 1 = 6g$) $\longrightarrow$ 2 moles of ammonia ($2 \times 17 = 34g$)

3. **Calculate the number of moles in**

    i) **27g of Al**   **(PTA - 5)**

    Mass of Al $= 27$g

    Atomic mass of Al $= 27$

    No of moles $= \dfrac{\text{Mass}}{\text{Atomic mass}} = \dfrac{27}{27} = 1$ mole.

    ii) **1.51×10^{23} molecules of NH_4Cl**   **(April-24)**

    1 mole of $NH_4Cl =$
    6.023×10^{23} molecules of NH_4Cl
    (Avogadro's number)

    No. of moles in 1.51×10^{23} molecules of NH_4Cl

    $= \dfrac{\text{Given number of molecules}}{\text{Avogadro's number}}$

    $= \dfrac{1.51 \times 10^{23}}{6.023 \times 10^{23}} = \dfrac{1}{4}$

    $= $ **0.25 moles**

4. **Give the salient features of "Modern atomic theory".**   **(PTA - 5, Sep.-20,22, April-24)**

    The salient features of modern atomic theory are as follows :

    ★ An atom is no longer indivisible (after the discovery of the electron, protron and neutron).
    ★ Atoms of the same element may have different atomic mass (discovery of isotopes $_{14}Cl^{35}$, $_{17}Cl^{37}$) Atoms of different elements may have same atomic mass (discovery of isobars $_{18}Ar^{40}$, $_{20}Ca^{40}$)
    ★ Atoms of one element can be transmuted into atoms of other elements. In other words, atom is no longer indestructible (discovery of artificial transmutation).
    ★ Atoms may not always combine in a simple whole number ratio (E.g. : Glucose $C_6H_{12}O_6$ C : H : O = 6 : 12 : 6 or 1 : 2 : 1 and sucrose $C_{12}H_{22}O_{11}$, C : H : O = 12 : 22 : 11) Atom is the smallest particle that takes part in a chemical reaction.
    ★ The mass of an atom can be converted into energy ($E = mc^2$)

5. **Derive the relationship between Relative molecular mass and Vapour density.**

                                                                        (Dept., PTA - 6)

    ★ The relative molecular mass of a gas or vapour is the ratio between the mass of one molecule of the gas or vapour to mass of one atom of hydrogen.

    Vapour density (V.D.) $= \dfrac{\text{Mass of a given volume of gas or vapour at S.T.P.}}{\text{Mass of the same volume of hydrogen}}$

    ★ According to Avogadro's law equal volumes of all gases contain equal number of molecules at S.T.P.
    ★ Thus, let the number of molecules in one volume = n, then

    V.D. at S.T.P. $= \dfrac{\text{Mass of 'n' molecules of a gas or vapour at S.T.P.}}{\text{Mass of 'n' molecules of hydrogen}}$

    ★ cancelling 'n' which is common, we get

    V.D. $= \dfrac{\text{Mass of 1 molecule of a gas or vapour at S.T.P.}}{\text{Mass of 1 molecule of hydrogen}}$

★ since hydrogen is diatomic,

$$\text{V.D.} = \frac{\text{Mass of 1 molecule of a gas or vapour S.T.P}}{\text{Mass of 2 atoms of hydrogen}}$$

i.e. $$\text{V.D.} = \frac{\text{Mass of 1 molecule of a gas or vapour at S.T.P}}{2 \times \text{Mass of 1 atom of hydrogen}}$$

But

$$\frac{\text{Mass of 1 molecule of a gas or vapour at S.T.P}}{\text{Mass of 1 atom of hydrogen}} = \text{Relative Molecular mass}$$

$$\therefore \text{V.D.} = \frac{\text{Relative molecular mass}}{2}$$

(OR)

Relative molecular mass $= 2 \times$ Vapour density

VIII. HOT questions.

1. Calcium carbonate is decomposed on heating in the following reaction

$$CaCO_3 \longrightarrow CaO + CO_2$$
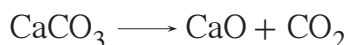
i. How many moles of Calcium carbonate are involved in this reaction?

There is only one mole of calcium carbonate involved in this reaction.

ii. Calculate the gram molecular mass of calcium carbonate involved in this reaction.

Gram molecular mass of calcium carbonate $(CaCO_3)$ = Mass of 1 Calcium
+ Mass of 1 Carbon
+Mass of 3 Oxygen atoms.

Gram atomic masses of Ca, C and O are 40, 12 and 16g respectively.

Gram molecular mass of calcium carbonate $(CaCO_3)$ = 40 + 12 + 3 (16)

= 40 + 12 + 48

= 100 g

iii. How many moles of CO_2 are there in this equation?

There is only one mole of CO_2 in this equation.

IX. Solve the following problems.

1. How many grams are there in the following?   (PTA - 4)

i. 2 moles of hydrogen molecule, H_2

2 moles of hydrogen molecule	=	$2H_2$
	=	4 atoms of hydrogen
Gram atomic mass of hydrogen	=	1g
Mass of 2 moles of hydrogen molecule	=	4×1
	=	**4g**

ii. 3 moles of chlorine molecule, Cl_2

3 moles of chlorine molecule	=	$3Cl_2$
	=	6 Cl atoms.
Gram atomic mass of chlorine	=	35.45g

Mass of 3 moles of chlorine molecule   =   mass of 6 Cl atoms

= $6 \times 35.45g$

=   **213g**

iii. 5 moles of sulphur molecule, S_8

5 moles of sulphur molecule   = $5S_8$

= $5 \times 8 = 40$ 'S' atoms

Gram atomic mass of sulphur   =   32g

Mass of 5 moles of sulphur molecule   =   Mass of 40 'S' atoms

= 40×32

=   **1280g**

iv. 4 moles of phosphorous molecule, P_4

4 moles of phosphorous molecule   = $4P_4$

= $4 \times 4 = 16$ 'P' atoms

Gram atomic mass of phosphorous   =   30g

Mass of 4 moles of phosphorous   =   Mass of 16 'P' atoms

= 16×30

=   **480g**

2. **Calculate the % of each element in calcium carbonate.**   **(PTA - 2, July-23)**

(Atomic mass: C-12, O -16, Ca - 40)

Molecular formula of calcium carbonate is $CaCO_3$.

Gram molecular mass of Calcium Carbonate

= Mass of 1 Ca + (Mass of 1 C + Mass of 3 'O' atoms)

= $40 + 12 + 3(16)$

=   100g

% of carbon   = $\dfrac{\text{Mass of carbon}}{\text{Gram molecular mass of } CaCO_3} \times 100$

= $\dfrac{12}{100} \times 100 = 12\%$

% of calcium   = $\dfrac{\text{Mass of calcium}}{\text{Gram molecular mass of } CaCO_3} \times 100$

= $\dfrac{40}{100} \times 100 = 40\%$

% of oxygen   = $\dfrac{\text{Mass of oxygen}}{\text{Gram molecular mass of } CaCO_3} \times 100$

= $\dfrac{48}{100} \times 100 = 48\%$

3. **Calculate the % of oxygen in $Al_2(SO_4)_3$.**   (PTA - 2)

(Atomic mass: Al-27, O-16, S -32)

Gram molecular mass of $Al_2(SO_4)_3$ = Mass of 2(Al) + 3 (S) + 12(O)

$$= (2 \times 27) + (3 \times 32) + (12 \times 16)$$

$$= 54 + 96 + 192$$

$$= 342g$$

% of oxygen $= \dfrac{\text{Mass of Oxygen}}{\text{Gram molecular mass of } Al_2(SO_4)_3} \times 100$

$$= \dfrac{192}{342} \times 100$$

$$= \mathbf{56.14\%}$$

4. **Calculate the % relative abundance of B -10 and B -11, if its average atomic mass is 10.804 amu.**

Let the % of B - 10 be x

∴ % of B – 11 is (100 – x)

Average atomic mass $= \dfrac{x \times 10}{100} + \dfrac{(100-x)\,11}{100} = 10.804$

$$= 10x + 11 (100 - x) = 1080.4$$

$$= 10x + 1100 - 11x = 1080.4$$

$$= -x + 1100 = 1080.4$$

$$-x = 1080.4 – 1100$$

$$-x = -19.6$$

$$x = 19.6\%$$

Substitute the value of x in

B – 11 = (100 – x) %

∴ B – 11 = (100 – 19.6) %

% abundance of B – 10 = 19.6 %

% abundance of B –11 = (100 – 19.6)

$$= \mathbf{80.4\ \%}$$

PTA & Exam Questions (Interior)

I. **Choose the best answer**

1. Analyse the following and choose the correct statement (s).   (PTA - 4)

   i) An electron has considerable mass

   ii) A hetero atomic molecule is formed from different kinds of atoms.

   iii) Mass number and atomic mass of an element are same

   a) i, ii and iii are correct   b) i and iii are correct

   c) only ii is correct   d) only iii is correct

   Ans : c) only ii is correct

2. If a molecule is made of similar kind of atoms, then it is called _____ .(PTA - 6, May-22)

   a) mono atomic molecule   b) hetero atomic molecule

   c) homo atomic molecule   d) poly atomic molecule

   Ans : c) homo atomic molecule

3. The gram molecular mass of water is : **(April-23)**

a) 2 g   b) 16 g   c) 18 g   d)8 g

Ans : c) 18 g

VI. Short answer questions

1. Write any two application of "Avogadro's Law". **(Sep.-20)**

➤ It explains Gay -Lussac's Law.

➤ It helps in the determination of atomicity of gases.

➤ It helps to derive molecular formula of gaseous compound.

➤ It determines the relationship between molecular mass and vapour density.

➤ It helps to determine the gram molar volume of all gases (22.4 litre at STP).

2. Mention any two applications of Avogadro's Law. **(April -23)**

➤ It explains Gay-Lussac's law.

➤ It helps in the determination of atomicity of gases.

➤ Molecular formula of gases can be derived using Avogadro's law

3. Under same conditions of temperature and pressure, if you collect 3 litre of O_2, 5 litre of Cl_2 and 6 litre of H_2. **(April-24)**

(A) Which has the highest number of molecules ?

6 litre of H_2

(B) Which has the lowest number of molecules ?

3 litre of O_2

VII. Long answer questions

1. i) Give the differences between atoms and molecules (ii) calculate the relative molecular mass of glucose. **(May-22)**

i) Differences between atoms and molecules.

	Atom	Molecule
1	An atom is the smallest particle of an element.	A molecule is the smallest particle of an element or compound.
2	Atom does not exist in free state except in noble gases.	Molecule exists in free state.
3	Except some of noble gases, other atoms are highly reactive.	Molecules are less reactive.
4	Atom does not have a chemical bond.	Atoms in a molecule are held by chemical bonds.
	E.g. : Na, Zn...etc.	**E.g. :** H_2, CO_2... etc.

(ii) The molecular mass of glucose ($C_6H_{12}O_6$) = Mass of {6(C) + 12(H) + 6 (O)}

= 6(12) + 12(1) + 6(16)

= 72 + 12 + 96

= **180g**

VIII. HOT questions

1. Calculate the percentage of Sulphur in H_2SO_4.   (April-23)

$$\text{Molecular mass of } H_2SO_4 = (1 \times 2) + (32 \times 1) + (16 \times 4)$$
$$= 2 + 32 + 64$$
$$= 98 \text{ g}$$

$$\% \text{ of S in } H_2SO_4 = \frac{\text{Mass of sulphur}}{\text{Molecular mass of } H_2SO_4} \times 100$$

$$\% \text{ of S in } H_2SO_4 = \frac{32}{48} \times 100 = 32.65\%$$

2. **The mass percentage of carbon is 27.28% and the mass percentage of oxygen is 72.73% calculate the molecular mass of that compound.**   (PTA - 4)

Solution :

$$\text{Mass percentage of carbon} = 27.28$$
$$\text{Atomic mass of carbon} = 12$$
$$\text{Mass percentage of oxygen} = 72.73$$
$$\text{Atomic mass of oxygen} = 16$$
$$\text{Molecular mass of the compound} = ?$$

$$\text{Mass percentage of carbon} : \frac{\text{Mass of carbon in the compound}}{\text{Molecular mass of the compound}} \times 100$$

$$\text{Molecular mass of the compound} : \frac{\text{Mass of carbon in the compound}}{\text{Mass percentage of carbon}} \times 100$$

$$\text{Molecular mass of the compound} : \frac{12 \times x}{27.28} \times 100 _____(1)$$

$$\text{Molecular mass of the compound} : \frac{\text{Mass of oxygen in the compound}}{\text{Mass percentage of oxygen}} \times 100$$

$$\text{Molecular mass of the compound} : \frac{16 \times y}{72.73} \times 100 _____(2)$$

Equation (1) and (2)

$$\frac{12 \times x}{27.28} \times 100 = \frac{16 \times y}{72.73} \times 100$$

$$\frac{12 \times x}{27.28} = \frac{16 \times y}{72.73}$$

$$\frac{12x}{16y} = \frac{27.28}{72.73}$$

$$\frac{x}{y} = \frac{436.48}{872.76}$$

$$\frac{x}{y} = \frac{1}{2}$$

$$\mathbf{x : y = 1 : 2}$$

Molecular formula of the compound Co_2

Molecular formula of the compound

$12 \times 1 + 16 + 2 = 44$

2. i) Calculate the mass of 1.51×10^{23} molecule of H_2O   **(Dept.)**

Solution :

Gram mass of H_2O

$$2(H) \rightarrow 2 \times 1 = 2$$
$$1(O) \rightarrow 1 \times 16 = \underline{16}$$
$$\therefore \text{ G. molar mass of } H_2O = \underline{18}$$

$$\text{No. of mole} = \frac{\text{Number of molecules}}{\text{Avogadro's number}}$$

$$= \frac{1.51 \times 10^{23}}{6.023 \times 10^{23}}$$

$$= \boxed{\frac{1}{4} = 0.25 \text{ mole}}$$

$$\text{No. of moles} = \frac{\text{mass}}{\text{molecular mass}}$$

$$\boxed{\text{Mass} = \text{molecular mass} \times \text{No. of mole}}$$

$$= 0.25 \times 18$$

Mass = 4.5 g

ii) Calculate the moles of 46 g sodium.

$$\text{No. of mole} = \frac{\text{Mass of the element}}{\text{Atomic mass of the element}}$$

$$= \frac{46}{23}$$

= 2 moles of sodium

iii) Calculate the number of molecules present in the 36 g water.

Molecular mass of the H_2O = 18g

18g of H_2O = 1 mole of H_2O

36 g of H_2O = 2 moles of H_2O

$\therefore$ 1 mole of H_2O = 6.023×10^{23} molecules of H_2O
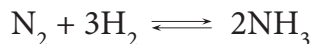
2 moles of H_2O = $2 \times 6.023 \times 10^{23}$

$$= 12.046 \times 10^{23}$$

(OR)

$$= \mathbf{1.2046 \times 10^{24} \text{ molecules of } H_2O.}$$

3. In the chemical industries the following chemical reaction is used to produce ammonia in large scale.   (PTA - 3)

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

Based on mole concept. calculate the mass of nitrogen gas and hydrogen gas required in kilogram to produce 1000 kg of ammonia by using the above chemical equation.

Solution :

Mass of NH_3 produced $= 1000kg = 10^6g$

Molecular mass of NH_3

$1(N) \longrightarrow 1 \times 14 = 14$

$3(H) \longrightarrow 3 \times 1 = 3$

$= 17 \text{ g}$

No. of moles of $NH_3 = \dfrac{\text{Mass of} NH_3 \text{produced}}{\text{Molecular mass of } NH_3}$

$= \dfrac{10^6}{17}$ ———— (1)

i) 2 moles of NH_3 is produced from 3 moles of H_2

$\therefore \dfrac{10^6}{17}$ moles of NH_3 is produced $\dfrac{10^6}{17} \times \dfrac{3}{2}$

$\boxed{\text{Required mass of } H_2 = \text{No. of mole} \times \text{molecular mass}}$

$\dfrac{10^6}{17} \times \dfrac{3}{2} \times (2 \times 1) = 176.47 \text{ kg. Hz}$

ii) 2 moles of NH_3 produced from 1 mole of N_2

$\dfrac{10^6}{17}$ moles of NH_3 produced $\dfrac{10^6}{17} \times \dfrac{1}{2}$ mass of N_2

Required mass of N_2

$= \dfrac{10^6}{17} \times \dfrac{1}{2} \times (14 \times 2)$

$= \dfrac{28}{34} \times 10^6$

$= 0.82353 \times 10^6$

$= 823.53 \text{ kg of } N_2$

$\therefore$ Required mass of $N_2 \qquad = \quad 823.53 \text{ kg}$

$\therefore$ Required mass of $H_2 \qquad = \quad$ **176.47 kg.**

4. Calculate the molecular mass of CO_2.   (Sep.-21)

Molecular mass of Co_2

Atomic mass of C $=$ 12g

Atomic mass of O $=$ 16g

Gram molecular mass of $Co_2 = 1(C) \rightarrow 1 \times 12 = 12$

$= 2(O) \rightarrow 2 \times 16 = \underline{32}$

$\underline{44}$

$\therefore$ **Gram molecular mass of Co_2** $\quad = \qquad\qquad\qquad\qquad\qquad\qquad$ **44 g.**

8. Periodic Classification of Elements

Important Formulae

1	Ionic bond	NaBr, KBr, NaCl, NaI, KI, kCl, $CaCl_2$, K_2O ñŸÁ‹ MgO.
2	Covalent bond	PCl_3, HCl, H_2O, H_2, O_3, CH_4, NH_3, CO_2, PCl_5, PCl_4, SH_4 C_2H_5OH
3	Both	$CaCO_3$, $BaSO_4$, Na_2SO_4, $AIBr_3$ Sodium acetate and Magnesium nitrate.

Bookback Questions & Answers

I.   Choose the best answer

1. The number of periods and groups in the periodic table are _____.   **(Sep.-22)**

    a) 6,16   b) 7,17   c) 8,18   d) 7,18

    Ans : d) 7,18

2. The basis of modern periodic law is _____.

    a) atomic number   b) atomic mass
    c) isotopic mass   d) number of neutrons

    Ans : a) atomic number

3. _____ group contains the member of halogen family.   **(PTA - 1)**

    a) 17th b) 15th c) 18th d) 16th

    Ans : a) 17th

4. _____ is a relative periodic property.

    a) atomic radii   b) ionic radii   c) electron affinity d) electronegativity

    Ans : d) electronegativity

5. Chemical formula of rust is _____.

    a) $FeO.xH_2O$ b) $FeO_4.xH_2O$ c) $Fe_2O_3.xH_2O$ d) FeO

    Ans : c) $Fe_2O_3.xH_2O$

6. In the alumino thermic process the role of Al is _____.

    a) oxidizing agent   b) reducing agent
    c) hydrogenating agent   d) sulphurising agent

    Ans : b) reducing agent

7. The process of coating the surface of a metal with a thin layer of zinc is called _____.

    a) painting   b) thinning   c) galvanization   d) electroplating

    Ans : c) galvanization

8. Which of the following have inert gases 2 electrons in the outermost shell ?

    a) He   b) Ne   c) Ar   d) Kr

    Ans : a) He

9. Neon shows zero electron affinity due to _____.

    a) stable arrangement of neutrons   b) stable configuration of electrons

    c) reduced size   d) increased density

    Ans : b) stable configuration of electrons

10. _____ is an important metal to form amalgam.   **(Dept., Sep.-22, July-23)**

    a) Ag   b) Hg   c) Mg   d) Al

    Ans : b) Hg

II. Fill in the blanks

1. If the electronegativity difference between two bonded atoms in a molecule is greater than 1.7, the nature of bonding is _____.   **(PTA - 5)**

    Ans : ionic

2. _____ is the longest period in the periodic table.

    Ans : Sixth period

3. _____ forms the basis of modern periodic table.

    Ans : Atomic number

4. If the distance between two Cl atoms in Cl_2 molecule is 1.98Å, then the radius of Cl atom is _____.

    Ans : 0.99Å

5. Among the given species A^-, A^+, and A, the smallest one in size is _____.

    Ans : A^+

6. The scientist who propounded the modern periodic law is _____.

    Ans : Henry Mosley

7. Across the period, ionic radii _____ (increases, decreases).

    Ans : decreases

8. _____ and _____ are called inner transition elements.

    Ans : Lanthanides, Actinides

9. The chief ore of Aluminium is _____.

    Ans : bauxite

10. The chemical name of rust is _____.

    Ans : hydrated ferric oxide ($Fe_2O_3.xH_{63}O$)

III. Match the following   (PTA - 6)

1	Galvanisation	Noble gas elements
2	Calcination	Coating with Zn
3	Redox reaction	Silver-tin amalgam
4	Dental filling	Alumino thermic process
5	Group 18 elements	Heating in the absence of air

Ans :

1	Galvanisation	Coating with Zn
2	Calcination	Heating in the absence of air
3	Redox reaction	Alumino thermic process
4	Dental filling	Silver-tin amalgam
5	Group 18 elements	Noble gas elements

IV. State whether True or False: (If false give the correct statement)

1. Moseley's periodic table is based on **atomic mass.**

   Ans : False

   Correct statement : Mosley's periodic table is based on **atomic number.**

2. Ionic radius **increases** across the period from left to right.

   Ans : False

   Correct statement : Ionic radius **decreases** across the period from left to right due to increase in nuclear charge.

3. All ores are minerals; but all minerals cannot be called as ores.

   Ans : True

4. Al wires are used as **electric cables** due to their silvery white colour.

   Ans : False

   Correct statement : Al wires are used as electric cables because aluminium is a **good conductor electricity** and not because of its silvery white colour.

5. An alloy is a **heterogeneous** mixture of metals.

   Ans : False

   Correct statement : An alloy is a **homogeneous** mixture of metals.

V. Assertion and Reason. Answer the following questions using the data given below

   i) A and R are correct, R explains A.
   ii) A is correct, R is wrong.
   iii) A is wrong, R is correct.
   iv) A and R are correct, R doesn't explains A.

1. **Assertion** : The nature of bond in HF molecule is ionic   **(PTA-2)**

   Reason : The electronegativity difference between H and F is 1.9

        Ans : iii) A is wrong, R is correct.

2. **Assertion** : Magnesium is used to protect steel from rusting

   Reason : Magnesium is more reactive than iron.

        Ans : i) A and R are correct, R explains A.

3. **Assertion** : An uncleaned copper vessel is covered with greenish layer.   **(PTA-5)**

   Reason : copper is not attacked by alkali.

        Ans : iv) A and R are correct, R doesn't explains A.

VI. Short answer questions

1. **A is a reddish brown metal, which combines with O_2 at < 1370 K gives B, a black coloured compound. At a temperature > 1370 K, A gives C which is red in colour. Find A, B and C with reaction.**   **(PTA -1)**

'A' is copper which is a reddish brown metal.

'A' with O_2 at <1370K gives 'B' a black coloured compound.

Thus 'B' is copper (II) oxide, CuO

$$2Cu + O_2 \xrightarrow{\text{<1370K}} 2CuO$$
$$\text{'B' (black)}$$

At a temperature > 1370K 'A' gives 'C' which is red in colour. 'C' is Copper (I) Oxide,

$$4Cu + O_2 \xrightarrow{\text{>1370K}} 2Cu_2O$$
$$\text{'C' (red)}$$

Result :

'A' is Copper, Cu

'B' is Copper (II) Oxide, CuO

'C' is Copper (I) Oxide, Cu_2O

2. **A is a silvery white metal. A combines with O_2 to form B at 800°C, the alloy of A is used in making the aircraft. Find A and B.**   **(PTA - 1)**

★ 'A' is silvery white metal. Thus 'A' is Aluminium (Al), the alloy of which is used in making the aircraft.

'A' with O_2 At 800°C forms 'B'

$$4Al + 3O_2 \xrightarrow{\text{800°C}} 2Al_2O_3$$
$$\text{'A'} \qquad\qquad\qquad \text{'B'}$$

Thus **'A'** is aluminium, Al, **B'** is aluminium oxide, Al_2O_3

3. **What is rust? Give the equation for formation of rust.**

                                        (PTA - 4, Sep.-21, July-23, April-24)

★ Rust is hydrated ferric oxide Fe_2O_3. XH_2O. It is formed when iron is exposed to moist air in the form of a brown layer at the surface.

$$4Fe + 3O_2 + xH_2O \longrightarrow 2Fe_2O_3.xH_2O$$

(brown hydrated ferric oxide)

4. **State two conditions necessary for rusting of iron.**

• moist air

• Oxygen (O_2)

• Presence of water

VII. Long answer questions

1. a) **State the reason for addition of caustic alkali to bauxite ore during purification of bauxite.**

    ★ When the impure bauxite ore is ground and heated under pressure with a solution of concentrated caustic soda solution at 150°C we get sodium meta aluminate.
    $(NaAlO_2)$ $Al_2O_3 + 2NaOH \longrightarrow 2NaAlO_2 + H_2O$

    ★ On diluting sodium meta aluminate with water, a precipitate of aluminium hydroxide is formed. $NaAlO_2 + 2H_2O \longrightarrow Al(OH)_3 \downarrow + NaOH$

    ★ The precipitate is filtered, washed, dried and ignited to 1000°C to get pure alumina (Al_2O_3)

    $2Al(OH)_3 \xrightarrow{\;1000°C\;} Al_2O_3 + 3H_2O$

    b) **Along with cryolite and alumina, another substance is added to the electrolyte mixture. Name the substance and give one reason for the addition.**

    ★ Along with cryolite and alumina, fluorspar is also added to the electrolyte mixture. Fluorspar lowers the fusion temperature of the electrolyte.

2. **The electronic configuration of metal A is 2,8,18,1.**   (PTA - 1)

    The metal A when exposed to air and moisture forms B a green layered compound. A with con. H_2SO_4 forms C and D along with water. D is a gaseous compound. Find A,B,C and D.

    ★ The electronic configuration of metal A is 2, 8, 18, 1..... Metal A is copper.

    ★ A when exposed to air and moisture forms ∴ B, a green layered compound.

    ★ B is basic copper carbonate, $CuCO_3.Cu(OH)_2$.

    $2Cu + O_2 + CO_2 + H_2O \longrightarrow CuCO_3.Cu(OH)_2$
    'A'   'B'

    ★ A with con. H_2SO_4 forms C and D along with water. D is a gaseous compound. 'C' is copper sulphate, $CuSO_4$ and 'D' is sulphur dioxide, SO_2

    $Cu + 2H_2SO_4 \longrightarrow CuSO_4 + SO_2 + 2H_2O$
      A   Conc.   C   D

    Result :

    A is Copper, Cu

    B is basic Copper Carbonate, $CuCO_3.Cu(OH)_2$

    C is Copper Sulphate, $CuSO_4$

    D is Sulphur dioxide, SO_2

3. **Explain smelting process.**

Chief ore = Haematite (Fe_2O_3)

Concentration : Gravity separation.

Smelting   :

Furnace   : blast furnace

Charge   : Roasted ore, coke and lime stone.

Ratio   : 8 : 4 : 1

Introduced through cup and cone arrangement at the top.

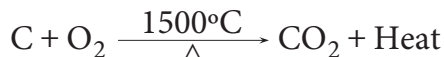Important region in the furnace = 3.

Blast Furnace

a) **Lower region : (Combustion Zone]**

Temperature = 1500°C

Charge comes in contact with a hot blast of air.

Coke burns with oxygen to form CO_2

Heat is liberated, hence it is an exothermic reaction.

$$C + O_2 \xrightarrow[\Delta]{1500°C} CO_2 + Heat$$

b) **The Middle region :**

Temperature = 1000°C

CO_2 is reduced to CO

$$CO_2 + C \xrightarrow[\Delta]{1000°C} 2CO + Heat$$

Lime stone decomposed to calcium oxide and CO_2

$$CaCO_3 \rightarrow CaO + CO_2$$
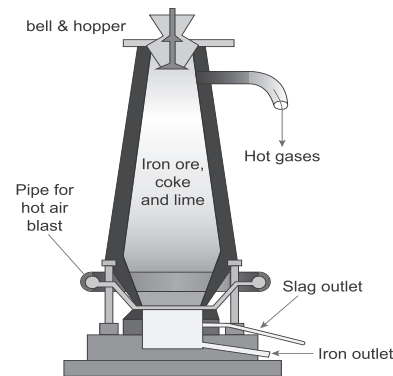
VIII. HOT questions

1. **Metal A belongs to period 3 and group 13. A in red hot condition reacts with steam to form B. A with strong alkali forms C. Find A,B and C with reactions** **(PTA - 1)**

Metal A belongs to period 3 group 13.

∴ A is Aluminium, Al

A in red hot condition reacts with steam to form B.

∴ B is Aluminium oxide, Al_2O_3

$$\boxed{2Al + 3H_2O \longrightarrow Al_2O_3 + 3H_2 \uparrow}$$

A with strong alkali forms C

∴ C is sodium meta aluminate, $NaAlO_2$

$$\boxed{2Al + 2NaOH + 2H_2O \longrightarrow \underset{C}{2NaAlO_2} + 3H_2 \uparrow}$$
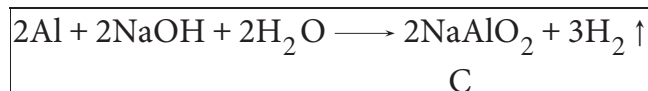
Results :

i)   **A** is Aluminium, Al

ii) **B** is Aluminium oxide, Al_2O_3

iii) **C** is sodium meta aluminte, $NaAlO_2$

Aluminium becomes passive due to the formation of an oxide film on its surface.

2. Name the acid that renders aluminium passive. Why?   (PTA - 3)

★   Dilute (or) concentrated nitric acid does not attack aluminium but it renders aluminium passive due to the formation of an oxide film on its surface.

3. a)   Identify the bond between H and F in HF molecule.

★   Covalent bond with ionic character.

b)   What property forms the basis of identification?

★   Electro negativity.

c)   How does the property vary in periods and in groups?

★   Electro negativity increases from left to right in a period

★   it decreases from top to bottom in a group.

Test Yourself

Predict the nature of the bond in the following molecules.   (PTA - 2)

(i) NaCl   (ii) NaBr   (iii) NaI   (iv) NaF   (v) NaH

★   The electronegativity values of F, Cl, Br, I, H and Na are 4, 3, 2.8, 2.5, 2.1 and 1 respectively.

★   The difference in the electronegativity values of the two atoms involved in the following molecules can be calculated as follows :

i)   NaCl   =   3 - 1   =   2

ii)   NaBr   =   2.8 - 1   =   1.8

iii)   NaI   =   2.5 - 1   =   1.5

iv)   NaF   =   4 - 1   =   3

v)   NaH   =   2.1 - 1   =   1.1

★   In NaCl. NaBr and NaF the difference is found to be more than 1.7. So they are more ionic.

★   In NaI and NaH the difference is found to be less than 1.7. So they are more covalent.

PTA & Exam Questions (Interior)

I.   Choose the best answer

1. When a sodium atom loses an electron it forms Na^+ ion. The radius of Na^+ ion is lesser than Na atom. This is because   (PTA - 3)

   a)   The attractive force of nucleus is more in Na^+ ion than in Na atom

   b)   The attractive force of nucleus is more in Na atom than in Na^+ ion

   c)   Number of protons present in Na atom is less than in Na^+ ion

   d)   Number of electrons present in Na^+ ion is more than in Na atom

Ans : a) The attractive force of nucleus is more in Na^+ ion than in Na atom

2. Alloy used in the manufacturing of pressure cooker is _____.   (Sep.-21)

   a)   Bross   b) Bronze   c)   Magnalium   d)   Duralumin

Ans : d) Duralumin

3. If the electronegativity difference between two bonded atoms in a molecule is greater than 1.7, then the nature of bonding is _____.   (PTA-5)

   a)   Ionic   b) Covalent   c)   polar

   d)   Co-ordinate covalent

Ans : a) Ionic

VI.   Short answer questions

1.   i)   **From the following clues identify the group number in the periodic table and write the names of any two elements of that group.**   (PTA - 1)

   a)   **The atoms of this group have very stable electronic configuration.**

   b)   **These elements are mostly unreactive.**

   ➤   Helium (He) Neon (Ne) Argon (Ar) are the un reactive elements (or) noble gas.

   ➤   These are the elements of the 18th group in the periodic table.

2.   **Copper is a reddish brown metal, that reacts with O_2 at less than 1370 K to give A, a black coloured compound. At a temperature greater than 1370 K, Copper reacts with O_2, to give B which is a red coloured compound. Write the balanced chemical equations for the formation of A and B.**   (PTA - 4)

   Copper reacts with O_2 below 1370K to form copper (II) oxide which is black.

   $$2Cu + O_2 \xrightarrow[1370K]{below} 2CuO$$
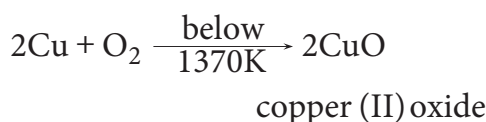
   $$copper\,(II)\,oxide$$

   Copper reacts with O_2 Above 1370K to form copper (I) oxide which is red.

   $$4Cu + O_2 \xrightarrow[1370K]{Above} 2Cu_2O$$

   $$black$$
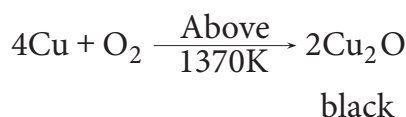
   Compound A $\longrightarrow$ CuO $\longrightarrow$ copper (II) oxide

   Compound B $\longrightarrow$ Cu_2O $\longrightarrow$ copper (I) oxide

3.   **Copper pyrites is the prime ore of copper. It is concentrated by froth flotation method. Give the reason.**   (PTA - 4)

   ➤   Copper pyrites is a sulphide ore. Sulphide ores are lighter and wetted by oil. They float on the surface along with froth flotation.

   ➤   Gangue particle are wetted by water and settle at the bottom.

   ➤   Hence copper pyrites ore is concentrated by froth flotation method.

4.   i)   **'X' is an element which belongs to 1st group of the modern periodic table 'X' is a gas and it's covalent radius value is 0.37 A°. Identify and write the chemical symbol of 'X'.**   (PTA-6)

   Since the covalent radius is 0.37 A° the element is hydrogen.

   x - is a gas and 1st group element.

   It is hydrogen gas and its formula is H_2.

   ii)   **A is a metal and belongs to Boron family in modern periodic table. It acts as a good reducing agent. It reduces iron oxide into iron. It is used to make household utensils. Write the balanced chemical equation for the reduction of iron oxide by 'A'.**   (PTA - 6)

   Metal A belong to boron family and used to make utensils, it is aluminium.

   Aluminium reduces iron oxide into iron.

   $$Fe_2O_3 + 2Al \longrightarrow 2Fe + Al_2O_3 + Heat$$
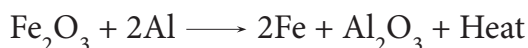
5. **Mention any two uses of copper.** (April-23)

➤ It is extensively used in manufacturing electric cables and other electric appliances.

➤ It is used for making utensils, containers, calorimeters and coins,

➤ It is used in electroplating.

➤ It is alloyed with gold and silver for making coins and jewels.

6. **What is an amalgam? Give an example.** (April-23)

➤ An amalgam is an alloy of mercury with another metal.

E.g. : Silver - Tin amalgam is used for dental filling

VII. Long answer questions

1. **Electronegativity value of hydrogen is 2 : 1 and that of sodium is 1. Find out the nature of bonding present in the compound, when hydrogen combines with fluorine and hydrogen combines with sodium. (Electronegativity value of fluorine is 4)**

(PTA-2)

Compound	Element	Electro negative value	D/B in electro negative value	Nature of bond
NaH	Na	1	1 : 1	Covalent bond
	H	2 : 1		
NaF	Na	1	3	Ionic bond
	F	4		

2. **A is the second most abundant metal available next to aluminium on the earth. A forms its magnetic oxide B, when steam is passed over metal A in red hot condition. A forms an alloy C with carbon and nickel. C is used to make aircraft parts and propeller. Identify and write names of B and C. Write the balanced chemical equation for the formation of magnetic oxide.** (PTA - 2)

➤ Second most abundant metal A = Iron. When steam is passed over red hot iron magnetic oxide (B) is formed.

$$3Fe + 4H_2O \text{ (steam)} \longrightarrow Fe_3O_4 + 4H_2 \uparrow$$

Magnetic oxide

A → Iron

B → Fe_3O_4

C → Nickel steel. (Fe, C, Ni)

It is used to make aircraft parts and propeller.

3. **What are the methods used for preventing corrosion?** (Dept., Sep.-20, 21)

i) Alloying ⟶ Metal can be alloyed (Ex) Stainless steel.

ii) Surface coating ⟶ Application of a protective coating over the metal.

a) Galvanisation ⟶ Coating of zinc over a metal

b) Electroplating ⟶ Coating one metal over the other metal by electrolysis

c) Anodizing / An electrochemical process which converts the metal surface into decorative, durable and corrosion resistant.

d) Cathodic protection $\longrightarrow$ A metal surface is coated with another metal. Which is easily corrodiable.

The easily corrosive metal is called sacrificial metal (anode).

4. **Give reason for the following statements on periodic trends in modern periodic table of elements.** **(PTA- 6)**

a) Along the period, from left to right, the atomic radius values of the elements decrease whereas along the groups, from the top to bottom, the atomic radius values increase.

b) The electron affinity values increase along the period from left to right and decrease down the group.

c) The ionization energy values increase along the period from left to right and decrease down.

No	Periodic property	Along the period from Left to Right	Down the group from top to bottom
i	Atomic radius	decreases	increases
ii	Electron affinity	increases	decreases
iii	Ionization energy	increases	decreases
iv	Reason	i) Shell number remain the same.	valence shell number increases.
		ii) Number of protons increases.	Distance between the valence shell and nucleus increases.
		iii) Atomic size decreases.	Atomic size increases.
		iv) Attraction over the electron increases.	Attraction over the electron decreases.
		v) More energy needed to remove an electron.	Less energy is needed to remove an electron.

5. a) **What is an alloy ?**   **(May - 22)**

 b) **Give the reasons for alloying ?**

Alloy : An alloy is a homogeneous mixture of two or more metals or of one or more metals with certain non - metallic elements.

Reasons for alloys :

➢ To modify appearance and colour

➢ To modify chemical activity.

➢ To lower the melting point.

➢ To increase hardness and tensile strength.

➢ To increase resistance to electricity.

Biology

12. Plant Anatomy and Plant Physiology

Bookback Questions & Answers

I.   Choose the correct answer.

1.   Casparian strips are present in the _____ of the root.   **(Dept., July-23)**
      a)   cortex   b) pith   c)   pericycle   d) endodermis
      Ans : d) endodermis

2.   The endarch condition is the characteristic feature of   **(May-22, Sep.-22April -24)**
      a)   root   b) stem   c)   leaves   d) flower
      Ans : b) stem

3.   The xylem and phloem arranged side by side on same radius is called _____.
      a)   radial   b) amphivasal   c)   conjoint   d) None of these
      Ans : c) conjoint

4.   Which is formed during anaerobic respiration ?   **(Dept., Sep.-20)**
      a)   Carbohydrate   b) Ethyl alcohol   b)   Acetyl CoA   d) Pyruvate
      Ans : b) Ethyl alcohol

5.   Kreb's cycle takes place in   **(PTA-3,April-23)**
      a)   chloroplast   b)   mitochondrial matrix
      c)   stomata   d)   inner mitochondrial membrane
      Ans : b) mitochondrial matrix

6.   Oxygen is produced at what point during photosynthesis ?   **(PTA - 4)**
      a)   when ATP is converted to ADP   b)   when CO_2 is fixed
      c)   when H_2O is splitted   d)   All of these
      Ans : c) when H_2O is splitted

II.   Fill in the blanks.

1.   The innermost layer of the cortex in root is called _____.
      Ans : Endodermis

2.   Xylem and phloem are arranged in an alternate radii constitute a vascular bundle called _____.
      Ans : Radial bundle

3.   Glycolysis takes place in _____.
      Ans : cytoplasm

4.   The source of O_2 liberated in photosynthesis is _____.
      Ans : Water molecule (H_2O)

5.   _____ is ATP factory of the cells.
      Ans : Mitochondria

III. State whether the statements are true or false. Correct the false statement.

1. **Phloem** tissue is involved in the transport of water in plant.

   Ans : False

   Correct statement : Xylem tissue is involved in the transport of water in plants.

2. The waxy protective covering of a plant is called as cuticle.

   Ans : True

3. In a monocot stem cambium is **present** in between xylem and phloem.

   Ans : False

   Correct statement : In a monocot stem cambium is **absent** in between xylem and phloem.

4. Palisade parenchyma cells occur below the upper epidermis in a **dicot root.**

   Ans : False

   Correct statement : Palisade parenchyma cells occur below the upper epidermis in a **dicot leaf.**

5. Mesophyll contains chlorophyll.

   Ans : True

6. Anaerobic respiration produces **more ATP than** aerobic respiration.

   Ans : False

   Correct statement : Anaerobic respiration produces **lesser ATP than** aerobic respiration.

IV. Match the following.

Amphicribral	*Dracaena*
Cambium	Translocation of food
Amphivasal	Fern
Xylem	Secondary growth
Phloem	Conduction of water

Ans:	Amphicribral	Fern
	Cambium	Secondary growth
	Amphivasal	*Dracaena*
	Xylem	Conduction of water
	Phloem	Translocation of food

V. Answer in a sentence.

1. What is a collateral vascular bundle?

   ★ When the vascular bundle has xylem towards the centre and phloem towards the periphery (outward), it is called the collateral vascular bundle.

   E.g.: Monocot stem.

2. Where does the carbon that is used in photosynthesis come from?

   ★ It comes from carbondioxide present in the atmosphere.

3. What is the common step in aerobic and anaerobic pathway?

   ★ Glycolysis.

4. Name the phenomenon by which carbohydrates are oxidized to release ethyl alcohol.

   ★ Anaerobic respiration or Ethanol Fermentation.

VI.   **Short answer questions.**

1.   **Give an account of the vascular bundle of dicot stem.**
   ★   Conjoint - i.e. - Xylem and phloem are seen in the same radius.
   ★   Collateral - i.e. - Xylem is towards the centre and phloem is towards the periphery.
   ★   Endarch - Protoxylem lies towards the centre, metaxylem towards the periphery.
   ★   Open - Cambium is seen between the xylem and phloem.
   ★   All the vascular bundles are arranged in the form of a ring below the endodermis.

2.   **Write a short note on mesophyll.**
   Mesophyll :
   ★   The tissue present between the upper and lower epidermis of the leaf is called mesophyll. It consists of two types of parenchyma cells.
   Palisade Parenchyma :
   ★   lies below the upper epidermis. These are elongated cells with more chloroplasts to take part in photosynthesis. They have no intercellular spaces.
   Spongy Parenchyma :
   ★   lies above the lower epidermis. These are irregularly arranged spherical or oval cells with more intercellular spaces meant for gaseous exchange.

3.   **Draw and label the structure of oxysomes.**   **(July-23)**

F_1 Head
Stalk
F_0 Base
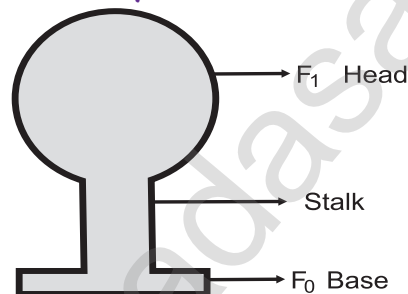
Structure of Oxysomes

4.   **Name the three basic tissue systems in flowering plants.**   **(April-23)**
   Three basic tissue systems in flowering plants are :
   ★   Dermal tissue system.
   ★   Ground tissue system
   ★   Vascular tissue system.

5.   **What is photosynthesis and where in a cell does it occur?**   **(PTA - 3, Sep.-21)**
   ★   It is a process in which all autotrophic organisms like green plants algae and chlorophyll containing bacteria utilize the energy from sunlight. Algae and chlorophyll containing bacteria utilize the energy from sunlight and synthesize carbohydrates by combining water and CO_2 by utilizing energy from sunlight.
   ★   Photosynthesis takes place in the thylakoid membrane and stroma of the chloroplasts.

6.   **What is respiratory quotient?**   **(PTA - 1, May-22, Sep.-21,22, April-24)**
   ★   Respiratory Quotient (R.Q) is the ratio of volume of carbon dioxide liberated and the volume of oxygen consumed during respiration. It is expressed as

$$R.Q. = \frac{\text{Volume of } CO_2 \text{ liberated}}{\text{Volume of } O_2 \text{ consumed}}$$

7. Why should the light dependent reaction occur before the light independent reaction?   **(April-24)**

★ In light independent reaction (Dark reaction), CO_2 is reduced to carbohydrate with the help of ATP and $NADPH_2$ which are produced at the end of light reaction.

★ As these energy rich compounds (ATP and $NADPH_2$) are produced by light dependent reaction, it should occur before light independent reactions to complete the photosynthetic process.

8. Write the reaction for photosynthesis.   **(May-22)**

$$6CO_2 + 12H_2O \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6 + 6H_2O + 6O_2 \uparrow$$

Carbon dioxide + water   Glucose + water + Oxygen
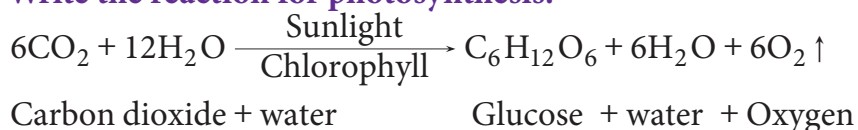
VII. Long answer questions.

1. Differentiate the following.   **(Sep.-20,21)**

a) Monocot root and Dicot root

Dicot Root	Monocot Root
Xylem is **Tetrarch.**	Xylem is **Polyarch.**
Cambium is present.	Cambium is absent.
Secondary growth is seen.	Secondary growth is absent.
Pith is Absent	Pith is present.
Conjunctive tissue is made up of parenchyma. **E.g. :** Bean.	Conjunctive tissue is made up of Sclerenchyma. **E.g. :** Maize

b) Aerobic and Anaerobic respiration   **(Sep.-22)**

Aerobic respiration	Anaerobic respiration
It takes place with the help of oxygen.	Takes place in the absence of oxygen.
Glucose is completely oxidised into CO_2, water and energy.	Glucose is partially converted into ethanol or lactic acid.
More energy is released.	Lesser amount of energy is released.
It occurs in all higher plants and animals.	It occurs in bacteria and yeasts.
Overall reaction: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + ATP$	$C_6H_{12}O_6 \rightarrow 2CO_2 + 2C_2H_5OH + (energy)\,ATP$

2. Describe and name the three stages of cellular respiration that aerobic organisms use to obtain energy from glucose.

a) Glycolysis (Glucose splitting):

★ It is the breakdown of one molecule of glucose (6 Carbon) into two molecules of pyruvic acid (3 Carbon). Glycolysis takes place in cytoplasm of the cell.

★ It is the first step of both aerobic and anerobic respiration.

b) Krebs Cycle:

★ This cycle occurs in mitochondrial matrix. At the end of glycolysis, 2 molecules of pyruvic acid enter into mitochondria.

★ The oxidation of pyruvic acid into CO_2 and water takes place through this cycle. It is also called **Tricarboxylic Acid Cycle** (TCA).

c) Electron Transport Chain:

★ This is accomplished through a system of electron carrier complex called electron transport chain (ETC) located on the inner membrane of the mitochondria.

★ $NADH_2$ and $FADH_2$ molecules formed during glycolysis and Krebs cycle are oxidised to NAD^+ and FAD^+ to release the energy via electrons.

★ The electrons, as they move through the system, release energy which is trapped by ADP to synthesize ATP. This is called **oxidative phosphorylation.**

★ In this process, O_2 the ultimate acceptor of electrons gets reduced to water.

3. **How does the light dependent reaction differ from the light independent reaction? What are the end products and reactants in each? Where does each reaction occur within the chloroplast?**

Difference between Light dependent and light independent reactions.

	Light dependent reactions	**Light independent reactions**
1	It requires sunlight for the energy source.	It does not require sunlight.
2	Photosynthetic pigments absorb sunlight energy and convert it into chemical energy as ATP and $NADPH_2$.	CO_2 is reduced to carbohydrates with the help of chemical energy ATP and $NADPH_2$ produced by light reaction.
3	It is also called Hill reaction discovered by Robin Hill.	It is called dark reaction or Calvin Cycle.
b) Reactants and end products :		
4.	In this reactants are sunlight, water and photosynthetic pigments.	In this reactants are CO_2, ATP and $NADPH_2$.
5.	End products of light reactions are ATP and $NADPH_2$.	End products are glucose, water and oxygen.
c) Place of occurance :		
6.	Light reactions occur in the thylakoid membranes (grana) of chloroplasts.	Dark reactions occur in the stroma of chloroplasts.
7.	It occurs in grana of the chlorophasts.	It occurs in stroma of the chloroplast.

VIII. Higher Order Thinking Skills(HOTS)

1. The reactions of photosynthesis make up a biochemical pathway.   (PTA-5)

A) What are the end products of light and dark reaction of photosynthesis?

Photosynthetic process	End products
Light reactions.	ATP and $NADPH_2$
Dark reactions.	Glucose, water and oxygen

B) Explain how the biochemical pathway of photosynthesis recycles many of its own reactions and identify the recycled reactants.

★ During photosynthetic process ATP and $NADPH_2$ are recycled.

★ During light reaction, solar energy is absorbed by chlorophyll pigment to synthesize ATP and $NADPH_2$ from ADP and $NADP^+$ respectively.

Recycling of reactants :

Light reation

$ADP + P \rightarrow ATP$

$NADP^+ + H_2 \rightarrow NADPH_2$

Dark reaction

$ATP \rightarrow ADP + P$

$NADPH_2 \rightarrow NADP^+ + H_2$
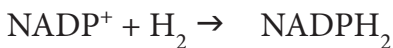
2. Where do the light dependent reaction and the Calvin cycle occur in the chloroplast?

★ Light dependent reactions of photosynthesis occur in the thylakoid (grana) membrane of the chloroplasts.

★ Calvin cycle (Dark reaction) occurs in the stroma of the chloroplasts.

PTA & Exam Questions (Interior)

V. Answer in a sentence.

1. What is vascular bundle?   (PTA - 1)

➤ It consists of xylem and phlolem tissues.

➤ They are present in the form of bundles called vascular bundle.

➤ Xylem → conduct water and minerals to different parts of the plant.

➤ Phloem → conduct food materials to different parts of the plant.

2. What is the common step in aerobic and anaerobic pathway and where does it occur in a cell?   (PTA - 5)

➤ It takes place in cytoplasm in the cell.

➤ It is a breakdown of one molecule of glucose into two molecules of pyruvic acid.

➤ It is the first step of both aerobic and anerobic respiration.

3. What are the factors affecting photosynthesis?   (Sep.-22, April-23)

Internal factors :

Pigments, Leaf age, Accumulation of carbohydrates, Hormones.

External factors :

Light, Carbon dioxide, Temperature, Water, Mineral elements.

VI. Short answer questions.

1. **Draw and label the different types of Conjoint vascular bundles.** **(PTA - 4)**
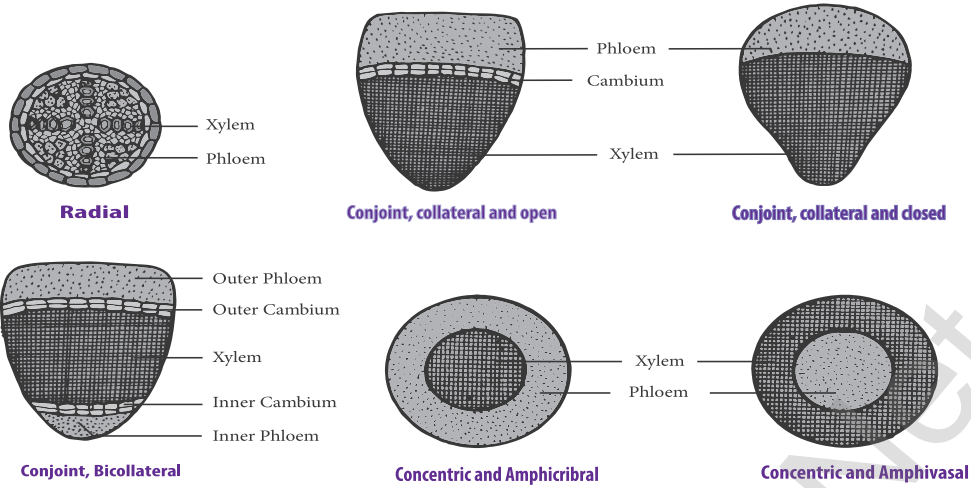
Types of vascular bundles

2. **Draw the ground plan of dicot and monocot root.** **(PTA - 6)**

A sector enlarged

Transverse section of Dicot root

A sector enlarged

Transverse section of Monocot root
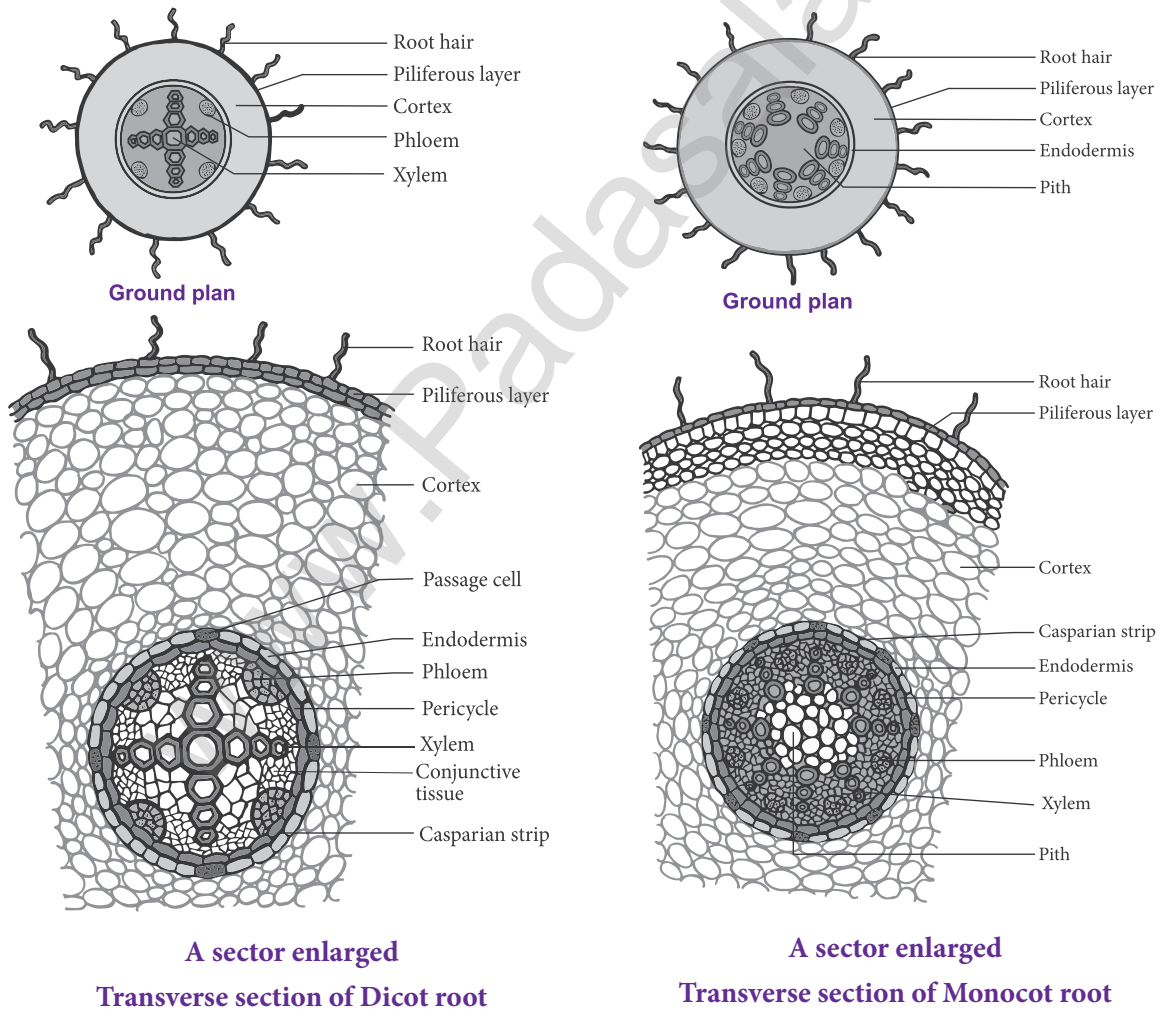
13. Structural Organisation of Animals

Bookback Questions & Answers

I. Choose the correct answer.

1. In leech locomotion is performed by
    a) Anterior sucker
    b) Parapodia
    c) Setae
    d) Contraction and relaxation of muscles

    Ans : d) Contraction and relaxation of muscles

2. The segments of leech are known as
    a) Metameres (somites)
    b) Proglottids
    c) Strobila
    d) All the above

    Ans : a) Metameres (somites)

3. Pharyngeal ganglion in leech is a part of
    a) Excretory system
    b) Nervous system
    c) Reproductive system
    d) Respiratory system

    Ans : b) Nervous system

4. The brain of leech lies above the
    a) Mouth   b) Buccal Cavity   c) Pharynx   d) Crop

    Ans : c) Pharynx

5. The body of leech has
    a) 23 segments   b) 33 segments   c) 38 segments   d) 30 segments

    Ans : b) 33 segments

6. Mammals are _____ animals.
    a) Cold blooded   b) Warm blooded   c) Poikilothermic   d) All the above

    Ans : b) Warm blooded

II. Fill in the blanks.

1. The posterior sucker is formed by the fusion of the _____ segments.

    Ans : last seven

2. The existence of two sets of teeth in the life of an animal is called _____ dentition.

    Ans : diphyodont

3. The anterior end of leech has a lobe-like structure called _____.

    Ans : anterior sucker

4. The blood sucking habit of leech is known as _____.   **(PTA - 5)**

    Ans : sanguivorous

5. _____ separate nitrogenous waste from the blood in rabbit.

    Ans : Nephrons (kidney)

6. _____ of spinal nerves are present in rabbit.

    Ans : 37 pairs

III. Identify whether the statements are True or False. Correct the false statements.

1. An anticoagulant present in saliva of leech is called **heparin**.
   Ans : False
   Correct statement : An anticoagulant present in saliva of leech is called **Hirudin**.

2. The vas deferens serves to transport the ovum. **(PTA-6)**
   Ans : False
   Correct statement : The vas deferens serves to transport the **sperms.** (or) The oviduct serves to transport the ovum.

3. Diastema is the gap between **premolar and molar** teeth in rabbit.
   Ans : False
   Correct statement : Diastema is the gap between **incisor and premolar** teeth in the rabbit.

4. The cerebral hemispheres of the rabbit are connected by a band of nerve tissues called **corpora quadrigemina.** **(PTA-6)**
   Ans : False
   Correct statement : The cerebral hemispheres of the rabbit are connected by a band of nerve tissues called **corpus callosum.**

IV. Match columns I, II and III correctly. **(PTA - 2)**

Organs	Membranous Covering	Location
Brain	pleura	abdominal cavity
Kidney	capsule	mediastinum
Heart	meninges	enclosed in thoracic cavity
Lungs	pericardium	cranial cavity

Ans :

Organs	Membranous Covering	Location
Brain	pleura	cranial cavity
Kidney	capsule	abdominal cavity
Heart	meninges	mediastinum
Lungs	pericardium	enclosed in thoracic cavity

V. Answer in a sentence :

1. Give the common name of the *Hirudinaria granulosa.*
   ★ Indian Cattle Leech.

2. How does a leech respire? **(PTA - 1)**
   ★ Leech respires through the skin by diffusion.

3. Write the dental formula of rabbit. **(Dept., April-24)**
   ★ Dental formula of rabbit -
   $$I\frac{2}{1}, C\frac{0}{0}, PM\frac{3}{2}, M\frac{3}{3} \text{(or)} \frac{2033}{1023}$$

4. **How many pairs of testes are present in leech?**
   ★ Eleven pairs of testes are present in leech.

5. **How is diastema formed in the rabbit?** (PTA - 6)
   ★ In the rabbit, diastema is a gap between the incisors and premolar teeth due to the absence of canine teeth between them.

6. **What organs are attached to the two bronchi?**
   ★ Lungs and trachea are attached to the two bronchi.

7. **Which organ acts as suction pump in leech?**
   ★ Muscular pharynx acts as suction pump to suck the blood of animals.

8. **What does CNS stand for?** (July-23)
   ★ CNS stand for Central Nervous System.

9. **Why is the teeth of the rabbit called heterodont?** (PTA-4)
   ★ In the rabbit, teeth are of different types namely incisors, premolar and molar.
   ★ So, the dentition is called Heterodont.

10. **How does leech suck blood from the host?** (PTA - 2)
    ★ Leech attaches itself to the host by posterior sucker.
    ★ Then it makes a triradiate or Y - shaped incision in the skin of the host by the jaws protruded through the mouth and sucks the blood by muscular pharynx.

VI. Short answer questions :

1. **Why are the rings of cartilages found in trachea of the rabbit?** (PTA - 4, Sep.-20)
   ★ Tracheal walls of the rabbit are supported by rings of cartilage which help in the free passage of air.

2. **List out the parasitic adaptations in leech.** (Dept., April-23)
   ★ Blood is sucked by pharynx. Anterior and posterior ends of the body are provided with suckers by which the leech attaches itself to the body of the host.
   ★ The three jaws inside the mouth cause a painless Y-shaped wound in the skin of the host.
   ★ The salivary glands produce hirudin which does not allow the blood to coagulate. Thus, a continuous supply of blood is maintained.
   ★ Parapodia and setae are completely absent. Blood is stored in the crop.

VII. Long answer questions :

1. **How is the circulatory system designed in leech to compensate the heart structure ?**
   ★ In Leech, circulation is brought about by **haemocoelic system.** True blood vessels are absent. Instead, haemocoelic channels or canals filled with blood like fluid are present. This haemocoelic fluid contains **haemoglobin.**
   ★ There are four longitudinal channels of which dorsal one lies above the alimentary canal, ventral one lies below the alimentary canal and two lateral channels are seen on either side of the alimentary canal. Heart is absent. The lateral canals serve as heart and have inner valves. The four channels are connected together posteriorly in the 26th segments.

2. **How does locomotion take place in leech?**   **(PTA - 5)**

   Looping or crawling movement :

   ★ It is brought about by the contraction and relaxation of body muscles. The anterior and posterior suckers serve for attachment during looping movement on the substratum.

   Swimming movement :

   ★ Leeches can swim very actively and perform undulating movements in water.

3. **Explain the male reproductive system of the rabbit with a labelled diagram.**

   Male reproductive system of the rabbit:
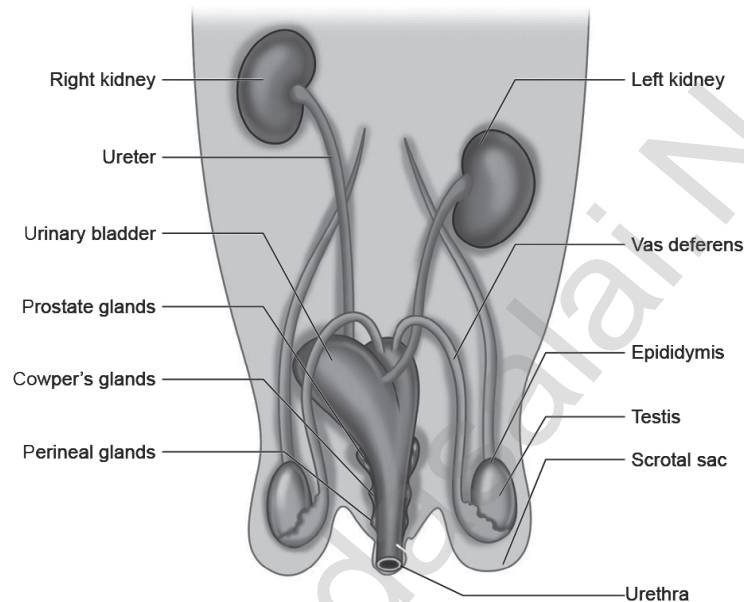
Male reproductive system of Rabbit

   ★ The male reproductive system of rabbit consists of a pair of testes which are ovoid in shape. Testes are enclosed by scrotal sacs in the abdominal cavity.

   ★ Each testis consists of numerous fine tubules called **seminiferous tubules.** This network of tubules leads into a coiled tubule called **epididymis,** which leads into the sperm duct called **vas deferens.**

   ★ The vas deferens joins the urethra just below the urinary bladder. The urethra runs backward and passes into the penis.

   ★ There are three accessory glands namely **prostate gland, cowper's gland** and **perineal gland.** Their secretions are involved in reproduction.

VIII. Higher Order Thinking Skills (HOTS)

1. **Arjun is studying in tenth standard. He was down with fever and went to meet the doctor. As he went to the clinic he saw a patient undergoing treatment for severe leech bite. Being curious, Arjun asked the doctor why leech bite was not felt as soon as it attaches to the skin? What would have been the reply given by the doctor?**

   ★ The parasitic leech makes a triradiate or Y - shaped incision in the skin of the host by the jaws protruded through the mouth to suck the blood. At that time, it injects an anaesthetic substance that prevents the host from feeling the bite.

   ★ It also secretes an anticoagulant **Hirudin** to ensure free flow of blood. Hence the bite of leech and the sucking of blood is not felt on the skin of the host.

2. **Shylesh has some pet animals at his home. He has few rabbits too, one day while feeding them he observed something different with the teeth. He asked his grandfather, why is it so? What would have been the explanation of his grandfather?**

★ Rabbit has three different types of teeth namely incisors, premolars and molars. Canine teeth are absent as it is a herbivorous animal.

★ So, a gap called **diastema** is formed between the incisors and premolars.

★ This helps in mastication and chewing of food in harbivorons animals.

IX. **Value based questions.**

1. **Leeches do not have an elaborate secretion of digestive juices and enzymes - Why ?**

★ The salivary glands of Leech secrete hirudin to prevent coagulation of blood. Leeches do not have other digestive juices and enzymes. As it sucks the blood of the host, it stores a large amount of blood in the crop before it goes to the stomach.

★ Digestion takes place in the stomach by the action of proteolytic enzyme slowly and then absorbed by the intestine. So leeches do not have digestive juices and enzymes.

2. **How is the digestive system of rabbit suited for herbivorous mode of feeding?**

(PTA-3)

★ Digestive system of rabbit is well suited for herbivorous mode of feeding. Hence canines are absent and diastema gap is formed between the incisors and premolars.

★ It helps the rabbit to masticate and chew the food properly. Thus teeth are suited for herbivorous life. Herbivorous rabbit mainly feeds on plant materials which contain cellulose. Caecum seen at the junction of small and large intestines contains useful bacteria that help in the digestion of cellulose.

PTA & Exam Questions (Interior)

I. **Choose the correct answer.**

1. According to the dental formula _____ kind of teeth is absent in rabbit.   **(PTA-1)**

a) molar   b) pre - molar   c) incisor   d) canine

Ans : d) canine

VI. **Short answer questions :**

1. **What are the glands embedded in the Rabbit skin to regulate the body temperature?**

(PTA - 3)

➢ The **sweat glands** and **sebaceous glands** embedded in the skin **regulate** the **body temperature.**

PRACTICALS

Physics

1. Determination of weight of an object using the Principle of moments

Aim : To determine the weight of an object using the principle of moments

Apparatus required : A metre scale, a knife edge, slotted weights, thread

Procedure:

i.   A metre scale is supported at its centre of gravity by a knife edge or suspended by using a thread tied to its centre so that the scale is in the horizontal position. Ensure that the scale is in equilibrium position.

ii. A known weight W2 and an unknown weight W1 are suspended from to either side of the the scale using the weight hangers.

iii. Fix the position of one weight hanger and adjust the position of the second weight hanger such that the scale is in equilibrium.

iv. Measure the distance d1 and d2 of the two weight hangers from the centre of the scale accurately.

v.   The experiment is repeated for different positions of the unknown weight. Measure the distances. The reading are tabulated as follows:

Observation :

S.No	Weight in the wieght hanger(W_2) kg	Distance of known wieght d_1 (m)	Distance of unknown wieght d_2 (m)	$W_2 \times d_2$ (kg m)	Unknown weight $W_1 = \dfrac{W_2 \times d_2}{d_1}$ (kg)
1	1	15	12	15	1.25
2	1	20	16	20	1.25
3	1	25	20	25	1.25

Mean : <u>1.25</u> kgwt

Calculations :

Moment of a force can be calculated using the formula

Moment of the force = Force x distance

Anticlock wise moment by unknown weight = $W_1 \times d_1$

Clockwise moment by known weight = $W_2 \times d_2$

$W_1 \times d_1 = W_2 \times d_2$

Unknown weight = $W_1 =$ $W_1 = \dfrac{W_2 \times d_2}{d_1}$

Result :

Using the principle of moments, the weight of the unknown body W1 = <u>**1.25**</u> Kg Wt (or) N

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2. Determination of focal length
of a convex lens

Aim : To determine the focal length of a convex lens by using

1. Distant object method

2. uv method

Apparatus required :

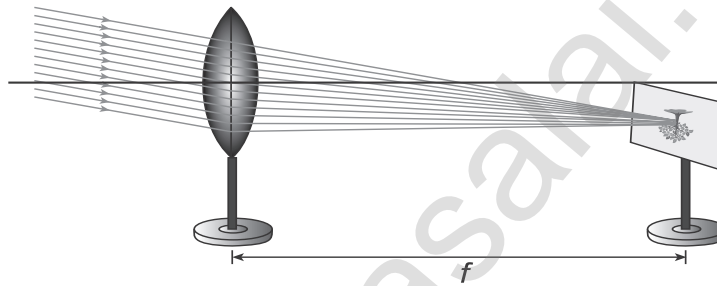A convex lens, stand, wire gauze object, screen and measuring scale.

Formula : $f = \dfrac{uv}{(u + v)}$ cm

Here,

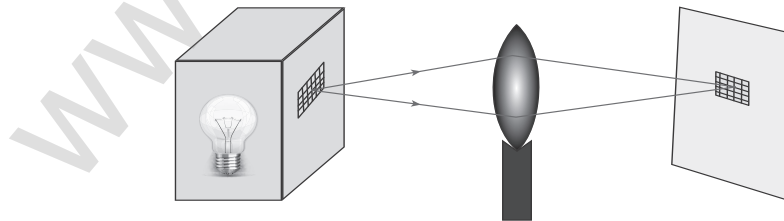u is the distance between the object (light source) and the convex lens

v is the distance of the image (screen) from the convex lens f is the focal length of the convex lens

1.   **Distant Object Method:**

➤   Fix the given convex lens vertically on the stand and place it on the table near an open window of the laboratory. Locate a distant object (tree or building) through the open window. Place the screen behind the convex lens. Adjust the position of the convex lens and the screen so as to get a sharp, inverted and diminished image. Measure the distance between the screen and the convex lens with the help of the measuring scale. This distance is equal to the approximate focal length of the convex lens (f)

2.   **uv - Method :**

➤   Fix the given convex lens vertically on the stand and place it on the table. Place the wire gauze object on the left side of the convex lens (say at a distance greater than 2f). Measure the distance between the object and the lens (u). Place the screen on the right side of the convex lens and adjust its position to get a sharp, inverted and diminished image. Measure the distance between the screen and the lens (v). Repeat the same procedure, by changing the distance of the object (u) and tabulate your observations.

Observation :

Focal length of the convex lens (By distance object method) is (f) = **10.5 cm**

2f = **21 cm**

S.No	Size of the Image	Position of the object	Distance between the object and the lens (u) cm	Distance between the screen and the Lens (v) cm	Focal length of convex lens $f = \dfrac{uv}{(u+v)}$ cm
1	Diminished	u > 2f	23	19.5	10.55
2			22	20.3	10.55
3	Same size	u = 2f	21	21	10.50
4	Magnified	u < 2f	19	24	10.60
5			18.5	24.9	10.61
				Mean	**10.56 cm**

Result :

The focal length of the given convex lens

1. By distance object method   f = **10.5 cm**

2. By 'uv' method   f = **10.56 cm**

3. Determination of resistivity

Objective :

To determine the resistivity of the material of the given coil of wire.

Equipment required :

A coil of wire, screw gauge, a metre scale, battery, key, ammeter, voltmeter, rheostat and connecting Wires.

Formula :

The resistivity of the material of the coil of wire is $\rho = \left(\dfrac{A}{L}\right)R$ (in ohm metre)

Where A is the area of cross section of the wire (m²)
L is the length of the coil of wire (m)
R is the resistance of the coil of wire (ohm)

Circuit Diagram :

Procedure :

•   Connect the battery, ammeter, given wire, rheostat and key in series, as shown in the circuit diagram.

•   Connect the voltmeter in parallel to the unknown resistor.

•   Close the key and hence the circuit is closed.
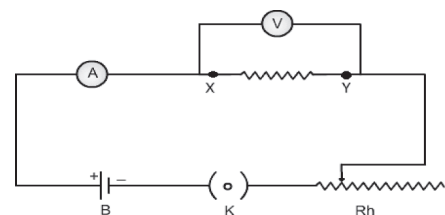
- Adjust the rheostat such that the ammeter reads a current of 0.5 ampere.
- Note down the potential difference across the resistor as shown by the voltmeter.
- Adjust the rheostat and change the current in steps of 0.5A (that is 0.5A, 1.0A, 1.5A, etc.).
- For each current, note down the corresponding potential difference as shown by the voltmeter.
- Tabulate the observations.
- Measure the diameter of the wire using a screw gauge.
- Measure the length of the coil using metre scale

Observations :

(i) To find the resistance :

S. No	Ammeter reading-I (Ampere)	Voltmeter reading-V (Volt)	Resistance = V/I (Ohm)
1	0.2	0.4	2
2	0.3	0.6	2
3	0.4	0.8	2
		MEAN	2 ohm (Ω)

(ii) To find the diameter of the wire using screw gauge :

Least count = 0.01 mm

Zero error : No error

S. No	Pitch Scale reading-PSR (mm)	Head scale coincidence-HSC	Head scale reading-HSR=HSC×LC (mm)	Total reading = PSR + HSR (mm)
1	1	62	0.62	1.62
2	1	63	0.63	1.63
3	1	65	0.65	1.65
			Mean Diameter	1.64 mm.

Calculations :

Radius of the wire, r = diameter/2 = **0.82×10^{-3}** m

Area of cross section of the wire, A = πr^2 = **2.11×10^{-6}** m^2

Length of the wire L = **1** m.

Resistivity of the material of the wire

= $\rho = \left(\dfrac{A}{L}\right)R$ = **4.22×10^{-6}** Ω m

Result :

The resistivity of the material of the wire = **4.22×10^{-6}** Ω m

Chemistry
4. Identification of the dissolution of the given salt whether it is exothermic or endothermic

Aim :

To test the dissolution of given salt is exothermic or endothermic

Principle :

If the reaction or process liberates the heat, then it is called exothermic.

If the reaction or process absorbs the heat, then it is called endothermic

Apparatus required :

Two beakers, Thermometer, stirrer, weighed amount of two samples.

Procedure :

Take 50ml of water in two beakers and label them as A and B. Note the temperature of the water from beaker A and B. Then, add 5g of sample A into the beaker A and stir well until it dissolve completely. Record final temperature of the solution. Now, repeat the same for the sample B. Record the observation.

Observation :

S. No	Sample	Temperature before addition of sample (0°)	Temperature after addition of sample (0°)	Inference (temperature increases or decreases)
1	A	25°C	48	Temperature increases
2	B	25°C	18	Temperature decreases

Result :

From the inferences made

The dissolution of sample A is **Exothermic reaction.**

The dissolution of sample B is **Endothermic reaction.**

Note :

Sodium hydroxide, ammonium nitrate, glucose, calcium oxide etc. may be given as the sample.

5. Testing the solubility of the salt

Aim :

To test the solubility of the given salt based on the saturation and un saturation of the solution at a given temperature.

Principle :

A solution in which no more solute can be dissolved in the solvent at a given temperature is called saturated solution. If the solvent can dissolve more solute than what is present, the solution is called unsaturated solution.

Materials Required :

A 250 ml beaker, a Stirrer, sufficient quantity of distilled water, 100 ml measuring jar, table salt in three packets weighing as 25g, 11g, and 1g.

Procedure :

In a 250ml beaker ,pour 100 ml water using measuring jar. To this water add table salt (25 g) from first packet. stir the content very well. Add the next packet containing 11 g salt followed by constant stirring . Now add the third packet containing 1 g salt . Record your observations.

Observation :

S. No	Amount of salt added	Observation [Salt dissolved/undissolved]	Inference [unsaturated/saturated/super saturated]
1	25g	Salt dissovled	Unsaturated solution
2	36g (25 + 11)	Salt dissovled	Saturated solution
3	37g (25 + 11 + 1g)	Salt undissovled	Super Saturated solution

Result :

From the above observation, it is inferred that the amount of salt required for saturation is **36** g.

6. Testing the "water of hydration of salt".

Aim :

To check whether the given sample of salt possesses 'Water of Hydration' or not. To verify the presence of water molecules in the given hydrated salt .

Water of crystallization or water of hydration is the phenomenon shown by certain salts in which water molecules are present inside the crystals are responsible for their colour and geometry.

E.g. Crystalline copper sulphate $CuSO_4.5H_2O$

Materials Required :

A pinch of crystalline copper sulphate in a test tube, tongs, spirit lamp.

Procedure :

S.No	Experiment	Observation	Inference
1.	A pinch of crystalline copper sulphate taken in a test tube and heated for sometime.	Water droplets are seen on the inner walls of the test tube.	The water of hydration is **Present.**

Result :

In the given sample of salt water of hydration is **Present.**

(OR)

Aim :

To check whether the given sample of salt possesses 'Water of Hydration' or not. To verify the presence of water molecules in the given hydrated salt .

Principle :

Water of crystallization or water of hydration is the phenomenon shown by certain salts in which water molecules are present inside the crystals are responsible for their colour and geometry.

E.g. Crystalline copper sulphate $CuSO_4.5H_2O$

Materials Required :

A pinch of crystalline copper sulphate in a test tube, tongs, spirit lamp.

Procedure :

S.No	Experiment	Observation	Inference
1.	A pinch of crystalline copper sulphate taken in a test tube and heated for sometime.	Water droplets are not seen on the inner walls of the test tube.	The water of hydration is **Absent.**

Result : In the given sample of salt water of hydration is **Absent**.

7. Test the given sample for the presence of acid or base

Aim :

To Identify the presence of an acid (or) a base in the given sample.

Materials required :

Test tubes, test tube stand, glass rod, phenolphthalein, methyl orange, sodium carbonate salt and the given sample.

Principle :

	In acid medium		**In Base medium**
a)	Phenolphthalein is colourless	a)	Phenolphthalein is pink in colour
b)	Methyl orange is pink in colour	b)	Methyl orange is yellow in colour
c)	Sodium carbonate gives brisk effervescence.	c)	Sodium carbonate does not give brisk effervescence.

Procedure :

S. No	**Experiment**	**Observation (Colour change)**	**Inference (Acid / Base)**
1	Take 5ml of the test solution in a test tube and add a few drops of Phenolphthalein to it.	No change in colour.	Presence of acid
2	Take 5ml of the test solution in a test tube and add a few drops of Methyl orange to it.	SolutionTurns pink in colour	Presence of acid
3	Take 5ml of the test solution in a test tube and add a pinch of sodium carbonate salt.	Brisk effervescence occurs.	Presence of acid

Result : The given test solution contains **Acid**.

(OR)

Aim :

To Identify the presence of an acid (or) a base in a given sample.

Materials required :

Test tubes, test tube stand, glass rod, phenolphthalein, methyl orange, sodium carbonate salt and the given sample.

Principle :

	In acid medium		**In Base medium**
a)	Phenolphthalein is colourless	a)	Phenolphthalein is pink in colour
b)	Methyl orange is pink in colour	b)	Methyl orange is yellow in colour
c)	Sodium carbonate gives brisk effervescence.	c)	Sodium carbonate does not give brisk effervescence.

S. No	Experiment	Observation (Colour change)	Inference (Acid / Base)
1	Take 5ml of the test solution in a test tube and add a few drops of Phenolphthalein in it.	Solution Turns pink in colour	Presence of base
2	Take 5ml of the test solution in a test tube and add a few drops of Methyl orange in it.	SolutionTurns yellow in colour	Presence of base
3	Take 5ml of the test solution in a test tube and add a pinch of sodium carbonate salt.	No brisk effervescence.	Presence of base

Result : The given test solution contains **Base**.

Bio - Botony

8. Photosynthesis - Test tube and Funnel experiment
(Demonstration)
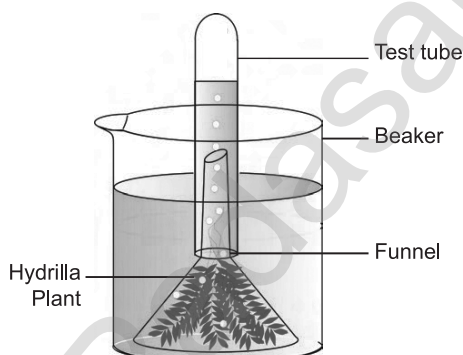
Aim :
To prove that oxygen is evolved during photosynthesis.

Materials required :
Test tube, funnel, beaker, pond water and Hydrilla plant.

Procedure :
1. Take a few twigs of Hydrilla plant in a beaker containing pond water.
2. Place an inverted funnel over the plant.
3. Invert a test tube filled with water over the stem of the funnel.
4. Keep the apparatus in the sunlight for few hours.

Observation :
After one hour, it is noted that water gets displaced down from the test tube.

Inference
During photosynthesis, oxygen is evolved as a by-product. Gas bubbles liberated from the Hydrilla plant reach the top of the test tube and it displaces the water downwards. Take the test tube and keep the burning stick near the mouth of the test tube. Increased flame will appear. Hence, it is proved that oxygen is evolved during photosynthesis.

9. Parts of a flower

Aim :

To dissect and display the parts of the given flower and observe the Calyx, Corolla, Androecium and Gynoecium. Draw labelled sketches.
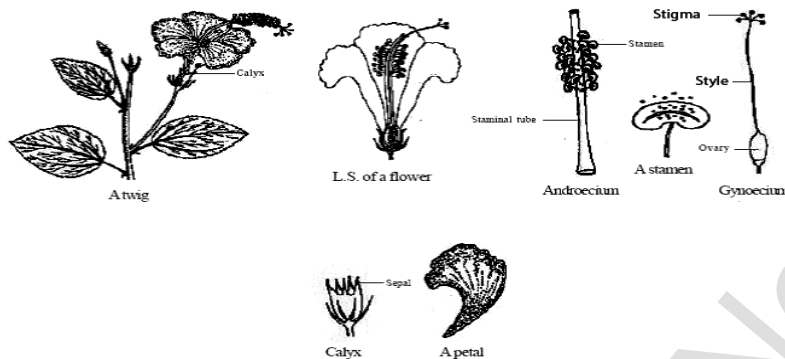
Materials Required : Flower, needle and paper

Procedure : With the help of the needle dissect the different whorls of the flower

Floral Parts :

Calyx

Corolla } Accessory organ

Androecium   -   Male part of the flower

Gynoecium   -   Female part of the flower } Reproductive organ

Observation:

Draw and label the parts of the flower.

10. Mendel's Monohybrid Cross

Aim :

To study the monohybrid cross by using model / picture / photograph. To find out the phenotypic ratio and genotypic ratio in pea plant using checker board

Note :

Depict parental generation and the gametes using colour chalk pieces

Definition:

Cross involving one pair of contrasting characters is called monohybrid cross.

Procedure :

1.   Pure breeding tall plant is crossed with pure breeding dwarf plant.

2.   All the F1 hybrid plants were tall (Tt)

3.   Selfing the F1 hybrid plants resulted in tall and dwarf plants in F2 generation.

Result :

Phenotypic ratio = Tall - 3 : Dwarf - 1

Genotypic ratio = Pure Tall - 1 : Hybrid Tall - 2 : Pure Dwarf - 1

Inheritance of only one pair of contrasting character is called monohybrid cross.

A cross between two forms of a single trait like a cross between Tall and Dwarf pea plant.
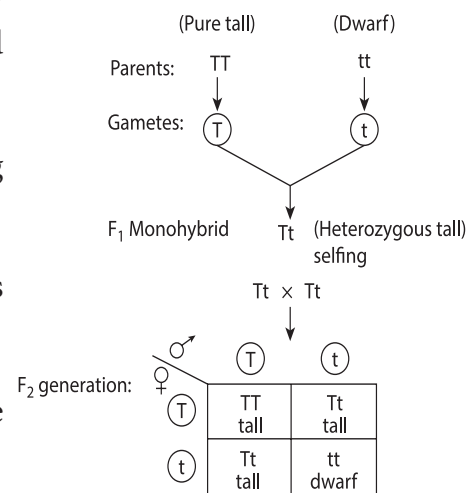
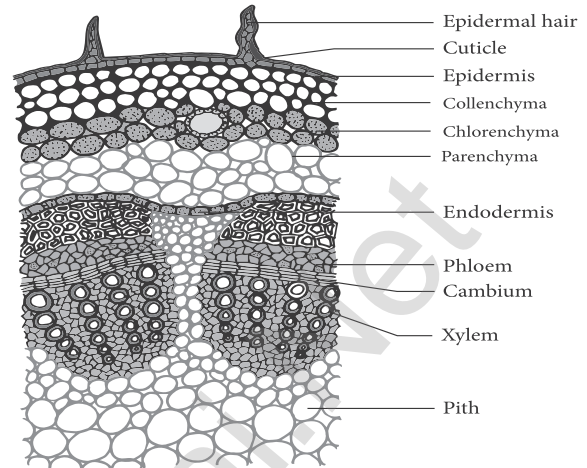## 11. Observation of Transverse section of Dicot Stem and Dicot Root

Aim :

To observe transverse section (T.S) of Dicot Stem / Dicot Root from permanent slides.

**Observation :** A. The given slide is identified as T.S of Dicot Stem

Reasons

i)   Vascular bundles are arranged in a ring.

ii) Conjoint, collateral, endarch and open vascular bundle.

iii) Ground tissued differentiated into cortex, endodermis, pericycle and pith.

iv) 3 to 6 layer of collenchymas tissues present in hypodermis.

Epidermal hair
Cuticle
Epidermis
Collenchyma
Chlorenchyma
Parenchyma

Endodermis

Phloem
Cambium

Xylem

Pith

Observation : B. The given slide is identified as T.S of Dicot Root

Reasons

i)   Vascular bundle are radial

ii) Xylem is exarch and Tetrarch

iii) Casparian strips and passage cells are present in endodermis

iv) Cortex is made up of parenchymatous cells

Root hair

Piliferous layer

Cortex

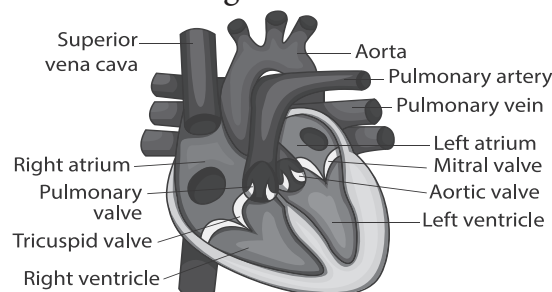Passage cells
Endodermis
Phloem
Pericycle
Xylem

Casparian strip
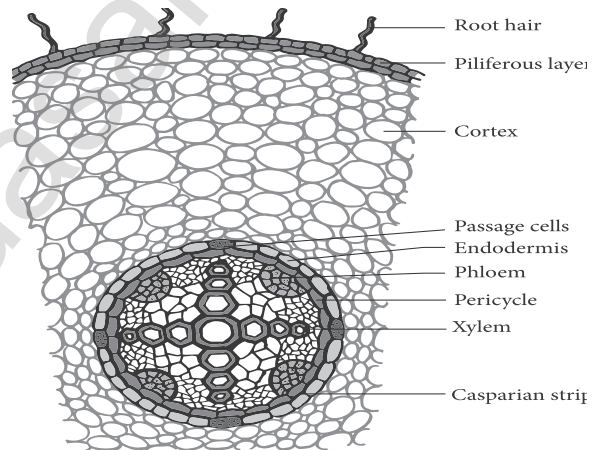
Bio -Zoology

12. Observation of Models - Human Heart and Human Brain Identification of longitudinal section (L.S) of the human heart.

Aim :

To observe and draw a labelled sketch of L.S of human heart and describe the structure.
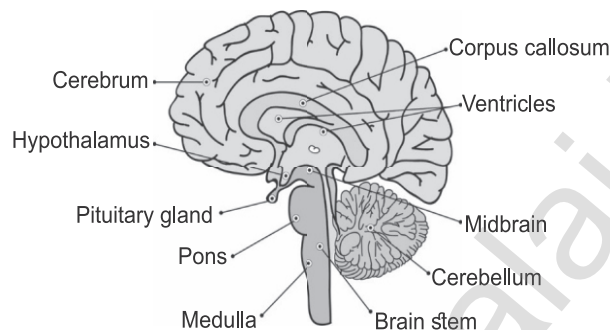
Materials Required : Model showing the L.S of human heart

Superior
vena cava
Aorta
Pulmonary artery
Pulmonary vein
Left atrium
Mitral valve
Right atrium
Aortic valve
Pulmonary
valve
Left ventricle
Tricuspid valve
Right ventricle

Identification : The given model is identified as L.S. of human heart

Notes :

1. The human heart has four chambers. It is made up of two auricles and two ventricles

2. The auricles are separated by interauricular septum and ventricles are separated by interventricular septum. It prevents the mixing of oxygenated and deoxygenated blood.

3. Tricuspid valve - It is located between the right auricle and the right ventricle

4. Bicuspid valve - It is located between the left auricle and the left ventricle

5. The heart is covered by a protective double walled membrane called pericardium

6. The heart pumps blood to all parts of the body.

Identification of L.S. of the Human Body

Aim : To observe and draw a labelled sketch of L.S of human brain and comment on it

Materials Required : Model showing the L.S of human brain

Identification : The given model is identified as L.S. of human brain

Notes :

1. The brain is enclosed in the cranial cavity

2. It is the controlling centre of all the body activities.

3. It is covered by three connective tissue membrane or meninges: Duramater Arachnoid membrane and Piamater

4. The human brain is divided into three parts namely forebrain, midbrain and hindbrain
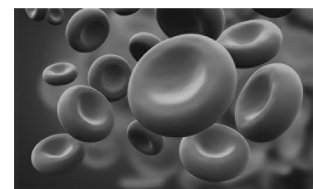
13. Identification of Blood Cells

Aim :

Identification of blood cells (Red blood cells and white blood cells). To draw a neat labelled diagram and write a note on the blood cells identified.

**Materials Required :** Permanent prepared slides of blood cells.

Identification : The given slide is identified as **Red blood cells**

Notes :

1. They are biconcave and disc shaped.

2. They are also known as erythrocytes

3. Mature mammalian RBC's do not have nucleus.

Red Blood Cells

4. Haemoglobin is a respiratory pigment which gives red colour.

5. It transports oxygen from lungs to tissues and carbon- dioxide from tissues to lungs

Identification : The given slide is identified as **White blood cells.**

Monocyte   Lymphocyte   Neutrophil   Eosinophil   Basophil
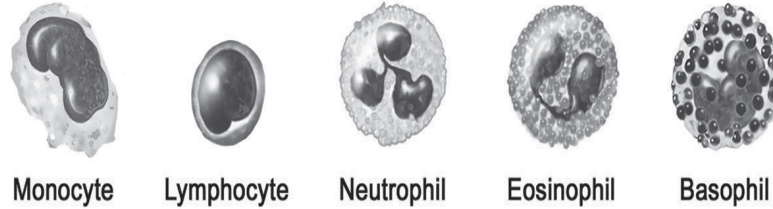
Notes :

1. WBC's are colourless and they have nucleus.

2. They are also known as Leucocytes

3. They show amoeboid movements.

4. They fight against germs and other foreign bodies and thus protect the body from microbial infections and diseases.

5. There are five different types of WBC namely Neutrophils, Eosinophils, Basophils, Lymphocytes and Monocytes

14. Identification of Endocrine Glands

Aim:

To identify the endocrine gland, its location, hormone secreted and functions - Thyroid gland and Pancreas

Materials Required :

1. Endocrine glands – (a) Thyroid gland (b) Pancreas – Islets of Langerhans

2. Any one endocrine gland should be flag labelled.
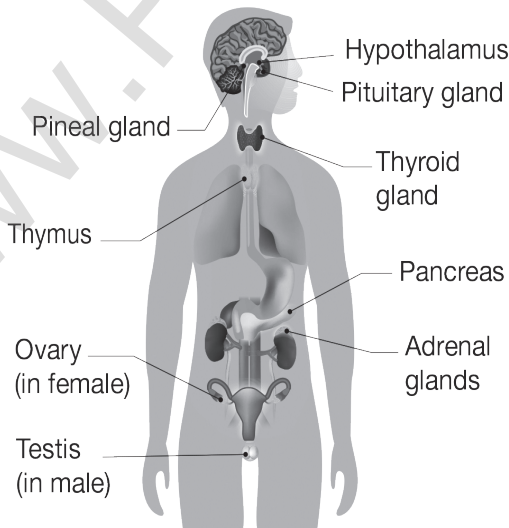
Identification :
The flag labelled endocrine gland is identified as Thyroid gland
Location :
Thyroid gland is a bilobed gland located in the neck region on either side of the trachea.

Hormones secreted :

Triiodothyronine (T3) and Thyroxine (T4)

Functions of Hormones :

1. Thyroid hormone increases the basal metabolic rate (BMR).

2. It increases the body temperature.

3. It regulates metabolism

4. It is required for normal growth and development

5. It is also known as personality hormone.

6. Deficiency of thyroxine results in simple goiter, myxoedema (in adults) and cretinism (in children).

7. Excess secretion causes Grave's diseases.

(b) Pancreas – Islets of Langerhans

Identification :

The flag labelled endocrine gland is identified as Islets of Langerhans in the Pancreas.

Location :

Islets of Langerhans are seen embedded in the pancreas which is located in the abdominal region.

Hormones secreted:

1. α cells secrete glucagon

2. β cells secrete insulin

Functions of Hormones :

1. Insulin converts glucose into glycogen and stores it in liver and muscles.

2. Glucagon converts glycogen into glucose.

3. Insulin and glucagon maintain the blood sugar level (80 – 120 mg/dl) by their antagonistic function.

4. Decrease in insulin secretion causes diabetes mellitus.

Quarterly Exam Question Paper

X - Science

Time Allowed : 3 Hours]   **[Maximum Marks : 75**

Part - I

Answer ALL the questions.   **12 × 1 = 12**

1. The unit of g is ms^{-2}. It can be expressed as
   a) cms^{-1} b) $N\,kg^{-1}$ c) $Nm^2\,kg^{-1}$ d) cm^2s^{-2}

2. The focal length of a lens is –0.25m, then its power is
   a) –4D   b) 2.5D   c) –40D   d) –2D

3. Temperature is the average _____ of the molecules of a substance.
   a) Difference in K.E. and P.E.   b) Sum of P.E. and K.E.
   c) Difference in the T.E. and P.E.   d) Difference in K.E. and T.E.

4. The unit of conductance is
   a) mho   b) joule   c) ohm   d) ohm metre

5. 1 mole of any substance contains _____ molecules.
   a) 6.023×10^{23} b) 6.023×10^{-23} c) 3.0115×10^{23} d) 12.046×10^{23}

6. Neon shows zero electron affinity due to _____.
   a) stable arrangement of neutrons   b) stable configuration of electrons
   c) reduced size   d) increased density

7. Which of the following is the universal solvent?
   a) Acetone   b) Benzene   c) Water   d) Alcohol

8. Oxygen is produced at what point during photosynthesis?
   a) When ATP is converted to ADP   b) When CO_2 is fixed
   c) When H_2O is split   d) All of these

9. Rabbits do not have
   a) Canines   b) Incisors   c) Premolars   d) Molars

10. Which one of the following regarding blood composition is correct?
    a) Plasma = Blood + Lymphocyte   b) Serum = Blood + Fibrinogen
    c) Lymph = Plasma + RBC + WBC
    d) Blood = Plasma + RBC + WBC + Platelets

11. Identify the exocrine gland.
    a) Pituitary gland   b) Adrenal gland   c) Salivary gland   d) Thyroid gland

12. The large elongated cells that provide nutrition to developing sperms are
    a) Primary germ cells   b) Sertoli cells   c) Leydig cells   d) Spermatogonia

Part - II

Answer any SEVEN questions. (Q. No. 22 is compulsory)   **7 × 2 = 14**

13. State the principle of moments.

14. State Boyle's law.

15. Give any two examples for hetero atomic molecules.

16. Say true or false, If false give the correct statement.
    i)   Moseley's periodic table is based on atomic mass.
    ii) An alloy is a heterogenous mixture of metals.

17. What is respiratory quotient?

18. What are heart sounds? How are they produced ?

19. Match the following.

A	Nissil's granules	1	Forebrain
B	Hypothalamus	2	Peripheral Nervous System
C	Cerebellum	3	Cyton
D	Schwann cell	4	Hind brain

20. Why are Thyroid Hormones refered as Personality Hormone?

21. Fill in.
    a)   The pairs of contrasting character of Mendel are called _____.
    b)   Down's syndrome is the genetic condition with _____ chromosomes.

22. 3.5 litres of ethanol is present in 15 litres of aqueous solution of ethanol. Calculate the volume percent of ethanol solution.

Part - 3

Answer any SEVEN questions. (Q. No. 32 is compulsory)   **7 × 4 = 28**

23. Differentiate the eye defects : Myopia and Hypermetropia.

24. Derive the ideal gas equation.

25. a)   Name the acid that renders alumium passive. Why?
    b)   Identify the bond between H and F in HF molecule.
    c)   What property forms the basis of identification?

26. In what way hygroscopic substances differ from deliquescent substances. Give examples.

27. a) Write the dental formula of rabbit
    b) How does leech suck blood from the host?

28. Enumerate the functions of blood.

29. a) Draw a neat labelled diagram of a neuron.
    b) Differentiate between voluntary and involuntary actions.

30. Write the physiological effects of gibberllins.

31. a)   Name the secondary sex organs in male.
    b)   Draw the structure of human sperm and mark the parts?

32. A piece of wire of resistance 10Ω is drawn out so that its length is increased to three times its original length. Calculate the new resistance.

Part -4

Answer all the questions.
Draw the diagram wherever necessary.   **7 × 3 = 21**

33. a)   State Newton's laws of motion.   **(OR)**
    b)   With the help of a circuit diagram derive the formula for the resultant resistance of three resistances connected in (i) series and (ii) parallel.

34. a)   Give the salient futures of "Modern atomic theory".   **(OR)**
    b)   Write notes on various factors affecting solubility.

35. a)   The sex of the new born child is a matter of chance and neither of the parents may be considered responsible for it. What would be the possible fusion of gametes to determine the sex of the child? Explain.   **(OR)**
    b)   Write the events involved in the sexual reproduction of a flowering plant.
        i)   Discuss the first event and write the types.
        ii)   Mention the advantages and the disadvantages of that plant.

Half Yearly Exam Question Paper

X - Science

Time Allowed : 3 Hours]   **[Maximum Marks : 75**

Part - I

Choose the correct answer.   **12 × 1 = 12**

1. If the Earth shrinks to 50% of its real radius its mass remaining the same, the weight of body on the Earth will
    a) decrease by 50%   b) increase by 50%
    c) decrease by 25%   d) increase by 300%

2. If a substance is heated or cooled the change in mass of that substance is
    a) Positive   b) Negative
    c) Zero   d) none of the above

3. If a sound wave travels with a frequency of 1.25×10^4 Hz at 344 ms^{-1}, the wavelength will be
    a) 27.52m   b) 275.2m   c) 0.02752m   d) 2.752m

4. The gram molecular mass of NH_3 is
    a) 17 g   b) 44 g   c) 18 g   d) 36 g

5. Solubility of NaCl in 100 ml water is 36 g. If 20 g of salt is dissolved in 100 ml of water how much more salt is required for satuaration.
    a) 12 g   b) 11 g   c) 16 g   d) 20 g

6. Which of the following are used as anaesthetics?
    a) Carboxylic acid   b) Ethers   c) Esters   d) Aldehydes

7. The membrane that is present around the lungs is
    a) Pleura   b) Capsule
    c) Pericardium   d) None of the above

8. A person who met with an accident lost control of body temperature, water balance and hunger, which of the following parts of brain is supposed to be damaged?
    a) Medulla oblongata   b) Cerebrum
    c) Pons   d) Hypothalamus

9. Which one of the following is an IUCD?
    a) Copper T   b) Oral pills   c) Diaphragm   d) Tubectomy

10. The best way of direct dating fossils of recent origin is by
    a) Radio - carbon method   b) Uranium lead method
    c) Potassium - Argon method   d) Both (a) and (c)

11. Excessive consumption of alcohol leads to
    a) Loss of memory   b) Cirrhosis of liver
    c) state of hallucination   d) Suppression of brain function

12. Which software is used to create animation?

   a) Paint   b) PDF   c) MS Word   d) Scratch

Part - II

Answer any seven questions. (Q. No. 22 is compulsory)   7 × 2 = 14

13. Why are traffic signals red is colour?

14. Name any two devices, which are working on the heating effect of the electric current?

15. State two conditions necessary for rusting of iron.

16. Write any two differences between reversible and irreversible reactions.

17. Write the reaction for photosynthesis.

18. Match.

1	Leukaemia	a	Absence of antibody
2	Leucopenia	b	Absense of antigen
3	AB blood group	c	Blood cancer
4	O blood group	d	Decrease in leucocytes

19. Which harmone requires iodine for its formation? What will happen if intake of iodine in our diet is low?

20. What do you understand by the term phenotype and genotype?

21. State the application of DNA finger printing technique.

22. $_{88}Ra^{226}$ experiences three α - decay. Find the number of neutrons in the daughter element.

Part - III

Answer any seven questions. (Q. No. 32 is compulsory)   7 × 4 = 28

23. a) State Boyle's law

    b) Distinguish between ideal gas and real gas.

24. a) What do you understand by the term "ultrasonic vibration" ?

    b) Name three animals which can hear Ultrasonic vibrations.

25. a) Give any two salient features of Modern Atomic Theory.

    b) Calculate the number of moles in 27 g of Al.

26. a) What happens when $MgSO_4.7H_2O$ is Heated ?

    b) In what way hygroscopic substances differ from deliquescent substances. (any two)

27. List the parasitic adaptations in leech.

28. Describe the structure of spinal cord.

29. i)   State whether the following state ments are true or false. If false correct the statement.

       a) Stalk of the ovule is called pedicle.

       b) LH is secreted by the posterior pituitary.

    ii) Why are family planning methods not adopted by all the people of our country?

30. a) Why is Archaeopteryx considered to be a connecting link ?

b) Define Ethno botany.

31. a) How does insulin deficiency occur?

b) Mention the diseases caused by tobacco smoke.

32. The molecular formula of an alcohol is $C_4H_{10}O$. The locant number of its OH group is 2.

i) Draw its structural formula?

ii) Give its IUPAC name.

iii) It is saturated or unsaturated?

Part - IV

Answer all the questions in detail.　　　　　　　$7 \times 3 = 21$

33. a) i) List any two properties of light?

ii) Explain the rules for obtaining images formed by a convex lens with the help of ray diagram.

(OR)

b) i) Compare the properties of alpha, beta and gamma radiations.

ii) In Japan, some of the new born children are having congenital diseases. Why?

34. a) Explain smelting process.

(OR)

b) i) Calculate the pH of 1.0×10^{-4} molar solution of HNO3.

ii) How does pH play an important role in everyday life.

35. a) i) What is bolting?

ii) Where are estrogens produced? What is the role of estrogens in the human body?

(OR)

b) i) What is the importance of rainwater harvesting?

ii) What are the environmental effects caused by sewage?

Public Exam Question Paper
March - 2024
Science - X

Time Allowed : 3 Hours]   **[Maximum Marks : 75**

Instructions :   (1)   Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.

(2)   Use **Blue** or **Black** ink to write and underline and pencil to draw diagrams.

Note   :   This question paper contains four parts.

Part - I

Note :   i)   Answer all the questions.   **12 × 1 = 12**

ii) Choose the most appropriate answer from the given four alternatives and write the option code and the corresponding answer.

1.   The endarch condition is the characteristic feature of :

a)   Root   b) Stem   c)   Leaves   d) Flowers

Ans : b) Stem

2.   TFM in soaps represents _____ content in soap.

a)   Mineral   b) Vitamin   c)   Fatty matter   d) Carbohydrate

Ans : c) Fatty matter

3.   The value of Universal Gas Constant :

a) $3.81 \text{ J mol}^{-1} \text{ K}^{-1}$ b) $8.03 \text{ J mol}^{-1} \text{ K}^{-1}$ c) $1.38 \text{ J mol}^{-1} \text{ K}^{-1}$ d) $8.31 \text{ J mol}^{-1} \text{ K}^{-1}$

Ans : d) $8.31 \text{ J mol}^{-1} \text{ K}^{-1}$

4.   Kilowatt hour is the unit of :

a)   resistivity   b) conductivity   c)   electrical energy d) electrical power

Ans : c) electrical energy

5.   An enzyme which cuts DNA is :

a)   Protease   b)   Restriction endonuclease

c)   DNA Ligase   d)   RNAase

Ans : b) Restriction endonuclease

6.   One mole of any substance contains _____ molecules.

a) 6.023×10^{23} b) 6.023×10^{-23} c) 3.0115×10^{23} d) 12.046×10^{23}

Ans : a) 6.023×10^{23}

7.   Which one is referred as "Master gland"?

a)   Pineal gland   b) Pituitary gland   c)   Thyroid gland   d) Adrenal gland

Ans : b) Pituitary gland

8. Which among the following is not the characteristic of anemophilous plants.
   a) the flowers produce enormous amount of pollen grains.
   b) the stigmas are large and protruding.
   c) the flowers are brightly coloured, have smell and nectar.
   d) pollen grains are small and dry.

   Ans : c) the flowers are brightly coloured, have smell and nectar.

9. Inertia of a body depends on :
   a) Weight of the object
   b) Acceleration due to gravity of planet
   c) Mass of the object
   d) Both (a) and (b)

   Ans : c) Mass of the object

10. Which is the correct sequence of blood flow ?
    a) Ventricle → Atrium → Vein → Arteries
    b) Atrium → Ventricle → Vein → Arteries
    c) Atrium → Ventricle → Arteries → Vein
    d) Ventricle → Vein → Artium → Arteries

    Ans : c) Atrium → Ventricle → Arteries → Vein

11. Which of the following is not an "element + element → compound" type reaction ?
    a) $C_{(s)} + O_{2(g)} \rightarrow 2CO_{2(g)}$
    b) $2K_{(s)} + Br_{2(I)} \rightarrow 2KBr_{(s)}$
    c) $2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$
    d) $4Fe_{(s)} + 3O_{2(g)} \rightarrow 2Fe_2O_{3(s)}$

    Ans : c) $2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$

12. Cancer of the epithelial cell is called as _____.
    a) Leukaemia   b) Sarcoma   c) Carcinoma   d) Lipoma

    Ans : c) Carcinoma

Part - II

Note : Answer any SEVEN questions, Q.No. 22 is compulsory.   **7 × 2 = 14**

13. **What is coefficient of apparent expansion ?**
    ➤ The ratio of the apparent rise in the volume of the liquid per degree rise in temperature to its unit volume is called co-efficient of apparent expansion. The SI unit of co efficient of apparent expansion is K^{-1}.

14. **Why is tungsten metal used in bulbs but not used as fuse wires ?**
    ➤ Tungsten has a very high melting point.
    ➤ If it is used in fuse wire, it will not melt when large current passes through it.
    ➤ The appliances will get damaged.

15. **What is rust? Give the equation for formation of rust.**
    ➤ Rust is hydrated ferric oxide $Fe_2O_3 . XH_2O$. It is formed when iron is exposed to moist air in the form of a brown layer at the surface.

    $4Fe + 3O_2 + xH_2O \longrightarrow 2Fe_2O_3.xH_2O$
    (brown hydrated ferric oxide)
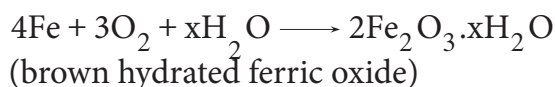
16. What is stage ?

➤ 'Stage' is a background appearing when we open the scratch window. The background will most often be white. We can change the background colour as we like.

17. Why is sinoatrial node called as pacemaker of heart ?

➤ Human heart is myogenic in nature. i.e. the contraction is initiated by a specialized portion the heart muscle itself. The sino atrial node present in the wall of the right atrium initiates the heart beat impulses and makes the heart to beat rhythmically.

➤ So, the SA node is called 'pace maker' of the heart.

18. What are the parts of the hind brain ?

➤ Hind brain consists of three parts namely :

1. Cerebellum, 2. Pons 3. Medulla oblongata.

19. Identify the parts A, B, C and D in the given figure.

Thyroid Gland
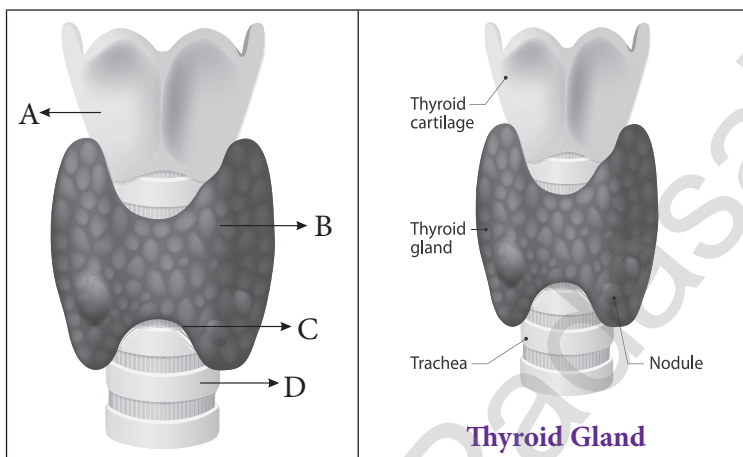
20. What is colostrum ? How is milk production hormonally regulated ?

➤ The first fluid which is released from the mammary gland after child birth is called **colostrum.**

➤ Milk production from the alveoli of mammary glands is stimulated by **prolactin hormone** secreted by the anterior pituitary gland.

➤ The ejection of milk is stimulated by posterior pituitary hormone oxytocin.

21. What is metastasis ?

➤ Metastasis is the process of spreading of cancer in the body. In this stage, the cancerous cells migrate to distant parts and affect new tissues.

22. If the pH of a solution is 4.5, find the value of its pOH.

Solution :

pH + pOH   =   14

pOH   =   14 – 4.5 = 9.5

pOH   =   9.5

Part - III

Note : Answer any SEVEN questions, Q.No. 32 is compulsory. $7 \times 4 = 28$

23.   **Explain the various types of inertia with examples.**

Inertia of rest :

➤   The resistance of a body to change its state of rest is called intertia of rest.

    E.g. : When you vigorously shake the branches of a tree, some of the leaves and fruits are detached and they fall down.

Intertia of motion :

➤   The resistance of a body to change its state of motion is called inertia of motion.

    E.g. : An athlete runs some distance before jumping. Because this will help him jump longer and higher.

Inertia of direction :

➤   The resistance of a body to change its direction of motion is called inertia of direction.

    E.g. : When you make a sharp turn while driving a car, you tend to lean sideways.

24.   **a)**   **Write any three features of natural and artificial radioactivity.**

	Natural radioactivity	Artificial radioactivity
1	Emission of radiation due to self disintegration of nucleus.	Emission of radiation due to disintegration of a nucleus through induced process.
2	Alpha, Beta and Gamma radiations are emitted.	Mostly elementary particles such as neutron, positron, etc. are emitted.
3	It is a spontaneous process.	It is an induced process.
4	This cannot be controlled.	This can be controlled.

   b)   **Name any two devices, which are working on the heating effect of current.**

   •   Electric iron   •   Electric toaster   •   Electric oven   •   Electric heater.

25.   **a)**   **What happens when $MgSO_4.7H_2O$ is heated ? Write the appropriate equation.**

➤ $MgSO_4.7H_2O$ has 7 molecules of water of crystallization. When the crystals of $MgSO_4.7H_2O$ are gently heated, it loses seven water molecules and becomes anhydrous magnesium sulphate.

$$MgSO_4.7H_2O \xrightleftharpoons[\text{Cooling}]{\text{Heating}} MgSO_4 + 7H_2O$$

Magnesium   Anhydrous Magnesium

sulphate   sulphate

hepta hydrated

➤   When few drops of water are added or it is allowed to cool, the colourless anhydrous salt again turns back into hydrated salt.

   b)   **Define : Solubility.**

➤   Solubility is defined as the number of grams of a solute that can be dissolved in 100g of a solvent to form its saturated solution at a given temperature and pressure.

$$\text{Solubility} = \frac{\text{Mass of solute}}{\text{Mass of solvent}} \times 100$$

26.　a)　What is Respiratory Quotient ?

★　Respiratory Quotient (R.Q) is the ratio of volume of carbon dioxide liberated and the volume of oxygen consumed during respiration. It is expressed as

$$R.Q. = \frac{\text{Volume of } CO_2 \text{ liberated}}{\text{Volume of } O_2 \text{ consumed}}$$

b)　Why should the light dependent reaction occur before light independent reaction during photosynthesis ?

➤　In light independent reaction (Dark reaction), CO_2 is reduced to carbohydrate with the help of ATP and $NADPH_2$ which are produced at the end of light reaction.

➤　As these energy rich compounds (ATP and $NADPH_2$) are produced by light dependent reaction, it should occur before light independent reactions to complete the photosynthetic process.

27.　Write the dental formula of rabbit.

➤　Dental formula of rabbit - $I\frac{2}{1}, C\frac{0}{0}, PM\frac{3}{2}, M\frac{3}{3}$ (or) $\frac{2033}{1023}$

28.　a)　Why is Euploidy considered to be advantageous to both plants and animals ?

➤　Euploidy is a condition in which an individual bears more diploid sets of chromosomes. Tetraploid plants are advantageous as they often result in increased fruit and flower size.

➤　It is used in plant breeding and horticulture. It plays a significant role in the evolution of new species.

b)　Classify Neurons based on its structure.

<div align="center">

Structure of a neuron

</div>

Structure of a neuron :

➤　Neuron typically consists of three parts namely

➤　1. Cyton, 2. Dendrites and 3. Axon.

Cyton :

➤　It is the nerve cell body or Perikaryon. It has an irregular body with abundant cytoplasm (Neuroplasm). It has Nissl granules and cell organcells like mitochondria, ribosome and endoplasmic recticulum. Neurons do not have ability to divide.

Dendrites :

➤　These are the numerous branched cytoplasmic processes that project from the surface of the cell body. They conduct nerve impulses towards the cyton. The branched projections increase the surface area for receiving the signals from other nerve cells.

Axon :

➤　The axon is a single, elongated, slender projection. The end of an axon is called synaptic knob. The plasma membrane of axon is called axolemma, while the cytoplasm is called axoplasm. It carries impulses away from the cyton. They are covered by a protective sheath called myelin sheath which is further covered by a layer of Schwann cells called neurilemma. Myelin sheath breaks at intervals by depressions called Nodes of Ranvier. The region between the nodes is called as internode. Myelin sheath acts as insulator and ensures rapid transmission of nerve impulses.

29. **How are Arteries and Veins structurally different from one another ?**

	Artery	Vein
1	Distributing vessel	Collecting vessel
2	Pink in colour	Red in colour
3	Deep location	Superficial in location
4	Blood flow with high pressure	Blood flow with low pressure
5	Wall of artery is strong, thick and elastic	Wall of vein is weak, thin and non-elastic

30. **Define Ethnobotany and write its importance.**

➢ Ethnobotany is the study of region's plants and their practical uses through the traditional knowledge of the local culture of people.

Importance of Ethnobotany :

➢ It provides traditional uses of a plant.

➢ It gives information about certain unknown and known useful plants.

31. **a)** **What are the consequences of deforestation ?**

➢ Deforestation is the destruction of large area of the forests.

➢ It leads to many ecological problems like floods, drought, soil erosion, loss of wildlife, extinction of species, imbalance of biogiochemical cycles, alterations in climatic conditions and desertification.

b) **State the application of DNA finger printing technique.**

➢ DNA fingerprinting technique is widely used in forensic applications like crime investigation such as identifying the culprit. It is also used for paternity testing in case of disputes. It also helps in the study of genetic diversity of population, evolution and speciation.

32. **a)** **Name the acid that renders Aluminium passive. Why ?**

b) **Calculate the number of moles in 1.51×10^{23} molecules of NH_4Cl.**

1 mole of NH_4Cl = 6.023×10^{23} molecules of NH_4Cl

(Avogadro's number)

No. of moles in 1.51×10^{23} molecules of NH_4Cl

$$= \frac{\text{Given number of molecules}}{\text{Avogadro's number}}$$

$$= \frac{1.51 \times 10^{23}}{6.023 \times 10^{23}} = \frac{1}{4}$$

= **0.25 moles**

Part - IV

Answer all the questions. Draw diagrams wherever necessary.   **3 × 7 = 21**

33. **a)** **i)** **What are the uses of convex lens ?**

➢ Convex lenses are used as camera lenses.

➢ They are used as magnifying lenses.

➢ They are used in making microscope, telescope and slide projectors.

➢ They are used to correct the defect of vision called hypermetropia

ii) Define dispersion of light.

➤ When a beam of white light or composite light is refracted through any transparent media such as glass or water, it is split into its component colours. This phenomenon is called as dispersion of light.

iii) Why are traffic signals red in colour ?

➤ Red has the longest wavelength.

➤ It is mostly scattered by atmospheric particles. As a result whether it is fog or smoke - red light passes comparatively easily through them.

iv) What is the least count of travelling microscope ?

➤ A travelling microscope is one of the best instrument for measuring very small length with high degree of accuracy at the order of 0.01mm.

➤ It works based on the principle of vernier.

➤ Its least count is 0.01 mm.

(OR)

b) i)   What is an echo ?

ii) State two conditions necessary for hearing an echo.

iii) What are the medical applications of echo ?

iv) How can you calculatge the speed of sound using echo ?

Echo :

★ An echo is the sound reproduced due to the reflection of the original sound from various rigid surfaces such as walls, ceilings, surfaces of mountains etc.

a) Conditions necessary for hearing an echo.

★ The minimum time gap between the original sound and echo must be 0.1S.

★ The minimum distance required to hear an echo in 17.2m.

b) The medical applications of echo.

★ The principle of echo is used in obstetric untrasonography, which is used to create realtime visual images of the developing embryo or foetus in the mother's uterus.

c) Calculate the speed of sound using echo.

★ The sound pulse emitted by the source travels a total distance of 2d while travelling from the source to the wall and then back to the receiver.

★ The time taken for this has been observed to be 't'. Hence, the speed of sound wave is given by

$$\text{Speed of sound} = \frac{\text{Distance travelled}}{\text{Time taken (T)}}$$

$$V = \frac{2d}{t}$$

34. a) i) Under same conditions of temperature and pressure, if you collect 3 litre of O_2, 5 litre of Cl_2 and 6 litre of H_2,

(A) Which has the highest number of molecules ?

6 litre of H_2

(B) Which has the lowest number of molecules ?

3 litre of O_2

ii) **Give the salient features of 'Modern Atomic theory'.**

The salient features of modern atomic theory are as follows :

★ An atom is no longer indivisible (after the discovery of the electron, protron and neutron).

★ Atoms of the same element may have different atomic mass (discovery of isotopes $_{14}Cl^{35}$, $_{17}Cl^{37}$) Atoms of different elements may have same atomic mass (discovery of isobars $_{18}Ar^{40}$, $_{20}Ca^{40}$)

★ Atoms of one element can be transmuted into atoms of other elements. In other words, atom is no longer indestructible (discovery of artificial transmutation).

★ Atoms may not always combine in a simple whole number ratio (E.g. : Glucose $C_6H_{12}O_6$ C : H : O = 6 : 12 : 6 or 1 : 2 : 1 and sucrose $C_{12}H_{22}O_{11}$, C : H : O = 12 : 22 : 11) Atom is the smallest particle that takes part in a chemical reaction.

★ The mass of an atom can be converted into energy (E = mc^2)

(OR)

b) i) **How do detergents cause water pollution ?**

★ Some detergents having a branched hydrocarbon chain are not fully bio - degradable by micro - organisms present in water. So they cause water pollution.

ii) **An organic compound 'A' is widely used as a preservative and has the molecular formula $C_2H_4O_2$. This compound reacts with ethanol to form a sweet smelling compound 'B', then,**

(A) **Identify the compound 'A'.**

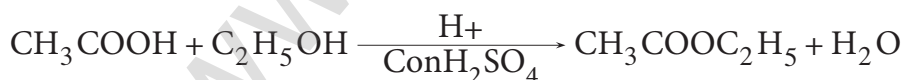(B) **Write the chemical equation for its reaction with ethanol to form compound 'B'.**

(C) **Name the process.**

i) **Identify the compound 'A'.**

Compound 'A' → ethanoic acid. (CH_3COOH)

ii) **Write the chemical equation for its reaction with ethanol to form compound 'B'.**

Ethanoic acid reacts with ethanol to form a sweet smelling compound B.

$$CH_3COOH + C_2H_5OH \xrightarrow[\text{ConH}_2SO_4]{\text{H+}} CH_3COOC_2H_5 + H_2O$$

Ethanoic acid　　　　　　　　　　　　　　　B

　　　　　　　　　　　　　　　　　　Ethyl acetate

　　　　　　　　　　　　　　　　　　(Ethyl ethanoate)

iii) **Name the process :**

The process is **esterification.**

Compound 'A' is acetic acid (ethanoic acid), CH_3COOH
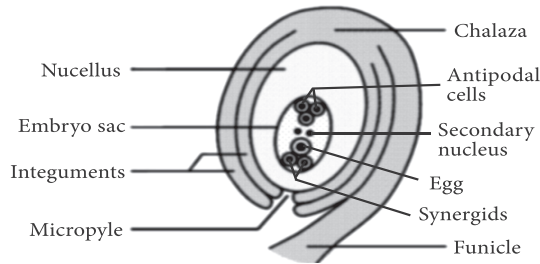
Compound 'B' is the Ester (or) Ethyl acetate (Ethyl ethanoate), $CH_3COOC_2H_5$

35. a) i) **What are synthetic auxins ? Give an example.**

➤ Synthetic auxins are artificially synthesized that have properties like auxins are called as synthetic auxins.

E.g. : 2, 4 D (2, 4 - Dichlorophenoxy Acetic Acid).

ii) **With a neat labelled diagram, describe the parts of the typical angiospermic ovule.**

Structure of an Ovule

★ The main part of the ovule is the **nucellus** which is enclosed by two integuments leaving an opening called micropyle.

★ The ovule is attached to the ovary wall by a stalk known as **funiculus.**

★ **Chalaza** is the basal part.

★ The embryo sac contains seven cells and the eighth nuclei located within the nucellus.

★ Three cells at the micropylar end form the egg apparatus and the three cells at the chalaza end are the **antipodal cells.**

★ The remaining two nuclei are called **polar nuclei** found in the centre.

★ In the egg apparatus, one is the egg cell (female gamete) and the remaining two cells are the **synergids.**

(OR)

b) i) **Who is called the "Father of Indian Green Revolution" ?**

Dr. M.S. Swaminathan

ii) **Differentiate between out - breeding and in - breeding.**

	Outbreeding	Inbreeding
1	It refers to the breeding of two unrelated animals.	It refers to the breeding of closely related animals with the same breed for about 4 - 6 generations.
2	Hybrids are stronger and vigorous than the parents. **E.g.:** Mule	Continued in breeding reduces fertility and productivity. **E.g. :** Hissardale

iii) **Differentiate between Type - I and Type - II Diabetes mellitus.**

Factors	Type-1 Insulin dependent diabetes mellitus (IDDM)	Type-2 Non-insulin dependent diabetes mellitus (NIDDM)
Prevalence	10-20%	80-90%
Age of onset	Juvenile onset (< 20 years)	Maturity onset (>30 years)
Body weight	Normal or Underweight	Obese
Defect	Insulin deficiency due to destruction of β-cells	Target cells do not respond to insulin*-+-.
Treatment	Insulin administration is necessary	Can be controlled by diet, exercise and medicine

✍ ✍ ✍ ✍ ✍