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1. LAWS OF MOTION

KEY FORMULAE

1.	Linear Momentum	$p = mv$
2.	Parallel forces acting in the same direction	$F_{net} = F_1 + F_2$
3.	Parallel unequal forces acting in the opposite direction	$F_{net} = F_1 - F_2$ (if $F_1 > F_2$) $F_{net} = F_2 - F_1$ (if $F_2 > F_1$)
4.	Torque	$\tau = F \times d$
5.	Moment of couple	$M = F \times S$
6.	Acceleration	$a = \frac{v-u}{t}$
7.	Force	$F = m \times a$
8.	Impulse	$J = \Delta p$
9.	Conservation of linear momentum	$m_1v_1 + m_2v_2 = m_1u_1 + m_2u_2$
10.	Newton's universal law of gravitation	$F = \frac{Gm_1m_2}{r^2}$
11.	Acceleration due to gravity	$g = \frac{GM}{R^2}$
12.	Mass of the Earth	$M = \frac{gR^2}{G}$
13.	Weight	$W = mg$

I. Choose the correct answer.

1. Inertia of a body depends on **(APRIL - 2024)**
   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 equals to **(PTA - I)** ※※
   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 used ※※
   a. swimming
   b. tennis
   c. cycling
   d. hockey **Ans: c. cycling**

6. The unit of 'g' is ms^{-2}.It can be also expressed as
   a. $cm\ s^{-1}$
   b. $N\ kg^{-1}$
   c. $N\ m^2\ kg^{-1}$
   d. $cm^2\ s^{-2}$ **Ans: b. $N\ kg^{-1}$**

7. One kilogram force equals to ※
   a. 9.8 dyne b. 9.8×10^4N 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. 4M 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?
    a. Newton's third law of motion **(JULY-24, JUNE-23, GMQ-2019, SEP-2021, 22)**
    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**
5. A man of mass 100 kg has a weight of _____ at the surface of the Earth. ※※
   Ans: 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

   <u>In the absence of an external force,</u> the linear momentum of a system of particles is always conserved.

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

Ans: False

Apparent weight of a person is **not** equal to his actual weight.

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

Ans: False

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

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

Ans: False

Turning a nut with a spanner having a **long** handle is so easy 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

Astronauts are falling freely around the Earth due to their **huge orbital velocity**.

IV. Match the following. (PTA - I)

Column - I		Column - II			Answers		
1.	Newton's I law	-	a.	propulsion of a rocket	-	**b.**	**Stable equilibrium of a body**
2.	Newton's II law	-	b.	Stable equilibrium of a body	-	**c.**	**Law of force**
3.	Newton's III law	-	c.	Law of force	-	**d.**	**Flying nature of bird**
4.	Law of conservation of Linear momentum	-	d.	Flying nature of bird	-	**a.**	**propulsion of a rocket**

V. Assertion & Reasoning.

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.

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.

Ans: b. If 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.

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.

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

VI. Answer briefly.

1. Define inertia. Give its classification. ※※ **(APR - 2023, SEP - 2022)**

1. 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 as inertia.

2. It is classified into three types,

   i. Inertia of rest

   ii. Inertia of motion

   iii. Inertia of direction

2. Classify the types of force based on their application. (SEP - 2022)

Based on the direction and application forces can be classified into,

i. Like parallel forces

ii. Unlike parallel forces

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

Ans:

$F_1 = 5$ N

$F_2 = 15$ N

Resultant force $F_{net} = F_2 - F_1$ (since $F_2 > F_1$)

$= 15 - 5$

$= 10$N

1. The resultant force will be in the direction of force with greater magnitude.
2. The direction of action of the resultant force will be in the direction of the greater force (15N).
3. The direction will be along 15N.

4. Differentiate mass and weight. ※※ **(MAY - 2022)**

	Mass		Weight
1.	It is the quantity of **matter** contained in the body.	1.	It is the **gravitational force** exerted on a body due to gravity.
2.	Its SI unit is **kilogram**.	2.	Its SI unit is **Newton**.
3.	It is a **scalar** quantity.	3.	It is a **vector** quantity.

5. Define moment of a couple. ※※ **(JULY - 2024)**

1. **Rotating effect** of a couple is known as moment of a couple.
2. It is measured by the product of any one of the forces and the perpendicular distance between the line of action of two forces.
3. Moment of a couple = Force × perpendicular distance between the line of action of forces

$$M = F \times S$$

4. **E.g:** Turning a tap.

6. State the principle of moments.

1. 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 anticlockwise direction.

2. Moment in clockwise direction = Moment in anticlockwise direction

$$F_1 \times d_1 = F_2 \times d_2$$

7. State Newton's second law. ※※ **(GMQ - 2019, MAY - 2022)**

According to Newton's second law, "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".

$$F = m \times a$$

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

1. When the handle of the spanner is long, the **force required** to turn the body is **less**.
2. This turning effect of a body depends upon the **perpendicular** distance of the line of action of the applied force from the axis of rotation.

Moment of force = F × d

Hence, a spanner with a long handle is preferred to tighten screws in heavy vehicles.

9. While catching a cricket ball the fielder lowers his hands backwards. Why?

1. In cricket, a fielder pulls back his hands while catching the ball.
2. Because, he experiences a **smaller force** for a **longer interval of time** to catch the ball, resulting in a **lesser impulse** on his hands.
3. Further, as **time increases**, the rate of **change in momentum decreases** and the **force** acting on his hands is **reduced**.

$$\text{Force} = \frac{\text{momentum}}{\text{time}}$$

10. How does an astronaut float in a space shuttle? **(JULY - 2024)**

1. Astronauts are not floating but falling freely around the earth due to their **huge orbital velocity**.
2. Since space station and astronauts have equal acceleration, they are under **free fall condition**.
3. Hence, astronauts are in the state of weightlessness and seem floating.

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.

Solution:

$M_1 : M_2 = 3 : 4$ (since $M_1 = 4, M_2 = 3$)

$a_1 = 12\ ms^{-2}$

$a_2 = ?$

According Newton's III law of motion

$F_1 = -F_2$

$M_1 \times a_1 = -M_2 \times a_2$

$4 \times 12 = -3 \times a_2$

$a_2 = -\frac{48}{3}$

$a_2 = -16$

$a_2 = 16\ ms^{-2}$

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

Solution:

Mass of ball = 1 kg

Initial speed = $10\ ms^{-1}$

Final speed = $-10\ ms^{-1}$ (because it rebounds elastically)

Change in momentum (Δp) = mv - mu

$= 1(-10) - 1(10)$

$= -10 - 10$

$\Delta p = -20\ kg\ ms^{-1}$

∴ change in linear momentum is $20\ kg\ ms^{-1}$ in the opposite direction of its motion.

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

Solution:

Force to unscrew nut one (F_1) = 140 N

Force to unscrew nut two (F_2) = 40 N

Length of spanner one (d_1) = 40 cm = 0.4 m

Length of spanner two (d_2) = ?

Equating the torque in both the cases,

$F_1 d_1 = F_2 d_2$

$140 \times 0.4 = 40 \times d_2$

$d_2 = \frac{140 \times 0.4}{40}$

$= \frac{56}{40}$

$d_2 = 1.4\ m$

The length of the spanner two (d_2) = 1.4 m.

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.

Solution:

Acceleration due to gravity $g = \frac{GM}{R^2}$

$g_1 : g_2 = ?$

$R_1 : R_2 = 4:7$

$M_1 : M_2 = 2:3$

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

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

$$= \frac{M_1}{M_2} \times \frac{R_2^2}{R_1^2}$$

$$= \frac{2}{3} \times \frac{7^2}{4^2}$$

$$= \frac{\cancel{2}}{3} \times \frac{49}{\cancel{16}\,8}$$

$$= \frac{49}{24}$$

$g_1 : g_2 = 49 : 24$

∴ The ratio of their accelerations due to gravity $g_1 : g_2 = 49 : 24$

VIII. Answer in detail.

1. What are the types of inertia? Give an example for each type. (SEP-22,PTA - III)

Definition: **(APRIL - 2024)**

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 as **inertia**.

Inertia is of three types,

i. Inertia of rest

ii. Inertia of motion

iii. Inertia of direction

I. Inertia of rest:

The resistance of a body to **change** its state of **rest** is called inertia of rest.

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

II. Inertia of motion:

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

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

III. Inertia of direction:

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

Example: Making a sharp turn while driving a car, we tend to lean sideways.

2. State Newton's laws of motion? ※※※ **(SEP - 2021, 22)**

First Law of motion:
Everybody continues to be in its state of rest or in the state of uniform motion along a straight line unless it is acted upon by some external force.
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.

Third Law of motion:
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. (APR - 23)

(OR)

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 a is produced. Using this data derive the relation between the force, mass and acceleration. (PTA - V)

Newton's second law of motion:

1. "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".

2. Let, 'm' be the mass of a moving body, moving along a straight line with an initial speed 'u'.

3. 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 $\Delta p = P_f - P_i$

$= mv - mu$

By Newton's second law of motion,

Force, $F \propto$ rate of change of momentum

$$F \propto \frac{\text{change in momentum}}{\text{time}}$$

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

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

Here, k is the proportionality constant.

k = 1 in all systems of units. Hence,

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

Since, acceleration = $\frac{\text{change in velocity}}{\text{time}}$, $a = \frac{(v-u)}{t}$.

Hence, we have

$$F = m \times a$$

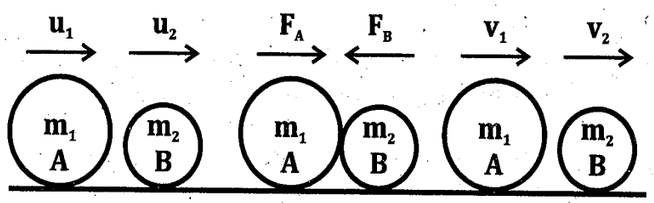
Force = mass × acceleration.

4. State and prove the law of conservation of linear momentum. (GMQ - 2019)

Law 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".

Proof:



Conservation of linear momentum

1. 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.
2. Let the velocity of the **first body** be **higher** than that of the second body, **i.e.,** $u_1 > u_2$.
3. During an interval of **time t** second, they tend to have a collision.
4. After the impact, both of the bodies move along the same straight line with a velocity v_1 and v_2 respectively.

Force on body B due to A,

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

Force on body A due to B,

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

By Newton's III law of motion,

Action force = Reaction force

$$F_B = -F_A$$

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

$$\boxed{m_1v_1 + m_2v_2 = m_1u_1 + m_2u_2}$$

The above equation confirms **in the absence of an external force, the algebraic sum of the momentum after collision is numerically equal to the sum of the momentum before collision.**

Thus, the law of conservation linear momentum is proved.

5. Describe rocket propulsion. ※※※ **(PTA - IV, SEP - 2020, 22)**

Rocket Propulsion:

1. Propulsion of rockets is based on the **law of conservation of linear momentum** as well as **Newton's III law** of motion.
2. Rockets are filled with a **fuel** (either liquid or solid) in the propellant tank.
3. When the rocket is fired, the fuel is burnt and a **hot gas is ejected** with a high speed from the nozzle of the rocket, producing a huge momentum.
4. To balance this momentum, an **equal and opposite reaction** force is produced in the **combustion chamber**, which makes the rocket project forward.
5. While in motion, the **mass** of the rocket gradually **decreases**, until the fuel is completely burnt out.
6. Since, there is **no net external force** acting on it, the **linear momentum** of the system is **conserved**.
7. The **mass** of the rocket **decreases with altitude**, which results in the gradual **increase in velocity** of the rocket.
8. 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**.

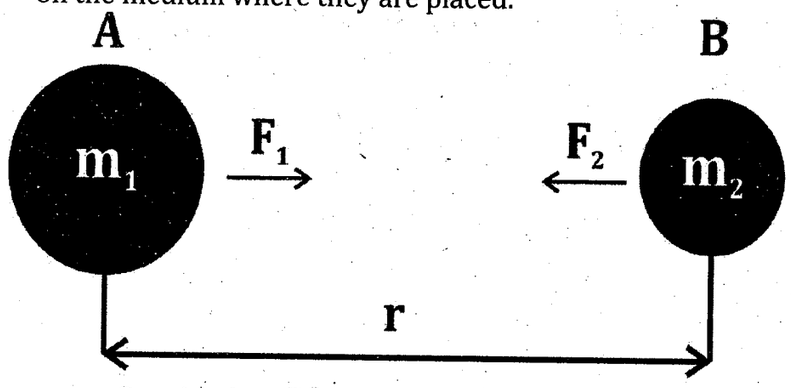
6. State the universal law of gravitation and derive its mathematical expression.

Newton's universal law of gravitation states that, **(JUNE - 2023)**

"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".

Derivation:

1. Force between the masses is always attractive and it does not depend on the medium where they are placed.



Gravitational force between two masses

2. Let, m_1 and m_2 be the masses of two bodies A and B placed *r* metre apart in space

Force $F \propto m_1 \times m_2$

$F \propto 1/r^2$

On combining the above two expressions

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

$$F = \frac{G m_1 m_2}{r^2}$$

where G is the universal gravitational constant.

Its value in SI unit is 6.674×10^{-11} N m² kg⁻².

7. Give the applications of universal law of gravitation. ※ **(JULY - 2024)**

1. **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.
2. Helps in **discovering new stars** and **planets.**
3. One of the irregularities in the motion of stars is called **'Wobble'** lead 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.
4. Helps to explain **germination of roots** is due to the property of geotropism which is the property of a root responding to the gravity.
5. Helps to predict the **path of the astronomical bodies.**

IX. HOT questions.

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

Given data:

Mass (m_1) = 8 kg
Mass (m_2) = 2 kg
applied force (F) = 15 N

$$= \frac{m_2}{m_1 + m_2} \times \text{applied force}$$

$$= \frac{2}{8+2} \times 15 = \frac{\cancel{2}}{\cancel{10}_{\cancel{5}}} \times \cancel{15}^{3}$$

= 3 N

Force exerted on the 2 kg mass **= 3 N**

2. A heavy truck and 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)

Given data:

$$\frac{1}{2} m_1 v_1^2 = \frac{1}{2} m_2 v_2^2 = K$$

$$\therefore V_1^2 = \frac{2K}{m_1}; V_2^2 = \frac{2K}{m_2}$$

$$V_1 = \sqrt{\frac{2K}{m_1}}; \; V_2 = \sqrt{\frac{2K}{m_2}}$$

∴ momentum of the two bodies is given by

$$P_1 = \sqrt{2\, m_1 k} \; ; \quad P_2 = \sqrt{2\, m_2 k}$$

m_1 = 4 times that of the bike

$m_2 = 1$

$$\therefore P_1 = \sqrt{2 \times 4 \times k} \; ; \quad P_2 = \sqrt{2 \times 1 \times k}$$

$$= \sqrt{8k} \; ; \quad \sqrt{2k}$$

$$= 2\sqrt{2k} \; ; \quad 1\sqrt{2k}$$

= 2 :1

∴ Ratio of momenta **= 2:1**

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

1. Wearing helmet and seat belt helps in preventing accidents.
2. When the car is moving with a high speed, our body tends to be in movement due to inertia of motion in the forward direction.
3. So, when there is a sudden collision, serious injuries can happen.

However, seat belt exerts a force on our body to slow down the forward motion.

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

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 N c. 10^2 dyne d. 1 dyne **Ans: d. 1 dyne**

II. Short answers.

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

Given:

Mass (m) = 50 kg
Acceleration (a) = 1.8 ms^{-2}
Acceleration due to gravity (g) = 9.8 ms^{-2}

Solution:

Lift is moving downward with an acceleration 'a'.

$R = m(g - a)$
$= 50(9.8 - 1.8) = 50 \times 8$
$= 400\ N = \frac{400}{9.8} = 40.82 Kg$

∴ The apparent weight realised by a 50 kg of man is **40.82 Kg. (400 N.)**
Apparent weight is **lesser than** the actual weight (R < W)

2. **Assertion:** When a person swims he pushes the water using the hands backwards and the water pushes the person in the forward direction. **(PTA - 3)**
   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 but 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.

3. **Write short notes on gears. (SEP - 2020)**
   1. A gear is a circular wheel with teeth around its rim.
   2. It helps to change the speed of rotation of a wheel by changing the torque and helps to transmit power.

III. Long answers.

1. **Why the apples weigh more at poles than at equator? (PTA - 3)**
   1. Apples weigh more at poles than at equator due to the difference in **acceleration due to gravity** of the Earth.
   2. The value of g is maximum at the polar region and minimum at the equatorial region.
   3. Hence, apples weigh more at the poles.
2. **Use the analogy to fill the blank (PTA - 4)**

a.	Opening a Door	: Moment of force	
	Opening a water tap	: _____	**(Moment of a couple)**
b.	Pushing a bus by a group of people	: Like parallel forces.	
	Tug of war	: _____	**(Unlike parallel forces)**

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

Given data:

Force (F) = 5N
Acceleration (a) = 5 cm s^{-2} = 0.05 ms^{-2}

Solution:

$\therefore$ Mass (m) $= \frac{F}{a}$ $[\because F = ma]$

$= \frac{5}{0.05} = \frac{500}{5} = 100Kg$

∴ The mass of the body is **100Kg.**

4. **Calculate the velocity of a moving body of mass 5 kg whose linear momentum is 2kg ms^{-1}. (GMQP - 2019)**

Given data:

linear momentum (p) = 2 Kg ms^{-1}
mass (m) = 5 Kg

Solution:

Linear momentum (p) = mass (m) × velocity (v)

$\therefore$ Velocity $= \frac{\text{Linear momentum}}{\text{mass}}$

$= \frac{2}{5} = \mathbf{0.4\ ms^{-1}}$

5. i. **Shock absorbers are used in luxury buses. Why? (PTA - 2)**
   Shock absorbers are used in luxury buses to **reduce impulse** on jerks while moving on uneven roads.

   ii. **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)**

Given data:

Weight of a man on earth (w) = 686 N

$$m = \frac{686}{9.8} = \mathbf{70\,Kg}$$

Acceleration due to gravity for moon (g') = 1.625 ms^{-2}

Weight of a man on moon = w' = mg'

= 70 × 1.625

w' = **113.75 N**

The weight of the same person on moon is **113.75 N**

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

Ans: Newtons III Law of motion

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

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

Given data:

Height from the centre of the Earth, R' = R + h

The acceleration due to gravity at that height, g' = g / 4

Solution:

$$g = GM / R^2,\ g' = GM / (R')^2$$

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

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

$$2 = 1 + \frac{h}{R} \text{ or } h = R, \qquad R' = 2R$$

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

ADDITIONAL QUESTIONS

I. Match the following:

1.

Column A		Column B		Answers
1. Natural motion	- a.	inertia	- **b.**	**force independent**
2. Violent motion	- b.	force independent	- **e.**	**force dependent**
3. Galileo	- c.	unlike parallel force	- **a.**	**inertia**
4. Tug of war	- d.	law of force	- **c.**	**unlike parallel force**
5. Newton's II law	- e.	force dependent	- **d.**	**law of force**

2.

Column A		Column B		Answers
1. Linear momentum	- a.	opposite direction	- **b.**	**impact of force**
2. Like parallel force	- b.	impact of force	- **c.**	**same direction**
3. Unlike parallel force	- c.	same direction	- **a.**	**opposite direction**
4. Newton	- d.	unbalanced force	- **e.**	**law of motion**
5. Action of a lever	- e.	law of motion	- **d.**	**unbalanced force**

3.

Column A		Column B		Answers
1. Rocket propulsion	- a.	Torque	- **e.**	**linear momentum**

2. Spring	- b.	Stars	- **d**	**Reduce impulse**
3. Steering wheel	- c.	Weightlessness	- **a.**	**Torque**
4. Astronauts	- d.	Reduce impulse	- **c.**	**Weightlessness**
5. Wobble	- e.	linear momentum	- **b.**	**Stars**

4.

Column A		Column B		Answers
1. Linear momentum	- a.	M = F × S	- **d.**	**P = mv**
2. Moment of couple	- b.	J = Δp	- **a.**	**M = F × S**
3. Force	- c.	$g = \frac{GM}{R^2}$	- **e.**	**F = m × a**
4. Impulse	- d.	P = mv	- **b.**	**J = Δp**
5. Acceleration due to gravity	- e.	F = m × a	- **c.**	**$g = \frac{GM}{R^2}$**

5.

Column A		Column B		Answers
1. 1 N	- a.	1 g cm s^{-2}	- **e.**	**1 kg m s^{-2}**
2. 10^5 dyne	- b.	9.8 N	- **d.**	**1 N**
3. 1 dyne	- c.	980 dyne	- **a.**	**1 g cm s^{-2}**
4. 1 kg f	- d.	1 N	- **b.**	**9.8 N**
5. 1 g f	- e.	1 kg m s^{-2}	- **c.**	**980 dyne**

II. Choose the correct answer:

1. The product of mass and velocity of a moving body gives the magnitude of _____
   a. force b. direction c. linear momentum d. inertia
   Ans: c. linear momentum

2. An athlete running some distance before running is an example of inertia at _____.
   a. direction b. rest c. motion d. division **Ans: c. motion**

3. _____ is an external form of push or pull.
   a. Momentum b. Force c. Velocity d. Speed
   Ans: b. Force

4. _____ stated that the natural state of all earthly bodies is at rest.
   a. Aristotle b. Galileo c. Newton d. Pluto
   Ans: a. Aristotle

5. _____ deals with the bodies which are at rest under the action of forces.
   a. Kinetics b. Kinematics c. Dynamics d. none of the above
   Ans: d. none of the above

6. _____ deals with the effect of force on bodies.
   a. Kinetics b. Kinematics c. Mechanics d. Dynamics
   Ans: c. Mechanics

7. i. A is a circular wheel with teeth around its rim.
   ii. Two equal and unlike parallel forces constitute a torque.
   iii. $F_1 \times d_1 = F_2 \times d_2$ is the expression for principle of moments.
   iv. The product of force and time gives impulse.
   a. i. & iii. are correct b. iv. & ii. are correct
   c. iii. & iv. are correct d. ii. & iii. are correct
   Ans: c. iii. & iv. are correct

8. $m_1v_1 + m_2v_2 = m_1u_1 + m_2u_2$, is the expression for the law of conservation of_____.
   a. energy b. linear momentum c. force d. gravitation
   Ans: b. linear momentum

9. The mean value of the acceleration due to gravity on the surface of the Earth is _____ m s^{-2}
   a. 0.98 b. 980 c. 9.8 d. 99.8 **Ans: c. 9.8**

10. A rollercoaster exhibits the phenomenon of _____.
a. gravity b. apparent weight
c. weightlessness d. impulse **Ans: c. weightlessness**

11. The apparent weight of a person moving upward in a lift is given by _____.
a. R = mg b. R = 0 c. R < W d. R > W
Ans: d. R > W

12. The value of acceleration due to gravity on the moon is _____ m s^{-2}.
a. 9.8 b. 16.25 c. 1.625 d. 0.1625 **Ans: c. 1.625**

13. The ability of a body to maintain its state of rest or motion is called _____.
a. momentum b. velocity c. impulse d. inertia
Ans: d. inertia

14. The CGS unit of force is _____.
a. Newton b. Kilogram c. Dyne d. kg f
Ans: c. Dyne

15. Force = 40 N, distance of object = 90 cm. Then moment of force will be _____.
a. 3.6 Nm b. 36 Nm c. .36 Nm d. 3600 Nm
Ans: b. 36 Nm

16. Newton's law of _____ helps in discovering new stars and planets.
a. inertia b. gravitation c. motion d. linear momentum
Ans: b. gravitation

17. The resultant force of two equal parallel forces acting in opposite direction in the same line of action is _____.
a. $F_{net} = F_1 + F_2$ b. $F_{net} = F_1 - F_2$
c. $F_{net} = F_2 + F_1$ d. $F_{net} = 0$ **Ans: d. $F_{net} = 0$**

18. $F_1 \times d_1 = F_2 \times d_2$ is the expression for principle of _____.
a. moments b. couple c. force d. inertia
Ans: a. moments

19. Action of a lever is an example of _____ force.
a. balanced b. unbalanced
c. like parallel d. none of the above **Ans: b. unbalanced**

20. Linear momentum is given by ρ = _____.
a. m × a b. m × v c. m × f d. f × m
Ans: b. m × v

21. The SI unit of torque is _____.
a. Nm^2 b. Nm^{-1} c. Nm d. none of the above **Ans: c. Nm**

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

1. Making a sharp turn while driving a car, we tend to lean sideways, due to inertia of motion.

Ans: False
Making a sharp turn while driving a car, we tend to lean sideways, due to inertia of **direction**.

2. If the resultant force is not equal to zero, then the motion of the body is due to balanced forces.

Ans: False
If the resultant force is not equal to zero, then the motion of the body is due to **unbalanced** forces.

3. The direction of moment of a force or couple is taken as negative if the body is rotated in the anti - clockwise direction.

Ans: False
The direction of moment of a force or couple is taken as **positive** if thebody is rotated in the anti - clockwise direction.

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

Ans: True

5. Force between the masses is always repulsive and it does not depend on the medium where they are placed.

Ans: False
Force between the masses is always **attractive** and it does not depend on the medium where they are placed.

6. Mass of a body is defined as the gravitational force exerted on it due to the Earth's gravity alone.

Ans: False
Weight of a body is defined as the gravitational force exerted on it due to the Earth's gravity alone.

7. The geometric radius of the Earth is maximum in the equatorial region and minimum in the polar region.

Ans: True

8. The value of acceleration due to gravity on the surface of the moon is 3.625 ms^{-2}.

Ans: False
The value of acceleration due to gravity on the surface of the moon is **1.625 ms^{-2}**.

9. Astronauts are not floating but falling freely around the earth due to their huge centripetal acceleration.

Ans: False
Astronauts are not floating but falling freely around the earth due to their huge **orbital velocity**.

IV. Assertion and Reason.

1. **Assertion:** Astronauts are not floating but falling freely around the earth due to their huge orbital velocity.

Reason : Astronauts have equal acceleration, they are under free fall condition.

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.

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

2. **Assertion:** The geometric radius of the Earth is maximum in the equatorial region and minimum in the polar region.

Reason : 'g' depends on the geometric radius of the Earth.

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.

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

3. **Assertion:** When birds fly they push the air downwards with their wings and the air pushes the bird upwards.

Reason : 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.

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.

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

4. **Assertion:** Automobiles are fitted with springs and shock absorbers to reduce jerks while moving on uneven roads.

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

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.

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

V. Analog

1.	1 N	:	$1\ kg\ ms^{-2}$	
	1 dyne	:	_____	**($1\ g\ cm\ s^{-2}$)**
2.	1 Kg f	:	9.8 N	
	1 g f	:	_____	**(980 dyne)**
3.	Mass	:	kg	
	Weight	:	_____	**(N)**
4.	Statics	:	rest	
	Dynamics	:	_____	**(motion)**
5.	Natural motion	:	force independent	
	Violent motion	:	_____	**(force dependent)**
6.	Torque (τ)	:	F × d	
	Moment of couple (M)	:	_____	**(F × S)**
7.	Law of inertia	:	Newton's I law	
	Law of force	:	_____	**(Newton's II law)**
8.	Upward motion	:	R > W	
	Downward motion	:	_____	**(R < W)**

VI. Problem solving.

1. **Find the acceleration of a car which changes its velocity from 10m/s to 20m/s in one minute.**

Solution:

Initial velocity (u) = 10m/s
Final velocity (v) = 20m/s
Time (t) = 60 s

$$\text{Acceleration} = \frac{v-u}{t} = \frac{20-10}{60} = \frac{10}{60}$$

$$= \frac{1}{6}\ m/sec^2$$

$$= 0.16\ m/s^2$$

2. **The velocity of a train is 30 m/s to 40 m/s in 20 seconds. Calculate the acceleration.**

Solution:

Initial velocity (u) = 30 m/s
Final velocity (v) = 40 m/s
Time (t) = 20 s

$$\text{Acceleration} = \frac{v-u}{t} = \frac{40-30}{20} = \frac{10}{20}$$

$$= \frac{1}{2}\ m/sec^2$$

$$= 0.5\ m/s^2$$

3. **Calculate the velocity of a moving body of mass 7 kg whose linear momentum is 5 kg ms^{-1}.**

Solution:
Given:

Linear momentum = $5kg\ ms^{-1}$
Mass = 7kg ; Velocity = ?
Linear momentum = Mass × Velocity

$$\text{Velocity} = \frac{\text{Linear momentum}}{\text{mass}}$$

$$v = \frac{5}{7}$$

$$v = 0.71\ ms^{-1}$$

4. **Calculate the mass of a body moving with velocity 1.33 ms^{-1}. Whose linear momentum is 15 $kgms^{-1}$.**

Solution:
Given:

Velocity = $1.33ms^{-1}$
Linear momentum = $15\ kgms^{-1}$ Mass = ?
Linear momentum = Mass × Velocity

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

$$= \frac{15}{1.33}$$

$$m = 11.28\ kg$$

5. **A swing is pushed at a point whose distance from the hinges is 60 cm, with a force of 30 N. Calculate the moment of the force about the hinges.**

Solution:

Given:

Force (F) = 30 N

Distance (d) = 60cm = 0.6 m

Moment of a force (M) = F × d

= 30 × 0.6

= 18.0

∴ M = 18 Nm

6. **A steering wheel is rotated at a point whose distance is 70 cm, the moment of the force is 28Nm. Calculate the force.**

Solution:

Given:

Moment of force (M) = 28 Nm

Distance (d) = 70cm = 0.7 m

Moment of the force = F × d

$$\therefore F = \frac{M}{d} = \frac{28}{0.7} = 40\ N$$

F = 40 N

7. **What will be the momentum of a body of mass 13kg which is moving with a velocity $0.5ms^{-1}$.**

Solution:

Given:

Mass = 13 kg

Velocity = $0.5\ ms^{-1}$

Momentum (P) = m × v

= 13 × 0.5

P = $6.5\ kgms^{-1}$

8. **Calculate the momentum of a toy car of mass 200g moving with a speed of 5m/s.**

Solution:

Given:

Mass of the toy car (m) = 200g = 0.2 kg

Speed (v) = 5 m/s

Momentum (P) = m × v

= 0.2 × 5

= 1 kg m/s

9. **A body of mass 25kg has a momentum of 125 $kgms^{-1}$. Calculate the velocity of the body.**

Solution:

Given:

Mass of the body (m) = 25 kg

Momentum (P) = $125\ kgms^{-1}$

P = m × v

$$V = \frac{P}{m} = \frac{125}{25}$$

= $5\ ms^{-1}$

VII. HOTS:

1. **Why does a person while firing a bullet holds the gun tightly to his shoulders?**

   1. Because while firing the bullet, the bullet moves in the forward direction with a greater force and as a reaction by Newton's third law the gun will also move with the same force in the backward direction.
   2. To prevent the shoulders of the person getting injured he must hold the gun tightly.
   3. So that the force is not felt that strongly.

2. **Why is it advised to keep the luggage's on the roof of a bus tied with a rope.**

   1. When the bus moves the luggage's also moves with the velocity same as that of the bus and in the same direction.
   2. When the bus changes its direction or accelerates, due to inertia of motion luggage moves in the same direction and may get thrown away from roof of buses.

3. **Why does the boat moves backwards when the sailor jumps in the forward direction.**

   1. Because while jumping the sailor pushes the boat backwards (action).
   2. By Newton's third law the boat pushes him in the forward direction (reaction).

4. **Why is it easier to stop a tennis ball in comparison to a cricket ball moving with the same speed?**

   1. Tennis ball is lighter (less mass) than a cricket ball.
   2. A tennis ball moving with same speed has less momentum (mass × velocity) than a cricket ball.
   3. Hence, it is easier to stop a tennis ball having less momentum than a cricket ball.

VIII. Short Answers:

1. **Define Statics.**

   It deals with the bodies, which are at rest under the action of forces.

2. **Define Dynamics.**

   It is the study of moving bodies under the action of forces.

3. **Define Kinematics.**

   It deals with the motion of bodies without considering the cause of motion.

4. **Define kinetics.**

   It deals with the motion of bodies considering the cause of motion.

5. **What is balanced force and unbalanced force?**

   Balanced force:

   If the resultant force of all the forces acting on a body is equal to zero, then the body will be in equilibrium. Such forces are called **balanced forces**.

   Unbalanced force:

   If the resultant force is not equal to zero, then it causes the motion of the body due to **unbalanced forces**.

6. Define moment of the force.

The rotating or turning effect of a force about a fixed point or fixed axis is called **moment of the force** about that point or **torque (τ)**.

7. Define Units of force.

SI unit of force is newton (N) and in C.G.S system its unit is dyne.

8. Define 1 Newton.

The amount of force required for a body of mass 1kg produces an acceleration of $1ms^{-2}$, **$1N = 1kg\ ms^{-2}$.**

9. Define 1 Dyne.

The amount of force required for a body of mass 1 gram produces an acceleration of $1cm\ s^{-2}$, **$1\ dyne = 1g\ cm\ s^{-2}$**; also **$1N = 10^5$ dyne.**

10. Define Unit force.

The amount of force required to produce an acceleration of $1ms^{-2}$ in a body of mass 1kg is called *'unit force'*.

11. Define Gravitational unit of force.

In the SI system of units, gravitational unit of force is kilogram force, represented by kg f. In the CGS system its unit is gram force represented by gf.

$1kg\ f = 1kg \times 9.8ms^{-2} = 9.8N$;

$1g\ f = 1g \times 980\ cm\ s^{-2} = 980dyne$.

12. Define Impulse.

When a force F acts on a body for a period of time t, then the product of force and time is known as **'impulse'** represented by 'J'.

$$J = F \times t$$

IX. Long Answers:

1. Explain Newton's third law of motion with two examples.

Newton's Third Law of Motion:

For every action, there is an equal and opposite reaction. They always act on two different bodies.

If a body A applies a force F_A on a body B, then the body B reacts with force F_B on the body A, which is equal to F_A in magnitude, but opposite in direction. $F_B = -F_A$.

Examples:

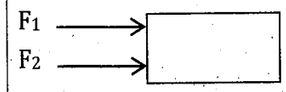
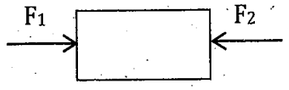
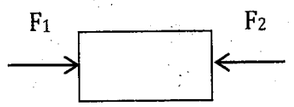
1. When birds fly they push the air downwards with their wings (Action) and the air pushes the bird upwards (Reaction).
2. When a person swims he pushes the water using the hands backwards (Action), and the water pushes the swimmer in the forward direction (Reaction).

2. Mention Galileo's concepts of force, motion and inertia of bodies.

1. The natural state of all earthly bodies is either the state of rest or the state of uniform motion.

2. A body in motion will continue to be in the same state of motion as long as no external force is applied.
3. When a force is applied on bodies, they resist any change in their state. This property of bodies is called 'inertia'.
4. When dropped from a height in vacuum, bodies of different size, shape and mass fall at the same rate and reach the ground at the same time.

3. Tabulate the action of forces and resultant forces with suitable diagrams.

	Action of forces	Diagram	Resultant force (F_{net})
1.	Parallel forces are acting in the same direction		$F_{net} = F_1 + F_2$
2.	Parallel unequal forces are acting in opposite directions		$F_{net} = F_1 - F_2$ (if $F_1 > F_2$) $F_{net} = F_2 - F_1$ (if $F_2 > F_1$) F_{net} is directed along the greater force.
3.	Parallel equal forces are acting in opposite directions in the same line of action ($F_1 = F_2$)		$F_{net} = F_1 - F_2$ ($F_1 = F_2$) $F_{net} = 0$

4. Tabulate the different possibilities of apparent weight of a person moving in a lift.

Case 1: Lift is moving **upward** with an acceleration 'a'.	Case 2: Lift is moving **downward** with an acceleration 'a'.	Case 3: Lift is at **rest.**	Case 4: Lift is **falling down freely**.
$R - W = F_{net} = ma$ $R = W + ma$ $R = mg + ma$ **$R = m(g + a)$**	$W - R = F_{net} = ma$ $R = W - ma$ $R = mg - ma$ **$R = m(g - a)$**	Here, the acceleration is zero $a = 0$ $R = W$ **$R = mg$**	Here, the acceleration is equal to g $a = g$ **$R = m(g - g)$**
$R > W$	$R < W$	$R = W$	$R = 0$
Apparent weight is **greater** than the actual weight.	Apparent weight is **lesser** than the actual weight.	Apparent weight is **equal** to the actual weight.	Apparent weight is equal to **zero**.

X. Fill in the blanks.

1. Mechanics is divided into _____ and _____. **(statics, dynamics)**
2. _____ deals with the bodies which are at rest under the action of forces. **(Statics)**
3. _____ is the study of moving bodies under the action of forces. **(Dynamics)**
4. Dynamics is divided into _____ and _____. **(kinematics, kinetics)**
5. _____ deals with the motion of bodies considering the cause of motion. **(Kinetics)**
6. In a _____ motion, a moving body comes to rest without any external influence of force. **(natural)**
7. In a _____motion, force is needed to make the bodies behave contrary to their own natural state. **(violent)**

8. Natural motion is also called _____. **(force independent)**
9. Violent motion is also called _____. **(force dependent)**
10. Ability of a body to maintain its state of rest or motion is called _____. **(Inertia)**
11. _____ of a couple is measured by the product of any one of the forces and the perpendicular distance between them. **(Moment)**
12. _____ measures the impact of force on a body. **(linear momentum)**
13. Linear momentum acts in the direction of _____. **(velocity)**
14. Linear momentum helps to measure the _____ of force. **(magnitude)**
15. The unit of momentum in SI system is _____. **(kg m s^{-1})**
16. The unit of momentum in C.G.S system is _____. **(g cm s^{-1})**
17. Newton's First Law gives the definition of force as well as _____. **(inertia)**
18. _____ is an external effort in the form of push or pull. **(Force)**
19. Force has both _____ and _____. **(magnitude, direction)**
20. Force is a _____ quantity. **(vector)**
21. Unlike parallel forces act in _____ direction. **(opposite)**
22. _____ force is equal to the vector sum of all the forces. **(Resultant)**
23. Forces with resultant force equal to zero are called _____. **(balanced forces)**
24. Forces with resultant force not equal to zero are called_____. **(unbalanced forces)**
25. If the resultant force acting on a body is zero, then the body will be in _____. **(equilibrium)**
26. The rotating or turning effect of a force about a fixed point or axis is called _____. **(Torque)**
27. Torque is a _____ quantity. **(vector)**
28. The SI unit of Torque is _____. **(N m)**
29. Two equal and unlike parallel forces applied simultaneously at two points constitute a _____. **(couple)**
30. Rotating effect of a couple is known as _____. **(moment of a couple)**
31. Turning a tap is an example of a _____. **(couple)**
32. The SI unit of moment of couple is _____. **(N m)**
33. The C.G.S unit of moment of couple is _____. **(dyne cm)**
34. The direction of moment of force or couple is taken _____ if the body is rotated in the anti - clockwise direction. **(positive)**
35. The direction of moment of force or couple is taken negative if the body is rotated in the _____ direction. **(clockwise)**
36. A steering wheel enables us to transfer the _____ to the wheels with less effort. **(torque)**
37. At equilibrium, the algebraic sum of the moments of all individual forces about any point is equal to _____. **(zero)**
38. $F_1 \times d_1 = F_2 \times d_2$, is the expression for _____. **(principle of moments)**
39. Newton's _____ Law helps us to measure the amount of force. **(second)**
40. Acceleration produced along the radius is called _____. **(centripetal acceleration)**
41. SI unit of force is_____. **(Newton)**
42. The unit of force in C.G.S system is _____. **(dyne)**
43. A large force acting for a very short interval of time is called _____. **(impulsive force)**
44. Impulse is equal to _____ of change in momentum. **(magnitude)**
45. $F_B = -F_A$ is the derivation for Newton's _____ law. **(third)**
46. A cricketer pulls his hands back while catching a ball to lower the _____ on his hands. **(impulse)**
47. The gravitational unit of force in SI system is _____. **(kg f)**
48. 1 kg f = _____ N **(9.8)**
49. 1 g f = _____ dyne **(980)**
50. The _____ of a body does not change as long as no external force acts on it. **(linear momentum)**
51. Impulse is represented by _____. **(J)**
52. Propulsion of rockets is based on the law of conservation of _____. **(linear momentum)**
53. The mass of a rocket decreases with _____. **(altitude)**
54. As the mass of a rocket decreases with altitude, its _____ increases. **(velocity)**
55. The velocity at which a rocket is able to escape from the gravitational pull of the Earth is called _____. **(escape velocity)**

56. Force between the masses is always _____. **(attractive)**
57. Force of an object does not depend on the _____ in which it is placed. **(medium)**
58. The acceleration of a falling object is due to the Earth's _____ force. **(gravitational)**
59. The mean value for acceleration due to gravity is taken as _____ms^{-2}. **(9.8)**
60. The acceleration due to gravity of the Earth is represented as _____. **(g)**
61. The SI unit of gravity is _____. **(m s^{-2})**
62. The velocity of a falling body varies by _____m s^{-1} for every 1 second. **(9.8)**
63. Mass of the Earth is _____ kg. **(5.972×10^{24})**
64. The value of Universal gravitational constant is _____. **(6.674×10^{-11} N m^2 kg^{-2})**
65. The value of _____ is not the same at all points on the Earth. **(gravity)**
66. Geometric radius of the Earth is _____ in the equatorial region. **(maximum)**
67. Geometric radius of the Earth is _____ in the polar region. **(minimum)**
68. The value of gravity is maximum in the _____ region. **(polar)**
69. The value of gravity is minimum in the _____ region. **(equatorial)**
70. The value of gravity _____ with altitude. **(decreases)**
71. The value of gravity is _____ at the centre of the Earth. **(zero)**
72. The SI unit of mass is _____. **(kg)**
73. Weight is a _____ quantity. **(vector)**
74. The value of acceleration due to gravity on the moon is _____ m s^{-2} **(1.625)**
75. The motion of a body where the acceleration is equal to the acceleration due to gravity is called _____. **(free fall)**
76. During free fall the apparent weight of a person is _____. **(zero)**
77. Astronauts fall freely around the Earth due to their huge _____. **(orbital velocity)**
78. Space stations are said to be in a state of _____. **(weightlessness)**
79. Dimensions of heavenly bodies can be measured using _____ law. **(gravitational)**
80. One of the irregularities in the motion of stars is called _____. **(Wobble)**
81. The product of force and time is called _____. **(impulse)**
82. _____ is the weight of the body acquired due to the action of gravity and other external forces. **(Apparent weight)**
83. Galileo stated that, the natural state of all earthly bodies is at _____. **(rest)**
84. When two different bodies of different mass are dropped from a height, the heavier body falls _____ than the lighter one. **(faster)**
85. At natural state, all earthly bodies are in a state of rest or in _____. **(uniform motion)**
86. When dropped from a height in vacuum, bodies of different size, shape and mass reach the ground at the _____. **(same time)**
87. The property of a body to resist any change in its state of rest is called _____. **(inertia)**
88. The resistance of a body to change its state of rest is called _____. **(inertia of rest)**
89. The resistance of a body to change its state of motion is called _____. **(inertia of motion)**
90. The resistance of a body to change its state of direction of motion is called _____. **(inertia of direction)**
91. When you shake the branches of a tree some fruits and leaves fall down, this is an example of _____. **(inertia of rest)**
92. Taking a sharp turn while driving a car is an example of inertia of _____. **(direction)**
93. Based on direction, forces are classified into _____ types. **(two)**
94. A Tug of war is an example of a _____force. **(unlike parallel)**
95. When a body is in equilibrium, it experiences _____ force. **(balanced)**
96. When the resultant force of a body is not equal to zero, then the body experiences _____ force. **(unbalanced)**
97. Drawing water from a well is an example of _____ force. **(unbalanced)**
98. The turning effect of applied force is _____ when the distance between the fixed edge and the point of application is more. **(more)**
99. The axis of a fixed edge about which an object is rotated is called _____. **(axis of rotation)**

2. OPTICS

KEY FORMULAE		
1.	Velocity of light	$c = v\lambda$
2.	Snell's law	$\frac{\sin i}{\sin r} = \frac{\mu_2}{\mu_1}$
3.	Refractive index	$\mu = \frac{c}{v}$
4.	Rayleigh's scattering law	$S \propto \frac{1}{\lambda^4}$
5.	Lens formula	$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$
6.	Magnification	$m = \frac{v}{u}$
7.	Lens maker's formula	$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$
8.	Power of a lens	$P = \frac{1}{f}$
9.	Myopia	$f = \frac{xy}{x-y}$
10.	Hypermeteropia	$f = \frac{dD}{d-D}$

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 - 2022)**

   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 - III)**

   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 **(APR - 2023)**

   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 ※※ **(JULY - 2024)**

   a. 4m b. −40m c. −0.25m d. −2.5m

   Ans: c. −0.25m

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 **(SEP - 2020, PTA - II)**

   a. convex lens b. concave lens
   c. convex mirror d. bi focal lenses **Ans: d. bi focal lenses**

9. Which of the following lens 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: 1**
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: wavelength**

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

III. True or false. If false correct it.

1. Velocity of light is greater in denser medium than in rarer medium.
Ans: False
Velocity of light is greater in **rarer** medium than in **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 cause 'hypermetropia' ※※
Ans: False
Decrease in the converging power of eye lens cause 'hypermetropia'

4. The convex lens always gives small virtual image.
Ans: False
The **concave** lens always gives small virtual image.

IV. Match the following.

Column - I		Column - II			Answers		
1.	Retina	-	a.	pathway of light	-	**d.**	**screen of the eye**
2.	Pupil	-	b.	far point comes closer	-	**a.**	**pathway of light**
3.	Ciliary muscles	-	c.	near point moves away	-	**e.**	**power of accommodation**
4.	Myopia	-	d.	screen of the eye	-	**b.**	**far point comes closer**
5.	Hypermetropia	-	e.	power of accommodation	-	**c.**	**near point moves away**

V. Assertion & Reasoning.

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.

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.

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.

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.

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

VI. Answer Briefly.

1. **What is refractive index?** ※ **(JULY - 2024)**

Refractive index:

The ratio of **speed of light in vacuum** to the **speed of light in a medium** is defined as refractive index **'μ'** of that medium.

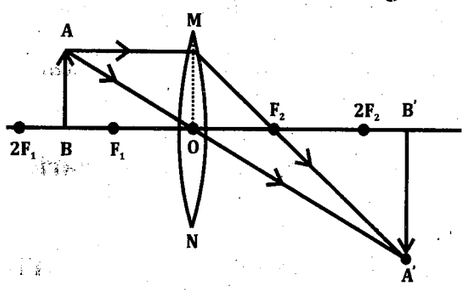
$$\mu = \frac{c}{v}$$

2. **State Snell's law.** ※※ **(SEP - 2022)**

Snell's Law states that, 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. It is given by,

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

3. Draw a ray diagram to show the image formed by a convex lens when the object is placed between F and 2F. (JUNE - 2023, GMQ - 2019)



Object placed between F and C

4. Define dispersion of light. (APRIL - 2024)

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

5. State Rayleigh's law of scattering. ※※ (JUNE - 2023, PTA - III)

"The amount of **scattering** of light is **inversely proportional** to the **fourth power** of its **wavelength**".

$$S \propto \frac{1}{\lambda^4}$$

6. Differentiate convex lens and concave lens. ※※ (JULY-24, JUNE-23, PTA-III)

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

7. What is power of accommodation of eye?

1. The **ability of the eye** lens to focus **nearby** as well as the **distant objects** is called power of accommodation of the eye.
2. It is achieved by **changing the focal length** of the eye lens with the help of **ciliary muscles**.

8. What are the causes of 'Myopia'? (GMQ - 2019)

1. Myopia occurs due to the **lengthening** of eye ball.
2. The focal length of eye lens is **reduced** or the distance between **eye lens** and **retina increases**.
3. With this defect, **nearby** objects can be **seen clearly** but distant objects cannot be seen clearly.

9. Why does the sky appear in blue colour? (APR - 2023, PTA - I)

1. When sunlight passes through the atmosphere, the **blue colour** (shorter wavelength) is **scattered** to a **greater** extent than the red colour (longer wavelength).
2. This scattering causes the sky to appear in blue colour.

10. Why are traffic signals red in colour? ※ (APRIL - 2024, PTA - IV)

1. As the red light has highest wavelength among all the colours, it is scattered least.
2. It travels a longer distance in the atmosphere.
3. Hence, most of the lights are scattered away and only the red light travel longer distances through rain, fog, dust etc., to reach our eyes effectively.

VII. Give the answer in detail.

1. List any five properties of light. ※※ (JULY - 2024, MAY - 2022)

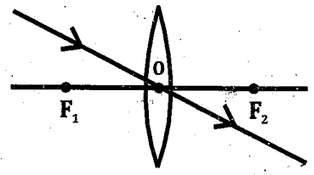
Properties of light:

1. Light is a **form of energy**.
2. It always travels along a **straight line**.
3. It does **not need any medium** for its propagation. It can even travel through vacuum.
4. The speed of light in vacuum or air is, $c = 3 \times 10^8\ ms^{-1}$.
5. Different coloured light has **different wavelength** and **frequency**.
6. Among the visible light, **violet** light has the **lowest** wavelength and **red** light has the **highest** wavelength.
7. When light is incident on the interface between two media, it is **partly reflected** and **partly refracted**.

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

Rule - 1:

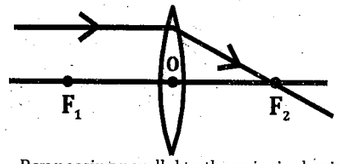
When a ray of light strikes the convex lens obliquely at its **optical centre**, it continues to follow its path **without any deviation.**



Ray passing through the optical centre

Rule - 2:

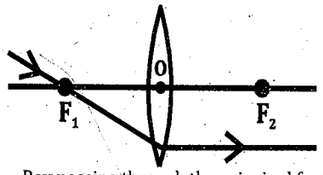
When a ray of light passes **parallel** to the **principal axis** of convex lens, the **refracted** ray is **converged** to the **principal focus.**



Ray passing parallel to the principal axis

Rule - 3:

When a ray passes through the **principal focus** the refracted ray will be **parallel** to the **principal axis.**



Ray passing through the principal focus

(JULY - 2024, APR - 2023, PTA - VI, SEP - 2021, 22)

3. Differentiate the eye defects: Myopia and Hypermeteropia.

	Myopia		Hypermeteropia
1.	It is also known as **short sightedness.**	1.	It is also known as **long sightedness.**
2.	It occurs due to the **lengthening** of eye ball.	2.	It occurs due to the **shortening** of eye ball.
3.	**Distant objects** cannot be seen clearly.	3.	**Nearby objects** cannot be seen clearly.
4.	The focal length of eye lens is **reduced.**	4.	The focal length of eye lens is **increased.**
5.	The distance between eye lens and retina **increases.**	5.	The distance between eye lens and retina **decreases.**
6.	The **far point** has come **closer.**	6.	The **near point** has moved **farther.**
7.	The images of distant objects are formed **before the retina.**	7.	The images of nearby objects are formed **behind the retina.**
8.	It can be corrected using **concave lens.**	8.	It can be corrected using **convex lens.**

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

Compound Microscope:

A compound microscope is used to see the **tiny objects** and has **better magnification power** than simple microscope.

Construction:

1. A compound microscope consists of **two convex lenses.**
2. The lens with the **shorter focal length** is placed **near** the **object**, and is called as 'objective lens' or 'objective piece'.
3. The lens with **larger focal length** and larger aperture placed **near** the **observer's eye** is called as 'eye lens' or 'eye piece'.
4. Both the lenses are fixed in a **narrow tube** with adjustable provision.

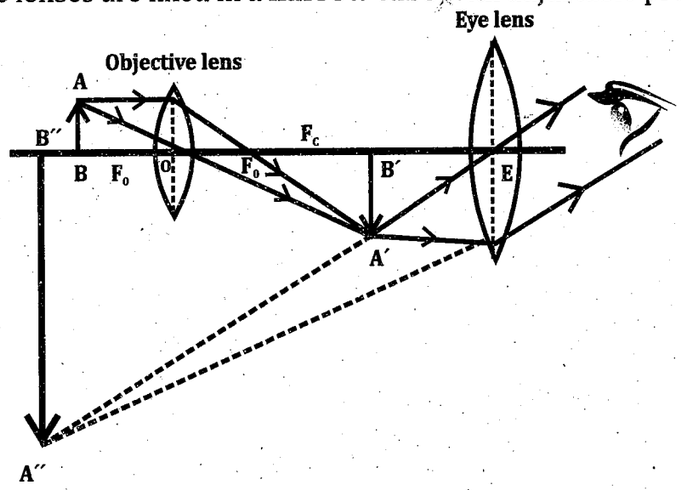


Image formation in compound microscope

Working:

1. The **object** (AB) is placed at a distance **slightly greater** than the **focal length** of the objective lens ($u > f_0$).
2. A **real, inverted** and **magnified** image (A'B') is formed at the other side of the objective lens.
3. This image **behaves as** the **object** for the eye lens.
4. The position of the eye lens is adjusted in such a way, that the **image** (A'B') falls **within** the **principal focus** of the eye piece.
5. This eye piece forms a **virtual, enlarged** and **erect** image (A"B") on the **same side** of the object.

VIII. Numerical problems.

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

Solution:

If the object is placed at a distance of 20cm.

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

$$f = 10cm$$

$$u = -20cm$$

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

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

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

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

$$= \frac{2-1}{20} = \frac{1}{20}$$

$$\frac{1}{v} = \frac{1}{20} \Rightarrow \mathbf{v = 20cm}$$

Image distance = v = 20cm

Distance: 20 cm

$$m = \frac{v}{u} = \frac{20}{-20} = -1$$

Nature : Real, inverted and same size

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

Solution:

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

$$f = -15cm$$

$$u = -10cm$$

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

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

$$= \frac{\frac{1}{\cancel{-15}} \times \cancel{30}^{2} + \frac{1}{\cancel{-10}} \times \cancel{30}^{3}}{30}$$

$$= \frac{-2-3}{30} = -\frac{5}{30} = -\frac{1}{6}$$

V = – 6cm

$$m = \frac{v}{u} = \frac{h_2}{h_1}$$

$$= \frac{-6}{-10} = \frac{h_2}{3}$$

$$= \frac{-18}{-10} = h_2$$

Size of the image h_2 = 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?

Ans:

Yes, he can get the image

b. Is there any change in the focal length?

Ans: No,

The lens becomes plane of convex. It converges the light rays similar to that of convex lens.

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

The eyes of nocturnal birds like owl has large cornea and a large pupil, these features increase their field of vision and an increase retinal surface and help them to collect more ambient light during night.

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Choose the correct answer.

1. The scattered light in Raman scattering contains _____ lines. **(PTA - 5)**
   a. stoke's b. anti stoke's c. rayleigh's d. all the above
   Ans: d. all the above

2. What is the least count of travelling microscope? **(APRIL - 2024)** **Ans: 0.01mm**
3. The least distance for human eye is _____ cm. **(PTA -VI)** **(25)**

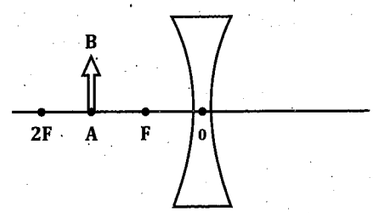
II. Short answers.

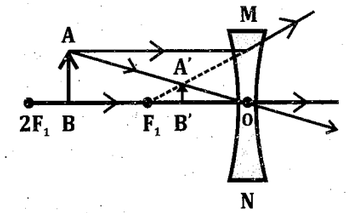
1. **Write applications of convex lenses.** **(APRIL - 2024)**
   1. Convex lenses are used as **camera lenses** and **magnifying lenses.**
   2. They are used in making microscope, telescope and slide projectors.
   3. They are used to correct the defect of vision called **hypermetropia.**

1. **A beam of light passing through a diverging lens of focal length 0.3m appears to be focused at a distance 0.2m behind the lens. Find the position of the object.** **(SEP - 2020)**
   Solution:
   $f = -0.3\,m,\ v = -0.2\,m$
   from lens equation
   $$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$
   $$\frac{1}{u} = \frac{1}{v} - \frac{1}{f}$$
   $$\frac{1}{u} = \frac{1}{-0.2} - \frac{1}{-0.3} = \frac{-10}{6}$$
   $$u = \frac{-6}{10} = \mathbf{-0.6\,m}$$

2. **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 & SEP - 2022)**
   Given:
   x = 4m and y = 20m
   Solution:
   Focal length of the correction lens is
   $$f = \frac{xy}{x-y}$$
   $$f = \frac{4 \times 20}{4-20} = \frac{80}{-16} = \mathbf{-5m}$$
   Power of the correction lens.
   $$\frac{1}{f} = -\frac{1}{5} = \mathbf{-0.2D}$$

3. **Complete the ray diagram of a concave lens.** **(PTA - 6)**
   Ans:



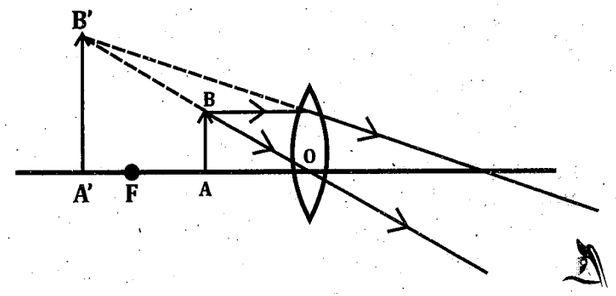


III. Long answers.

1. **The power of a lens is −2D. Find the focal length of a lens.** **(PTA - 4)**
   Given data:
   Power of lens (P) = −2D
   $$\therefore \text{focal length (f)} = \frac{1}{P}$$
   $$= \frac{1}{-2}$$
   $$= -0.5\ m$$
   ∴ Focal length of a lens is **−0.5 m.**

2. **What are the uses of simple microscope?** **(SEP - 2020)**
   1. By watch repairers and jewellers.
   2. To read small letters clearly.
   3. To observe parts of flower, insects etc.
   4. To observe finger prints in the field of forensic science.

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



   ii. **Find the position and write its nature and size of the image formed by simple microscope.**
   1. As per this position the convex lens produces an **erect, virtual** and **enlarged image** (A' B').
   2. The image formed is in the same side of the object.

4. **An object of height 3 cm is placed at 10 cm from a convex lens which produces an image at 20 cm from its optical centre. Calculate the magnification and height of the image produced.** **(PTA - 5)**
   Given:
   $h_1 = 3\ cm, u = -10\ cm,\ \ v = -20\ cm$
   We know that,

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

$$\therefore \frac{1}{v} = \frac{1}{f} - \frac{1}{u} \longrightarrow \frac{1}{-20} - \frac{1}{-10}$$

$$= \frac{1}{-20} + \frac{1}{10} = \frac{-1+2}{20} = \frac{1}{20}$$

$\therefore$ v = 20 cm

The image is formed at a distance of **20 cm behind the mirror**.

Magnification:

$$m = \frac{-v}{u} = \frac{h_2}{h_1}$$

$$= \frac{20}{-10} = \frac{h_2}{3}$$

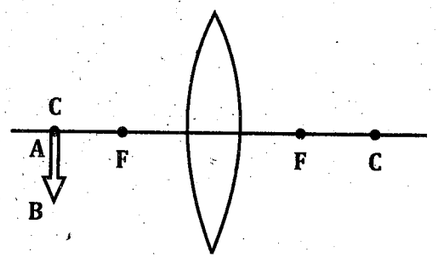
$$\therefore h_2 = 6 \text{ cm}$$

Image size is **6 cm, virtual** and **erect**.

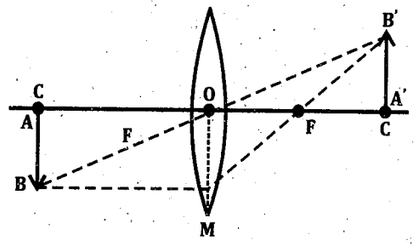
5. Write any 2 applications of concave lens. (SEP - 2021)

1. Concave lenses are used as eye lens of **'Galilean Telescope'**.
2. They are used in wide angle **spy hole** in doors.
3. They are used to correct the defect of vision called **'myopia'**.

6. i. 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)



Ans:



II. A student in a class room can read text book but he / she can't able to 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)

His / her eye defect is **'Myopia'**

Causes:

i. Lengthening of eyeball.
ii. Focal length of eye lens is reduced.
iii. The distance between eye lens and retina increases.
iv. The far point has come closer.
v. The images of distant objects are formed before the retina.

Remedy:

Doctor advices his / her to use a **concave lens** of appropriate power to correct this defect.

7. List the advantages of telescopes. (PTA - 3)

1. Elaborate view of the Galaxies, Planets, Stars and other heavenly bodies is possible.
2. Telescope can be viewed even with the low intensity of light.

ADDITIONAL QUESTIONS

I. Match the following:

1.

	Column A		Column B		Answers
1.	Velocity of light	a.	$s \alpha \frac{1}{\lambda^4}$	**d.**	$c = n\lambda$
2.	Snell's Law	b.	$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$	**c.**	$\frac{\sin i}{\sin r} = \frac{\mu_2}{\mu_1}$
3.	Rayleigh scattering	c.	$\frac{\sin i}{\sin r} = \frac{\mu_2}{\mu_1}$	**a.**	$s \alpha \frac{1}{\lambda^4}$
4.	Power of lens	d.	$c = n\lambda$	**e.**	$P = \frac{1}{f}$
5.	Lens formula	e.	$P = \frac{1}{f}$	**b.**	$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

2.

	Column A		Column B		Answers
1.	Tyndall scattering	a.	gases	**b.**	**colloids**
2.	Rayleigh scattering	b.	colloids	**a.**	**gases**
3.	Mie scattering	c.	monochromatic light	**d.**	**pollen**
4.	Raman scattering	d.	pollen	**c.**	**monochromatic light**

3.

	Column A		Column B		Answers
1.	Myopia	a.	convex	**e.**	**short sightedness**
2.	Hypermeteropia	b.	old age hypermeteropia	**d.**	**long sightedness**
3.	Camera lens	c.	concave	**a.**	**convex**
4.	Galiliean Telescope	d.	long sightedness	**c.**	**concave**
5.	Presbyopia	e.	short sightedness	**b.**	**old age hypermeteropia**

4.

	Column A		Column B		Answers
1.	Convex lens	a.	diverging	**d.**	**converging**
2.	Concave lens	b.	optical centre	**a.**	**diverging**
3.	Lens	c.	enlarged image	**e.**	**optically transparent medium**
4.	Distance of lens	d.	converging	**b.**	**optical centre**
5.	Magnitude > 1	e.	optically transparent medium	**c.**	**enlarged image**

5.

	Column A		Column B		Answers
1.	Refractive surface of eye	a.	iris	**e.**	**cornea**
2.	Centre of Iris	b.	retina	**d.**	**pupil**
3.	Coloured part of eye	c.	eye lens	**a.**	**iris**
4.	Back surface of eye	d.	pupil	**b.**	**retina**
5.	Ciliary muscles	e.	cornea	**c.**	**eye lens**

II. Choose the correct answer:

1. The speed of light in vacuum is _____ ms^{-1}.
   a. 3×10^8 b. 388×10^8 c. 0.38×10^8 d. 3.6×10^8 **Ans: a. 3×10^8**
2. Light is characterized by _____ and frequency.
   a. waves b. wavelength c. force d. distance **Ans: b. wavelength**
3. Among visible light, _____ has the lowest wavelength.
   a. red b. green c. indigo d. violet **Ans: d. violet**
4. The second law of refraction is also known as _____.
   a. law of reflection b. law of dispersion
   c. Snell's law d. mie scattering **Ans: c. Snell's law**
5. The ratio of speed of light in vacuum and in medium is defined as its _____.
   a. velocity b. refractive index
   c. reflective index d. scattering property **Ans: b. refractive index**
6. The refractive index of a medium is dependent on the _____.
   a. wavelength b. velocity c. frequency d. none of the above
   Ans: a. wavelength
7. In _____ scattering, the energy of the incident beam and the scattered beam are the same.
   a. Rayleigh b. Mie c. Tyndall d. none of the above
   Ans: d. none of the above
8. _____ scattering is responsible for the white appearance of the clouds.
   a. Rayleigh b. Mie c. Tyndall d. Raman **Ans: b. Mie**
9. The spectral lines having frequency equal to the incident frequency is called _____.
   a. Antistoke b. Stoke c. Rayleigh d. Raman
   Ans: c. Rayleigh
10. When one of the faces of a biconcave lens is plane, it is known as _____ lens.
    a. concave b. convex c. plano - concave d. plano - convex
    Ans: c. plano - concave
11. _____ lenses are used as camera lenses.
    a. Concave b. Bifocal c. Convex d. None of the above
    Ans: c. convex
12. For a concave lens, when an object is placed at infinity, a _____ image is formed at the focus.
    a. real b. virtual c. enlarged d. diminished
    Ans: b. virtual
13. Distances are measured from the _____ of the lens.
    a. focus b. curvature c. beyond curvature d. optical centre
    Ans: d. optical centre
14. _____ lenses are used as eye lens of 'Galilean Telescope'
    a. Convex b. Concave c. Bifocal d. None of the above
    Ans: b. Concave
15. Power of accommodation is achieved by changing the _____ of the eye lens.
    a. curvature b. retina c. focal length d. None of the above
    Ans: c. focal length
16. Myopia can be corrected using _____ lens.
    a. concave b. convex c. both d. none of the above
    Ans: a. concave
17. _____ is an optical instrument used to see distant objects.
    a. Microscope b. Telescope c. Kaleidoscope d. none of the above
    Ans: b. Telescope

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

1. The lines having frequencies lower than the incident frequency are called antistoke lines.
   Ans: False
   The lines having frequencies lower than the incident frequency are called **stoke lines**.
2. When rays parallel to the principal axis strike a convex lens the refracted rays are diverged.
   Ans: False
   When rays parallel to the principal axis strike a convex lens the refracted rays are **converged.**
3. In astigmatism, the eye cannot see parallel and horizontal lines clearly.
   Ans: True
4. Astigmatism can be corrected by using bifocal lenses.
   Ans: False
   Astigmatism can be corrected by using **cylindrical** lenses.
5. Compound microscope has 50 to 200 times more magnification power than simple microscope.
   Ans: True
6. The least count of a travelling microscope is 0.001 mm.
   Ans: False
   The least count of a travelling microscope is **0.01 mm**.
7. The first telescope was invented by Galileo in 1608.
   Ans: False
   The first telescope was invented by **Johann Lippershey** in 1608.
8. The image in an astronomical telescope is diminished.
   Ans: False
   The image in an astronomical telescope is **inverted**.

IV. Assertion and Reason.

1. **Assertion:** In a convex lens, the size of the image is much smaller than that of the object.
   Reason : Object is placed at infinity.
   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 the assertion.
   c. Assertion is true but reason is false.
   d. Assertion is false but reason is true.
   Ans: b. If both assertion and reason are true but reason is not the correct explanation of the assertion.
2. **Assertion:** Colour of the sun is red at sunrise and sunset.
   Reason : The light rays from the sun have to travel a larger distance in the atmosphere than at noon.
   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 the assertion.
   c. Assertion is true but reason is false.
   d. Assertion is false but reason is true.
   Ans: a. If both assertion and reason are true and reason is the correct explanation of assertion.
3. **Assertion:** A beam of sunlight, enters into a dusty room through a window, then its path becomes visible to us.

Reason : The tiny dust particles present in the air of the room scatter the beam of light.

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 the assertion.
c. Assertion is true but reason is false.
d. Assertion is false but reason is true.

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

4. **Assertion:** The refractive index of the medium is different for different coloured lights.

Reason : The incident ray, the refracted ray of light and the normal to the refracting surface all lie in the same plane.

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 the assertion.
c. Assertion is true but reason is false.
d. Assertion is false but reason is true.

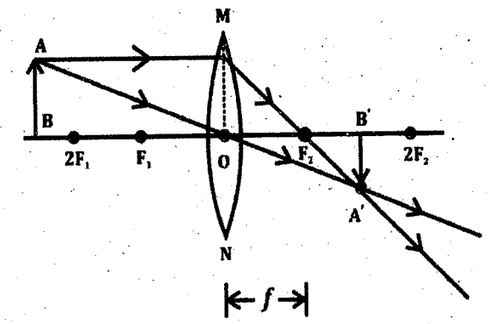
Ans: c. Assertion is true but reason is false.

V. Analog

1.	Violet	:	lowest wavelength	
	Red	:	_____	**(highest wavelength)**
2.	Snell's law	:	$\frac{\text{Sin i}}{\text{Sin r}}$	
	Rayleigh's scattering law	:	_____	$(\frac{1}{\lambda 4})$
3.	Stokes line	:	low frequency	
	Anti stokes line	:	_____	**(high frequency)**
4.	Thicker	:	convex	
	Thinner	:	_____	**(concave)**
5.	Len's formula $\left(\frac{1}{f}\right)$	:	$\frac{1}{v} - \frac{1}{u}$	
	Lens maker's $\left(\frac{1}{f}\right)$	:	_____	$(\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$
6.	Convex lens	:	converging, real image	
	Concave lens	:	_____	**(diverging, virtual image)**
7.	Pupil	:	path way	
	Iris	:	_____	**(controls amount of light)**
8.	Myopia	:	short sightedness	
	Hypermeteropia	:	_____	**(long sightedness)**
9.	Concave lens	:	distance vision	
	Convex lens	:	_____	**(reading purpose)**
10.	Telescope	:	see distant object	
	Microscope	:	_____	**(very small in dimension)**

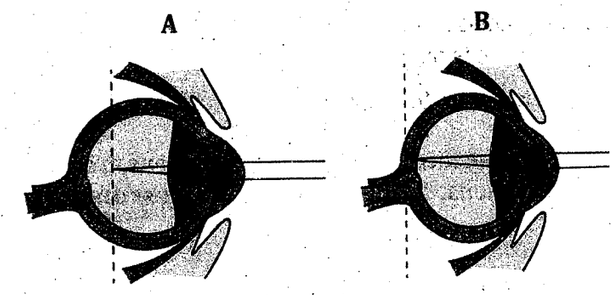
VI. To label the parts in the given diagram.

1. Draw ray diagram to show the formation of image by a convex lens when the object is placed beyond $2F_1$.



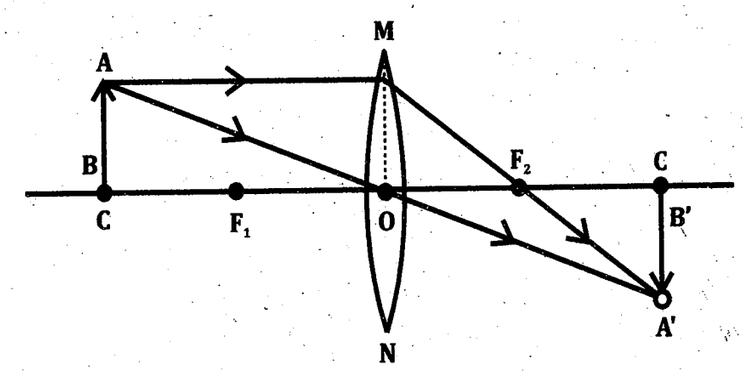
Object placed beyond C (>2F)

2. Identify the type of defect of vision in A and B and mention the lens used to correct it.



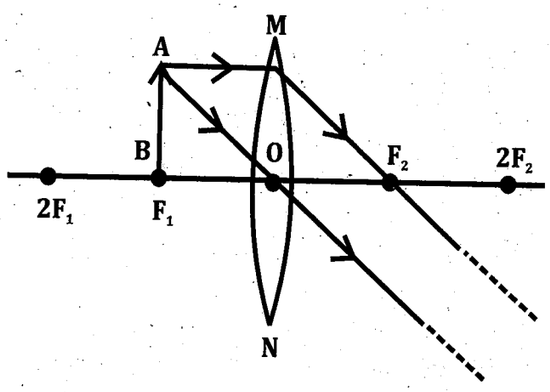
Ans: A - Myopia B - Hypermetropia
A - Concave B - Convex

3. Draw ray diagram to show the formation of image by a convex lens when the object is placed at C.



Object placed at C

4. If the object is placed at a principal focus F_1 of a convex lens, draw the ray diagram for the image formation.



Object placed at the principal focus F

VII. Problem solving.

1. The radii of curvature of two surfaces of a double convex lens are 10 cm each. Calculate its focal length and power of the lens. Refractive indices of glass and liquid are 1.5 and 1.8 respectively.

Given data,

$R_1 = 10$ cm, $R_2 = -10$ cm, $\mu_g = 1.5$ and $\mu_l = 1.8$

Solution:

In air,

$$\frac{1}{f_a} = ({}_a\mu_g - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

$$(1.5-1)\left[\frac{1}{10} + \frac{1}{10}\right]$$

$$\frac{1}{f_a} = 0.5\left[\frac{2}{10}\right]$$

$$= 0.5\left[\frac{1}{10}\right]$$

$$\frac{1}{f_a} = \frac{1}{10}$$

$\therefore f_a = 10$ cm

$$P_a = \frac{1}{f_a} = \frac{1}{0.1\,m}$$

$$\left[\frac{1\times10}{0.1\times10} = \frac{10}{1} = 10\right]$$

$P_a = 10$ dioptres

2. A needle of size 5 cm is placed 45 cm from a lens produced an image on a screen placed 90 cm away from the lens. Identify the type of the lens and calculate its focal length and size of the image.

Solution:

Given data

$h_1 = 5$ cm, $u = -45$ cm, $v = 90$ cm

$f = ?$, $h_2 = ?$

We know that $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$$= \frac{1}{90} - \frac{1}{-45}$$

$$\frac{1}{f} = \frac{1}{30}$$

$\therefore f = 30$ cm

Since f is positive, the lens is converging.

Since $\frac{h_2}{h_1} = \frac{v}{u}$

$$\frac{h_2}{5} = \frac{90}{-45} = -2$$

$$\frac{h_2}{5} = -2$$

$\therefore h_2 = -10$ cm

The negative sign indicates that the image is real and inverted.

3. Light rays travel from vacuum into a water whose refractive index is 1.31. If the angle of incidence is 30°. Calculate the angle of refraction inside the water.

Solution:

According to Snell's law

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

$\mu_1 \sin i = \mu_2 \sin r$

Here $\mu_1 = 1.0$; $\mu_2 = 1.31$; $i = 30°$

(1.0) $\sin 30° = 1.31 \sin r$

$$1 \times \frac{1}{2} = 1.31 \sin r$$

$$\therefore \sin r = \frac{1}{2\times1.31}$$

$$= 0.38$$

$\therefore r = \sin^{-1}(0.38)$

$r = 22.33°$

4. A beam of light rays passing through a rare medium into denser medium whose refractive index is 1.43. If the angle of incidence is 90°. Calculate the angle of refraction inside the denser medium.

Solution:

According to Snell's law

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

$\mu_1 \sin i = \mu_2 \sin r$

Here $\mu_1 = 1.0$, $\mu_2 = 1.43$, $i = 90°$

(1.0) $\sin 90° = 1.43 \sin r$

$1 = 1.43 \sin r$

$\therefore \sin r = \frac{1}{1.43} = 0.69$

$\therefore r = \sin^{-1}(0.69)$

$r = 43.63°$

5. **A person with myopia can see objects placed at a distance of 8m. If he wants to see objects at a distance of 25 cm. What should be the focal length and power of the concave lens he must wear?**

Solution:

Given that $x = 8$ m, $y = 25$ m

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

$$= \frac{8 \times 25}{8-25} = -11.8$$

Power of the correction lens

$$\frac{1}{f} = -\frac{1}{11.8} = -0.1$$

$= -0.1D$

6. **A candle is placed at a distance 5 cm from a concave lens of focal length 4 cm find the image distance.**

Solution:

$f = -0.5$ m

$v = -0.4$ m

$u = ?$

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

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

$$= \frac{1}{-0.4} - \frac{1}{-0.5}$$

$$\frac{1}{u} = -\frac{1}{0.1}$$

$\therefore u = -0.1$ m

7. **A needle is placed 12 cm away from a convex mirror of focal length 15 cm. Give the location of the image?**

Solution:

Object distance, $u = -12$ cm

Focal length $f = 15$ cm

Image distance $v = ?$

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

$$= \frac{1}{15} - \frac{1}{-12} = \frac{4+5}{60} = \frac{9}{60}$$

$$\therefore v = \frac{60}{9} = 6.7 \text{ cm}$$

Hence, the image of the needle is 6.7 cm away from the mirror.

8. **A tank is filled with water to a height of 12.5 cm. The apparent depth of a needle lying at the bottom of the tank is measured by a microscope to be**

1.4 cm. What is the refractive index of water?

Solution:

Actual depth of the needle in water $h_1 = 12.5$ cm

Apparent depth of the needle in water $h_2 = 9.4$ cm

The value of μ can be obtained as follows

$$\mu = \frac{h_1}{h_2} = \frac{12.5}{9.4} = 1.33$$

Hence, the refractive index of water is about 1.33

9. **Double convex lenses are to be manufactured from a glass of refractive index 1.55, with both faces of the same radius of curvature. What is the radius of curvature required if the focal length is to be 20 cm?**

Solution:

Refractive index of glass, μ = 1.55

Focal length of the double convex lens f = 20 cm

Radius of curvature of one face of the lens = R_1

Radius of curvature of the other face of the lens = R_2

Radius of curvature of the double - convex lens = R

$\therefore R_1 = R$ and $R_2 = -R$

The value of R can be calculated as,

$$\frac{1}{f} = (\mu - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

$$\frac{1}{20} = (1.55 - 1)\left[\frac{1}{R} + \frac{1}{R}\right]$$

$$\frac{1}{20} = 0.55 \times \frac{2}{R}$$

$R = 0.55 \times 2 \times 20$

$= 22$ cm

Hence, the radius of curvature of the double - convex lens is 22 cm

10. **A beam of light converges at a point P. Now a lens is placed in the path of the convergent beam 12 cm from P. At what point does the beam converge if the lens is a convex lens of focal length 20 cm.**

Solution:

Focal length of the convex lens, f = 20 cm

Image distance = v

According to the lens formula

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

$$\frac{1}{v} - \frac{1}{12} = \frac{1}{20}$$

$$\frac{1}{v} = \frac{1}{20} + \frac{1}{12} = \frac{3+5}{60}$$

$$= \frac{8}{60}$$

$$\therefore v = \frac{60}{8}$$

$$v = 7.5 \text{ cm}$$

Hence, the image is formed 7.5 cm away from the lens toward its right.

VIII. HOTS

1. Why does the sun appear white at noon?

1. At noon, the sun is at the top and the light rays coming from it have to travel less distance in the atmosphere of earth.
2. Hence, all colours get scattered very less, and appears white.

2. Why does the sky appear dark instead of blue to an astronaut?

1. The sky appears dark instead of blue to an astronaut because there is no atmosphere in the outer space that can scatter sunlight.
2. As the sunlight is not scattered, no scattered light reach the eyes of the astronauts and the sky appears black to them.

3. For a person with hypermeteropia, the near point has moved to 2.3 m. Calculate the focal length of the correction lens in order to make his eyes normal.

Solution:

Given that, d = 2.3 m

D = 25 cm = 0.25 m (for a normal eye)

Focal length of the correction lens is

$$f = \frac{d \times D}{d - D} = \frac{2.3 \times 0.25}{2.3 - 0.25} = \frac{0.575}{2.05} = 0.28 \text{ m}$$

$$f = 0.28 \text{ m}$$

IX. Short Answers:

1. Write any two disadvantages of telescopes.

1. Frequent maintenances needed.
2. It is not easily portable.

2. What is travelling microscope?

1. A travelling microscope is one of the best instrument for measuring very small length with high degree of accuracy at the order of **0.01 mm**.
2. It works based on the **principle of vernier**.
3. Its least count is **0.01 mm.**

3. What is convex lens?

1. It is a lens bounded by two spherical surfaces such that it is **thicker** at the centre than at the edges.
2. A beam of light passing through it, is **converged** to a point.
3. So, a convex lens is also called as **converging lens**.

4. What is concave lens?

1. It is a lens bounded by two spherical surfaces such that it is **thinner** at the centre than at the edges.
2. A parallel beam of light passing through it, is **diverged** or spread out.
3. So, a concave lens is also called as **diverging lens**.

5. What is Tyndall scattering or Tyndall effect?

The scattering of light rays by the **colloidal particles** in the **colloidal solution** is called Tyndall Scattering or Tyndall Effect.

6. What is Mie scattering.

When the diameter of the scatterer is **similar** to or **larger** than the wavelength of the incident light it is called Mie scattering.

X. Long Answers:

1. Explain the two laws of refraction.

First law of refraction:

The incident ray, the refracted ray of light and the normal to the refracting surface all lie in the same plane.

Second law of refraction:

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. This law is also known as Snell's law.

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

1. Refractive index gives us an idea of how fast or how slow light travels in a medium. The ratio of speed of light in vacuum to the speed of light in a medium is defined as refractive index 'μ' of that medium.
2. The speed of light in a medium is low if the refractive index of the medium is high and vice versa.
3. When light travels from a denser medium into a rarer medium, the refracted ray is bent away from the normal drawn to the interface.
4. When light travels from a rarer medium into a denser medium, the refracted ray is bent towards the normal drawn to the interface.

2. Explain Cartesian sign conventions in detail.

1. The object is always placed on the **left side** of the lens.
2. All the distances are measured from the **optical centre** of the lens.
3. The distances measured in the **same direction** as that of incident light are taken as **positive**.
4. The distances measured **against the direction** of incident light are taken as **negative**.
5. The distances measured **upward** and perpendicular to the principal axis is taken as **positive**.
6. The distances measured **downward** and perpendicular to the principal axis is taken as **negative**.

3. Describe the working of the Human Eye.

1. The transparent layer cornea bends the light ray through pupil located at the centre part of the Iris.
2. The adjusted light passes through the eye lens.
3. Eye lens is convex in nature.
4. So, the light rays from the objects are converged and a real and inverted image is formed on retina.
5. Then, retina passes the received real and inverted image to the brain through optical nerves.
6. Finally, the brain senses it as erect image.

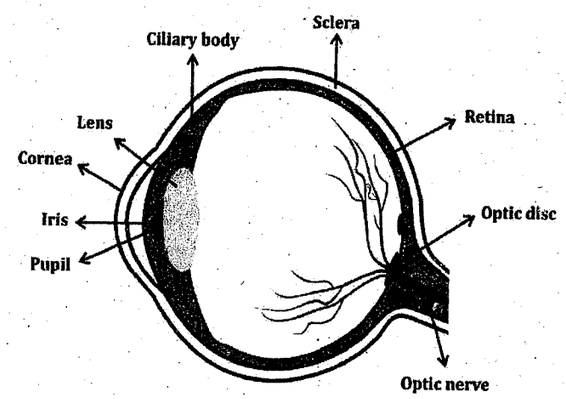
4. Explain in detail about Structure of a human eye with neat labelled diagram.

1. The eye ball is approximately spherical in shape with a diameter of about 2.3 cm.
2. It consists of a tough membrane called sclera, which protects the internal parts of the eye.

Important parts of human eye are

Cornea:

1. This is the thin and transparent layer on the front surface of the eyeball.
2. It is the main refracting surface.
3. When light enters through the cornea, it refracts or bends the light on to the lens.



Human eye

Iris:

1. It is the coloured part of the eye.
2. It may be blue, brown or green in colour.
3. Every person has a unique colour, pattern and texture.
4. Iris controls amount of light entering into the pupil like camera aperture.

Pupil:

1. It is the centre part of the Iris.
2. It is the pathway for the light to retina.

Retina:

1. This is the back surface of the eye.
2. It is the most sensitive part of human eye, on which real and inverted image of objects is formed.

Ciliary muscles:

1. Eye lens is fixed between the ciliary muscles.

2. It helps to change the focal length of the eye lens according to the position of the object.

Eye Lens:

It is the important part of human eye. It is convex in nature.

5. Explain the construction of Simple Microscope. (PTA - 2)

1. Simple microscope has a convex lens of short focal length.
2. It is held near the eye to get enlarged image of small objects.
3. Let an object (AB) is placed at a point within the principal focus (u < f) of the convex lens and the observer's eye is placed just behind the lens.

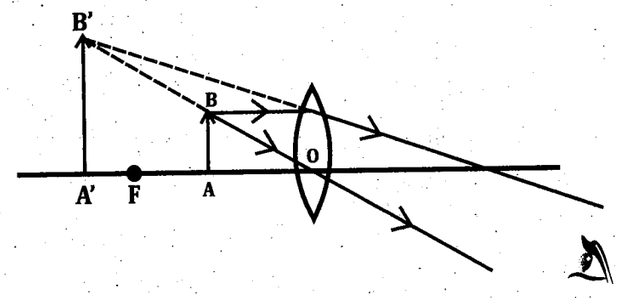


Image formation in simple microscope

4. As per this position the convex lens produces an erect, virtual and enlarged image (A' B').

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

XI. Fill in the blanks.

1. Light travels in the form of _____. **(waves)**
2. Objects which emit their own light are called _____ objects. **(luminous)**
3. The Stars and the Sun are _____ objects. **(luminous)**
4. Light is a form of _____. **(energy)**
5. Light travels along a _____ line. **(straight)**
6. Light does not need a _____ for propagation. **(medium)**
7. The speed of light in vacuum or air is _____. **(3×10^8 m s^{-1})**
8. The velocity of light is given by _____. **($c = v\lambda$)**
9. Among visible light, _____ light has the lowest wavelength. **(violet)**
10. Among visible light, _____ light has the highest wavelength. **(red)**
11. When a ray of light travels from one transparent medium into another obliquely, the path of light undergoes _____. **(deviation)**
12. The deviation of a ray of light is called _____. **(refraction)**
13. The velocity of light is more in _____ medium. **(rarer)**
14. The velocity of light is less in _____ medium. **(denser)**
15. The second law of refraction is also known as _____. **(Snell's Law)**
16. The speed of light is low if the _____ of the medium is high. **(refractive index)**
17. When light travels from a denser medium to a rarer medium, the refracted ray is bent _____ from the normal. **(away)**
18. When light travels from a rarer medium to a denser medium, the refracted ray is bent _____ from the normal. **(towards)**
19. The _____ is the fundamental and natural source of light. **(Sun)**
20. Mercury vapour lamp is an example of a _____ light source. **(composite)**
21. The splitting up of light into its component colours is called _____. **(dispersion)**

22. Angle of refraction is the smallest for _____. **(red)**
23. Angle of refraction is the highest for _____. **(violet)**
24. The angle of refraction is determined in terms of the _____ of the medium. **(refractive index)**
25. The refractive index of a medium is dependent on the _____ of the light. **(wavelength)**
26. The band of colours in the dispersion of light is called _____. **(spectrum)**
27. If a source of light produces a light of single colour, it is known as a _____ source. **(monochromatic)**
28. _____ light is a composite light which consists of light of various colours or wavelengths. **(Sun)**
29. The angle of refraction is determined in terms of the _____ of the medium. **(refractive index)**
30. The interacting particle in the scattering of light is called as _____. **(scatterer)**
31. If the energy of the incident beam of light and the scattered beam of light are same, then it is called as _____. **(elastic scattering)**
32. The _____ and _____ of the scatterer results in different types of scattering. **(nature, size)**
33. The light rays from the sun travel a _____ distance during sunrise and sunset. **(greater)**
34. The scattering of sunlight by the atoms or molecules of the gases in the Earth's atmosphere is known as _____ scattering. **(Rayleigh)**
35. The amount of scattering of light is inversely proportional to the _____ power of its wavelength. **(fourth)**
36. The shorter wavelength colours are scattered _____ than the longer wavelength colours. **(more)**
37. When sunlight passes through the atmosphere, the _____ colour is scattered to a greater extent than the red colour. **(blue)**
38. Mie scattering is also as _____ scattering. **(elastic)**
39. _____ scattering is responsible for the white appearance of the clouds. **(Mie)**
40. Milk, ice cream, muddy water are _____. **(colloids)**
41. The scattering of light rays by the colloidal particles in the colloidal solution is called _____ Scattering. **(Tyndall)**
42. The spectral lines having frequency equal to the incident ray frequency is called _____. **(Rayleigh lines)**
43. The spectral lines which are having frequencies other than the incident ray frequency are called _____. **(Raman lines)**
44. The lines having frequencies lower than the incident frequency is called _____ lines. **(stokes)**
45. The lines having frequencies higher than the incident frequency is called _____ lines. **(antistokes)**
46. A _____ is an optically transparent medium bounded by two spherical refracting surfaces or one plane and one spherical surface. **(lens)**
47. Lenses are classified into _____ types. **(two)**
48. Convex lens is also called as _____ lens. **(bi - convex)**
49. Concave lens is also called as _____ lens. **(bi - concave)**
50. _____ lens is thicker at the centre than at the edges. **(convex)**
51. _____ lens is thinner at the centre than at the edges. **(concave)**
52. A _____ lens is also called as converging lens. **(convex)**
53. A _____ lens is also called as diverging lens. **(concave)**
54. In a _____ lens one of the faces of a bi - convex lens is plane. **(plano - convex)**
55. In a _____ lens one of the faces of a bi - concave lens is plane. **(plano - concave)**
56. When a ray of light strikes the concave lens obliquely at its optical centre it follows without _____. **(deviation)**
57. When rays parallel to the principal axis strike a convex lens the refracted rays _____. **(converge)**
58. When an object is placed at infinity for a convex lens a real image is formed at the _____. **(principal focus)**
59. When an object is placed beyond C for a convex lens, real and inverted image is formed between _____ and the principal focus. **(center of curvature)**
60. For a convex lens, when an object is placed between F and C the size of the image is _____ than that of the object. **(bigger)**
61. For a convex lens, when an object is placed at focus, a real image is formed at _____. **(infinity)**
62. For a convex lens, when an object is placed between principal focus and optical centre, a _____ image is formed. **(virtual)**
63. _____ lenses are used as camera lenses. **(convex)**

64. _____ lenses are used as magnifying lenses. **(convex)**
65. _____ lenses are used in making microscope and telescope. **(convex)**
66. Convex lenses are used to correct the defect of vision called _____. **(hypermeteropia)**
67. In a concave lens, when an object is placed at infinity a virtual image is formed at the _____. **(focus)**
68. Concave lenses are used as eye lens of _____ telescope. **(Galilean)**
69. _____ lenses are used in wide angle spy hole in doors. **(Concave)**
70. Concave lenses are used to correct the defect of vision called _____. **(myopia)**
71. According to Sign Convention, the object is always placed on the _____ side of the lens. **(left)**
72. All the distances are measured from the _____ of the lens. **(optical centre)**
73. The distances measured against the direction of incident light are taken as _____. **(negative)**
74. The distances measured upward and perpendicular to the principal axis is taken as _____. **(positive)**
75. _____ is defined as the ratio of the height of the image to the height of an object. **(Magnification)**
76. Magnification is denoted by the letter _____. **('m')**
77. Any optically transparent material will have a _____. **(refractive index)**
78. Convex lens mostly produces _____ images. **(real)**
79. Concave lens mostly produces _____ images. **(virtual)**
80. The ability of a lens to converge or diverge is called as its _____. **(power)**
81. Power of a lens is numerically defined as the reciprocal of its _____. **(focal length)**
82. The SI unit of power of a lens is _____. **(dioptre)**
83. By convention, the power of a convex lens is taken as _____. **(positive)**
84. By convention, the power of a concave lens is taken as _____. **(negative)**
85. 1 D is the power of a lens whose focal length is _____. **(1 meter)**
86. The lens formula and the lens maker's formula are applicable to only _____ lenses. **(thin)**
87. The diameter of the eye ball is about _____ cm. **(2,3)**
88. The eye ball consists of a tough membrane called _____. **(sclera)**
89. The _____ protects the internal parts of the eye. **(sclera)**
90. The _____ is the main refracting surface of the eye. **(cornea)**
91. The _____ is the coloured part of the eye. **(iris)**
92. The _____ is the centre part of the iris. **(pupil)**
93. The eye lens is fixed between the _____ muscles. **(ciliary)**
94. The eye lens is _____ in nature. **(convex)**
95. The ability of the eye lens to focus nearby as well as distant objects is called _____ of the eye. **(power of accommodation)**
96. The power of accommodation is achieved by changing the _____ of the eye lens. **(focal length)**
97. In a condition where myopia and hypermeteropia affect a single individual, _____ lens is used. **(bifocal)**
98. In _____ the eye cannot see parallel and horizontal lines clearly. **(Astigmatism)**
99. Astigmatism can be corrected by using _____ lenses. **(cylindrical)**
100. A _____ microscope has a convex lens of short focal length. **(simple)**
101. Magnification power of microscopes can be increased by decreasing the _____ of the lens used. **(focal length)**
102. Compound microscope has _____ to _____ times more magnification power than simple microscope. **(50, 200)**
103. A _____ microscope is used to measure very small length with high degree of accuracy. **(travelling)**
104. A _____ microscope works on the principle of vernier. **(travelling)**
105. _____ is an optical instrument to see the distant objects. **(Telescope)**
106. The first telescope was invented by _____. **(Johann Lippershey)**
107. _____ made a telescope to observe distant stars. **(Galileo)**
108. The telescope invented by _____ was similar to the astronomical telescope. **(Kepler)**
109. In reflecting telescope _____ mirrors are used. **(parabolic)**
110. Galilean telescope, Keplerian telescope are some of the examples of _____ telescopes. **(refracting)**
111. Gregorian, Newtonian are some of the examples of _____ telescopes. **(reflecting)**
112. _____ and _____ are the two major types of telescopes. **(astronomical, terrestrial)**
113. A _____ telescope is used to view heavenly bodies. **(astronomical)**

3. THERMAL PHYSICS

KEY FORMULAE		
1.	Relation between Celsius and Kelvin	$K = C + 273$
2.	Relation between Fahrenheit and Kelvin	$K = (F + 460) \times \frac{5}{9}$
3.	Linear expansion	$\frac{\Delta L}{L_0} = \alpha_L \Delta T$
4.	Superficial expansion	$\frac{\Delta A}{A_0} = \alpha_A \Delta T$
5.	Cubical expansion	$\frac{\Delta V}{V_0} = \alpha_V \Delta T$
6.	Boyle's law	$P \propto \frac{1}{V}$
7.	Charles's law	$V \propto T$
8.	Avogadro's law	$V \propto n$

I. Choose the correct answer.

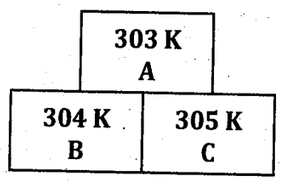
1. The value of universal gas constant ※※ **(APRIL - 2024)**
   a. $3.81\ J\ mol^{-1}\ K^{-1}$ b. $8.03\ J\ mol^{-1}\ K^{-1}$
   c. $1.38\ J\ mol^{-1}\ K^{-1}$ d. $8.31\ J\ mol^{-1}\ K^{-1}$ **Ans: d. $8.31\ J\ mol^{-1}\ K^{-1}$**

2. If a substance is heated or cooled, the change in mass of that substance is **(PTA - I)**
   a. positive b. negative c. zero d. none of the above
   Ans: c. zero

3. If a substance is heated or cooled, the linear expansion occurs along the axis of
   a. X or –X b. Y or –Y
   c. both (a) and (b) d. (a) or (b) **Ans: c. both (a) and (b)**

4. 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 T.E and P.E d. difference in K.E and T.E
   Ans: c. difference in T.E and P.E

5. In the Given diagram, the possible direction of heat energy transformation is ※※
   a. $A \leftarrow B, A \leftarrow C, B \leftarrow C$
   b. $A \rightarrow B, A \rightarrow C, B \rightarrow C$
   c. $A \rightarrow B, A \leftarrow C, B \rightarrow C$
   d. $A \leftarrow B, A \rightarrow C, B \leftarrow C$



Ans: a. $A \leftarrow B, A \leftarrow C, B \leftarrow C$

※※

II. Fill in the blanks.

1. The value of Avogadro number_____. **(SEP - 20) Ans: 6.023×10^{23}/mol**
2. The temperature and heat are _____ quantities. **Ans: scalar (PTA - II)**
3. One calorie is the amount of heat energy required to raise the temperature of _____ of water through _____. ※ **Ans: 1 gram, 1°C**
4. According to Boyle's law, the shape of the graph between pressure and reciprocal of volume is _____. **Ans: straight line**

III. State whether the following statements are true or false, if false explain why?

1. For a given heat in liquid, the apparent expansion is more than that of real expansion. ※※
   Ans: False
   For a given heat in liquid, the **real** expansion is more than that of **apparent** expansion.
2. Thermal energy always flows from a system at higher temperature to a system at lower temperature.
   Ans: True
3. According to Charles's law, at constant pressure, the temperature is inversely proportional to volume. **(PTA - II)**
   Ans: False
   According to Charles's law, at constant pressure, the temperature is **directly** proportional to volume.

IV. Match the items in column - I to the items in column - II.

	Column - I		Column - II		Answers		
1.	Linear expansion	-	a.	change in volume	-	d.	**change in length**
2.	Superficial expansion	-	b.	hot body to cold body	-	e.	**change in area**
3.	Cubical expansion	-	c.	$1.381 \times 10^{-23}\ JK^{-1}$	-	a.	**change in volume**
4.	Heat transformation	-	d.	change in length	-	b.	**hot body to cold body**
5.	Boltzmann constant	-	e.	change in area	-	c.	**$1.381 \times 10^{-23}\ JK^{-1}$**

V. Assertion and reason type questions.

1. **Assertion:** If one end of the rod is heated, other end also is heated.
   Reason : Heat always flows from a region of lower temperature to higher temperature of the rod.

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 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.

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

2. **Assertion:** Gas is highly compressible than solid and liquid. **(PTA - II)**

Reason : Interatomic or intermolecular distance in the gas is comparably high.

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 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.

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

VI. Answer in Briefly.

1. **Define one calorie. (APR - 2023, GMQ - 2019, SEP - 2022)** ※※

One calorie is defined as the amount of heat energy required to rise the temperature of **1 gram** of water through **1°C**.

2. **Distinguish between linear, areal or superficial expansion.** ※

	Linear expansion		Areal or Superficial expansion
1.	When a body is heated or cooled, the **length** of the body changes due to change in its temperature.	1.	It is the increase in the **area** of a solid object due to heating.
2.	The **ratio** of increase in **length** of the body per **degree** rise in temperature to its unit length is called the coefficient of linear expansion.	2.	The **ratio** of increase in **area** of the body per **degree** rise in temperature to its unit area is called the coefficient of superficial expansion.
3.	$\frac{\Delta L}{L_0} = \alpha_L \Delta T$	3.	$\frac{\Delta A}{A_0} = \alpha_A \Delta T$

3. **What is co - efficient of cubical expansion? (PTA - VI)**

1. The **ratio** of increase in **volume** of the body per **degree** rise in temperature to its **unit volume** is called as coefficient of cubical expansion.
2. It is measured in K^{-1}

3. Co - efficient of cubical expansion can be expressed as,

$$\frac{\Delta V}{V_0} = \alpha_V \Delta T$$

4. **State Boyle's law. (JULY - 24, JUNE - 2023, GMQ - 2019, MAY - 2022)** ※※

Boyle's law states that when the **temperature** of a gas is kept **constant**, the **volume** of a fixed mass of gas is **inversely** proportional to its **pressure**.

$$P \propto \frac{1}{V}$$

5. **State - the law of volume.**

The law of volume states that, when the **pressure** of gas is kept **constant**, the **volume** of a gas is **directly** proportional to the **temperature** of the gas.

$$V \propto T$$

6. **Distinguish between ideal gas and real gas.** ※※ **(JUNE - 2023)**

	Ideal Gases		Real Gases
1.	The atoms or molecules of a gas do not interact with each other.	1.	The molecules or atoms of a gas interact with each other.
2.	At low pressure or high temperature the interatomic or intermolecular forces of attraction are weak.	2.	At very high temperature or low pressure, a real gas behaves as an ideal gas because of the lack of inter atomic or intermolecular force of attraction.

7. **What is co - efficient of real expansion? (SEP - 2020)**

1. The ratio of the **true** rise in the **volume** of the liquid per degree rise in **temperature** to its unit volume.
2. It's SI unit is K^{-1}

8. **What is co - efficient of apparent expansion? (APRIL - 2024)**

1. Coefficient of apparent expansion is defined as the ratio of the **apparent** rise in the **volume** of the liquid per degree rise in **temperature** to its unit volume.
2. It's SI unit is K^{-1}

VII. Numerical problems.

1. **Find the final temperature of a copper rod. Whose area of cross section changes from 10 m² to 11 m² due to heating. The copper rod is initially kept at 90 K. (Coefficient of superficial expansion is 0.0021 / K).**

Given data:

Initial area (A_0) = 10 m²

Final area $= 11\ m^2$

$\therefore$ Change in area (ΔA) $= 11\ m^2 - 10\ m^2$

$= 1\ m^2$

Initial temperature(T_i) $= 90\ K$

Final temperature (T_f) $= ?$

Coefficient of superficial expansion (α_A) = 0.0021 / K (or) (0.0021 K^{-1})

Solution:

$$\frac{\Delta A}{A_0} = \alpha_A \Delta T$$

$$\frac{1}{10} = 0.0021\ (T_f - T_i)$$

$$0.0021\ (T_f - T_i) = \frac{1}{10}$$

$$0.0021(T_f - T_i) = 0.1$$

$$T_f - T_i = \frac{0.1}{0.0021}$$

$$T_f - 90 = 47.62$$

$$\therefore T_f = 47.62 + 90$$

$$\mathbf{T_f = 137.62\ K}$$

2. **Calculate the coefficient of cubical expansion of a zinc bar. Whose volume is increased 0.25 m³ from 0.3m³ due to the change in its temperature of 50 K.**

Given data:

Initial volume (V_0) $= 0.3\ m^3$

Final volume $= 0.25\ m^3 + 0.3\ m^3$

$= 0.55\ m^3$

$\therefore (\Delta V) = 0.25\ m^3$

Change in temperature (ΔV) $= 50\ K$

Coefficient of cubical (α_v) $= ?$

Solution:

$$\frac{\Delta V}{V_0} = {}_v \Delta T$$

$$\frac{0.25}{0.3} = \alpha_v\ (50)$$

$$0.833 = \alpha_v\ (50)$$

$$\therefore \alpha_v = \frac{0.833}{50}$$

$$\alpha_v = \mathbf{0.0167\ /\ K}$$

VIII. Answer in detail.

1. Derive the ideal gas equation. ※※※

1. The ideal gas equation relates **all the properties** of an ideal gas.

2. It obeys **Boyle's law** and **Charles' law** and **Avogadro's law.** According to Boyle's law,

$$PV = \text{constant} \longrightarrow (1)$$

According to Charles's law,

$$\frac{V}{T} = \text{constant} \longrightarrow (2)$$

According to Avogadro's law,

$$\frac{V}{n} = \text{constant} \longrightarrow (3)$$

After combining equations (1), (2) and (3) we can get the following equation.

$$\mathbf{\frac{PV}{nT} = constant} \longrightarrow (4)$$

The above relation is called the combined law of gases.

If we consider a gas, which contains μ moles of the gas, the number of atoms contained will be equal to μ times the Avogadro number, N_A.

i.e., $n = \mu N_A$. $\longrightarrow$ (5)

Using equation (5), equation (4) can be written as

$$\frac{PV}{\mu N_A T} = \text{constant}$$

The value of the constant in the above equation is taken to be k_B, which is called as **Boltzmann constant ($1.38 \times 10^{-23}\ JK^{-1}$).** Hence, we have the following equation:

$$\frac{PV}{\mu N_A T} = k_B$$

$PV = \mu N_A k_B T$. (Here, $\mu N_A k_B = R$, which is termed as universal gas constant R is 8.31 J $mol^{-1}K^{-1}$)

PV = RT

2. Explain the experiment of measuring the real and apparent expansion of a liquid with a neat diagram. (GMQ - 2019)

Aim:

To measure real and apparent expansion of liquid.

Apparatus Required:

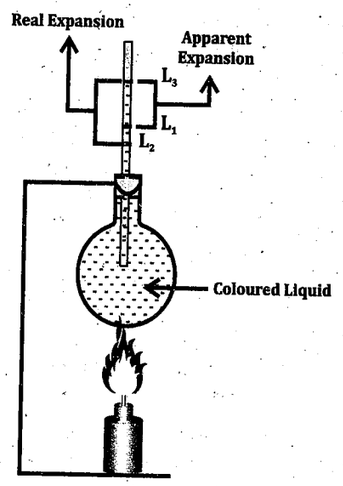
Round bottomed flask, a narrow glass tube with a scale, burner.

Procedure:

1. The **liquid** whose real and apparent expansion is to be determined is poured in a **container** up to a level.
2. Mark this level as L_1.
3. Now, **heat** the container and the liquid using a burner.
4. Initially, the container receives the thermal energy and it **expands**.
5. As a result, the **volume** of the liquid appears to have **reduced**.
6. Mark this reduced level of liquid as L_2.
7. On further **heating**, the **expansion** of the liquid occurs.
8. Hence, the level of liquid rises to L_3.
9. Now, the difference between the levels L_1 and L_3 is called as apparent expansion.

   Apparent expansion = $L_3 - L_1$
10. The difference between the levels L_2 and L_3 is called real expansion.

    Real expansion = $L_3 - L_2$



Real and apparent expansion of liquid

Result: The **real expansion** is always **more** than that of **apparent expansion**.

IX. HOT questions.

1. If you keep ice at 0°C and water at 0°C in either of your hands, in which hand you will feel more chillness? Why?

1. More chillness will be felt in the hand with **ice**.
2. Because ice at 0°C has taken more heat from the medium than water at 0°C for its change of state from water to ice.

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Choose the correct answer.

1. The co efficient of linear expansion depends on _____. **(PTA - 4)**
   a. original length b. increasing temperature
   c. nature of material d. a. and b. **Ans: c. nature of material**

2. Variation in dimensions of any object due to rise in temperature is called as _____. **(PTA - 5)**
   a. thermal expansion b. thermal variation
   c. thermal convection d. evaporation **Ans: a. thermal expansion**

3. If the atoms or molecules of a gas do not interact with each other, then the gas is said to be _____. **(PTA - 6)**
   a. a real gas b. an ideal gas c. a noble gas d. a rare gas
   Ans: b. an ideal gas

4. _____ is the average kinetic energy of the molecules of a substance. **(PTA - 2)**
   Ans: Temperature

II. Short answers.

1. **State Avogadro's law.** **(SEP - 2021)**

   At constant pressure and temperature, the **volume** of a gas is **directly proportional** to **number of atoms** or molecules present in it.

   $$V \alpha n \text{ or } \frac{V}{n} = \text{constant}$$

2. **State whether the following statement is true or false, justify your answer.**
   During the process of transferring heat energy, the body at lower temperature is cooled while the body at higher temperature is heated. (PTA - 4)

   Ans: False.

   Reason:

   For any exchange of heat. The heat gained by the cold system is equal to heat lost by the hot system.

   During the process of transferring heat energy, the body at **lower** temperature is **heated**. While the body at **higher** temperature is **cooled**.

3. **Assertion:** Heat always flows from the body of higher temperature to the body of lower temperature.
   Reason : The mass of the body is not altered when it is heated or cooled. **(PTA - 5)**

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

4. A container of capacity 70 ml is filled with a liquid up to 50 ml. When it is heated the liquid level falls to 48.5 ml and then rises to 51.2 ml. Find the apparent and real expansion. **(PTA - 6)**

Given data:

Level of the liquid $L_1 = 50$ ml

Level of the liquid $L_2 = 48.5$ ml

Level of the liquid $L_3 = 51.2$ ml

Apparent expansion $= L_3 - L_1$

$= 51.2 \text{ ml} - 50 \text{ ml} =$ **1.2 ml**

Real expansion $= L_3 - L_2$

$= 51.2 \text{ ml} - 48.5 \text{ ml} =$ **2.7 ml**

So, real expansion > apparent expansion

III. Long answers.

1. i. Define: Co - efficient of linear expansion. **(PTA - 1)**

The ratio of increase in **length** of the body per degree rise in temperature to its **unit length** is called as the coefficient of linear expansion. It's SI unit is K^{-1}.

ii. The length of an aluminium rod at the temperature 303 K is 50m. What would be its increase in length when it is heated to 323 K? (The linear co - efficient of Aluminium is $23 \times 10^{-6} K^{-1}$) **(PTA - 1)**

Given data:

Length of an aluminium rod $(L_0) = 50$ m

Initial temperature $(t_1) = 303$ K

Final temperature $(t_2) = 323$ K

Linear co - efficient of an aluminium $(\alpha_L) = 23 \times 10^{-6} K^{-1}$

Solution:

The change in length on heating,

$$\Delta L = L_0 \alpha_L \Delta T$$

$$\therefore \Delta T = t_2 - t_1 = 323 - 303$$

$$= 20K$$

$$= 50 \times 23 \times 10^{-6} \cancel{k^{-1}} \times 20 \cancel{K}$$

$$= 23000 \times 10^{-6} m$$

$$\Delta L = 0.023 \text{ m}$$

2. Keeping the temperature as constant, if a gas in a container is compressed four times of its initial pressure. The volume of gas changing from 20cc (V_1 cc) to V_2 cc. Find the final volume V_2. **(PTA - 3)**

Given data:

Initial pressure $(P_1) = P$

Final pressure $(P_2) = 4P$

Initial volume $(V_1) = 20$ cc $= 20 \text{ cm}^3$

Final pressure $(V_2) = ?$

Solution:

Using Boyle's Law,

$PV =$ constant

$$P_1V_1 = P_2V_2$$

$$V_2 = \frac{P_1}{P_2} \times V_1$$

$$= \frac{P}{4P} \times 20 \text{ cm}^3$$

$$V_2 = 5 \text{cm}^3$$

3. Convert 80°F temperature into Kelvin scale. **(PTA - 6)**

Given:

$F = 80°$

Solution:

$$K = (F + 460) \times \frac{5}{9}$$

$$= (80 + 460) \times \frac{5}{9}$$

$$= (540) \times \frac{5}{9}$$

$$= 60 \times 5$$

$$= 300 \text{ K}$$

ADDITIONAL QUESTIONS

I. Match the following:

	Column - I		Column - II		Answers
1.	Linear expansion	- a.	areal expansion	- d.	**longitudinal expansion**
2.	Superficial expansion	- b.	Joule	- a.	**areal expansion**
3.	Cubical expansion	- c.	Kelvin	- e.	**volumetric expansion**
4.	Heat	- d.	longitudinal expansion	- b.	**Joule**
5.	Temperature	- e.	volumetric expansion	- c.	**Kelvin**

1.

	Column - I		Column - II		Answers
1.	Absolute temperature	- a.	scalar quantity	- e.	**Thermodynamic temperature**
2.	Absolute scale	- b.	heat energy	- d.	**Kelvin scale**
3.	Thermal energy	- c.	perfect gas	- b.	**heat energy**
4.	Heat	- d.	Kelvin scale	- a.	**scalar quantity**
5.	Ideal gas	- e.	Thermodynamic temperature	- c.	**perfect gas**

2.

	Column - I		Column - II		Answers
1.	Charles law	- a.	PV = RT	- e.	**Law of volume**
2.	Avogadro law	- b.	$8.31 \text{ J mol}^{-1}\text{K}^{-1}$	- d.	**6.023×10^{23}/mol**
3.	Gas Equation	- c.	PV = Constant	- a.	**PV = RT**
4.	Boyle's law	- d.	6.023×10^{23}/mol	- c.	**PV = Constant**
5.	Universal gas constant	- e.	Law of volume	- b.	**$8.31 \text{ J mol}^{-1}\text{K}^{-1}$**

II. Choose the correct answer:

1. 0K = _____ °C.
   a. 273 b. 243 c. −273 d. −243 **Ans: c. −273**
2. Absolute temperature is also known as _____ temperature.
   a. thermal b. Thermo c. Thermostatic d. Thermodynamic **Ans: d. Thermodynamic**
3. When two bodies have the same temperature, they are said to be in _____.
   a. absolute zero b. thermodynamic temperature
   c. thermal equilibrium d. thermal energy **Ans: c. thermal equilibrium**
4. _____ is the amount of heat energy required to rise the temperature of 1 gram of water through 1°C.
   a. One Joule b. One Kelvin c. One Newton d. One calorie **Ans: d. One calorie**
5. All forms of matter undergo _____ on heating.
   a. contraction b. repulsion c. expansion d. evaporation **Ans: c. expansion**
6. Superficial expansion is also known as _____ expansion.
   a. linear b. areal c. cubical d. cuboidal **Ans: b. areal**
7. PV= constant, is the expression for _____ law.
   a. Charles b. Boyle c. Avogadro d. Newton **Ans: b. Boyle**
8. i. Avogadro's number is equal to 6.023×10^{23} / mol
   ii. PV= constant, expresses Charles law.
   iii. $V \propto T$, expresses Boyles law.
   iv. PV = RT, expresses ideal gas equation.
   a. i. & iii. are correct b. ii. & iv. are correct
   c. iii. & ii. are correct d. i. & iv. are correct **Ans: d. i. & iv. are correct**
9. The value of universal gas constant is _____ J mol^{-1} K^{-1}.
   a. 8.31 b. 83.1 c. 0.831 d. 831 **Ans: a. 8.31**
10. 1.38×10^{-23} JK^{-1} is called _____ constant.
    a. gas b. Boyle's c. Boltzmann d. none of the above **Ans: c. Boltzmann**
11. Expansion of a liquid without considering the expansion of the container is called _____ expansion.
    a. real b. apparent c. superficial d. cubical **Ans: b. apparent**
12. Atoms or molecules of a gas which do not interact with each other are called _____.
    a. ideal gas b. unique gas
    c. both (a) & b d. none of the above **Ans: a. ideal gas**

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

1. Value of universal gas constant is 3.31 J $mol^{-1}K^{-1}$.
   Ans: False
   Value of universal gas constant is **8.31 J $mol^{-1}K^{-1}$**.
2. If a liquid is heated directly without using any container, then the expansion is termed as real expansion of the liquid.
   Ans: True
3. The coefficient of cubical expansion of liquid is dependent of temperature whereas its value for gases independent on the temperature of gases.

   Ans: False
   The coefficient of cubical expansion of liquid is **independent** of temperature whereas its value for gases **depends** on the temperature of gases.
4. The ratio of increase in area of the body per degree rise in temperature to its unit area is called as coefficient of cubical expansion.
   Ans: False
   The ratio of increase in **volume** of the body per degree rise in temperature to its unit **volume** is called as coefficient of cubical expansion.
5. The value of coefficient of linear expansion is same for different materials.
   Ans: False
   The value of coefficient of linear expansion is **different** for different materials.
6. Heat always flows from a system at lower temperature to a system at higher temperature.
   Ans: False
   Heat always flows from a system at **higher** temperature to a system at **lower** temperature.

IV. Analog

1.	Temperature	:	Kelvin	
	Heat	:	_____	**(Joule)**
2.	$\frac{\Delta L}{L_o}$	:	$\alpha_L \Delta T$	
	$\frac{\Delta A}{A_o}$	:	_____	**($\alpha_A \Delta T$)**
3.	Aluminium	:	7×10^{-5} K^{-1}	
	Water	:	_____	**(20.7×10^{-5} K^{-1})**
4.	Real expansion	:	heated directly	
	Apparent expansion	:	_____	**(heated indirectly)**
5.	Boyle's law	:	$P \alpha \frac{1}{V}$	
	Charles's law	:	_____	**($V \alpha T$)**
6.	Avogadro's number	:	6.023×10^{23}/mol	
	Boltzmann constant	:	_____	**($1.38 \times 10^{23} JK^{-1}$)**
7.	Triple point	:	$\frac{1}{273.16}$	
	0K	:	_____	**(− 273°C)**
8.	Ideal gas	:	PV = RT	
	Universal gas	:	_____	**($R = \mu N_A K_B$)**

V. Problem solving.

1. **A container whose capacity is 100 ml is filled with a liquid up to 70 ml. Then, the liquid in the container is heated. Initially, the level of the liquid falls from 50 ml to 68.5 ml. Then we heat more, the level of the liquid rises to 73.2 ml. Find the apparent and real expansion.**
   Solution:
   Level of the liquid L_1 = 70 ml
   Level of the liquid L_2 = 68.5 ml
   Level of the liquid L_3 = 73.2 ml
   Apparent expansion = $L_3 - L_1$
   = 73.2 − 70
   = **3.2 ml**

Real expansion $= L_3 - L_2$
$= 73.2 - 68.5$
$= 4.7$ ml

∴ So, real expansion>apparent expansion.

2. **A steel is 40 cm long is at 20°C. The co efficient of linear expansion for steel is $12 \times 10^{-6}°C^{-1}$. Find the increase in length when it is at 70°C.**

Solution:

The change in temperature (ΔT) $= 70°C - 20°C$
The original length (L_1) $= 40$ cm
Coefficient of linear expansion for steel ($\propto$) $= 12 \times 10^{-6}°C^{-1}$
The change in length (ΔL) = ?
The change in length (ΔL)

$$(\Delta L) \propto L_1 \Delta T$$
$$= 12 \times 10^{-6}°C^{-1} \times 40cm \times 50°C$$
$$= 24000 \times 10^{-6} cm$$
$$= 24 \times 10^3 \times 10^{-6} cm$$
$$= 24 \times 10^{-3} cm$$
$$= \frac{24}{10^{-3}} cm \text{ (or) } \frac{24}{1000} cm$$
$$\Delta L = 0.024 cm$$

3. **An iron rod heated from 30°C to 80°C. The final length of iron is 115 cm and the coefficient of linear expansion is $3 \times 10^{-3}°C^{-1}$. What is the original length?**

The change in temperature(ΔT) $= 80°C - 30°C$
$= 50°C$
The final length (L_2) $= 115$ cm
The coefficient of linear expansion ($\propto$) $= 3 \times 10^{-3}°C^{-1}$
The original length (L_1) = ?

Solution:

Formula for the change in length for the linear expansion

$$\Delta L = \propto L_1 \Delta T$$

∴ final length

$$L_2 = L_1 + \Delta T$$
$$L_2 = L_1 + \propto L_1 \Delta T$$
$$= L_1(1 + \propto \Delta T)$$
$$115cm = L_1(1 + (3 \times 10^{-3}°C^{-1})(50°C))$$
$$= L_1(1 + 150 \times 10^{-3})$$
$$= L_1(1 + 0.15)$$
$$L_1 = \frac{115}{1.15} cm$$
$$L_1 = 100 cm$$

4. **At constant temperature, a gas is compressed two times of its initial pressure. The volume of gas in the container changing from 40CC to V_2 cc. Find the final volume V_2.**

Data:

Initial pressure (P_1) = P
Final pressure (P_2) = 2P
Initial volume (V_1) = 40 CC = $40cm^3$
Final volume (V_2) = ?
Using Boyle's law, PV = constant

$$P_1V_1 = P_2V_2$$
$$V_2 = \frac{P_1}{P_2} \times V_1$$
$$= \frac{P}{2P} \times 40cm^3$$
$$V_2 = 20cm^3$$

5. **An aluminium rod heated from 20°C to 100°C. The initial length of rod is 5cm. The coefficient of cubical expansion is $24 \times 10^{-6}°C^{-1}$ its final volume expansion is $125.72cm^3$. Find the change in volume.**

Solution:

The initial length (L_o) = 5cm
∴ Initial volume (V_o) $= (5cm)^3$
$= 125cm^3$
Final volume of expansion(V_f) $= 125.72cm^3$
∴ change in volume (ΔV) $= V_f - V_o$
$= 125.72 - 125$
$\Delta V = 0.72cm^3$.

6. **An steel bar heated from 20°C 100°C. The initial length of steel bar is 5cm and the coefficient of cubic expansion is $18.2 \times 10^{-5}°C^{-1}$. Find the final cubic expansion of the steel bar.**

Solution:

The coefficient of cubic expansion $= 18.2 \times 10^{-5}°C^{-1}$
The initial length L_o = 5cm
Initial temperature = 20°C
Final temperature = 100°C
∴ change in temperature (ΔT) = 80°C
Final cubic expansion is,

$$V_f = L_f^3$$
$$= [L_o(1 + \propto \Delta T)]^3$$
$$= [5cm(1 + 18.2 \times 10^{-5}°C^{-1} \times 80°C)]^3$$
$$= [5cm(1 + 0.1456)]^3$$
$$= [5cm(1.1456)]^3$$
$$V_f = 187.94cm^3.$$

VI. HOTS

1. **A steel container filled to the rim with ethanol. When initial temperature is 20°C and final temperature is 80°C. Ethanol's cubic expansion is $75 \times 10^{-5}°C^{-1}$ and its initial volume is $1000cm^3$. Find the change in volume of ethanol.**

Solution:

The initial volume (V_o) $= 1000 cm^3$
Initial temperature (T_o) = 20°C
Final temperature (T_f) = 80°C
Coefficient of cubical expansion ($\propto$) $= 75 \times 10^{-5}°C^{-1}$
Change in volume (ΔV) $= V_o(1 + \propto \Delta T)$
$= 1000 cm^3 (1 + 75 \times 10^{-6}°C^{-1} \times 60°C)$
$= 1000 cm^3 (1 + 0.0045)$
$= 1000 cm^3 (0.0045)$

$= 1004.5 cm^3$

$\therefore \Delta V = V_f - V_o$

$= 1004.5 - 1000$

$= 4.5 cm^3$

2. **5 moles of nitrogen gas is in a 100 liter fixed cylinder at 300 K. What is the pressure of the gas?**

Given data:

$V = 100L$

$n = 5$ moles

$R = 0.08205 \frac{L.atm}{mol.K}$

$T = 300 K$

$\therefore PV = nRT$

$P = \frac{nRT}{V}$

$= \frac{(5 \text{ moles})\left(0.08205 \frac{L.atm}{mol.K}\right)(300K)}{100L} = \frac{123.075}{100} atm$

$P = 1.23 atm$

VII. Short Answers:

1. **Define thermodynamic temperature.**

The temperature measured in relation to **absolute zero** using the Kelvin scale is known as thermodynamic temperature.

2. **Give the relation between the different types of scale of temperature.**

1. Celsius and Kelvin : $K = C + 273$
2. Fahrenheit and Kelvin: $K = (F + 460) \times \frac{5}{9}$

$0K = -273^\circ C$

3. **Define - thermal equilibrium.**

Two or more physical systems or bodies are said to be in thermal equilibrium if there is **no net flow of thermal energy** between the systems.

4. **What is thermal energy.**

When a hot object is in contact with another cold object, a form of **energy flows** from the hot object to the cold object is known as thermal energy.

5. **What is heating?**

The process in which heat energy flows from a body at a **higher temperature to** another object at **lower temperature** is known as heating.

6. **Write the characteristic features of heat energy transfer.**

1. Heat always flows from a system at higher temperature to a system at lower temperature.
2. The **mass** of a system is **not altered** when it is heated or cooled.
3. For any exchange of heat, the heat gained by the cold system is equal to heat lost by the hot system.

Heat gained = Heat lost

7. **Define kilocalorie.**

One kilocalorie is defined as the amount of heat energy required to **rise** the temperature of **1 kilogram** of water through **1°C**.

8. **Write the changes undergo when a certain amount of heat energy is given to a substance.**

1. Temperature of the substance **rises**.
2. The substance may change its state from solid to liquid or from liquid to gas.
3. The substance will **expand** when **heated**.

9. **What is coefficient of superficial expansion?**

The ratio of increase in **area** of the body per degree rise in temperature to its **unit area** is called coefficient of superficial expansion.

10. **Define temperature.**

1. Temperature is defined as the **degree of hotness** of a body.
2. The SI unit of temperature is **Kelvin** (K).

VIII. Long Answers:

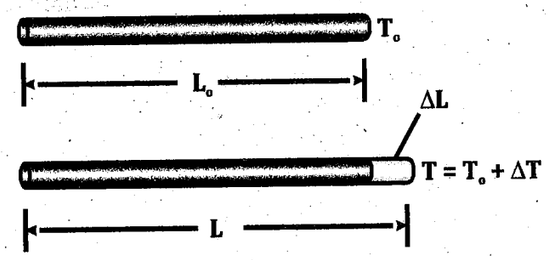
1. **Explain linear expansion with equation.**

Linear expansion:

1. When a body is heated or cooled, the length of the body changes due to change in its temperature.
2. Then the expansion is said to be linear or longitudinal expansion.
3. The ratio of increase in length of the body per degree rise in temperature to its unit length is called as the coefficient of linear expansion.
4. The value of coefficient of linear expansion is different for different materials.
5. The equation relating the change in length and the change in temperature of a body is

$$\frac{\Delta L}{L_o} = \alpha_L \Delta T$$

6. ΔL - change in length (Final length - Original length)
7. L_o - original length
8. ΔT - change in temperature (Final temperature - Initial temperature)
9. α_L - coefficient of linear expansion.



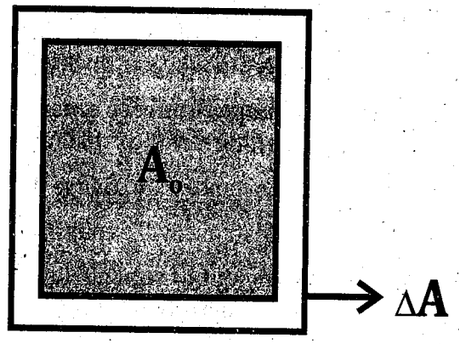
Linear expansion

2. **Explain superficial expansion with equation.**

Superficial expansion:

1. If there is an increase in the area of a solid object due to heating, then the expansion is called superficial or areal expansion.
2. Superficial expansion is determined in terms of coefficient of superficial expansion.
3. The ratio of increase in area of the body per degree rise in temperature to its unit area is called as coefficient of superficial expansion.
4. Coefficient of superficial expansion is different for different materials.
5. The SI unit of coefficient of superficial expansion is K^{-1}.

6. The equation relating to the change in area and the change in temperature is given below.
7. ΔA - change in area (Final area - Initial area)
8. A_o - original area
9. ΔT - change in temperature (Final temperature - Initial temperature)
10. α_A - coefficient of superficial expansion.



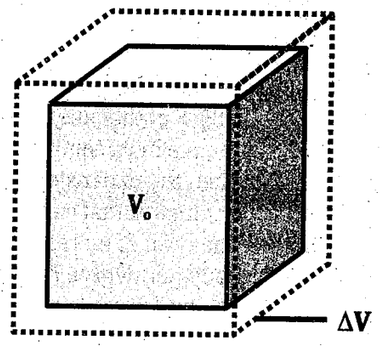
Superficial expansion

3. Explain cubical expansion with equation.

Cubical expansion:

1. If there is an increase in the volume of a solid body due to heating, then the expansion is called cubical or volumetric expansion.
2. As in the cases of linear and areal expansion, cubical expansion is also expressed in terms of coefficient of cubical expansion.
3. The ratio of increase in volume of the body per degree rise in temperature to its unit volume is called as coefficient of cubical expansion.
4. This is also measured in K^{-1}.
5. The equation relating to the change in volume and the change in temperature is given below:

$$\frac{\Delta V}{V_o} = \alpha_v \Delta T$$



Cubical expansion

6. ΔV - change in volume (Final volume - Initial volume)
7. V_o - original volume
8. ΔT - change in temperature (Final temperature - Initial temperature)
9. α_v - coefficient of cubical expansion.
10. Different materials possess different coefficient of cubical expansion.

IX. Fill in the blanks.

1. _____ is the primary source of thermal energy for all living organisms. **(Sun)**
2. _____ is defined as the degree of hotness of a body. **(Temperature)**
3. Temperature is the property, which determines the direction of flow of _____. **(heat)**
4. Temperature is a _____ quantity. **(scalar)**
5. The SI unit of temperature is _____. **(Kelvin)**
6. The temperature measured in relation to absolute zero using the Kelvin scale is known as _____. **(absolute scale temperature)**
7. Absolute scale temperature is also known as _____ temperature. **(thermodynamic)**
8. _____ K is the absolute scale of temperature of the body. **(Zero)**
9. If two bodies are said to be in thermal equilibrium, then they will be at the _____. **(same temperature)**
10. Thermal energy is also known as _____. **(heat energy)**
11. Heat energy flows from a body at a _____ temperature to another object at _____ temperature. **(higher, lower)**

12. Heat is a _____ quantity. **(scalar)**
13. The rise in temperature is in proportion to the amount of _____ supplied. **(heat energy)**
14. All forms of matter undergo _____ on heating. **(expansion)**
15. The ratio of the increase in length of the body per degree rise in temperature to its unit length is called as the _____. **(coefficient of linear expansion)**
16. The SI unit of coefficient of linear expansion is _____. **(K^{-1})**
17. The SI unit of coefficient of superficial expansion is _____. **(K^{-1})**
18. If there is an increase in the volume of a solid body due to heating, then the expansion is called_____. **(cubical)**
19. _____ will have more expansion than a liquid. **(Gas)**
20. _____ have the highest expansion. **(Gases)**
21. The coefficient of cubical expansion of liquid is independent of _____. **(temperature)**
22. If a liquid is heated directly without using any container, then the expansion that we observe is termed as _____ expansion of the liquid. **(real)**
23. _____ determines whether a body is in equilibrium or not with its surroundings. **(temperature)**
24. Celsius and degree Fahrenheit are units of _____. **(temperature)**
25. 0K = _____°C. **(−273)**
26. The transfer of heat energy continues until the bodies attain _____. **(Thermal equilibrium)**
27. When a cold body is placed in contact with hot body _____ energy is transferred from the hot body to the cold body. **(Thermal)**
28. In thermal equilibrium, the temperature of the cold body _____. **(increases)**
29. The process of transfer of heat continues until the two bodies attain the same _____. **(temperature)**
30. During the process of transferring heat energy, the body at _____ temperature is heated. **(lower)**
31. The _____ of a system is not altered when it is heated or cooled. **(mass)**
32. The heat gained by the cold system is _____ to the heat lost by the hot system. **(equal)**
33. _____ is defined as the amount of heat energy required to rise the temperature of 1 gram of water through 1°C. **(One calorie)**
34. _____ is defined as the amount of heat energy required to rise the temperature of 1 kilogram of water through 1°C. **(One kilocalorie)**
35. The extent of expansion of solids is _____ than in liquids and gases. **(smaller)**
36. Linear expansion is also called as _____ expansion. **(longitudinal)**
37. Superficial expansion is also called as _____ expansion. **(areal)**
38. Cubical expansion is also called as _____ expansion. **(volumetric)**
39. The coefficient of cubic expansion of water is _____ K^{-1}. **(20.7×10^{-5})**
40. When heated, the atoms in a liquid or gas _____ energy. **(gain)**
41. The expansion of a liquid without considering the expansion of the container is called the _____ expansion of the liquid. **(apparent)**
42. $P \propto \frac{1}{V}$, is the expression for_____ law. **(Boyle's)**
43. Gases are classified as _____ and _____ gases. **(real, ideal)**
44. Ideal gas is also called as _____ gas. **(perfect)**
45. A real gas at low pressure or high temperature can be termed as a _____ gas. **(perfect)**
46. _____ gases obey Boyle's, Charles and Avogadro's Law. **(Ideal)**
47. The ideal gas equation relates all the properties of an _____ gas. **(Ideal)**
48. $\frac{PV}{nT}$ = constant, is called the _____ law of gases. **(combined)**
49. The value of Boltzmann constant is _____. **(1.38×10^{-23} JK^{-1})**
50. The ideal gas equation is also called as _____. **(equation of state)**
51. For a given heat energy, the real expansion is always more than that of _____ expansion. **(apparent)**

4. ELECTRICITY

KEY FORMULAE		
1.	Electric current	$I = \frac{Q}{t}$
2.	One ampere	$\frac{\text{1 coulomb}}{\text{1 second}}$
3.	Potential difference	$\frac{\text{Work done (W)}}{\text{Charge (Q)}}$
4.	One volt	$\frac{\text{1 joule}}{\text{1 coulomb}}$
5.	Ohm's Law	$V = IR$
6.	One ohm	$\frac{\text{1 volt}}{\text{1 ampere}}$
7.	Conductance	$G = \frac{1}{R}$
8.	Electric resistivity	$\rho = \frac{RA}{L}$
9.	Electrical conductivity	$\sigma = \frac{1}{\rho}$
10.	Resistors in series	$R_S = nR$
11.	Resistors in parallel	$R_p = \frac{R}{n}$
12.	Series connection of parallel resistors	$R_{total} = R_{p1} + R_{p2}$.
13.	Parallel connection of series resistors	$\frac{1}{R_{total}} = \frac{1}{R_{s1}} + \frac{1}{R_{s2}}$
14.	Joule's law	$H = I^2Rt$
15.	Electric power	$P = VI$
16.	Energy	$E = Pt$

I. Choose the best answer.

1. Which of the following is correct?
   a. Rate of change of charge is electrical power.
   b. Rate of change of charge is current.
   c. Rate of change of energy is current.
   d. Rate of change of current is charge.

   Ans: b. Rate of change of charge is current.

2. SI unit of resistance is ※※ **(SEP - 2021)**
   a. mho b. joule c. ohm d. ohm meter

   Ans: c. ohm

3. In a simple circuit, why does the bulb glow when you close the switch?
   a. The switch produces electricity.
   b. Closing the switch completes the circuit.
   c. Closing the switch breaks the circuit.
   d. The bulb is getting charged.

   Ans: b. Closing the switch completes the circuit.

4. Kilowatt hour is the unit of ※※ **(APRIL - 24, JU - 23, GMQ - 19, SEP - 22)**
   a. resistivity b. conductivity
   c. electrical energy d. electrical power **Ans: c. electrical energy**

II. Fill in the blanks.

1. When a circuit is open, _____ cannot pass through it. **Ans: current**
2. The ratio of the potential difference to the current is known as _____. ※※ **Ans: resistance**
3. The wiring in a house consists of _____ circuits. ※ **Ans: parallel**
4. The power of an electric device is a product of _____ and _____. **Ans: electric current, potential difference**
5. LED stands for _____. **Ans: Light Emitting Diode**

III. State whether the following statements are true or false: If false correct the statement.

1. Ohm's law states the relationship between power and voltage. ※※
   Ans: False
   Ohm's law states the relationship between **current** and **potential difference**.
2. MCB is used to protect house hold electrical appliances.
   Ans: True
3. The SI unit for electric current is the coulomb. ※
   Ans: False
   The SI unit for electric current is the **ampere**.
4. One unit of electrical energy consumed is equal to 1000 kilowatt hour.
   Ans: False
   One unit of electrical energy consumed is equal to **1** kilowatt hour.
5. The effective resistance of three resistors connected in series is lesser than the lowest of the individual resistances. ※※
   Ans: False
   The effective resistance of three resistors connected in **parallel** is lesser than the lowest of the individual resistances.

IV. Match the items in column - I to the items in column - II. (PTA - V)

Column - I		Column - II		Answers		
1.	Electric current	a.	volt	e.	ampere
2.	Potential difference	b.	ohm meter	a.	volt
3.	Specific resistance	c.	watt	b.	ohm meter (PTA - IV)
4.	Electrical power	d.	joule	c.	watt
5.	Electrical energy	e.	ampere	d.	joule

V. Assertion and reason type questions.

1. **Assertion:** Electric appliances with a metallic body have three wire connections.

   Reason : Three pin connections reduce heating of the connecting wires.

   a. if both the assertion and the reason are true and the reason is the correct explanation of the assertion.
   b. if both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.
   c. if the assertion is true, but the reason is false.
   d. if the assertion is false, but the reason is true.

   Ans: c. if the assertion is true, but the reason is false.

2. **Assertion:** In a simple battery circuit the point of highest potential is the positive terminal of the battery.

   Reason : The current flows towards the point of the highest potential.

   a. if both the assertion and the reason are true and the reason is the correct explanation of the assertion.
   b. if both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.
   c. if the assertion is true, but the reason is false.
   d. if the assertion is false, but the reason is true.

   Ans: c. if the assertion is true, but the reason is false.

3. **Assertion:** LED bulbs are far better than incandescent bulbs.

   Reason : LED bulbs consume less power than incandescent bulbs.

   a. if both the assertion and the reason are true and the reason is the correct explanation of the assertion.
   b. if both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.
   c. if the assertion is true, but the reason is false.
   d. if the assertion is false, but the reason is true.

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

VI. Very short answer questions.

1. **Define the unit of current.** ※※※ **(JUNE - 2023)**

   1. The SI unit of electric current is **ampere (A)**.
   2. When a charge of 1 coulomb flows across any cross - section of a conductor, in one second is called 1 ampere.

$$\textbf{1 ampere} = \frac{\textbf{1 coulomb}}{\textbf{1 second}}$$

2. **What happens to the resistance, as the conductor is made thicker?**

   Ans: Resistance decreases ※※

   Because resistance is inversely proportional to area of cross section.

3. **Why is tungsten metal used in bulbs, but not in fuse wires?** ※ **(APRIL - 2024)**

   1. It is because tungsten has a **very high melting point**.
   2. If it is used in a fuse wire, it will **not melt** when a large amount of current is passed through it and the **appliance** will be **damaged**.

4. **Name any two devices, which are working on the heating effect of the electric current.** **(APRIL - 2024)**

   1. Electric heater
   2. Electric Iron

VII. Short answer questions.

1. **Define electric potential and potential difference.** ※※

   Electric potential:

   The electric potential at a point is defined as, "the amount of **workdone** in moving **a unit positive charge** from **infinity** to that point **against** the **electric force**".

   Electric potential difference:

   The electric potential difference between two points is defined as the amount of **work done** in moving a **unit positive charge** from **one point** to **another point** against the electric force.

2. What is the role of the earth wire in domestic circuits? ※※※

1. The earth wire provides a low resistance path to the electric current.
2. Whenever a **live wire** accidentally touches the body of the metallic electric appliance the earth wire sends the **current** to the **earth**.
3. Thus, the earth wire serves as a **protective conductor**, which saves us from **electric shocks**.

3. State Ohm's law. ※※

At a **constant temperature**, the steady **current** 'I' flowing through a conductor is **directly** proportional to the **potential difference** 'V' between the two ends of the conductor.

$$V = IR$$

4. Distinguish between the resistivity and conductivity of a conductor. (JULY - 24)

	Resistivity		Conductivity
1.	It is the **resistance** of a conductor of unit **length** and unit area of **cross-section**.	1.	It is the **reciprocal** of **electrical resistivity**.
2.	Its unit is **ohm meter**.	2.	Its unit is **ohm^{-1} meter^{-1}**
3.	$\rho = \frac{RA}{L}$	3.	$\sigma = \frac{1}{\rho}$

5. What connection is used in domestic appliances and why?

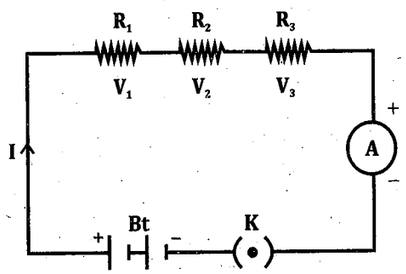
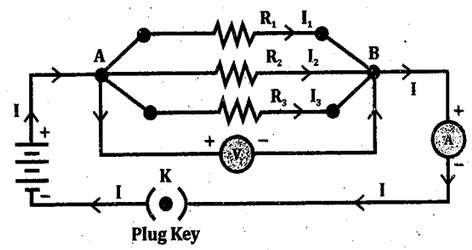
Parallel connection is used in domestic appliances.

Reason:

1. Each appliance will get the **full voltage**.
2. The parallel circuit **divides** the **current** through the appliances.
3. Each appliance will get the proper current depending on its **resistance**.
4. Each of them can be put on / off **independently**.

VIII. Long answer questions.

1. With the help of a circuit diagram derive the formula for the resultant resistance of three resistances connected: ※※※ **(PTA - IV)**

	Resistors in series	Resistors in parallel
1.	 Series connection of resistors	 Parallel connections of resistors
2.	**Three resistors** R_1, R_2, and R_3 be connected **in series**.	Three resistors R_1, R_2 and R_3 are connected in parallel across A and B.
3.	Current flowing through these resistors are same, but voltage is different.	Current flowing through these resistors are different, but voltage is same.
4.	According to **Ohm's Law**, the potential differences V_1, V_2 and V_3 across R_1, R_2 and R_3 respectively, are given by, $V_1 = I R_1$ ----------→ (1) $V_2 = I R_2$ ----------→ (2) $V_3 = I R_3$ ----------→ (3) The **sum** of the potential differences across the ends of each resistor is $V = V_1 + V_2 + V_3$ Using equations (1), (2) and (3), we get $V = I R_1 + I R_2 + I R_3$ ---→ (4) The **effective resistor** is a single resistor, which can replace the resistors effectively, so as to **allow** the **same current** through the electric circuit. Let, the **effective resistance** of the **series** - combination of the resistors, be R_s. Then, $V = I R_s$ ------→ (5) Combining equation (4) and (5) we get,	According to the Ohm's law, we have, $I_1 = \frac{V}{R_1}$ ----------→ (1) $I_2 = \frac{V}{R_2}$ ----------→ (2) $I_3 = \frac{V}{R_3}$ ----------→ (3) The total current through the circuit is given by $I = I_1 + I_2 + I_3$ Using equations (1), (2) and (3) we get $I = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$ ---------→ (4) Let the effective resistance of the parallel combination of resistors be R_p. Then $I = \frac{V}{R_p}$ ----------→ (5) Combining equations (4) and (5) we have $\frac{V}{R_p} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$

	$I R_s = IR_1 + IR_2 + IR_3$ $\mathbf{R_s = R_1 + R_2 + R_3}$ ------> (6)	$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ ----------> (6)
5.	When a number of resistors are connected in series, their equivalent resistance or effective resistance is equal to the **sum** of the **individual resistances**.	When a number of resistors are connected in parallel, the sum of the reciprocals of the individual resistances is equal to the reciprocal of the effective or equivalent resistance.
6.	When 'n' resistors of equal resistance R are connected in series, the equivalent resistance is 'n R'. i.e., $\mathbf{R_s = n R}$	When 'n' resistors of equal resistances R are connected in parallel, the equivalent resistance is $\frac{R}{n}$. Hence, $\mathbf{R_p = \frac{R}{n}}$
7.	The equivalent resistance in a series combination is greater than the highest of the individual resistances.	The equivalent resistance in a parallel combination is less than the lowest of the individual resistances.

2. a. What is meant by electric current? ※※ (PTA - I, MAY - 2022)

Electric current is defined as the rate of flow of charges in a conductor.

$$I = \frac{Q}{t}$$

b. Name and define its unit. (PTA - I, MAY - 2022)

1. The SI unit of electric current is **ampere**.
2. When a charge of **one coulomb** flows across any cross - section of a conductor, in **one second**.

$$\textbf{1 ampere} = \frac{\textbf{1 coulomb}}{\textbf{1 second}}$$

c. Which instrument is used to measure the electric current? How should it be connected in a circuit? (PTA - I, MAY - 2022)

Ans:

Instrument: **Ammeter**

It is connected in a circuit by series connection.

3. a. State Joule's law of heating. ※※※ (APR - 2023)

Joule's law of heating states that the heat produced in any resistor is:

1. Directly proportional to the **square** of the **current** passing through the resistor.
2. Directly proportional to the **resistance** of the resistor.
3. Directly proportional to the **time** for which the current is passing through the resistor.

$$\mathbf{H = I^2 Rt}$$

b. An alloy of nickel and chromium is used as the heating element. Why? (APR - 2023)

1. It has **high resistivity**
2. It has a **high melting point**
3. It is **not** easily **oxidized**

c. How does a fuse wire protect electrical appliances? (APR - 2023)

1. When a large current passes through the circuit, the fuse wire **melts** due to **Joule's heating effect** and hence the circuit gets **disconnected.**
2. Therefore, the circuit and the electric appliances are **saved** from any **damage**.

4. Explain about domestic electric circuits. (circuit diagram not required)(SEP-20)

1. The first stage of the domestic circuit is to bring the power supply to the main - box from a distribution panel, such as a **transformer**.
2. Main box contains

i. Fuse box:

1. It contains either a **fuse wire** or a miniature circuit breaker. **(MCB)**
2. It is used to protect the house hold electrical appliances from **overloading** due to excess current.
3. An MCB has a **spring** attached to the switch, which is attracted by an **electromagnet** when an excess current passes through the circuit.
4. It is activated **automatically** as well as **manually**.

ii. Meter:

It is used to **record** the **consumption** of electrical energy.

Insulated wire:

3. The electricity is brought to houses by **two** insulated wires.
4. One wire has a **red** insulation and is called the **'live wire'**.
5. The other wire has a **black** insulation and is called the **'neutral wire'**.
6. Both, the live wire and the neutral wire enter into a box where the **main fuse** is connected with the **live wire**.
7. After the electricity meter, these wires enter into the **main switch**, which is used to discontinue the electricity supply whenever required.
8. Then, these wires are connected to live wires of **two separate circuits**.

5 A rating circuit:

9. It is used to run the electric appliances with a **lower power rating**, such as tube lights, bulbs and fans.

15 A rating circuit:

10. It is used to run electric appliances with a **high power rating**, such as air - conditioners, refrigerators, etc.
11. All the circuits in a house are connected in **parallel**, so that the disconnection of one circuit does not affect the other circuit.
12. The electricity supplied to our house is actually an **alternating current** having an electric potential of **220V**.

5. a. What are the advantages of LED TV over the normal TV? (PTA - VI)

1. It has **brighter** picture quality.
2. It is **thinner** in size.
3. It uses **less power** and consumes very less energy.
4. Its **lifespan** is more.
5. It is more **reliable**.

b. List the merits of LED bulb. (JULY - 2024, PTA - 1)

1. As there is no filament, there is **no loss** of **energy** in the form of heat. It is **cooler** than the incandescent bulb.

2. In comparison with the fluorescent light, it has significantly **low power** requirement.
3. It is **not harmful** to the **environment**.
4. It has a wide range of **colours**.
5. It is **cost - efficient** and **energy efficient**.
6. Mercury and other toxic materials are not required.

IX. Numerical problems:

1. An electric iron consumes energy at the rate of 420 W when heating is at the maximum rate and 180 W when heating is at the minimum rate. The applied voltage is 220 V. What is the current in each case?

Solution:

Energy rating means power.

i. power = 420 W (when heating is maximum)

Voltage = 220 V

$\therefore P = VI$

$$\text{Current (I)} = \frac{P}{V}$$

$$= \frac{420}{220} = \frac{21}{11}$$

$$\mathbf{I = 1.91\ A}$$

ii. Power = 180 W (When heating is minimum)

Voltage = 220 V

$\therefore P = VI$

$$\text{Current (I)} = \frac{P}{V}$$

$$= \frac{180}{220} = \frac{18}{22}$$

$$\mathbf{I = 0.82\ A}$$

2. A 100 watt electric bulb is used for 5 hours daily and four 60 watt bulbs are used for 5 hours daily. Calculate the energy consumed (in kWh) in the month of January.

Solution:

For 100 W time t = 5 hours

For 60 W time t = 5 hours

100 W = 0.1 kW

4×60 W = 240 W = 0.24 kW

$E = P \times t$

For $E_1 = 0.1 \times 5$

$= 0.5$ J

$E_2 = 0.24 \times 5$

$= 1.2\ J$

$\therefore$Total energy $E = E_1 + E_2$

$= 0.5\ J + 1.2\ J$

$= 1.7\ J$

$\therefore$The energy consumed in the month of January $= 1.7 \times 31$

= 52.7 kWh

3. A torch bulb is rated at 3 V and 600 mA. Calculate it's

a. Power

b. Resistance

c. Energy consumed if it is used for 4 hour

Solution:

a. Power:

Power $= V \times I$

$= 3 \times 600 \times 10^{-3}$

P = 1.8 W

b. Resistance:

Resistance $= \frac{V}{I}$

$= \frac{3}{600 \times 10^{-3}}$

= 5Ω

c. Energy consumed if it is used for 4 hour:

Energy (E) $= P \times t$ $(P = 1.8\ W)$

$= 1.8 \times 4$

= 7.2 Watt hour

4. A piece of wire having a resistance R is cut into five equal parts.

a. How will the resistance of each part of the wire change compared with the original resistance?

b. If the five parts of the wire are placed in parallel, how will the resistance of the combination change? (PTA - III)

c. What will be ratio of the effective resistance in series connection to that of the parallel connection?

Solution:

Each part $= \frac{R}{5}$

a. We have,

$R = \frac{\rho l}{A}$

$\frac{R}{5} = \frac{\rho l}{A}$

$\therefore \mathbf{R = 5\frac{\rho l}{A}}$

b. In parallel, **(PTA - III)**

$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} + \frac{1}{R_5}$

$\frac{1}{R_P} = \frac{1}{\frac{R}{25}}$

$\therefore R_P = \mathbf{\frac{R}{25}}$

c. In series,

$\frac{1}{R_P} = \frac{25}{R_S}$

$= \frac{R_S}{R_P} = \frac{25}{1}$

ratio of R_S & $R_P = 25 : 1$

X. HOTS:

1. Two resistors when connected in parallel give the resultant resistance of 2 ohm; but when connected in series the effective resistance becomes 9 ohm. Calculate the value of each resistance.

$R_1 + R_2 = 9$

$R_2 = 9 - R_1$

Resistors when connected in parallel,

$\frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{2}$

$\frac{1}{R_1} + \frac{1}{9 - R_1} = \frac{1}{2}$

$\frac{9 - \cancel{R_1} + \cancel{R_1}}{R_1(9 - R_1)} = \frac{1}{2}$

$$\frac{9}{9R_1 - R_1^2} = \frac{1}{2}$$

$R_1^2 - 9R_1 + 18 = 0$

$(R_1 - 3)(R_1 - 6) = 0$

$\therefore$ **R_1 = 3, 6**

When $R_1 = 3\Omega$

$R_2 = 9 - R_1$

$= 9 - 3$

R_2 = **6 Ω**

When $R_1 = 6\,\Omega$

$R_2 = 9 - 6$

= 3 Ω

2. How many electrons are passing per second in a circuit in which there is a current of 5 A? (GMQ - 2019)

Current $I = \frac{Q}{t}$

$\therefore Q = I \times t = 5 \times 1$

$Q = 5\,C$

1 electron $= \frac{1}{1.6 \times 10^{-19} C}$

$= 5 \times \frac{1}{1.6 \times 10^{-19} C}$

$= 3.125 \times 10^{19}$

3. A piece of wire of resistance 10 ohm is drawn out so that its length is increased to three times its original length. Calculate the new resistance.

When the length increased by 3

The cross - section will reduce by 3

Then length will be 3l

While area $= \frac{A}{3}$

New resistance will be

$$\frac{\rho 3l}{\frac{A}{3}} = \frac{\rho 9l}{A}$$

$\frac{\rho l}{A}$ = 10 ohm

$= 9 \times \frac{\rho l}{A}$

$= 9 \times 10$

= 90

∴ The new resistance = **90 ohm**

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Choose the correct answer.

1. An electric heater of resistance 5Ω is connected to an electric source. If a current of 6 A flows through the heater, find the amount of heat produced in 5 minutes. **(SEP - 2020)**
   a. 48000 J b. 54000 J c. 45000 J d. 84000 J
   Ans: b. 54000 J

2. A charge of 12 coulomb flows through a blub in 5 second. What is the current through the bulb? **(MAY - 2022)**
   a. 60 A b. 17 A c. 2.4 A d. 24 A
   Ans: c. 2.4 A

3. The effective resistance of three resistors of resistances 5Ω, 3Ω and 2Ω are connected in series is _____. **(PTA - 2)**
   a. 1.03 Ω b. 10 Ω c. 0.97 Ω d. 2.5 Ω
   Ans: b. 10 Ω

4. Nichrome is used as heating element in electric heater because it has _____. **(PTA - 3)**
   a. high resistivity b. high melting point
   c. not easily oxidized d. all the above **Ans: d. all the above**

II. Short answers.

1. A charge of 10 coulomb flows through a bulb in 5 second. What is the current through the bulb? (GMQP - 2019)

Given data:

Charge (Q) = 10 C

Time (t) = 5S

Solution:

Current $(I) = \frac{Q}{T}$

$= \frac{10}{5}$

$= 2A$

∴ The current through the bulb is **2A**

2. A charge of 12 coulomb flows through a bulb in 5 seconds. What is the current through the bulb? (JUNE - 2023)

Given data:

Charge (Q) = 12 C

Time (t) = 5s

Solution:

Current $(I) = \frac{Q}{T}$

$= \frac{12}{5}$

$= 2.4\,A$

∴ The current through the bulb is **2.4 A**

3. Define the unit of electrical energy consumption. **(PTA - 5)**

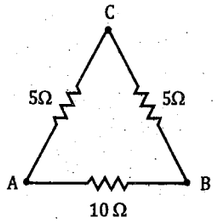
1. One kilowatt hour is known as one unit of electrical energy.
2. One kilowatt hour means that an electric power of 1000 watt has been utilized for an hour.

1 kWh = 1000 watt hour

= 1000 × (60 × 60) watt second

$= 3.6 \times 10^6$ J

4. Calculate the effective resistance of the given circuit across terminals AC. **(PTA - 2)**



From A to C is series

= AC + BC

Rs = 5 + 5 = 10Ω

In parallel,

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_s}$$

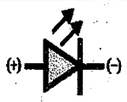
$$= \frac{1}{10} + \frac{1}{10} = \frac{2}{10} = 5\Omega$$

∴ The effective resistance of the given circuit across terminals AC is 5Ω.

III. Long answers.

1. a. Write the symbol for the following component. **(SEP - 2021)**

i. ground connection **ii. resistor**
iii. light emitting diode **iv. A diode**

	Component	Symbols
1.	Ground connection	
2.	resistor	
3.	light emitting diode	
4.	A diode	

2. Calculate the resistance of a conductor through which a current of 2 A passes, when the potential difference between its ends is 30 V. **(SEP - 2022)**

Solution:

Current through the conductor (I) = 2 A.

Potential Difference (V) = 30 V

From Ohm's law: $R = \frac{V}{I}$

Therefore, $R = \frac{30}{2} = \mathbf{15\ \Omega}$

3. Match the following. **(PTA - 2)**

	Column - I		Column - II		Answers	
1.	Ammeter	-	a.	-	c.	
2.	Diode	-	b.	-	a.	
3.	Galvanometer	-	c.	-	d.	
4.	Resistor	-	d.	-	b.	

4. An electric heater of resistance 5 Ω is connected to an electric source. If a current of a 6 A flows through the heater, then find the amount of heat produced in 5 minutes. **(PTA - 4)**

Given data:

Resistance R = 5 Ω

Current I = 6 A

Time t = 5 minutes

= 5 × 60 s = 300 s

Solution:

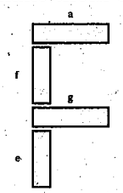
Amount of heat produced $H = I^2Rt$

$H = 6^2 \times 5 \times 300$

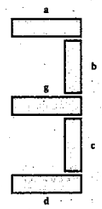
Hence, H = **54000 J**

5. Draw the picture of seven segment display for any one alpha numeric number. **(PTA - 3)**

For example, if you want to output the English letter 'F' you need to apply voltage to the light emitting diodes a, f, g, e to make them emit only.



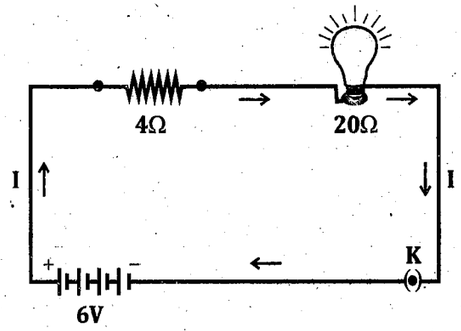
If you want to output the number '3' you need to apply voltage to the light emitting diodes a, b, g, c, d to make them emit only.



6. Which instrument is used to measure the potential difference? How will you connect it in a circuit? **(PTA - 5)**

1. **Voltmeter** is used to measure the potential difference.
2. The voltmeter is connected in **parallel** with the circuit.

7. **(PTA - 6)**



An electric lamp of resistance 20 ohm and a resistance of 4 ohm are connected in series to a 6 V battery as shown in the figure.

a. **Find the total resistance of the circuit.**

Ans: The total resistance of the circuit is **24 Ω**

b. **Find the current flowing through the circuit.**

Ans: Current $(I) = \frac{V}{R} = \frac{6}{24} = \frac{1}{4} = 0.25$ **A**

c. **Find the potential difference across the resistance.**

Ans: Potential difference = V = IR = 0.25 × 24

= 6 V

8. **Electric power lines in electrical post, hang very low in hot summer, why? (PTA - 4)**

1. Metals expand on heating.
2. Electrical wires expand in both length and diameter during hot summer.
3. Hence, they hang very low.

ADDITIONAL QUESTIONS

I. Match the following:

	Column A		Column B		Answers
1.	Ammeter	- a.	direction of current	- d.	**current**
2.	Voltmeter	- b.	Rheostat	- c.	**potential difference**
3.	Galvanometer	- c.	potential difference	- a.	**direction of current**
4.	Variable resistor	- d.	current	- b.	**Rheostat**

1.	**Column A**		**Column B**		**Answers**
1.	Electric potential	- a.	ohm^{-1} $metre^{-1}$	- c.	**volt**
2.	Resistance	- b.	ohm^{-1}	- d.	**ohm**
3.	Electrical resistivity	- c.	volt	- e.	**ohm metre**
4.	Conductance	- d.	ohm	- b.	**ohm^{-1}**
5.	Electrical conductivity	- e.	ohm metre	- a.	**ohm^{-1} $metre^{-1}$**

2.	**Column A**		**Column B**		**Answers**
1.	Copper	- a.	10^{10} to 10^{14}	- e.	**1.62×10^{-8}**
2.	Nickel	- b.	12.9×10^{-8}	- d.	**6.84×10^{-8}**
3.	Chromium	- c.	10^{13} to 10^{16}	- b.	**12.9×10^{-8}**
4.	Glass	- d.	6.84×10^{-8}	- a.	**$10^{10}$to 10^{14}**
5.	Rubber	- e.	1.62×10^{-8}	- c.	**10^{13} to 10^{16}**

3.	**Column A**		**Column B**		**Answers**
1.	Heating device	- a.	Joules heating effect	- b.	**Nichrome**
2.	Fuse wire	- b.	Nichrome	- a.	**Joules heating effect**
3.	Electric bulb	- c.	Neutral wire	- d.	**Tungsten**
4.	Red insulation	- d.	Tungsten	- e.	**live wire**
5.	Black insulation	- e.	live wire	- c.	**Neutral wire**

II. Choose the correct answer:

1. The motion of electric charges through a conductor constitutes _____.
   a. electric potential b. electric voltage
   c. electric current d. electric charge **Ans: c. electric current**

2. _____ is used to fix the magnitude of the current through a circuit.
   a. resistor b. ammeter c. voltmeter d. diode
   Ans: a. resistor

3. ⏚ ,is the symbol used for _____.
   a. Diode b. resistor c. rheostat d. none of the above
   Ans: d. none of the above

4. A galvanometer is used to indicate the _____of current.
   a. voltage b. frequency c. direction d. potential difference
   Ans: c. direction

5. A _____ is used to measure the potential difference.
   a. Ammeter b. Voltmeter c. Galvanometer d. Rheostat
   Ans: b. Voltmeter

6. The reciprocal of electrical resistivity is called _____.
   a. conductance b. resistance
   c. electrical conductivity d. none of the above
   Ans: c. electrical conductivity

7. The SI unit of electrical resistivity is _____.
   a. Ω b. $\Omega\, m^{-1}$ c. Ω m d. $\Omega\, m^{-2}$ **Ans: c. Ω m**

8. The resistivity of chromium is _____.
   a. 10^{13} to 10^{16} b. 6.84×10^{-18} c. 12.9×10^{-8} d. 1.6×10^{-8}
   Ans: c. 12.9×10^{-8}

9. Joule's law of heating is given by _____.
   a. $H = IR^2t$ b. $H = I^2t$ c. $H = I^2Rt$ d. none of the above
   Ans: c. $H = I^2Rt$

10. The filament in electric bulbs is made up of _____.
    a. cadmium b. tungsten c. mercury d. none of the above
    Ans: b. tungsten

11. The _____ wire is a protective conductor which saves us from electric shocks.
    a. Neutral b. Live c. Earth d. none of the above
    Ans: c. Earth

12. A _____ bulb has no filament.
    a. electric bulb b. LED
    c. Fluroscent d. none of the above **Ans: b. LED**

13. The first LED television was a _____ display.
    a. Dichromatic b. monochromatic
    c. colourless d. none of the above **Ans: b. monochromatic**

14. _____ introduced the first commercial LED television in 2009.
    a. Samsung b. SONY c. Panasonic d. LG **Ans: b. SONY**

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

1. One horse power is equal to 526 watts.
   Ans: False One horse power is equal to **746** watts.
2. The filament is made up of a material whose melting point is very low.
   Ans: False
   The filament is made up of a material whose melting point is very **high**.
3. The SI unit of electric power is volt.
   Ans: False
   The SI unit of electric power is **watt**.
4. The equivalent resistance in a series combination is greater than the highest of the individual resistances.
   Ans: True
5. Nichrome has the highest resistivity of $3.5 \times 10^{-8}\,\Omega$ m.
   Ans: False
   Nichrome has the highest resistivity of **$1.5 \times 10^{-6}\,\Omega$ m**.
6. The potential difference required for the flow of charges is provided by the battery.
   Ans: True
7. The electric current passes in the circuit from the negative terminal to the positive terminal.
   Ans: False
   The electric current passes in the circuit from the **positive** terminal to the **negative** terminal.

IV. Assertion and Reason.

1. **Assertion:** Potential difference is equal to the difference in the electric potential of two points.
   Reason : Resistance of a material is its property to oppose the flow of charges and hence the passage of current through it.
   a. If both the assertion and the reason are true and the reason is the correct explanation of the assertion.
   b. If both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.
   c. If the assertion is true, but the reason is false.
   d. If the assertion is false, but the reason is true.
   Ans: b. If both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.
2. **Assertion:** In home appliances, nichrome is used as the heating element.
   Reason : It is not easily oxidized.
   a. If both the assertion and the reason are true and the reason is the correct explanation of the assertion.
   b. If both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.
   c. If the assertion is true, but the reason is false.
   d. If the assertion is false, but the reason is true.
   Ans: a. If both the assertion and the reason are true and the reason is the correct explanation of the assertion.

3. **Assertion:** All the circuits in a house are connected in series.
   Reason : The disconnection of one circuit does not affect the other circuit.
   a. If both the assertion and the reason are true and the reason is the correct explanation of the assertion.
   b. If both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.
   c. If the assertion is true, but the reason is false.
   d. If the assertion is false, but the reason is true.
   Ans: d. If the assertion is false, but the reason is true.
4. **Assertion:** When a live wire comes in contact with a neutral wire, it causes a 'short circuit'.
   Reason : When the amount of current passing through a wire exceeds the maximum permissible limit, the wires get heated to such an extent that a fire may be caused.
   a. If both the assertion and the reason are true and the reason is the correct explanation of the assertion.
   b. If both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.
   c. If the assertion is true, but the reason is false.
   d. If the assertion is false, but the reason is true.
   Ans: b. If both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.

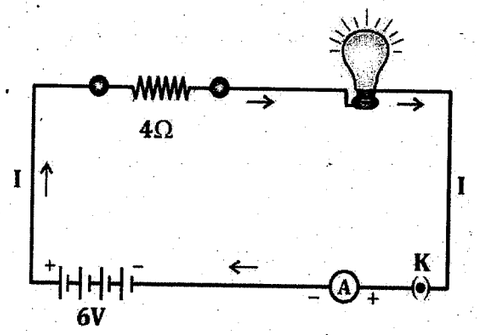
V. Analog

1.	Electric current	:	Ampere	
	Electric potential	:	_____	**(volt)**
2.	Ohm's law	:	IR	
	Resistance	:	_____	$(\frac{V}{I})$
3.	Length	:	$R \propto L$	
	Area	:	_____	$(R \propto \frac{1}{A})$
4.	ρ	:	$\frac{RA}{L}$	
	σ	:	_____	$(\frac{1}{\rho})$
5.	Less resistivity	:	conductor	
	More resistivity	:	_____	**(Insulator)**
6.	Copper	:	$1.62 \times 10^{-8}\Omega$m	
	Glass	:	_____	**(10^{10} to 10^{14})**
7.	R_P	:	$\frac{R}{n}$	
	R_S	:	_____	**(nR)**
8.	R_{total}	:	$R_{P1} + R_{P2}$	
	$\frac{1}{R_{total}}$	:	_____	$\left(\frac{1}{R_{S1}} + \frac{1}{R_{S2}}\right)$
9.	Fuse wire	:	melting point low	
	Tungsten	:	_____	**(melting point high)**
10.	Electric power	:	watt	

Electric energy : _____ (kilowatt hour)

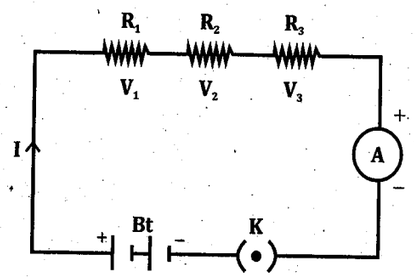
VI. To label the parts in the given diagram.

1. Draw a schematic diagram of an electric current comprising battery, electric bulb, ammeter and a switch.

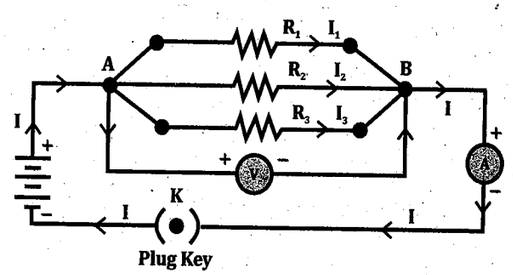


A simple electric circuit

2. In various electrical circuits we often use resistors in various combinations. Resistors can be connected in series or in parallel.
Draw a circuit diagram containing three resistors R_1, R_2, R_3 in
i. Parallel ii. Series along with a battery.

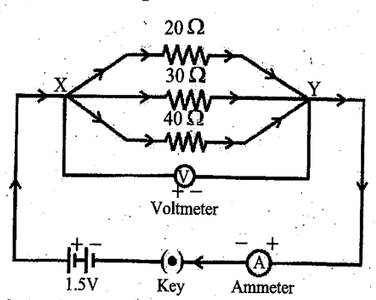


Series connection of resistors



Parallel connections of resistors

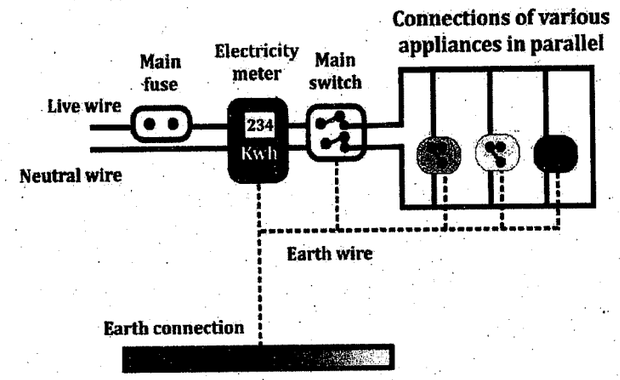
3. You are given three resistors of 20 Ω, 30 Ω, 40 Ω connected in parallel with a battery of 1.5V, a key, an ammeter and a voltmeter. Draw the circuit diagram showing the correct connections of all the given components.



4. Label the following parts in the given common domestic circuit.

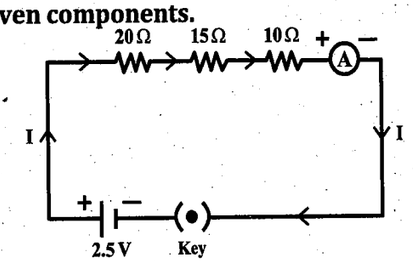
1.	Live wire	2.	Main fuse	3.	Electricity meter
4.	Main switch	5.	Neutral wire	6.	Earth wire

7. Earth connection



Domestic electric circuit

5. You are given three resistors of 20Ω, 15 Ω, 10 Ω connected in series with a battery of 2.5V, a key, an ammeter and a voltmeter. Draw the circuit diagram showing the correct connections of all the given components.



VII. Problem solving.

1. A 75W bulb draws a 680 mA. How much time will be required to pass a 30C charge through the bulb?

Given data:

Charge (Q) = 30C.
Current (I) = 680 mA = 68×10^{-3} A
Time (t) = ?

Solution:

$$I = \frac{Q}{t}$$

$$\therefore t = \frac{Q}{I}$$

$$= \frac{30}{68 \times 10^{-3}} = 441.17 \text{ S}$$

$$= \frac{441.17}{60}$$

$$= 7.35 \text{ min}$$

2. A current of 6A flows in a resistor. How many coulomb of charge pass through the resistor in 2 minutes.

Given data:

Current (I) = 6 A
Time (t) = 2 minutes

$= 2 \times 60$
$= 120\ s$

Solution:

Coulomb = current (I) × time (t)
$= 6 \times 120$
$= 720\ C$

3. **An energy of 12J is expended in moving a 2C charge from infinity to a print A. Summing infinity to be at zero potential. Determine the potential difference between point A and infinity.**

Given data:

Energy (J) = 12 J
Charge = 2 C

Solution:

$$V_A = \frac{\text{Energy}}{\text{Charge}} = \frac{12}{2}$$

$= 6\ V$ [∵ energy = work done]

4. **Determine the charge that requires 1 KJ energy to be moved from infinity to a point having a 12V potential.**

Given data:

Work done (W) = 1 KJ
Potential (V) = 10^3 J
Charge (Q) = ?

Solution:

$$\text{Charge (Q)} = \frac{W}{V}$$

$$= \frac{10^3}{12} = \frac{1000}{12}$$

$= 83.33\ C$

5. **An electrical iron carrying 2 A at 120 V. Find the resistance of the device?**

Given data:

Current = 2A
Volt = 120 V
Resistance = ?

Solution:

$$R = \frac{V}{I}$$

$$= \frac{120}{2} = 60\ \Omega$$

$\therefore R = 60\Omega$

6. **A car battery supplies 48J of energy at 12V over a certain period of time. Determine the charge moved during this period.**

Given data:

Work done (W) = 48J
Potential (V) = 12 V
Charge (Q) = ?

Solution:

$$Q = \frac{W}{V}$$

$$= \frac{48}{12}$$

$Q = 4C$

7. **A copper conductor of circular cross section 5mm in diameter is 5m long. Calculate its resistance at 20°C if the resistivity of copper at 20°C is $1.72 \times 10^{-8}\Omega$ m.**

Given data:

Resistivity of copper (P) = $1.72 \times 10^{-8}\ \Omega$ m
Length of the conductor (l) = 5 m
Area of cross - section = 5 mm
$= 5 \times 10^{-3}$
∴ Area of cross section = πr^2
(A) = $3.142\ (2.5 \times 10^{-3})^2$

Solution:

$$R = \frac{\rho l}{A}$$

$$= \frac{(1.72 \times 10^{-8})5}{\pi r^2}$$

$$= \frac{(1.72 \times 10^{-8})(5)}{(3.142)(2.5 \times 10^{-3})^2}$$

$$= \frac{8.6 \times 10^{-8}}{19.64 \times 10^{-6}}$$

$= 0.438 \times 10^{-2}$

$R = 4.38\ m\Omega$

8. **Calculate the current used by a 12V immersion heater that is designed to deliver 30000 J is 5 minutes.**

Given data:

Energy = 30000 J

Solution:

Energy = power × time
∴ 30000 = power × 5 × 60
30000 = power × 300

$$\therefore \text{power} = \frac{30000}{300}$$

$= 100\ W$

$$\text{Current} = \frac{100}{12} = 8.5\ A$$

Current (I) = 8.5 A

9. **Calculate the energy given out by a12 V car battery that delivers a current of 200 A for 3 seconds.**

Given data:

Current (I) = 200 A
Potential difference = 12 V
time = 3 seconds
Energy = ?

Solution:

Energy = power × time
= 12 × 200 × 3
= 72000 J

10. Calculate the resistance of a 100w light bulb if it takes a current of 0.8A. Given data:

Power = 100 w
Current (I) = 0.8 A
Resistance = ?

Solution:

Power = I^2R

$\therefore R = \frac{Power}{I^2}$

$= \frac{100}{0.64} = 156.3\Omega$

$\therefore R = 156.3\Omega$

VIII. HOTS

1. The work done in moving a charge of 5C across two points in a circuit is 50 J. What is the potential difference between the points?

Given data:

Charge (Q) = 5 C
Work done (W) = 50 J

Solution:

Potential difference (V) = $\frac{W}{2} = \frac{50}{5}$
= 10 V

$\therefore V = 10V$

2. How much current will an electric heater coil draw from 220 V source, if the resistance of heater coil is 110Ω?

Given data:

V = 220V, R = 110Ω, I = ?

Solution:

$I = \frac{V}{R} = \frac{220}{110}$

= 2Ω

3. The resistance of a wire of length 10m is 6Ω. If the area of cross section of the wire is $4 \times 10^{-7}m^2$ determine its resistivity.

Given data:

Length (L) = 10m
Resistance (R) = 6Ω
Area (A) = $4 \times 10^{-7}m^2$

Solution:

Resistivity $\rho = \frac{RA}{L}$

$= \frac{6 \times 4 \times 10^{-7}}{10}$

$= 24 \times 10^{-8}\ \Omega\ m$

4. Three resistors of resistance 7 ohm, 2 ohm and 1 ohm are connected in series with 5V battery. Calculate their effective resistance and the current flowing through the circuit.

Given data:

$R_1 = 7\Omega$, $R_2 = 2\Omega$, $R_3 = 1\Omega$, V = 5V

Solution:

$R_s = R_1 + R_2 + R_3$
$= 7 + 2 + 1 = 10$

$R_s = 10\Omega$

The current, $I = \frac{V}{R_s} = \frac{5}{10} = \frac{1}{2}$

I = 0.5A

5. Three resistors of 2Ω, 4 Ω and 8Ω are connected in parallel in a circuit. If a 2Ω resistors draws a current of 2A. Find the current through the other two resistors.

Given data:

$R_1 = 2\Omega$, $R_2 = 4\Omega$, $R_3 = 8\Omega$,
current I = 2A

Solution:

The potential difference across the 2Ω resistor $= I_1R_1$
$= 2 \times 2 = 4V$

Since, the resistors are connected in parallel in the circuit, the same potential difference will exist across the other resistors also.

So, the current in the 4Ω resistors,

$\frac{V}{R_2} = \frac{4}{4}$

= 1A.

Similarly, the current in the 8Ωresistors,

$\frac{V}{R_3} = \frac{4}{8} = \frac{1}{2}$

= 0.5 A

IX. Short Answers:

1. Define electrical potential.

1. The electric potential at a point is defined as the amount of work done in moving a **unit positive charge** from **infinity** to that **point** against the electric force.
2. The SI unit of electric potential is **volt.**

2. Define Electric potential difference between two points.

The electric potential difference between two points is defined as the amount of work done in moving a **unit positive charge** from **one point** to **another point** against the electric force.

3. Define one volt.

The potential difference between two points in one volt, if **one joule** of work is done in **moving one coulomb** of charge from one point to another against the electric force is called one volt.

$$\textbf{1 volt} = \frac{\textbf{1 joule}}{\textbf{1 coulomb}}$$

4. What is electrical resistivity of a material?

1. Electrical resistivity of a material is the resistance of a conductor of **unit length** and **unit area** of cross section.
2. Its unit is **ohm metre**.

5. Difference between series and parallel circuit.

	Criteria	Series	Parallel
1.	Equivalent resistance	More than the **highest** resistance.	Less than the **lowest** resistance.
2.	Amount of current	Current is **less** as effective resistance is **more**.	Current is **more** as effective resistance is **less**.
3.	Switching ON / OFF	If one appliance is disconnected, others also **do not work**.	If one appliance is disconnected, others will **work independently**.

6. What is one watt?

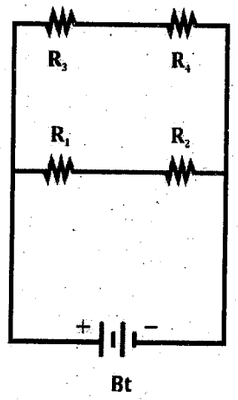
One watt is the power consumed when an electric device is operated at a potential difference of **one volt** and it carries a current of **one ampere**.

X. Long Answers:

1. With the help of a circuit diagram explain parallel connection of series resistors.

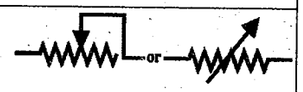
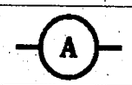
1. When a set of series resistors connected in a parallel circuit a parallel - series circuit is formed.
2. Let R_1 and R_2 be connected in series to give an effective resistance of R_{s1}.
3. Similarly, let R_3 and R_4 be connected in series to give an effective resistance of R_{s2}.
4. Then, both of these serial segments are connected in parallel.
5. $R_{s1} = R_1 + R_2$, $R_{s2} = R_3 + R_4$
6. Finally, using equation the net effective resistance is given by

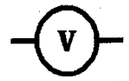
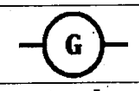
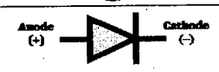
$$\frac{1}{R_{total}} = \frac{1}{R_{s1}} + \frac{1}{R_{s2}}.$$



Parallel-series combination of resistors

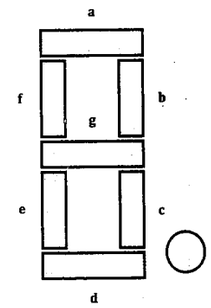
2. Tabulate the uses and symbols of some components of a electric circuit. (PTA - II, SEP - 2021)

	Component	Uses	Symbols
1.	Resistor	Used to fix the magnitude of the current through a circuit.	
2.	Variable resistor or Rheostat	Used to select the magnitude of the current through a circuit.	
3.	Ammeter	Used to measure the current.	

4.	Voltmeter	Used to measure the potential difference.	
5.	Galvanometer	Used to detect current and its direction.	
6.	A diode	Used in electronic devices.	
7.	Light emitting diode (LED)	Used in seven segment display.	
8.	Ground connection	Used to provide protection to the electrical components. It also serves as a reference point to measure the electric potential.	

3. Explain the seven segment display with diagram. (PTA - III)

1. A 'Seven segment display' is the display device used to give an output in the form of **numbers or text**.
2. It is used in digital meters, digital clocks, micro wave ovens, etc.,
3. It consists of **7 segments** of LEDs in the form of the digit **8**.
4. These seven LEDs are named as **a, b, c, d, e, f** and **g**.
5. An extra 8th LED is used to display a **dot**.



Seven segment display

XI. Fill in the blanks.

1. Electricity deals with the flow of charges through a _____. **(conductor)**
2. The motion of electric charges through a conductor, constitute an _____. **(electric current)**
3. Electric current flows from the _____ terminal of the battery to the _____ terminal. **(positive, negative)**
4. Electric current is represented by the symbol _____. **('I')**
5. A/An _____ consists of a battery, electric bulb and a switch. **(electric circuit)**
6. A _____ is used to fix the magnitude of current through a circuit. **(resistor)**
7. A _____ is used to provide protection to the electrical components. **(Ground connection)**
8. _____ serves as a reference point to measure electric potential. **(Ground connection)**
9. A _____ is used to detect the direction of current. **(Galvanometer)**
10. Abbreviate LED _____. **(Light Emitting Diode)**
11. A _____ is used to select the magnitude of current through a circuit. **(Rheostat)**
12. A _____ is used to measure the potential difference. **(voltmeter)**
13. The direction of current is taken as the direction of flow of _____ charge. **(positive)**
14. Electric charges flows from a _____ electric potential to a _____ electric potential. **(high, low)**
15. The SI unit of electric current is _____. **(ampere)**
16. An _____ is a closed conducting loop or path, which has a network of electrical components through which electrons are able to flow. **(electric circuit)**
17. The potential difference required for the flow of charges in a circuit is provided by the _____. **(battery)**
18. The direction of current is taken opposite to the direction of flow of _____. **(electrons)**
19. Electric current flows in a circuit from the _____ to _____ terminal. **(positive, negative)**
20. The SI unit of electric potential is _____. **(volt)**
21. A difference in _____ is needed for the flow of electric charges in a conductor. **(electric potential)**
22. Ohm's Law states the relationship between potential difference and _____. **(current)**

23. The graph between V and I is a _____ for a conductor. **(straight line)**
24. _____ of a material is its property to oppose the flow of charges. **(Resistance)**
25. The SI unit of resistance is _____. **(ohm)**
26. Conductance of a material is the reciprocal of its _____. **(resistance)**
27. The unit of conductance is _____. **(ohm^{-1})**
28. Conductance is represented as _____. **(mho)**
29. The unit of electrical conductivity is _____. **(ohm^{-1} $metre^{-1}$)**
30. Electrical conductivity is represented as _____. **(mho $meter^{-1}$)**
31. The resistance of any conductor is directly proportional to the length of the conductor and inversely proportional to its _____. **(area of cross section)**
32. _____ is a conductor with highest resistivity. **(Nichrome)**
33. _____ is used in making heating elements. **(Nichrome)**
34. _____ of a material is the property of a material to aid the flow of charges and the passage of current in it. **(Conductance)**
35. The reciprocal of electrical resistivity of a material is called its _____. **(electrical conductivity)**
36. Conductivity is _____ for conductors than for insulators. **(more)**
37. _____ is less for conductors than for insulators. **(resistivity)**
38. The resistivity of copper is _____. **(1.62×10^{-8})**
39. The resistivity of nickel is _____. **(6.84×10^{-8})**
40. The resistivity of chromium is _____. **(12.9×10^{-8})**
41. The resistivity of glass is _____. **(10^{10} to 10^{14})**
42. The resistivity of rubber is _____. **(10^{13} to 10^{16})**
43. A circuit with the combination of resistors is known as _____. **(system of resistors)**
44. Series circuits are commonly used in _____. **(flashlights)**
45. The equivalent resistance in a _____ combination is greater than the highest of the individual resistances. **(series)**
46. A _____ circuit has two or more loops through which current can pass. **(parallel)**
47. The equivalent resistance of a _____ circuit is less than the lowest resistance. **(parallel)**
48. If one appliance is disconnected in a _____ circuit, the others do not work. **(series)**
49. If one appliance is disconnected in a _____ circuit, others work independently. **(parallel)**
50. The wiring in a house consists of _____ circuits. **(parallel)**
51. Parallel resistors connected in series form a _____ circuit. **(series - parallel)**
52. Series resistors connected in parallel circuit form a _____ circuit. **(parallel - series)**
53. The current in a series circuit is _____ as effective resistance is more. **(less)**
54. The equivalent resistance of a _____ circuit is more than the highest resistance. **(series)**
55. The current in a _____ circuit is more as effective resistance is less. **(parallel)**
56. The equivalent resistance of a _____ circuit is less than the lowest resistance. **(parallel)**
57. The equivalent resistance in a _____ combination is less than the lowest of the individual resistances. **(parallel)**
58. _____ is an alloy of Nickel and Chromium. **(Nichrome)**
59. Electric bulb is made up of a small wire called the _____. **(filament)**
60. The melting point of the filament in an electric bulb is _____. **(very high)**
61. Electrical energy can develop _____ across a resistor. **(potential difference)**
62. The passage of _____ through a wire, results in the production of heat. **(electric current)**
63. The heating effect of _____ is used in devices like electric heater, electric iron, etc. **(current)**
64. Heat produced in any resistor is directly proportional to the square of the _____ passing through the resistor. **(current)**
65. Heat produced in any resistor is directly proportional to the resistance of the _____. **(resistor)**
66. The fuse wire is connected in _____, in an electric circuit. **(series)**
67. The fuse wire is made up of a material whose _____ is relatively low. **(melting point)**
68. When a large current passes through the circuit, the fuse wire melts due to _____. **(Joule's heating effect)**
69. The horse power (hp) is a unit in the _____. **(foot - pound - second)**
70. When current passes through this wire, _____ is produced in the filament. **(heat)**
71. _____ is the commonly used to make the filament in bulbs. **(Tungsten)**

72. _____ is defined as the rate of doing work or rate of spending energy. **(power)**
73. _____ is defined as the rate of consumption of electrical energy. **(electric power)**
74. The electric power is the product of the _____and the_____ due to which the current passes in a circuit. **(electric current, potential difference)**
75. Consumption of electrical energy is measured in _____. **(watt hour)**
76. The SI unit of electrical energy is _____. **(watt second)**
77. _____ is otherwise known as one unit of electrical energy. **(One kilowatt hour)**
78. One kilowatt hour means that an electric power of _____ watt has been utilized for an hour. **(1000)**
79. 1 kWh = _____ watt hour. **(1000)**
80. The red wire in a domestic electric circuit is called _____. **(live wire)**
81. The black insulated wire in a domestic circuit is called _____. **(neutral wire)**
82. The electricity supplied to our house has an electric potential of _____ V. **(220)**
83. Each appliance gets an equal voltage in a _____ circuit. **(parallel)**
84. In our homes, electricity is distributed through the _____ circuits. **(domestic electric)**
85. In USA and UK, domestic circuits are supplied with an alternating current of potential _____ V. **(110/120)**
86. Red, green, orange and yellow colours of an LED bulb are produced with the help of _____ and _____. **(Gallium Arsenide, Gallium Phosphide)**
87. _____ bulbs are used in traffic signals. **(LED)**
88. When a live wire comes in contact with a neutral wire, it causes a _____. **(short circuit)**
89. In domestic circuits, a third wire called the _____ is connected to the body of the metallic electric appliance. **(earth wire)**
90. The _____ wire serves as a protective conductor, which saves us from electric shocks. **(earth)**
91. An _____ bulb is a semiconductor device that emits visible light when an electric current passes through it. **(LED)**

5. ACOUSTICS

KEY FORMULAE

1.	Velocity	$V = \frac{\text{Distance}}{\text{Time}}$ $V = \frac{\lambda}{T}$ $V = n\lambda$
2.	Effect of density	$V \propto \sqrt{\frac{1}{d}}$
3.	Effect of temperature	$V_T = (V_0 + 0.61T)$
4.	Speed of sound	$V = \frac{2d}{t}$
5.	Distance	$d = v \times t$
6.	Frequency	$f = \frac{1}{T}$
Apparent frequency:		
7.	1. Both source and listener move 2. They move towards each other	$n' = \left(\frac{v+v_L}{v-v_s}\right)n$
8.	1. Both source and listener move. 2. They move away from each other.	$n' = \left(\frac{v-v_L}{V+V_s}\right)n$
9.	1. Both source and listener move. 2. They move one behind the other. 3. Source follows the listener.	$n' = \left(\frac{v-v_L}{v-v_s}\right)n$
10.	1. Both source and listener move. 2. They move one behind the other. 3. Listener follows the source.	$n' = \left(\frac{v+v_L}{v+v_s}\right)n$
11.	1. Source at rest. 2. Listener moves towards the source.	$n' = \left(\frac{v+v_L}{v}\right)n$
12.	1. Source at rest. 2. Listener moves away from the source.	$n' = \left(\frac{v-v_L}{v}\right)n$
13.	1. Listener at rest. 2. Source moves towards the listener	$n' = \left(\frac{v}{v-v_s}\right)n$
14.	1. Listener at rest. 2. Source moves away from the listener.	$n' = \left(\frac{v}{v+v_s}\right)n$

I. Choose the correct answer.

1. When a sound wave travels through air, the air particles **(SEP - 2021)**
   a. vibrate along the direction of the wave motion
   b. vibrate but not in any fixed direction
   c. vibrate perpendicular to the direction of the wave motion
   d. do not vibrate

   Ans: a. vibrate along the direction of the wave motion

2. Velocity of sound in a gaseous medium is330 ms^{-1}. If the pressure is increased by 4 times without causing a change in the temperature, the velocity of sound in the gas is
   a. 330 ms^{-1} b. 660 ms^{1} c. 156 ms^{-1} d. 990 ms^{-1}

   Ans: a. 330 ms^{-1}

   (Hint: Velocity of sound is independent of pressure)

3. The frequency, which is audible to the human ear is **(PTA - VI)**
   a. 50 kHz b. 20 kHz c. 15000 kHz d. 10000 kHz

   Ans: b. 20 kHz

4. The velocity of sound in air at a particular temperature is 330 ms^{-1}. What will be its value when temperature is doubled and the pressure is halved?
   a. 330 ms^{-1} b. 165 ms^{-1}
   c. $330 \times \sqrt{2}\, ms^{-1}$ d. $\frac{320}{\sqrt{2}\, ms^{-1}}$

   Ans: c. $330 \times \sqrt{2}\, ms^{-1}$

   [Hint: $V \propto \sqrt{T} \Rightarrow 330 \times \sqrt{2} ms^{-1}$**]**

5. If a sound wave travels with a frequency of 1.25×10^4 Hz at 344 ms^{-1}, the wavelength will be
   a. 27.52 m b. 275.2 m c. 0.02752 m d. 2.752 m

   Ans: c. 0.02752 m

   (Hint: $V = n\lambda$
   $n = 1.25 \times 10^4$
   $V = 344$
   $\lambda = \frac{V}{n} = \frac{344}{1.25 \times 10^4} = \frac{344}{12500}$
   $= 0.02752$ m)

6. The sound waves are reflected from an obstacle into the same medium from which they were incident. Which of the following changes?
   a. speed b. frequency
   c. wavelength d. none of these

   Ans: d. none of these

7. Velocity of sound in the atmosphere of a planet is 500 ms^{-1}. The minimum distance between the sources of sound and the obstacle to hear the echo, should be
   a. 17 m b. 20 m c. 25 m d. 50 m

   Ans: c. 25 m

(**Hint:** $d = \frac{v}{20} = \frac{500}{20} = 25$ m)

II. Fill up the blanks.

1. Rapid back and forth motion of a particle about its mean position is called _____. **Ans: vibration**
2. If the energy in a longitudinal wave travels from south to north, the particles of the medium would be vibrating in _____. **Ans: both north and south**
3. A whistle giving out a sound of frequency 450 Hz, approaches a stationary observer at a speed of $33 ms^{-1}$. The frequency heard by the observer is (speed of sound $= 330 ms^{-1}$) _____. **Ans: 500 Hz**

   (**Hint:** Because the source is moving towards the observer

   $$n' = \left(\frac{V}{v - v_s}\right) n$$

   $$n' = \left(\frac{330}{330 - 33}\right) 450$$

   $$= \frac{330 \times 450}{330 - 33} = \frac{148500}{297} = 500 \text{ Hz})$$

4. A source of sound is travelling with a velocity 40 km/h towards an observer and emits a sound of frequency 2000 Hz. If the velocity of sound is 1220 km/h, then the apparent frequency heard by the observer is _____. **Ans: 2068 Hz**

   (**Hint:** $n' = \left(\frac{V}{v - v_s}\right) n$

   $$= \frac{2000 \times 1220}{1220 - 40}$$

   $$= \frac{2440000}{1180} = 2068 \text{ Hz})$$

III. True or false. (If false give the reason)

1. Sound can travel through solids, gases, liquids and even vacuum.
   Ans: False
   Sound can travel through solids, gases, liquids and **not in** vacuum.
2. Waves created by Earth Quake are Infrasonic.
   Ans: True
3. The velocity of sound is independent of temperature.
   Ans: False
   The velocity of sound is **dependent** of temperature.
4. The velocity of sound is high in gases than liquids.
   Ans: False
   The velocity of sound is **less** in gases than liquids.

IV. Match the following.

Column - I		Column - II		Answers	
1.	Infrasonic	a.	Compressions	c.	**10 Hz**
2.	Echo	b.	22 kHz	d.	**Ultrasonography**
3.	Ultrasonic	c.	10 Hz	b.	**22 kHz**
4.	High pressure region	d.	Ultrasonography	a.	**Compressions**

V. Assertion and Reason Questions.

1. **Assertion:** The change in air pressure affects the speed of sound.

   Reason : The speed of sound in a gas is proportional to the square of the pressure.

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

   Ans: both assertion and reason is false.

2. **Assertion:** Sound travels faster in solids than in gases.

   Reason : Solid posses a greater density than that of gases.

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

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

VI. Answer very briefly.

1. **What is a longitudinal wave?** **(APR - 2023)**

   A longitudinal wave is a wave in which the particles of a medium vibrate along the direction of propagation of the wave.

2. **What is the audible range of frequency?** **(SEP - 2021)**

   Ans: Between 20 Hz and 20,000 Hz

3. **What is the minimum distance needed for an echo?**

   Ans: 17.2 m **(GMQ - 2019, SEP - 2021)**

4. What will be the frequency sound having 0.20 m as its wavelength, when it travels with a speed of 331 ms^{-1}?

$V = n\lambda$

$n = ?$

$\lambda = 0.20\ m$

$V = 331$

$n = \frac{v}{\lambda}$

$= \frac{331}{0.20}$

$= 1655\ Hz$

5. Name three animals, which can hear ultrasonic vibrations. (JUNE - 2023)

Ans: Dogs, bats and rats.

VII. Answer briefly.

1. Why does sound travel faster on a rainy day than on a dry day? (PTA - VI)

Effect of relative humidity:

1. During rainy day the **humidity increases.**
2. When humidity increases, the speed of **sound increases.**
3. Hence, we can hear sound from long distances **clearly** during rainy seasons.

This shows that, sound travels faster on a rainy day than on a dry day.

2. Why does an empty vessel produce more sound than a filled one?※ (PTA - II)

1. In an empty vessel the vibration of air molecules will be more due to multiple reflection.
2. Vibration of air is greater than liquids.
3. An empty vessel will be in a condition of allowing more amplified vibration because of the more free space available in the vessel.
4. Hence, an empty vessel produces more sound than a filled one.

3. Air temperature in the Rajasthan desert can reach 46°C. What is the velocity of sound in air at that temperature? ($V_0 = 331\ ms^{-1}$)

$V_T = (V_0 + 0.61T)$

Velocity $V_0 = 331\ ms^{-1}$

Temperature $T = 46\ ^\circ C$

$= 331 + (0.61 \times 46)$

$= 331 + 28.06$

$V_T = 359.06\ ms^{-1}$

4. Explain why, the ceilings of concert halls are curved? ※※ (PTA - VI, MAY - 2022)

1. Ceilings of concert halls are curved so that the sound after reflection reaches every corner of the concert hall and the audience can listen the sound clearly.
2. When the sound waves are reflected from the curved surfaces, the intensity of the reflected waves is changed.
3. It is due to the multiple reflections of sound waves from the curved walls.

5. Mention two cases in which there is no Doppler effect in sound? ※※※

1. When source and listener both are at **rest.** **(JULY - 24, GMQ - 2019, SEP - 2020)**
2. When source and listener move in such a way that distance between them remains **constant.**
3. When source and listener are moving in mutually **perpendicular** directions.

VIII. Problem Corner.

1. A sound wave has a frequency of 200 Hz and a speed of 400 ms^{-1} in a medium. Find the wavelength of the sound wave. ※※※

Solution:

$v = n\lambda$

$n = 200$

$v = 400$

$\lambda = ?$

$\lambda = \frac{v}{n}$

$= \frac{400}{200}$

$\lambda = 2m$

2. The thunder of cloud is heard 9.8 seconds later than the flash of lightning. If the speed of sound in air is 330 ms^{-1}, what will be the height of the cloud?

Solution:

Time = 9.8 s

Speed = 330ms^{-1}

Height of cloud = Distance travelled by sound

distance = speed of sound × time

$= 330 \times 9.8$ **= 3234 m**

3. A person who is sitting at a distance of 400 m from a source of sound is listening to a sound of 600 Hz. Find the time period between successive compressions from the source?

Solution:

Since the time interval between successive compressions is called time period

Frequency (n) = 600 Hz

T (time period) = ?

we know that

$$\text{frequency} = \frac{1}{T}$$

$$T = \frac{1}{\text{frequency}}$$

$$= \frac{1}{600} = \mathbf{0.0017s}$$

4. An ultrasonic wave is sent from a ship towards the bottom of the sea. It is found that the time interval between the transmission and reception of the wave is 1.6 seconds. What is the depth of the sea, if the velocity of sound in the seawater is 1400 ms⁻¹?

Solution:

Let d be the depth of the sea

$$v = \frac{2d}{t}$$

$$v = 1400$$

$$t = 1.6$$

$$d = \frac{v \times t}{2} = \frac{1400 \times 1.6}{2}$$

$$= \frac{2240}{2}$$

= 1120 m

5. A man is standing between two vertical walls 680 m apart. He claps his hands and hears two distinct echoes after 0.9 seconds and 1.1 second respectively. What is the speed of sound in the air?

Given data:

Distance between vertical walls (d) = 680 m

Time taken for 1st echo t_1 = 0.9 s

Time taken for 2nd echo t_2 = 1.1 s

$\therefore t = t_1 + t_2$

$= 0.9 + 1.1$

$t = 2$ s

$$\text{Speed of sound} = \frac{2d}{t}$$

$$= \frac{2 \times 680}{2}$$

= 680 ms⁻¹

6. Two observers are stationed in two boats 4.5 km apart. A sound signal sent by one, under water, reaches the other after 3 seconds. What is the speed of sound in the water?

Solution:

Distance between two observers = 4.5 km

Time = 3 s

$$\text{Speed of sound in water} = \frac{\text{Distance between two observers}}{\text{Time}}$$

$$= \frac{4.5}{3}$$

$= 1.5$ km/s

= 1500 m/s

7. A strong sound signal is sent from a ship towards the bottom of the sea. It is received back after 1s. What is the depth of sea given that the speed of sound in water 1450 ms⁻¹?

Solution:

Time taken by the signal to reach the bottom of the sea $= \frac{1}{2}$ s

Speed of sound in water=1450 m/s

Depth of the sea =Distance travelled by the signal

= Speed × time

$= 1450 \times \frac{1}{2}$

d = 725 m

IX. Answer in Detail.

1. What are the factors that affect the speed of sound in gases?

The factors that affect the speed of sound in gases are,

1. Effect of density
2. Effect of temperature
3. Effect of relative humidity

Effect of density:

1. The velocity of sound in a gas is inversely proportional to the square root of the density of the gas.

2. Hence, the velocity decreases as the density of the gas increases.

$$V \propto \sqrt{\frac{1}{d}}$$

Effect of temperature:

1. The velocity of sound in a gas is directly proportional to the square root of its temperature.

2. The velocity of sound in a gas increases with the increase in temperature.

$$V \propto \sqrt{T}$$

3. Velocity at temperature T is given by the following equation:

$$V_T = (V_o + 0.61\ T)\ ms^{-1}$$

4. Here, V_o is the velocity of sound in the gas at 0°C.For air, $V_o = 331\ ms^{-1}$.Hence, the velocity of sound changes by $0.61\ ms^{-1}$ when the temperature changes by one degree Celsius.

Effect of relative humidity:

1. When humidity increases, the speed of sound increases.

2. We can hear sound from long distances clearly during rainy seasons.

2. What is meant by reflection of sound? (APR - 2023)
Explain:
a. reflection at the boundary of a rarer medium.
b. reflection at the boundary of a denser medium.
c. reflection at curved surfaces.
Ans:
Reflection of sound:

1. When sound waves travel in a given medium and strike the surface of another medium, they can be **bounced back** into the first medium.

2. This phenomenon is known as reflection of sound.

a. Reflection at the boundary of a rarer medium.

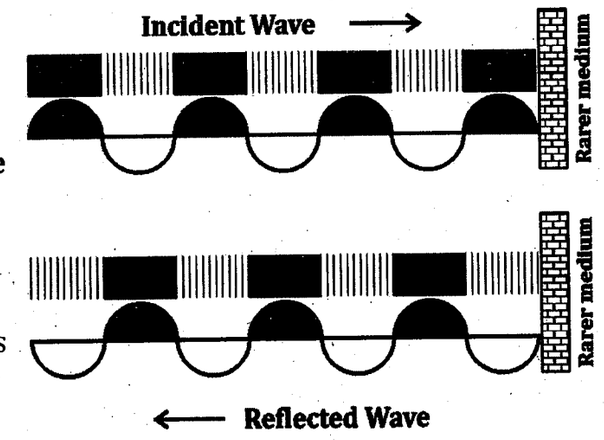
1. A wave travelling in a solid medium strikes on the **interface** between the **solid** and the **air**.

2. The **compression** exerts a force F on the surface of the **rarer medium**.

3. As a rarer medium has **smaller resistance** for any deformation, the surface of separation is **pushed backwards**.

4. As the particles of the **rarer medium** are **free to move**, a rarefaction is **produced** at the **interface**.

5. Thus, a **compression** is reflected as a rarefaction and a rarefaction travels from **right** to **left**.



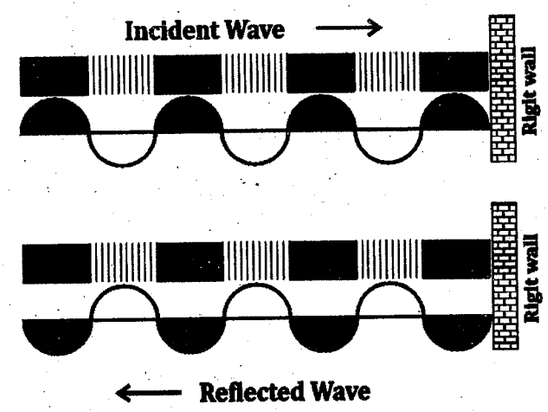
Reflection of sound at a rarer medium

b. Reflection at the boundary of a denser medium:

1. Suppose a compression travelling in air from **left** to **right** reaches a rigid wall it exerts a **force F**.

2. In turn, the wall exerts an **equal** and **opposite** reaction **R =– F** on the air molecules which results in compression.

3. Thus, a compression travelling towards the rigid wall is **reflected** back as a compression.



Reflection of sound at a denser medium

4. Thus the direction of compression is **reversed**.

c. Reflection at curved surfaces:

1. When sound waves are reflected from the **curved surfaces**, the **intensity** is **changed**.

2. When reflected from a **convex** surface, the reflected waves are **diverged** out and the intensity is **decreased**.

3. When sound is reflected from a **concave** surface, the reflected waves are **converged** and **focused** at a point.

4. **Parabolic** surfaces are used when it is required to focus the sound at a particular **point**.

5. In **elliptical** surfaces, sound from one focus will always be **reflected** to the **other focus**, no matter where it strikes the wall.

(APR - 2023)

3. a. What do you understand by the term 'ultrasonic vibration'? (SEP - 2020)

Ultrasonic vibrations are vibrations with frequency greater than 20 kHz.

b. State three uses of ultrasonic vibrations.

1. Ultrasonic sound is used in SONAR to measure the depth of the sea.
2. Dogs can be specially trained to respond to a whistle which produces ultrasonic vibrations.
3. The ultrasonic vibrations produced by bats help them to detect prey and obstacles in their path.
4. Ultrasonic sound is used in the treatment of muscular pain and arthritis.

c. Name three animals which can hear ultrasonic vibrations.

Ans: Dogs, bats and rats.

4. What is an echo? (APRIL - 2024)

Echo:

An echo is the sound reproduced due to the **reflection** of the **original sound** from various rigid surfaces.

E.g: walls, ceilings, surfaces of mountains, etc.,

a. State two conditions necessary for hearing an echo. (APRIL - 24, PTA - I)

1. The minimum time gap between the original sound and an echo must be **0.1s.**
2. The minimum distance required to hear an echo is **17.2m.**

b. What are the medical applications of echo? (AP - 24, SEP - 20, PTA - I)

1. The principle of echo is used in **obstetric ultrasonography**, which is used to create real - time visual images of the developing embryo or fetus in the mother's uterus.
2. This is a **safe testing tool**, as it does not use any harmful radiations.

c. How can you calculate the speed of sound using echo? (APRIL - 2024)

The speed of sound wave using an echo is given by,

$$\text{Speed of sound} = \frac{\text{distance travelled}}{\text{time taken}} = \frac{2d}{t}$$

X. HOT Questions.

1. Suppose that a sound wave and a light wave have the same frequency, then which one has a longer wavelength?

a. Sound
b. Light
c. Both a and b
d. data not sufficient

Ans: b. light

2. When sound is reflected from a distant object, an echo is produced. Let the distance between the reflecting surface and the source of sound remain the same. Do you hear an echo sound on a hotter day? Justify your answer.

1. No, we cannot hear an echo.
2. The speed of sound in a medium increase with an increase in temperature.
3. Hence, on a hotter day, the time interval between the original sound and the reflected sound will **decrease**.
4. Therefore, an echo can be heard only if the time interval between the original sound and the reflected sound is greater than 0.1 s

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Choose the correct answer.

1. Sound waves travel in air with a speed of about _____ at NTP. **(SEP - 2021)**

a. 340×10^8 m/s b. 340 m / s
c. 3×10^8 m/s d. 3×10^{-8} m/s **Ans: b. 340 m / s**

2. Arrange the following media in descending order on the basis of speed of sound **(PTA - 1)**

a. air > glass > water b. water > air > glass
c. glass < water < air d. glass > water > air **Ans: d. glass > water > air**

II. Short answers.

1. Write any two applications of echo. (MAY - 2022)

1. The principle of echo is used in obstetric **ultrasonography**.
2. Echo is used to determine the velocity of sound waves in any medium.
3. Some animals communicate with each other over and also locate objects.

2. A source producing a sound of frequency 90 Hz is approaching a stationary listener with a speed equal to (1/10) of the speed of sound. What will be the frequency heard by the listener? (PTA - 4)

Solution:

When the source is moving towards the stationary listener, the expression for apparent frequency is

$$n' = \left(\frac{v}{v - v_s}\right) n$$

$$= \left(\frac{v}{v - \left(\frac{1}{10}\right)v}\right) n = \left(\frac{10}{9}\right) n$$

$$= \left(\frac{10}{9}\right) \times 90 = \mathbf{100\ Hz}$$

3. A strong ultrasonic sound signal is sent from a ship towards the bottom of the sea. It is received by the receiver after 2s. Calculate the depth of sea. The speed of sound in water 1450 ms^{-1}. (PTA - 5)

Given data:

Speed of sound in water (v) = 1450 ms^{-1}

Time (t) = 2s

Depth of the Sea (d) = ?

Solution:

$$\text{Speed of sound} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$v = \frac{2d}{t}$$

$$2d = v \times t$$

$$d = \frac{v \times t}{2}$$

$$= \frac{1450 \times \cancel{2}}{\cancel{2}} = 1450\,m$$

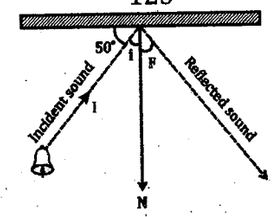
∴ Depth of the sea is **1450 m**

III. Long answers.

1. Use the analogy to fill the blank. (PTA - 3)

i.	Bats	:	Ultrasonic	
	Earth quake	:	_____	**(Infrasonic)**
ii.	Whispering gallery	:	Application of echo	
	Tracking a satellite	:	_____	**(Application of Doppler Effect)**

2. From the given figure, calculate angle of reflection of sound. (PTA - 4)



Angle of **incident** is **always equal** to angle of **reflection**.

So, $\angle i = 90° - 50°$

$= 40°$

$\angle i = \angle r = \mathbf{40°}$

3. A source of sound is moving with a velocity of 50ms^{-1} towards a stationary listener. The listener measures the frequency of the source as 1000 Hz. What will be the apparent frequency of the source when it is moving away from the listener after crossing him? (Velocity of sound in the medium is 330 ms^{-1}) (GMQP - 2019)

Solution:

When the source is moving towards the stationary listener, the expression for apparent frequency is

$$n' = \left(\frac{V}{V - V_S}\right) n$$

$$1000 = \left(\frac{330}{330 - 50}\right) n$$

$$n = \left(\frac{1000 \times 280}{330}\right)$$

n = 848.48 Hz

The actual frequency of the sound is 848.48 Hz. When the source is moving away from the stationary listener, the expression for apparent frequency is

$$n' = \left(\frac{V}{V + V_S}\right) n$$

$$= \left(\frac{330}{330 + 50}\right) \times 848.48$$

n' = 736.84 Hz

∴ Actual frequency (n) = **848.48 Hz**

Apparent frequency (n') = **736.84 Hz**

4. A source producing a sound of frequency 500 Hz is moving towards a static listener with a velocity of 30 ms^{-1}. The speed of the sound is 330 ms^{-1}. What will be the frequency heard by listener? (PTA - 2)

Solution:

When the source is moving towards the stationary listener, the expression for apparent frequency is.

$$n' = \left(\frac{V}{V - V_S}\right) n$$

$$= \left(\frac{330}{330 - 30}\right) \times 500$$

$$= 550 \text{ Hz}$$

5. Give any three differences between the sound and light waves. (PTA - 3)

	Sound waves		Light waves
1.	**Medium** is **required** for the propagation.	1.	**Medium** is **not required** for the propagation.
2.	These are **longitudinal waves.**	2.	These are **transverse waves.**
3.	Wavelength ranges from **1.65 cm** to **1.65 m**	3.	Wavelength ranges from 4×10^{-7} **m** to 7×10^{-7} **m.**
4.	It travels in air with a speed of about **340 ms^{-1}** at NTP	4.	It travels in air with a speed of 3×10^{8} **ms^{-1}** at NTP

6. At what speed should a source of sound move away from a stationary observer so that observer finds the apparent frequency equal to half of the original frequency? (PTA - 5)

Solution:

When the source is moving away from the stationary listener, the expression for the apparent frequency is

$$n' = \left(\frac{V}{V+V_S}\right)\cdot n$$

$$\frac{n}{2} = \left(\frac{V}{V+V_S}\right)\cdot n$$

$$V_s = V$$

ii. Calculate the frequency of visible light having wavelength 3000 A° travelling in vacuum.

Solution: **(PTA - 5)**

$$\text{Frequency } (n) = \frac{\text{Velocity}}{\text{Wavelength}}$$

$$= \frac{3\times10^{8}}{3000\times10^{-10}} = \frac{\cancel{3}\times10^{8}}{\cancel{3}\times10^{-7}}$$

$$= 10^{8+7} = \mathbf{10^{15}} \textbf{ cycle / sec}$$

ADDITIONAL QUESTIONS

I. Match the following:

	Column - I		Column - II		Answers
1.	Sound waves	- a.	Transverse	- e.	**Longitudinal**
2.	Light waves	- b.	Acoustical wonder	- b.	**Transverse**
3.	Air at 0°C	c.	343 ms^{-1}	d.	**331 ms^{-1}**
4.	Air at 20°C	d.	331 ms^{-1}	c.	**343 ms^{-1}**
5.	Golconda fort	- e.	Longitudinal	- a.	**Acoustical wonder**

1.

	Column - I		Column - II		Answers
1.	Audible waves	- a.	Bats	- b.	**stretched strings**
2.	Infrasonic	- b.	stretched strings	- d.	**Whale**
3.	Ultrasonic	- c.	Whispering halls	- a.	**Bats**
4.	Elliptical surface	- d.	Whale	- c.	**Whispering halls**

2.

	Column - I		Column - II		Answers
1.	Sound Boards	- a.	small gathering	- e.	**Auditoria**
2.	Ear trumpet	- b.	3×10^{8} ms^{-1}	- d.	**Hearing aid**
3.	Megaphone	- c.	340 ms^{-1} at NTP	- a.	**small gathering**
4.	Speed of sound	- d.	Hearing aid	- c.	**340 ms^{-1} at NTP**
5.	Speed of light	- e.	Auditoria	- b.	**3×10^{8} ms^{-1}**

3.

	Column - I		Column - II		Answers
1.	RADAR	- a.	radio waves	- b.	**location of aeroplanes**
2.	SONAR	- b.	location of aeroplanes	- e.	**submarines**
3.	Satellite	- c.	17.2 m	- a.	**radio waves**
4.	Echo	- d.	Acoustics	- c.	**17.2 m**
5.	Production of sound	- e.	17.2 m	- d.	**Acoustics**

4.

	Column - I		Column - II		Answers
1.	Automobile	- a.	2d/t	- c.	**Doppler effect**
2.	Echo	b.	∠i = ∠r	d.	**obstetric ultrasonography**
3.	Speed of sound	- c.	Doppler effect	- a.	**2d/t**
4.	St. Paul's cathedral	- d.	obstetric ultrasonography	- e.	**whispering gallery**
5.	Law of reflection	- e.	whispering gallery	- b.	**∠i = ∠r**

II. Choose the correct answer:

1. _____ is a branch of physics that deals with production of sound.
   a. Dynamics b. Statistics c. Acoustics d. Kinetics **Ans: c. Acoustics**
2. Vibrating bodies produce energy in the form of _____.
   a. waves b. velocity c. surfaces d. none of the above **Ans: a. waves**
3. Waves produced during an earthquake are called _____ waves.
   a. audible b. ultrasonic c. infrasonic d. none of the above **Ans: c. infrasonic**
4. Velocity of sound is maximum in _____.
   a. solids b. liquids c. gases d. all the above **Ans: a. solids**
5. The speed of sound in air at 0°C is _____ m s^{-1}.
   a. 331 b. 343 c. 380 d. 420 **Ans: a. 331**
6. <i = <r is the law of _____.
   a. refraction b. reflection c. rarefaction d. deflection **Ans: b. reflection**
7. The persistence of hearing for human ears is _____ second.
   a. 1 b. 0.1 c. 100 d. 0 **Ans: b. 0.1**
8. _____ are curved surfaces used in auditoria and halls to improve the quality of sound.
   a. Mega phone b. Ear trumpet
   c. Sound board d. none of the above **Ans: c. Sound board**
9. The speed of sound can be given by _____.
   a. $\frac{2t}{d}$ b. $\frac{2d}{t}$ c. $\frac{t}{d}$ d. $\left(\frac{d}{t}\right)^2$ **Ans: b. $\frac{2d}{t}$**
10. _____ is used to measure the speed of an automobile.

a. RADAR b. SONAR c. Doppler d. Ultrasonography

Ans: c. Doppler

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

1. The minimum distance required to hear an echo is $\frac{1}{10^{th}}$ part of the magnitude of the velocity of sound in air.
   Ans: False
   The minimum distance required to hear an echo is $\frac{1}{20^{th}}$ part of the magnitude of the velocity of sound in air.
2. Echo is used to determine the velocity of sound waves in any medium.
   Ans: True
3. The persistence of hearing for human ears is 0.01 second.
   Ans: False
   The persistence of hearing for human ears is **0.1** second.
4. SI unit of velocity is kilometre.
   Ans: False
   SI unit of velocity is **metre**.
5. When reflected from a convex surface, the reflected waves are converged out and the intensity is increased.
   Ans: False
   When reflected from a convex surface, the reflected waves are **diverged** out and the intensity is **decreased**.

IV. Analog

1. High pressure : compression
   Low pressure : _____ **(rarefaction)**
2. Infrasonic : below 20 Hz
   Ultrasonic : _____ **(greater than 20 k Hz)**
3. Effect of density : $V \propto \sqrt{\frac{1}{d}}$
   Effect of temperature : _____ **($V \propto \sqrt{T}$)**
4. Iron : $5950\ ms^{-1}$
   Water : _____ **($1493\ ms^{-1}$)**
5. Velocity of solid : maximum
   Velocity of gas : _____ **(least(minimum))**
6. Rare medium : water
   Denser medium : _____ **(Air)**
7. Source follows the listener : $\left(\frac{V-V_L}{V-V_S}\right)n$
   Listener follows the source : _____ $\left(\frac{V+V_L}{V-V_S}\right)n$
8. RADAR : Radio Detecting and Ranging
   SONAR : _____ **(Sound Navigation and Ranging)**

9. Velocity (V) : $\frac{\lambda}{T}$
   Speed of sound : _____ $\left(\frac{2d}{t}\right)$
10. Application of echo : ultrasonography
    Application of reflection : _____ **(mega phone)**

V. HOTS

1. A fighter aeroplane is seen before hearing its sound. Why?

1. A fighter aeroplane is seen before hearing its sound because light travels at a very high speed 3×10^8 m/s whereas the sound travels in air at 330 m/s.
2. Thus as soon as a fighter aeroplane appears it is seen at once whereas its sound take some time to reach us.

2. A large drum can produce a louder sound than a small drum. Why?

1. Loudness depends on the area of the vibrating body.
2. A large drum occupies more area than that of a small drum.
3. Therefore, a large drum can produce a louder sound than a small drum.

3. Echoes can be produced in mountains or valleys. Why?

1. The repetition of sound when it is reflected from a distant body is called an echo.
2. Echo can be heard if the minimum distance between source of sound and reflecting body is 17.2 m
3. There is enough distance in mountains or valleys.
4. Hence, echoes can be produced in such places.

4. We cannot talk to one another on the surface of moon. Why?

1. Sound requires a medium to propagate.
2. It cannot travel in the vacuum.
3. Since there is a vacuum on the moon therefore the sound of other person does not reach to our ear, so we cannot talk to another on the surface of moon.

5. Sound cannot reach us from space. Why?

1. Sound requires a medium to propagate.
2. It cannot travel in the vacuum.
3. Since there is a vacuum in the space, therefore, sound cannot reach us from space.

VI. Problem solving.

1. A source and listener are moving towards each other with the speed of 54km/hr. If the time frequency of sound emitted by the source is 500 Hz. Calculate the observed frequency when both source and listener are moving towards each other.
(Velocity of sound in air = $330\ ms^{-1}$)

Given data:

Time frequency (f) = 500 Hz

Velocity of sound (V_s) = $54\frac{km}{hr}$

$$\frac{km}{hr} = \frac{54\times1000}{3600} = 15ms^{-1}$$

Source and observe moving towards each other

∴ Apparent frequency is given by

$$n' = \left(\frac{V+V_o}{V-V_s}\right)(n)$$

$$= \left(\frac{330+15}{330-15}\right)500$$

$$= 547.62\ Hz.$$

2. **A fixed source emits sound of frequency 1000 Hz. What is the frequency heard by an observer moving towards the source at a constant speed of $20ms^{-1}$.**

Given data:

Frequency (f) = 1000 Hz

Velocity of sound (V_o) = $20ms^{-1}$

Solution:

Observer is moving towards the source

$$\therefore \text{Apparent frequency } n' = \left(\frac{V+V_o}{V-V_s}\right)n$$

$$= \left(\frac{340+20}{340}\right)1000$$

$$= 1059\ Hz.$$

3. **Calculate the Doppler shift if V and V_s are 30 m/s and 10 m/s and the wave frequency is 25Hz.**

Given data:

V = 50 m/s; V_s = 10 m/s; f_o = 25Hz

Solution:

Doppler effect equation is

$$\lambda_f = \frac{V-V_s}{f_o}$$

$$= \frac{50-10}{25}$$

$$= 1.6m$$

4. **A sound wave of frequency 30 Hz moves with a velocity of 65 m/s, if the source velocity is 10m/s calculate the Doppler shift.**

Given data:

V = 65 m/s; V_s = 10 m/s; f_o = 30Hz

Solution:

Doppler effect equation is

$$\lambda_f = \frac{V-V_s}{f_o}$$

$$= \frac{65-10}{30}$$

$$= 1.83m$$

5. **A submarine travels through water at a speed of 8m/s, emitting a sonar wave at a frequency of 1400 Hz. The speed of sound in the water is 530 m/s. A second submarine is located**

such that both submarines are travelling directly towards each other. The second submarine is moving at 6m/s. Calculate the frequency of the submarines.

Given data:

Frequency (f) = 1400 Hz

Velocity of source (V_s) = 8 m/s

Velocity of source (V_s) = 6 m/s

Solution:

$$\therefore \text{Apparent frequency } n' = \left(\frac{V+V_o}{V-V_s}\right)n$$

$$= \left(\frac{530+6}{530-8}\right)1400$$

$$n' = 1437.54\ Hz.$$

6. **What is the wavelength of a 1500 Hz sound in air (C = 340m/s)?**

Given data

Velocity of sound in air = 340 m/s

Wave length (λ) = ?

Frequency (n) = 1500 Hz

Solution:

$$V = n\lambda$$

$$\therefore \lambda = \frac{V}{n}$$

$$= \frac{340}{1500}$$

$$\lambda = 0.227$$

7. **A source producing a sound of frequency 600 Hz is moving towards a listener with a velocity of $60ms^{-1}$. The speed of the sound is 330 ms^{-1}. What will be the frequency heard by listener?**

Solution:

When the source is moving towards the stationary listener, the expression for apparent frequency is

$$n' = \left(\frac{V}{V-V_s}\right)n$$

$$n' = \left(\frac{330}{330-60}\right)600$$

$$= \left(\frac{330}{270}\right)600$$

$$= 733.3\ Hz$$

8. **What will be the frequency sound having 5m as its wavelength, when it travels with a speed of $331ms^{-1}$?**

Given data:

Wave length = 5 m

Velocity = $331ms^{-1}$

Frequency = ?

Solution:

$$V = n\lambda$$

$$n = \frac{V}{\lambda}$$

$$= \left(\frac{331}{5}\right)$$

$$= 66.2 \text{ Hz}$$

VII. Short Answers:

1. What is particle velocity?

The velocity with which the particles of the medium vibrate in order to **transfer** the **energy** in the form of a **wave** is called particle velocity.

2. What is wave velocity?

The velocity with which the wave travels through the **medium** is called wave velocity.

3. State the laws of reflection.

1. The incident wave, the normal to the reflecting surface and the reflected wave at the point of incidence lie in the **same plane.**
2. The angle of incidence ∠i is equal to the angle of reflection ∠r.

4. What are incident waves and reflected waves?

1. The sound wave that travel **towards** the **reflecting surface** are called the incident waves.
2. The sound waves **bouncing back** from the reflecting surface are called reflected waves.

5. What is meant by rarer and denser medium?

1. The medium in which the **velocity** of sound **increases** compared to other medium is called rarer medium.
2. The medium in which the **velocity** of sound **decreases** compared to other medium is called denser medium.

6. Write a short note on sound board.

1. Sound board is basically **curved surfaces**, which are used in auditoria and halls to improve the **quality** of **sound.**
2. It is placed such that the speaker is at the **focus** of the concave surface.
3. The sound of the speaker is reflected towards the audience thus improving the quality of sound heard by the audience.

7. Write a short note on mega phone.

1. A megaphone is a **horn - shaped device** used to address a small gathering of people.
2. It's one end is **wide** and the other end is **narrow.**
3. When a person speaks at the narrow end, the sound of his speech is concentrated by the **multiple reflections** from the walls of the tube.
4. Thus, voice can be heard **loudly** over a long distance.

8. Define Doppler effect.

Whenever there is a **relative motion** between a source and a listener, the frequency of the sound heard by the listener is **different** from the original frequency of sound omitted by the source.

This is known as "Doppler effect".

VIII. Long Answers:

1. Write down the categories of sound waves based on their frequencies.

Audible waves:

1. These are sound waves with a frequency ranging between **20 Hz** and **20,000 Hz.**
2. These are generated by **vibrating bodies** such as vocal cords, stretched strings etc.,

Infrasonic waves:

1. These are sound waves with a frequency **below 20 Hz** that cannot be heard by the human ear.
2. **E.g:** waves produced during earth quake, ocean waves, etc.,

Ultrasonic waves:

1. These are sound waves with a frequency **greater than 20 kHz.**
2. Human ear cannot detect these waves, but certain creatures like mosquito, dogs, bats, dolphins can detect these waves.
3. **E.g:** waves produced by bats.

2. Tabulate the expressions for apparent frequency due to Doppler effect.

	Position of source and listener	Note	Expression for apparent frequency
1.	1. Both source and listener move 2. They move towards each other	a. Distance between source and listener decrease. b. Apparent frequency is more than actual frequency.	$n' = \left(\frac{v+v_L}{v-v_s}\right)n$
2.	1. Both source and listener move. 2. They move away from each other.	a. Distance between source and listener increases. b. Apparent frequency is less than actual frequency. c. V_s and V_t, become opposite to that in case - 1.	$n' = \left(\frac{v-v_L}{V+V_s}\right)n$
3.	1. Both source and listener move. 2. They move one behind the other. 3. Source follows the listener.	a. Apparent frequency depends on the velocities of the source and the listener. b. V_s becomes opposite to that in case - 2.	$n' = \left(\frac{v-v_L}{v-v_s}\right)n$
4.	1. Both source and listener move. 2. They move one behind the other. 3. Listener follows the source.	a. Apparent frequency depends on the velocities of the source and the listener. b. v_s and v_L become opposite to that in case - 3.	$n' = \left(\frac{v+v_L}{v+v_s}\right)n$
5.	1. Source at rest. 2. Listener moves towards the source.	a. Distance between source and listener decreases. b. Apparent frequency is more than actual frequency. c. $v_s = 0$ in case – 1.	$n' = \left(\frac{v+v_L}{v}\right)n$

6.	1. Source at rest. 2. Listener moves away from the source.	a. Distance between source and listener increases. b. Apparent frequency is less than actual frequency. c. $v_S = 0$ in case – 2.	$n' = \left(\frac{v - v_L}{v}\right) n$
7.	1. Listener at rest. 2. Source moves towards the listener.	a. Distance between source and listener decreases. b. Apparent frequency is more than actual frequency. c. $v_L = 0$ in case – 1.	$n' = \left(\frac{v}{v - v_s}\right) n$
8.	1. Listener at rest. 2. Source moves away from the listener.	a. Distance between source and listener increases. b. Apparent frequency is less than actual frequency. c. $v_L = 0$ in case – 2.	$n' = \left(\frac{v}{v + v_s}\right) n$

IX. Fill in the blanks.

1. _____ waves are sound waves with frequency below 20 Hz. **(Infrasonic)**
2. Waves produced during an earthquake are called _____ waves. **(infrasonic)**
3. _____ waves are sound waves with frequency greater than 20 kHz. **(Ultrasonic)**
4. Human ear cannot detect _____ waves. **(ultrasonic)**
5. Bats produce _____ waves. **(ultrasonic)**
6. Sound requires a _____ for propagation. **(medium)**
7. Sound waves are _____ waves. **(longitudinal)**
8. Light waves are _____ waves. **(transverse)**
9. The wavelength of sound waves ranges from _____ cm to _____ m. **(1.65, 1.65)**
10. The wavelength of light waves ranges from _____ m to _____ m. **($4 \times 10^{-7}, 7 \times 10^{-7}$)**
11. The two types of velocity are _____ and _____. **(particle, wave)**
12. SI unit of velocity is _____. **(ms^{-1})**
13. The velocity with which the particles of a medium vibrate is called _____ velocity. **(particle)**
14. The velocity with which the wave travels through a medium is called _____ velocity. **(wave)**
15. The distance travelled by a sound wave in unit time is called the _____ of the sound wave. **(velocity)**
16. Velocity of sound is least in _____. **(gases)**
17. Velocity of sound is maximum in _____. **(solids)**
18. Elastic property of solids is characterized by their _____. **(elastic moduli)**
19. The speed of sound is directly proportional to the square root of the _____. **(elastic modulus)**
20. Velocity of sound in solids decreases as the _____ increases. **(density)**
21. The velocity of sound increases when the _____ of the material increases. **(elasticity)**
22. The speed of sound is inversely proportional to the square root of _____. **(density)**
23. The _____ of sound in a gas increases with the increase in temperature. **(velocity)**
24. The velocity of sound changes by 0.61 ms^{-1} when the temperature changes by _____. **(1°C)**
25. When the humidity increases, the speed of sound _____. **(increases)**
26. The speed of sound in air at 0°C is _____ ms^{-1} **(331)**
27. The speed of sound in air at 20°C is _____ ms^{-1} **(343)**
28. The speed of sound in sea water is _____ ms^{-1} **(1533)**
29. The speed of sound in kerosene is _____ ms^{-1} **(1324)**
30. The speed of sound in aluminium is _____ ms^{-1} **(6420)**
31. The speed of sound in iron is _____ ms^{-1} **(5950)**
32. The speed of sound in copper is _____ ms^{-1} **(5010)**
33. The angle of incidence is equal to the angle of _____. **(reflection)**
34. The reflection and refraction of sound is similar to the reflection of _____. **(light)**

35. The bouncing of sound waves from the interface between two media is termed as the _____. **(reflection of sound)**
36. The waves that bounce back are termed as the _____ waves. **(reflected)**
37. Sound waves that travel towards the reflecting surface are called the _____ waves. **(incident)**
38. The point of incidence and the point of reflection is the _____ on the reflecting surface. **(same)**
39. A perpendicular line drawn at the point of incidence is called the _____. **(normal)**
40. The angle which the incident sound wave makes with the normal is called the _____. **(angle of incidence)**
41. The angle which the reflected wave makes with the normal is called the _____. **(angle of reflection)**
42. A compression travelling towards the rigid wall is reflected back as a _____. **(compression)**
43. Rarefaction travels from _____ to _____. **(right, left)**
44. When sound is reflected from a _____ surface, the reflected waves are diverged out and the intensity is decreased. **(convex)**
45. When sound is reflected from a _____ surface, the reflected waves are converged and focused at a point. **(concave)**
46. _____ surfaces are used when it is required to focus the sound at a particular point. **(Parabolic)**
47. Many halls are designed with _____ reflecting surfaces. **(Parabolic)**
48. In _____ surfaces, sound from one focus will always be reflected to the other focus, no matter where it strikes the wall. **(elliptical)**
49. Echoes are caused due to the _____ of sound. **(reflection)**
50. The principle of _____ used in designing whispering halls. **(elliptical surfaces)**
51. A/an _____ is the sound reproduced due to the reflection of the original sound from various rigid surfaces. **(echo)**
52. Small rooms do not satisfy the basic conditions for hearing an _____. **(echo)**
53. The persistence of hearing for human ears is _____ second. **(0.1)**
54. The minimum time gap between the original sound and an echo must be _____ s. **(0.1)**
55. The minimum distance required to hear an echo is _____ part of the magnitude of the velocity of sound in air. **($1/20^{th}$)**
56. The principle of _____ is used in obstetric ultrasonography. **(echo)**
57. Echo is used to determine the _____ of sound waves in any medium. **(velocity)**
58. _____ are basically curved surfaces which are used in auditoria and halls to improve the quality of sound. **(Sound boards)**
59. _____ is a hearing aid used by people, having difficulty in hearing. **(Ear trumpet)**
60. A _____ is a horn - shaped device used to address a small gathering of people. **(megaphone)**
61. When a medium is at rest, the velocity of the medium is _____. **(zero)**
62. The frequency of radio waves emitted by a satellite decreases as the satellite passes _____ from the Earth. **(away)**
63. By measuring the change in the frequency of the radio waves, the _____ of the satellites is studied. **(location)**
64. The speed and location of the aeroplanes and aircrafts are tracked by _____. **(RADAR)**
65. The speed of marine animals and submarines can be determined by using _____. **(SONAR)**

6. NUCLEAR PHYSICS

KEY FORMULAE		
1.	1 Becquerel	$1\ Bq = \frac{1}{3.7 \times 10^{10}}$ curie
2.	Einstein's equation	$E = mc^2$
3.	1 Curie	3.7×10^{10} disintegrations/s
4.	1 Rd	10^6 disintegrations/s
5.	1 eV	1.602×10^{-19} joule
6.	1 MeV	10^6 eV
7.	Velocity of light in vacuum	$3 \times 10^8 ms^{-1}$

I. Choose the correct answer.

1. Man - made radioactivity is also known as _____.
   a. induced radioactivity b. spontaneous radioactivity
   c. artificial radioactivity d. a & c **Ans: d. a & c**

2. Unit of radioactivity is _____. ※※ **(SEP - 2021)**
   a. Roentgen b. Curie
   c. Becquerel d. all the above **Ans: d. all the above**

3. Artificial radioactivity was discovered by _____. ※※
   a. Becquerel b. Irene Curie c. Roentgen d. Neils Bohr
   Ans: b. Irene Curie

4. In which of the following, no change in mass number of the daughter nuclei takes place
   i. α decay ii. β decay iii. γ decay iv. neutron decay
   a. i. is correct b. ii. and iii. are correct
   c. i. & iv. are correct d. ii. & iv. are correct
   Ans: b. ii. and iii. are correct

5. _____isotope is used for the treatment of cancer. ※ **(JULY - 2024)**
   a. Radio Iodine b. Radio Cobalt
   c. Radio Carbon d. Radio Nickel **Ans: b. Radio Cobalt**

6. Gamma radiations are dangerous because _____.
   a. it affects eyes & bones
   b. it affects tissues
   c. it produces genetic disorder
   d. it produces enormous amount of heat **Ans: c. it produces genetic disorder**

7. _____ aprons are used to protect us from gamma radiations **(PTA - III)**
   a. Lead oxide b. Iron c. Lead d. Aluminium
   Ans: c. Lead

8. Which of the following statements is/are correct?
   i. α particles are photons
   ii. Penetrating power of γ radiation is very low
   iii. Ionization power is maximum for α rays
   iv. Penetrating power of γ radiation is very high
   a. i. & ii. are correct b. ii. & iii are correct
   c. iv. only correct d. iii. & iv. are correct
   Ans: d. iii. & iv. are correct

9. Proton - Proton chain reaction is an example of _____.
   a. Nuclear fission b. α - decay
   c. Nuclear fusion d. β - decay **Ans: c. Nuclear fusion**

10. In the nuclear reaction ${}_6X^{12} \xrightarrow{\alpha\ decay} {}_zY^A$, the value of A & Z. ※※
    a. 8, 6 b. 8, 4
    c. 4, 8 d. cannot be determined with the given data
    Ans: b. 8, 4

11. Kamini reactor is located at _____. ※※
    a. Kalpakkam b. Koodankulam
    c. Mumbai d. Rajasthan **Ans: a. Kalpakkam**

12. Which of the following is/are correct?
    i. chain reaction takes place in a nuclear reactor and an atomic bomb
    ii. the chain reaction in a nuclear reactor is controlled
    iii. the chain reaction in a nuclear reactor is not controlled
    iv. no chain reaction takes place in an atom bomb
    a. i. only correct b. i. & ii. are correct
    c. iv. only correct d. iii. & iv. are correct
    Ans: b. i. & ii. are correct

II. Fill in the blanks.

1. One roentgen is equal to _____ disintegrations per second. ※※
   Ans: 2.58×10^{-4} coulomb/kg

2. Positron is an _____. **Ans: elementary particle**

3. Anemia can be cured by _____ isotope. ※ **Ans: Radio - iron**

4. Abbreviation of ICRP _____.
   Ans: International Commission on Radiological Protection

5. _____ is used to measure exposure rate of radiation in humans.
   Ans: Dosimeter

6. _____ has the greatest penetration power. **Ans: γ - rays**

7. ${}_zY^A \rightarrow {}_{z+1}Y^A + X$; Then, X is _____. **Ans: beta particle (electron)**

8. $_{Z}X^{A} \rightarrow {}_{Z}Y^{A}$; This reaction is possible in _____ decay. **Ans: Gamma**

9. The average energy released in each fusion reaction is about _____ J. **Ans: 3.84×10^{-12}**

10. Nuclear fusion is possible only at an extremely high temperature of the order of _____ K. **Ans: 10^{7} to 10^{9}**

11. The radio isotope of _____ helps to increase the productivity of crops. **Ans: phosphorous (P - 32)**

12. If the radiation exposure is 100 R, it may cause _____. **(JU - 23) Ans: Leukemia**

III. State whether the following statements are true or false, if false correct the statement.

1. Plutonium -239 is a fissionable material.
   Ans: True

2. Elements having atomic number greater than 83 can undergo nuclear fusion.
   Ans: False
   Elements having atomic number greater than **82** can undergo **spontaneous radio activity**.

3. Nuclear fusion is more dangerous than nuclear fission.
   Ans: True

4. Natural uranium U - 238 is the core fuel used in a nuclear reactor.
   Ans: False
   Natural uranium **U - 235** is the core fuel used in a nuclear reactor.

5. If a moderator is not present, then a nuclear reactor will behave as an atom bomb.
   Ans: False
   If a **control rod** is not present, then a nuclear reactor will behave as an atom bomb.

6. During one nuclear fission on an average, 2 to 3 neutrons are produced.
   Ans: True

7. Einstein's theory of mass energy equivalence is used in nuclear fission and fusion.
   Ans: True

IV. Match the following.

Match - I:

Column - I			Column - II		Answers		
1.	BARC	-	a.	Kalpakkam	-	c.	**Mumbai**
2.	India's first atomic power station	-	b.	Apsara	-	d.	**Tarapur**
3.	IGCAR	-	c.	Mumbai	-	a.	**Kalpakkam**
4.	First nuclear reactor in India	-	d.	Tarapur	-	b.	**Apsara**

Match - II: **(PTA - VI)**

Column - I			Column - II		Answers		
1.	Fuel	-	a.	lead	-	d.	**uranium**
2.	Moderator	-	b.	heavy water	-	b.	**heavy water**
3.	Control rods	-	c.	cadmium rods	-	c.	**Cadmium rods**
4.	Shield	-	d.	uranium	-	a.	**lead**

Match - III:

Column - I			Column - II		Answers		
1.	Soddy Fajan	-	a.	Natural radioactivity	-	b.	**Displacement law**
2.	Irene Curie	-	b.	Displacement law	-	d.	**Artificial radioactivity**
3.	Henry Becquerel	-	c.	Mass energy equivalence	-	a.	**Natural radioactivity**
4.	Albert Einstein	-	d.	Artificial radioactivity	-	c.	**Mass energy equivalence**

Match - IV:

Column - I			Column - II		Answers		
1.	Uncontrolled fission reaction	-	a.	Hydrogen bomb	-	d.	**Atom bomb**
2.	Fertile material	-	b.	Nuclear reactor	-	c.	**Breeder reactor**
3.	Controlled fission reaction	-	c.	Breeder reactor	-	b.	**Nuclear reactor**
4.	Fusion reaction	-	d.	Atom bomb	-	a.	**Hydrogen bomb**

Match - V:

Column - I			Column - II		Answers		
1.	Fe - 59	-	a.	Age of fossil	-	c.	**Leukemia**
2.	I - 131 **(JU-23)**	-	b.	Function of heart	-	d.	**Thyroid disease**
3.	Na - 24 **(JU-23)**	-	c.	Leukemia	-	b.	**Function of heart**
4.	C - 14 **(JU-23)**	-	d.	Thyroid disease	-	a.	**Age of fossil**

V. Arrange the following in the correct sequence.

1. **Arrange in descending order, on the basis of their penetration power.**
   alpha rays, beta rays, gamma rays, cosmic rays
   Ans: Gamma rays, beta rays, Alpha rays, cosmic rays

2. **Arrange the following in the chronological order of discovery.**
   Nuclear reactor, radioactivity, artificial radioactivity, discovery of radium
   Ans: Radioactivity (1896), discovery of radium (1898), artificial radioactivity (1934), nuclear reactor (1942).

VI. Use the analogy to fill in the blank.

1.	Spontaneous process	:	Natural radioactivity,	**(JUNE - 2023)**
	Induced process	:	_____	**(artificial radioactivity)**
2.	Nuclear Fusion	:	Extreme temperature,	**(JUNE - 2023)**
	Nuclear Fission	:	_____	**(room temperature)**
3.	Increasing crops	:	Radio phosphorous,	
	Effective functioning of heart	:	_____	**(Radio sodium)**
4.	Deflected by electric field	:	α ray,	
	Null Deflection	:	_____	**(γ rays)**

VII. Numerical problem.

1. $_{88}Ra^{226}$ experiences three α- decay. Find the number of neutrons in the daughter element.

Ans:

I α decay:

$$_{88}Ra^{226} \longrightarrow {}_{86}X^{222} + {}_{2}He^{4}$$

II α decay:

$$_{86}X^{222} \longrightarrow {}_{84}Y^{218} + {}_{2}He^{4}$$

III α decay:

$$_{84}Y^{218} \longrightarrow {}_{82}Z^{214} + {}_{2}He^{4}$$

$_{82}Z^{214}$ - daughter nuclei

Atomic number = 82

Mass number = 214

Therefore, Number of neutrons = Mass number − atomic number

= 214 − 82

= **132**

2. A cobalt specimen emits induced radiation of 75.6 millicurie per second. Convert this disintegration into Becquerel. (one curie = 3.7×10^{10} Bq).

Given data,

Induced radiation in curie = 75.6 millicurie per second

= 75.6×10^{-3} curie/sec

One curie = 3.7×10^{10}

= $75.6 \times 10^{-3} \times 3.7 \times 10^{10}$

= 279.72×10^{7}Bq

VIII. Assertion and reason type questions.

1. **Assertion:** A neutron impinging on U^{235}, splits it to produce Barium and Krypton.

Reason : U - 235 is a fissile material.

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

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

2. **Assertion:** In a β - decay, the neutron number decreases by one.

Reason : In a β - decay atomic number increases by one.

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

Ans: d. Assertion is false, but the reason is true.

3. **Assertion:** Extreme temperature is necessary to execute nuclear fusion.

Reason : In a nuclear fusion, the nuclei of the reactants combine releasing high energy.

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

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

4. **Assertion:** Control rods are known as 'neutron seeking rods'.

Reason : Control rods are used to perform sustained nuclear fission reaction.

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

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

IX. Answer in one or two word (VSA).

1. **Who discovered natural radioactivity?** ※※ **(MAY - 2022)**

   Ans: Henri Becquerel

2. **Which radioactive material is present in the ore of pitchblende?**

   Ans: Uranium

3. **Write any two elements which are used for inducing radioactivity?**

   Ans: Boron and Aluminium

4. **Write the name of the electromagnetic radiation which is emitted during a natural radioactivity.**

   Ans: γ rays

5. **If A is a radioactive element which emits an α - particle and produces $_{104}Rf^{259}$. Write the atomic number and mass number of the element A.** ※※

   Ans:

   α - decay:

   $$_{106}A^{263} \longrightarrow {}_{104}\mathbf{Rf}^{259} + {}_{2}He^{4}$$

   Atomic Number - 106

   Mass Number - 263

6. **What is the average energy released from a single fission process?**

   Ans: 3.2×10^{-11}J ※

7. **Which hazardous radiation is the cause for the genetic disease?**

   Ans: gamma radiation

8. **What is the amount of radiation that may cause death of a person when exposed to it?** ※※

   Ans: 600 R

9. **When and where was the first nuclear reactor built?**

   Ans: In 1942, Chicago, USA

10. **Give the SI unit of radioactivity.**

    Ans: Becquerel (Bq)

11. **Which material protects us from radiation?**

    Ans: Lead

X. Answer the following questions in few sentences.

1. **Write any three features of natural and artificial radioactivity.** ※※※

   Features: **(APRIL - 24, PTA - I, MAY & SEP - 22)**

	Natural Radioactivity	Artificial Radioactivity
1.	It cannot be controlled.	It can be controlled.
2.	It is a **spontaneous** process.	It is an **induced** process.
3.	**Alpha, beta** and **gamma** radiations are emitted.	Mostly **elementary particles** such as neutron, positron, etc are emitted.
4.	Exhibited by elements with atomic number **more than 82.**	Exhibited by elements with atomic number **less than 82.**

2. **Define critical mass.**

   1. The **minimum mass** of a fissile material necessary to **sustain** the **chain reaction** is called critical mass.

   2. It depends on the **nature, density** and the **size** of the fissile material.

3. **Define one roentgen.** ※※

   One roentgen is defined as the quantity of radioactive substance which produces a charge of **2.58×10^{-4} coulomb** in 1 kg of air under standard conditions of pressure, temperature and humidity.

4. **State Soddy and Fajan's displacement law.** ※※

   1. When a radioactive element emits an **alpha particle**, a daughter nucleus is formed whose **mass number** is **less** by **4 units** and the **atomic number** is less by **2 units**, than the mass number and atomic number of the parent nucleus.

   2. When a radioactive element emits a **beta particle**, a daughter nucleus is formed whose **mass number** is the **same** and the **atomic number** is **more** by **1 unit**, than the atomic number of the parent nucleus.

5. **Give the function of control rods in a nuclear reactor.**

   1. Control rods are used to control the number of neutrons in order to have **sustained chain reaction.**

   2. To **absorb** the **neutrons.**

6. In Japan, some of the new born children are having congenital diseases. Why?

1. The reason for congenital diseases in Japanese newborn is a result of nuclear bomb blast at Hiroshima and Nagasaki during World war II.
2. As a result the radiation poisoning in Japan is still prevalent which leads to the various congenital diseases like,
   i. Chronic illness - heart defects
   ii. Disability - club foot
   iii. Down syndrome

7. Mr. Ramu is working as an X - ray technician in a hospital. But, he does not wear the lead aprons. What suggestion will you give to Mr. Ramu?

1. I will suggest Ramu to use a dosimeter to detect the levels of ionizing radiations he has been receiving.
2. I will ask him to use lead coated aprons and lead gloves to safe guard himself.
3. I will also brief him on the side effects of x - rays and the diseases he will be prone to, on continuous exposure.

8. What is stellar energy? (JULY - 2024)

Fusion reaction that takes place in the **cores** of the Sun and other stars results in an **enormous** amount of **energy** is called as 'stellar energy'.

9. Give any two uses of radio isotopes in the field of agriculture? (MAY - 22)

1. The radio isotope of **phosphorous** (P - 32) helps to increase the productivity of crops.
2. The radiations from the radio isotopes can be used to **kill** the **insects** and **parasites** and prevent the wastage of agricultural products.
3. Certain perishable cereals exposed to radiations **remain fresh** beyond their normal life, enhancing the storage time.

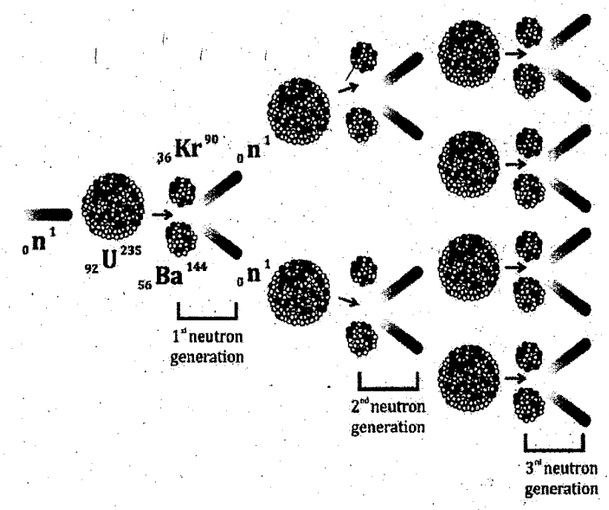
XI. Answer the following questions in detail.

1. Explain the process of controlled and uncontrolled chain reactions.

Controlled chain reaction:

1. In the controlled chain reaction the number of neutrons released is maintained to be **one**.
2. This is achieved by **absorbing** the **extra neutrons** with a **neutron absorber** leaving only one neutron to produce further fission.
3. Thus, the reaction is sustained in a controlled manner.
4. This energy is utilized for constructive purposes.
5. It is used in a nuclear reactor to produce energy in a sustained and controlled manner.

Uncontrolled chain reaction:



Uncontrolled chain reaction

1. In the uncontrolled chain reaction the number of neutrons multiplies **indefinitely** and causes fission in a large amount of the fissile material.
2. This results in the release of a **huge amount** of **energy** within a fraction of a second.
3. This kind of chain reaction is used in **atom bomb** to produce an explosion.

2. Compare the properties of alpha, beta and gamma radiations. (JUNE - 23, SEP - 20)

	Properties	α rays	β rays	γ rays
1.	Definition	**Helium nucleus** ($_2He^4$) consisting of two protons and two neutrons.	They are **electrons** ($_{-1}e^0$), basic elementary particle in all atoms.	They are electromagnetic waves consisting of **photons**.
2.	Charge	**Positively** charged particles. Charge = +2e	**Negatively** charged particles. Charge = − e	**Neutral** particles. Charge= zero
3.	Ionising power	**100 times** greater than β rays and **10,000** times greater than γ rays.	Comparatively **low**	**Very less** ionization power
4.	Penetrating power	**Low** penetrating power (even stopped by a thick paper)	Penetrating power is **greater** than that of α rays. They can penetrate through a thin metal foil.	They have a **very high** penetrating power greater than that of β rays. They can penetrate through thick metal blocks.
5.	Effect of electric and magnetic field	Deflected by **both** the **fields**. (in accordance with Fleming's left hand rule)	Deflected by both the fields; but the direction of deflection is **opposite** to that for alpha rays. (in accordance with Fleming's left hand rule)	They are **not deflected** by both the fields.
6.	Speed	Their speed ranges from $\frac{1}{10}$ to $\frac{1}{20}$ times the speed of light.	Their speed can go up to $\frac{9}{10}$ times the speed of light.	They travel with the **speed** of **light**.

3. What is a nuclear reactor? Explain its essential parts with their functions.

Nuclear reactor: **(APR - 2023)**

A Nuclear reactor is a device in which the **nuclear fission** reaction takes place in a **self - sustained** and **controlled manner** to produce electricity.

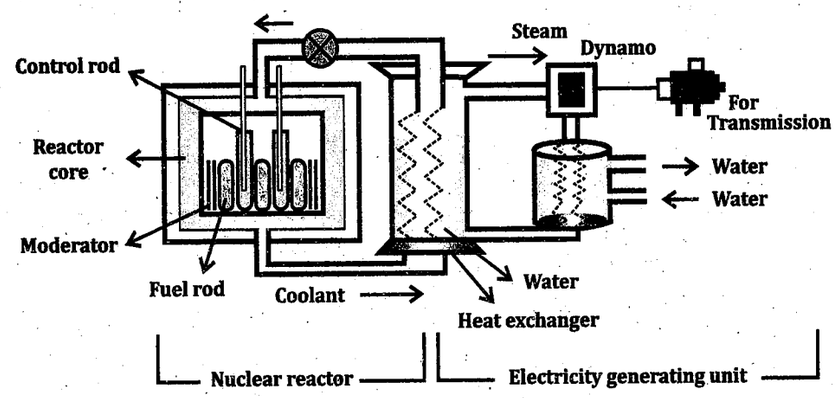
Essential parts and functions:

Fuel:

1. A **fissile material** is used as the fuel.
2. **Uranium** is commonly used as the fuel material.

Moderator:

1. It is used to **slowdown** the high energy neutrons to provide slow neutrons.
2. **Graphite** and **heavy water** are commonly used as moderators.



Schematic diagram of a nuclear reactor

Control rod:

1. It is used to control the number of neutrons in order to have **sustained chain reaction.**
2. Mostly **boron** or **cadmium** rods are used.
3. They **absorb** the neutrons.

Coolant:

1. It is used to **remove** the **heat** produced in the reactor core, to **produce steam.**
2. This steam is used to **run** a **turbine** in order to produce **electricity.**
3. **Water, air** and **helium** are some of the coolants.

Protection wall:

A thick concrete **lead wall** is built around the nuclear reactor in order to **prevent** the harmful radiations from **escaping** into the environment.

XII. HOT Questions:

1. Mass number of a radioactive element is 232 and its atomic number is 90. When this element undergoes certain nuclear reactions, it transforms into an isotope of lead with a mass number 208 and an atomic number 82. Determine the number of alpha and beta decay that can occur.

Ans:

$$n_\alpha = \frac{A-A'}{4}$$
$$= \frac{232-208}{4}$$
$$= \frac{24}{4} = 6$$
$$n_\beta = (2n_\alpha - Z + Z')$$
$$= (2(6) - 90 + 82)$$
$$= 4$$

Number of alpha decay = 6

Number of beta decay = 4

2. 'X - rays should not be taken often'. Give the reason. (PTA - V)

1. X - rays are linked to a slightly increased risk of cancer, there is an extremely low risk of short-term side effects.
2. Frequent exposure to x - rays can result in vomiting, bleeding, fainting, hair loss, and the loss of skin and hair.
3. X - rays provide a low dose of radiation and are not recommended to be taken often.

3. Cell phone towers should be placed far away from the residential area - Why?

1. Cell phone towers should be placed far away from human residences as they emit high frequency radiations.
2. These radiations causes several health issues like skin diseases, cancer, memory loss, headache, cardiovascular stress, low sperm count, birth defects.

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Choose the correct answer.

1. In which of the following reaction, the mass number decreases by four of the daughter nucleus? **(APR - 2023)**

a. α decay b. β decay c. γ decay d. neutron decay

Ans: a. α decay

2. In Beta decay **(PTA - 2)**

a. number of neutron decreases by one b. atomic number decreases by one
c. number of proton increases by one d. number of neutron increases by one

Ans: c. number of proton increases by one

3. The elements having atomic number is _____ undergo spontaneous radioactivity. **(PTA- 4)**

a. more than 83 b. less than 83 c. less than 73 d. equal to 83

Ans: a. more than 83

4. _____ element emits its radiation spontaneously. **(GMQP - 2019)**

a. Ni b. Pd c. Pt d. U

Ans: d. U

II. Short answers.

1. Calculate the amount of energy released when a radioactive substance undergoes fusion and results in a mass defect of 2 Kg. (APR - 2023)

Solution:

Mass defect in the reaction (m) = 2 kg

Velocity of light (c) $= 3\times10^8 ms^{-1}$

By Einstein's equation,

Energy released $E = mc^2$

So $E = 2\times(3\times10^8)^2$

$= \mathbf{1.8\times10^{17} J}$

III. Long answers.

1. Write the features of Nuclear fission and Nuclear fusion. (GMQP - 2019 & PTA - 6)

	Nuclear fission	Nuclear fusion
1.	The process of **breaking** up (splitting) of a heavy nucleus into two smaller nuclei is called 'nuclear fission'.	It is the **combination** of two lighter nuclei to form a heavier nucleus.
2.	Can be performed at **room temperature**.	**Extremely high temperature** and **pressure** is needed.
3.	**Alpha, beta** and **gamma** radiations are emitted.	**Alpha** rays, **positrons** and **neutrinos** are emitted.
4.	It leads to emission of **gamma radiation**. This triggers the mutation in the human gene and causes genetic transform diseases.	Only **light** and **heat** energy is emitted.

2. $_{92}U^{238}$ experiences α - decay. Find the number of neutrons in the daughter element. (SEP - 2021)

Solution:

Let X be the resulting nucleus after the emission of the alpha particles.

$$_{92}U^{238} \longrightarrow {}_{90}X^{234} + {}_2He^4$$

Number of neutrons = Mass number − Atomic number

$= 234 - 90 = \mathbf{144}$

The number of neutrons in the daughter element is **144**.

3. $_{92}U^{235}$ experiences one α decay. Find the number of neutrons in the final daughter nucleus that is formed. (PTA - 1)

Solution:

$$_{92}X^{235} \xrightarrow{\alpha\ decay} {}_{90}Y^{231} + {}_2He^4 + energy$$

Number of neutrons = mass number − atomic number

$= 231 - 90$

$= 141$

∴ Number of neutrons in the final daughter nucleus is **141.**

4. i. Write any two properties of gamma radiation. **(PTA - 3)**

1. They are neutral particles.
2. They have very less ionization power.
3. They travel with the speed of light.

ii. What are control rods? Give an example.

1. Control rods are used to control the number of **neutrons** in order to have **sustained chain reaction.**
2. Mostly **boron** or **cadmium** rods are used as control rods. They absorb the neutrons.

5. Nuclear fission of uranium nucleus (U^{235}) as follows

$_{92}U^{235} + {}_0n^1 \longrightarrow X + Y + {}_0n^1 + Q$ (energy). Find the daughter nuclei X and Y emitted from the above reaction. **(PTA - 4)**

Ans: $_{92}U^{235} + {}_0n^1 \longrightarrow {}_{56}Ba^{141} + {}_{36}Kr^{92} + 3\,{}_0n^1 + Q$ (energy)

X = Barium $\left({}_{56}Ba^{141}\right)$

Y = Krypton $\left({}_{36}Kr^{92}\right)$

6. i. In the nuclear reaction given below, the nucleus X changes to nucleus Y. **(PTA - 5)**

$_{88}X^{226}$ Y $+ {}_2He^4$ + energy

What are the atomic number and mass number of Y?

Solution:

$_{88}X^{226} \xrightarrow{\alpha \text{ decay}} {}_{86}Y^{222} + {}_2He^4 + \text{energy}$

Atomic number of Y = 86

Mass number of Y = 222

ii. Calculate the amount of energy released when a radioactive substance undergoes fusion and results in a mass defect of 1 kg. **(PTA - 5)**

Solution:

Mass defect in the reaction (m) = 1 Kg

Velocity of light (c) $= 3\times10^8 ms^{-1}$

By Einstein's equation,

Energy released $E = mc^2$

$E = 1\times(3\times10^8)^2$

$= 9\times10^{16}$ J (or) = **0.9×10^{17} J**

7. Use the analogy to fill the blank: **(PTA - 6)**

a. Nuclear fission : Atom bomb
Nuclear fusion : _____ **(Hydrogen bomb)**

b. Radio Iodine : Goitre
Radio Sodium : _____ **(Function of heart)**

8. Match the following. **(JUNE - 2023)**

	Volume - 1			Volume - II			Answer
1.	Co - 60	-	a.	Age of fossil	-	c.	**Cancer**
2.	I - 131	-	b.	Function of heart	-	d.	**Thyroid disease**
3.	Na - 24	-	c.	Cancer	-	b.	**Function of heart**
4.	C - 14	-	d.	Thyroid disease	-	a.	**Age of fossil**

9. Give the uses of radio isotopes in industries. **(PTA - 4)**

1. In industries, radioactive isotopes are used as tracers to detect any manufacturing defects such as cracks and leaks.
2. Packaging faults can also be identified through radioactivity.
3. Gauges, which have radioactive sources are used in many industries to check the level of gases, liquids and solids.
   a. An isotope of **Californium** (Cf^{252}) is used in the airlines to detect the **explosives** in the luggage.
   b. An isotope of **Americium** (Am^{241}) is used in many industries as a **smoke detector.**

10. Write down the medical applications of radio isotopes. **(PTA - II)**

1. **Radio sodium** (Na^{24}) is used for the effective **functioning** of **heart.**
2. **Radio - iodine** (I^{131}) is used to cure **goiter.**
3. **Radio - iron** is (Fe^{59}) is used for treatment and diagnose of **anaemia.**
4. **Radio phosphorous** (P^{32}) is used in the treatment of **skin diseases.**
5. **Radio cobalt** (Co^{60}) and **radio - gold** (Au^{198}) are used in the treatment of **skin cancer.**
6. Radiations are used to sterilize the surgical devices as they can kill the germs and microbes.

ADDITIONAL QUESTIONS

I. Match the following:

1.

	Column - I			Column - II			Answers
1.	Alpha decay	-	a.	Nagasaki	-	c.	**Uranium**
2.	Beta decay	-	b.	Plutonium	-	d.	**Phosphorus**
3.	Fissile material	-	c.	Uranium	-	b.	**Plutonium**
4.	Little Boy	-	d.	Phosphorus	-	e.	**Hiroshima**
5.	Fat Man	-	e.	Hiroshima	-	a.	**Nagasaki**

2.

	Column - I			Column - II			Answers
1.	Natural radioactivity	-	a.	Uranium	-	c.	**Spontaneous process**
2.	Artificial radioactivity	-	b.	Marie Curie	-	d.	**Induced process**
3.	Radium	-	c.	Spontaneous process	-	b.	**Marie Curie**
4.	Martin Klaproth	-	d.	Induced process	-	a.	**Uranium**

3.

	Column - I			Column - II			Answers
1.	Fuel	-	a.	Lead	-	c.	**Uranium**
2.	Moderator	-	b.	Cadmium	-	d.	**Graphite**

3.	Control rod	-	c. Uranium	-	**b.**	**Cadmium**
4.	Coolant	-	d. Graphite	-	**e.**	**Water**
5.	Protection wall	-	e. Water	-	**a.**	**Lead**

4.

	Column - I		**Column - II**		**Answers**
1.	Alpha particle	- a.	Stars	-	**c. Helium**
2.	Beta particle	- b.	Electromagnetic waves	-	**d. Electrons**
3.	Gamma particle	- c.	Helium	-	**b. Electromagnetic waves**
4.	Nuclear fusion	- d.	Electrons	-	**e. Thermonuclear reaction**
5.	Stellar energy	- e.	Thermonuclear reaction	-	**a. Stars**

II. Choose the correct answer:

1. _____ believed that matter is made up of tiny indestructible units called atoms.
   a. John Dalton b. Democritus c. JJ Thomson d. Goldstein
   Ans: b. Democritus
2. James Chadwick discovered _____.
   a. protons b. electrons c. neutrons d. positrons **Ans: c. neutrons**
3. The mass of an atom is concentrated on its _____.
   a. orbits b. electrons c. nucleus d. neutrons **Ans: c. nucleus**
4. Marie Curie and Pierre Curie invented _____ a new substance.
   a. Uranium b. pitchblende c. radium d. All the above **Ans: c. radium**
5. The phenomenon of nuclear decay with the emission of radiations is called _____.
   a. alpha decay b. radioactivity
   c. nuclear fission d. nuclear fusion **Ans: b. radioactivity**
6. The minimum mass of a fissile material to sustain chain reaction is called _____.
   a. subcritical b. supercritical
   c. critical mass d. atomic mass **Ans: c. critical mass**
7. 1 million electron volt = _____ ev.
   a. 10^{-6} b. 10^{4} c. 10^{6} d. 10^{12} **Ans: c. 10^{6}**
8. The average energy released in each fusion is _____.
   a. 38.4×10^{12} J b. 3.84×10^{12} J
   c. 3.84×10^{-11} J d. 3.84×10^{-12} J **Ans: d. 3.84×10^{-12} J**
9. The bomb dropped in Nagasaki used a _____ core.
   a. uranium b. plutonium c. radium d. thorium **Ans: b. plutonium**
10. All stars contain a large amount of _____.
   a. oxygen b. uranium c. radium d. none of the above
   Ans: d. none of the above

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

1. Graphite and cadmium are used as control rods in nuclear reactor.
   Ans: False **Boron** and cadmium are used as control rods in nuclear reactor.
2. Fusion reactors are used to convert non fissionable materials into fissionable materials.
   Ans: False
   Breeder reactors are used to convert non fissionable materials into fissionable materials.
3. When the body is exposed to about 80 R, it leads to death.
   Ans: False
   When the body is exposed to about **600 R**, it leads to death.
4. An isotope of Iron is used in the airlines to detect the explosives in the luggage.

   Ans: False
   An isotope of **Californium** is used in the airlines to detect the explosives in the luggage.
5. Radio - Iodine is used to cure tuberculosis.
   Ans: False
   Radio - Iodine is used to cure **goiter**.
6. Alpha rays, beta and gamma are emitted in nuclear fusion.
   Ans: False
   Alpha rays, **positrons** and **neutrinos** are emitted in nuclear fusion.
7. Hydrogen bomb is based on the principle of nuclear fission.
   Ans: False
   Hydrogen bomb is based on the principle of nuclear **fusion**.

IV. Assertion and Reason.

1. **Assertion:** In the controlled chain reaction the number of neutrons released is maintained to be one.
   Reason : By absorbing the extra neutrons with a neutron absorber leaving only one neutron to produce further fission.
   a. If both the assertion and the reason are true and the reason is the correct explanation of the assertion.
   b. If both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.
   c. If the assertion is true, but the reason is false.
   d. If the assertion is false, but the reason is true.
   Ans: a. If both the assertion and the reason are true and the reason is the correct explanation of the assertion.
2. **Assertion:** Nuclear power is the fifth largest source of power in India.
   Reason : Kudankulam Atomic Power Station is the India's first nuclear power station.
   a. If both the assertion and the reason are true and the reason is the correct explanation of the assertion.
   b. If both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.
   c. If the assertion is true, but the reason is false.
   d. If the assertion is false, but the reason is true.
   Ans: c. If the assertion is true, but the reason is false.
3. **Assertion:** A thick concrete lead wall is built around the nuclear reactor.
   Reason : To prevent the harmful radiations from escaping into the environment.
   a. If both the assertion and the reason are true and the reason is the correct explanation of the assertion.
   b. If both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.
   c. If the assertion is true, but the reason is false.
   d. If the assertion is false, but the reason is true.
   Ans: a. If both the assertion and the reason are true and the reason is the correct explanation of the assertion.
4. **Assertion:** Gamma radiation triggers the mutation in the human gene and causes genetic transformation of diseases.
   Reason : Fusion leads to emission of gamma radiation.

a. If both the assertion and the reason are true and the reason is the correct explanation of the assertion.
b. If both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.
c. If the assertion is true, but the reason is false.
d. If the assertion is false, but the reason is true.

Ans: c. If the assertion is true, but the reason is false.

V. Analog

1.	James Chadwick	:	neutrons	
	Rutherford	:	_____	**(nucleus)**
2.	Radioactivity element	:	uranium	
	Lighter element	:	_____	**(boron)**
3.	Natural radioactivity	:	uncontrolled	
	Artificial radioactivity	:	_____	**(controlled)**
4.	1 Rd	:	10^6 disintegrations per second	
	1 Curie	:	_____	**(3.7×10^{10} disintegrations per second)**
5.	High ionizing power	:	α ray	
	Low ionizing power	:	_____	**(γ ray)**
6.	Fissional material	:	U^{235}	
	Fertile material	:	_____	**(U^{238})**
7.	Uncontrolled	:	atom bomb	
	Controlled	:	_____	**(nuclear reactor)**
8.	Radio iodine	:	goiter	
	Radio carbon	:	_____	**(age of things)**
9.	100 R	:	cancer	
	600 R	:	_____	**(death)**
10.	Moderator	:	slow down	
	Control rod	:	_____	**(absorb neutron)**

VI. Problem solving.

1. Identify A, B, C and D from the following nuclear reactions.

i. $_{13}Al^{27} + A \longrightarrow {}_{15}P^{30} + B$

Solution: $_{13}Al^{27} + {}_{2}He^{4} \longrightarrow {}_{15}P^{30} + {}_{0}n^{1}$

ii. $_{12}Mg^{24} + B \longrightarrow {}_{11}Na^{24} + C$

Solution: $_{12}Mg^{24} + {}_{0}n^{1} \longrightarrow {}_{11}Na^{24} + {}_{1}H^{1}$

iii. $_{92}U^{238} + B \longrightarrow {}_{93}Np^{239} + D$

Solution: $_{92}U^{238} + {}_{0}n^{1} \longrightarrow {}_{93}Np^{239} + {}_{-1}e^{0}$

A is alpha particle, B is neutron, C is proton, and D is electron.

2. A radon specimen emits radiation of 3.7×10^3 G Bq per second. Convert this disintegration in terms of curie. (one curie = 3.7×10^{10} disintegration per second)

Solution:

$$1Bq = \text{one disintegration per second}$$
$$\text{one curie} = 3.7 \times 10^{10} Bq$$
$$1Bq = \frac{1}{3.7 \times 10^{10}} \text{ curie}$$
$$\therefore 3.7 \times 10^3 G\,Bq = 3.7 \times 10^3 \times 10^9 \times \frac{1}{3.7 \times 10^{10}}$$
$$= 100 \text{ curie}$$

VII. HOTS:

1. The number of beta particles emitted by a radioactive substance is twice the number of alpha particles emitted by it. The resulting daughter is an _____.

(Ans: isotope of parent)

Let the radioactive substance be $_{Z}X^{A}$ radioactive transition is given by

$$_{Z}X^{A} \xrightarrow{-\alpha} {}_{Z-2}X^{A-4} \xrightarrow{-2\beta} {}_{Z}X^{A-4}$$

The atoms of element having same atomic number but different mass numbers are called isotopes. So,

$_{Z}X^{A}$ and $_{Z}X^{A-4}$ are isotopes.

2. Nuclear decay given below.

$$_{Z}X^{A} \longrightarrow {}_{Z+1}Y^{A} \longrightarrow {}_{Z-1}B^{A-4} \longrightarrow {}_{Z-1}B^{A-4}$$

What are the particles emitted in this sequence?

Ans: β, α,

1. Alpha particles are positively charged particles with charge +2e and mass 4m. Emission of an α – particle reduces the mass of the radionuclide by 4 and its atomic number by 2.
2. β- particles are negatively charged particle with rest mass as well as charge same as that of electrons. γ- particles carry no charge and mass.
3. Radioactive transition will be as follows:

$$_{Z}X^{A} \longrightarrow {}_{Z+1}Y^{A} + {}_{-1}\beta^{0}$$
$$_{Z+1}Y^{A} \longrightarrow {}_{Z-1}\beta^{A-4} + {}_{2}\alpha^{0}$$
$$_{Z+1}\beta^{A-4} \longrightarrow {}_{Z-1}\beta^{A-4} + {}_{2}\gamma^{0}$$

3. A nuclear reaction given by

$$_{Z}X^{A} \longrightarrow {}_{Z+1}Y^{A} + {}_{-1}e^{0} + \gamma \text{ represents}$$

Ans: β – decay.

Since in the given reaction $_{-1}e^{0}$ and antineutrino $\left(\bar{\gamma}\right)$ are released. So it can be considered β – decay.

4. A nuclear decay is expressed as

$$_{6}C^{11} \longrightarrow {}_{5}B^{11} + \beta^{+} + X$$

Then the unknown particle X is _____.

Ans: Neutrino

Let Z be the charge number

A be the mass number of particle X, then conservation of charge number gives

$$6 = 5 + 1 + Z \left\{ \begin{array}{l} 6 = 6Z \\ \therefore Z = 6 - 6 \\ \quad = 0 \end{array} \right\}$$

$$\therefore Z = 0$$

Conservation of mass number gives,

$$11 = 11 + 0 + A$$
$$A = 0$$

X is a particle of zero charge and zero mass. This particle may be neutrino or antineutrino. As we know that for positive β - particle, neutrino is emitted and with negative β - particle, antineutrino is emitted.

Thus, in this case neutrino will be emitted.

5. Complete the equation for the following fission process.

$_{92}U^{235} + {}_0n^1 \longrightarrow {}_{38}Sr^{90} + \ldots\ldots$

Ans: $_{54}Xe^{143} + 3{}_0n^1$

It total atomic number on LHS = 92 + 10 = 92

Total atomic number on RHS = 38 + 54 + 0 = 92

Total mass number on LHS = 235 + 1 = 236

Total mass number on RHS = 90 + 143 + 3 × 1 = 236

Note: For nuclear reaction to be completed, the mass number and charge number on both sides should be same.

VIII. Short Answers:

1. What is Natural radioactivity?

1. The Phenomenon of spontaneous emission of radiation from certain elements on their **own** is called natural radioactivity.
2. The elements whose atomic number is **more than 83** undergo spontaneous radioactivity.
3. **E.g:** uranium, radium

2. What is artificial radioactivity?

The phenomenon by which even **light elements** are made radioactive, by artificial or induced methods, is called artificial radioactivity.

3. Define one Rutherford.

The quantity of a radioactive substance, which produces **10^6** disintegrations in one second is called one Rutherford.

1 Rd = 10^6 disintegrations per second.

4. Define Becquerel.

1. It is the **SI unit** of radioactivity.
2. It is defined as the quantity of one disintegration per second.
3. **1 Bq = 1** disintegration per second

5. What is alpha decay?

1. A nuclear reaction in which an unstable parent nucleus emits an **alpha particle** and forms a **stable daughter nucleus**, is called alpha decay.
2. **E.g:** $_{92}U^{238} \rightarrow {}_{90}Th^{234} + {}_2He^4$ **(α - decay)**

6. What is beta decay?

1. A nuclear reaction in which an unstable parent nucleus emits a **beta particle** and forms a stable daughter nucleus, is called beta decay.
2. **E.g:** $_{15}P^{32} \longrightarrow {}_{16}S^{32} + {}_{-1}e^0$ **(β - decay)**

7. What is fissionable material?

1. A fissionable material is a radioactive element, which undergoes **fission** in a sustained manner when it absorbs a neutron.
2. **E.g:** U^{235}

8. What is mass defect?

1. The mass of the daughter nucleus formed during a nuclear reaction is **lesser** than the sum of the masses of the two parent nuclei.
2. This difference in mass is called mass defect.

9. Give any two uses of radio isotopes in field of industries.

1. An isotope of **Californium** (Cf^{252}) is used in the airlines to detect the **explosives** in the luggage.
2. An isotope of **Americium** (Am^{241}) is used in many industries as a **smoke detector**.

10. Define nuclear fusion.

1. The process in which two lighter nuclei **combine** to form a heavier nucleus is termed as nuclear fusion.
2. **E.g:** $_1H^2 + {}_1H^2 \longrightarrow {}_2He^4 + Q$ (energy)

IX. Fill in the blanks.

1. Things around us are made up of _____. **(atoms)**
2. _____ in 400 BC believed that matter is made up of tiny indestructible units called atoms. **(Democritus)**
3. In 1803, _____ considered that elements consist of atoms which are identical in nature. **(John Dalton)**
4. _____ discovered cathode rays. **(J.J. Thomson)**
5. _____ rays are known as electrons. **(Cathode)**
6. Positive rays were named as protons by _____. **(Rutherford)**
7. James Chadwick discovered the charge less particles called _____. **(neutrons)**
8. The mass of an atom is concentrated in its central part called _____. **(Nucleus)**
9. Henri Becquerel discovered _____. **(radioactivity)**
10. _____ is a radioactive element. **(Uranium)**
11. Marie Curie and Pierre Curie detected radioactivity in _____. **(Pitchblende)**
12. _____ emitted radiations spontaneously like uranium. **(Radium)**
13. An ore of uranium is _____. **(Pitchblende)**
14. Marie Curie and Pierre Curie invented a new substance called _____. **(Radium)**
15. _____ elements emit harmful radioactive radiations. **(radioactive)**
16. The nucleus of some elements are_____. **(unstable)**
17. The nuclei undergo _____ to get converted into a more stable nuclei. **(nuclear decay)**
18. During nuclear decay the nuclei emit harmful _____ and _____. **(radiations, elementary particles)**
19. Elements which undergo radioactivity are called _____ elements. **(radioactive)**
20. The phenomenon of spontaneous emission of radiation from certain elements on their own is called _____ radioactivity. **(natural)**
21. The elements whose atomic number is more than 82 undergo _____ radioactivity. **(spontaneous)**
22. _____ and _____ undergo natural radioactivity. **(Uranium, Radium)**
23. Most of the radioactive elements are _____and_____ metals. **(rare earth, transition)**
24. Technetium is a radioactive substance with atomic number _____. **(43)**
25. Promethium is a radioactive substance with atomic number _____. **(61)**
26. _____ radioactive substances have been discovered so far. **(29)**
27. Artificial radioactivity is also known as _____. **(induced radioactivity)**

28. The phenomenon by which even lighter elements are made radioactive is called _____. **(artificial radioactivity)**
29. Irene Curie and F. Joliot discovered _____ radioactivity. **(artificial)**
30. During disintegration, the nucleus which undergoes disintegration is called _____ nucleus. **(parent)**
31. The nucleus which is produced after the disintegration is called a _____ nucleus. **(daughter)**
32. The phenomenon of nuclear decay with the emission of radiations is called _____. **(radioactivity)**
33. _____ is the traditional unit of radioactivity. **(Curie)**
34. One Curie = _____ disintegrations/s **(3.7×10^{10})**
35. 1 Rd = _____ disintegrations /s **(10^6)**
36. An _____ nucleus decays spontaneously. **(unstable)**
37. An unstable nucleus emits a _____ nucleus along with an ejected particle. **(daughter)**
38. The SI unit of radioactivity is _____. **(Becquerel)**
39. The radiation exposure of γ and x- rays are measured by an unit called _____. **(roentgen)**
40. One roentgen produces a charge of _____ coulomb. **(2.58×10^{-4})**
41. Alpha, beta and gamma radiations are emitted in_____. **(natural radioactivity)**
42. Natural radioactivity is a _____ process. **(spontaneous)**
43. Natural radioactivity is exhibited by elements with atomic number more than _____. **(82)**
44. _____ radioactivity cannot be controlled. **(Natural)**
45. Elementary particles such as neutron, positron, etc. are emitted in _____ radioactivity. **(artificial)**
46. Artificial radioactivity is an _____ process. **(induced)**
47. Artificial radioactivity is exhibited by elements with atomic number less than ____. **(82)**
48. _____ radioactivity can be controlled. **(Artificial)**
49. The particle which is used to induce artificial disintegration is known as _____. **(projectile)**
50. The particle which is produced after disintegration is called as _____ particle. **(ejected)**
51. When the projectile hits the parent nucleus, it is converted into an _____ nucleus. **(unstable)**
52. The activity of 1g of radium is _____. **(226)**
53. _____ is the quantity of radioactive substance which produces 10^6 disintegrations in one second. **(1 Rd)**
54. _____ was named after the planet Uranus. **(Uranium)**
55. Uranium was discovered by _____. **(Martin Klaproth)**
56. Uranium was discovered in a mineral called _____. **(pitchblende)**
57. _____ are the basic elementary particles in all atoms. **(Electrons)**
58. _____ are electromagnetic waves consisting of photons. **(γ - rays)**
59. The ionising power of alpha rays is _____ times greater than β – rays. **(100)**
60. The ionising power of alpha rays is _____ times greater than γ - rays. **(10,000)**
61. _____ rays have very less ionization power. **(γ)**
62. α – rays are _____ charged. **(positively)**
63. The charge of each alpha particle is _____. **(+2e)**
64. β – rays are _____ charged. **(negatively)**
65. The charge of a β – particle is _____. **(−e)**
66. _____rays are neutral particles. **(Gamma)**
67. The charge of a gamma particle is _____. **(zero)**
68. _____ rays have the lowest penetrating power. **(α)**
69. _____ rays have the highest penetrating power. **(γ)**
70. _____ rays travel with the speed of light. **(γ)**
71. The speed of a β – ray is _____ times the speed of light. **(9/10)**
72. _____ rays are not deflected by electric and magnetic fields. **(γ)**
73. Decay of uranium to thorium with the emission of an alpha particle is called _____ decay. **(alpha)**
74. During an alpha decay, the mass number decreases by _____. **(four)**
75. During an alpha decay, the atomic number decreases by _____. **(two)**
76. In γ - decay only the _____ of the nucleus changes. **(energy level)**
77. During a γ – decay, the atomic number and mass number of the radioactive nucleus are _____. **(same)**

78. In β – decay there is no change in the _____ number of the daughter nucleus. **(mass)**
79. During a β – decay, the atomic number increases by _____. **(one)**
80. The product nucleus is identified by its _____ number. **(atomic)**
81. The average energy released in each fission process is about _____. **(3.2×10^{-11}J)**
82. A fissionable material is a _____ element. **(radioactive)**
83. All isotopes of uranium do not undergo _____ when they absorb a neutron. **(nuclear fission)**
84. U^{238} does not undergo _____. **(fission)**
85. The process of breaking up of heavier nucleus into smaller nuclei is called _____. **(nuclear fission)**
86. A fissionable material is also termed as _____ material. **(fissile)**
87. _____ is a fissionable material of Uranium. **(U^{235})**
88. _____ is a non – fissionable material of Uranium. **(U^{238})**
89. Radioactive elements which can be converted into fissionable materials are called _____materials. **(fertile)**
90. The two types of chain reaction are _____ and _____. **(controlled, uncontrolled)**
91. In a _____ reaction the number of neutrons multiply rapidly. **(chain)**
92. U^{235} undergoes _____. **(fission)**
93. Uranium – 238, Thorium – 232, Plutonium – 240 are _____ materials. **(fertile)**
94. When U – 235 bombarded with a neutron undergoes fission producing _____ neutrons. **(three)**
95. A _____ reaction is a self - propagating process. **(chain)**
96. In the _____ chain reaction the number of neutrons released is maintained to be one. **(controlled)**
97. The energy released due to a controlled chain reaction can be utilized for _____ purposes. **(constructive)**
98. Controlled chain reaction is used in a _____ to produce energy in a sustained and controlled manner. **(nuclear reactor)**
99. In the _____ chain reaction the number of neutrons multiplies indefinitely. **(uncontrolled)**
100. _____ chain reaction is used in atom bomb. **(Uncontrolled)**
101. When the size of the fissionable material is equal to the optimum value, it is called _____. **(critical mass)**
102. _____ depends on the nature, density and size of the fissile material. **(Critical mass)**
103. The minimum mass of a fissile material necessary to sustain the chain reaction is called _____. **(critical mass)**
104. If the mass of the fissile material is less than the critical mass, it is termed as _____. **(subcritical)**
105. If the mass of the fissile material is more than the critical mass, it is termed as _____. **(supercritical)**
106. The fissile material in an atom bomb has a _____ void. **(cylindrical)**
107. The unit used to measure the energy of smaller particles is _____. **(Electron volt (eV))**
108. 1 eV = _____ joule. **(1.602×10^{-19})**
109. 1 MeV = _____ eV. **(10^6)**
110. The energy released in nuclear fission is about _____ MeV. **(200)**
111. An atom bomb consists of a piece of fissile material whose mass is _____. **(subcritical)**
112. An atom bomb has a _____ fissile material which can fit into this void. **(cylindrical)**
113. During the explosion of _____ tremendous amount of energy in the form of heat, light and radiation is released. **(atom bomb)**
114. A region of very high _____ and _____ is formed during the explosion of an atom bomb. **(temperature, pressure)**
115. _____ bombs were exploded in 1945 at Hiroshima and Nagasaki in Japan during the World War II. **(Atom)**
116. Deuterium is an isotope of _____. **(Hydrogen)**
117. Energy can be produced when two lighter nuclei combine to form a heavier nucleus is called as _____. **(nuclear fusion)**
118. The average energy released in each fusion reaction is about _____. **(3.84×10^{-12}J)**
119. The relationship between mass and energy can be given by, _____. **($E = mc^2$)**
120. The velocity of light in vacuum is _____ ms^{-1}. **(3×10^8)**

121. The nuclear bomb called _____ was dropped at Hiroshima during World War II. **(Little boy)**
122. The nuclear bomb called _____ was dropped at Nagasaki during World War II. **(Fat man)**
123. The bomb dropped at Hiroshima used a _____ core. **(Uranium)**
124. The bomb dropped at Nagasaki used a _____ core. **(Plutonium)**
125. The concept of mass – energy equivalence was proposed by _____. **(Einstein)**
126. Nuclear fusion takes place at a temperature from _____ to _____K. **(10^7, 10^9)**
127. _____ is named as thermonuclear reaction. **(Nuclear fusion)**
128. The energy generated by the stars is called _____ energy. **(stellar)**
129. All stars contain a large amount of _____. **(hydrogen)**
130. _____ reaction takes place in the cores of the Sun. **(Fusion)**
131. Hydrogen bomb is based on the principle of _____. **(nuclear fusion)**
132. The energy released in a fusion bomb is much _____ than the energy released in a fission bomb. **(higher)**
133. The Sun fuses about _____ million metric tons of hydrogen each second. **(620)**
134. The Sun radiates about _____ Joule of energy per second. **(3.8×10^{26})**
135. Nuclear fission leads to emission of _____ radiation. **(gamma)**
136. Radio isotopes can be obtained from _____. **(radioactivity)**
137. The radio isotope of phosphorous helps to increase the productivity of _____. **(crops)**
138. The radiations from the _____ can be used to kill the insects and parasites. **(radio isotopes)**
139. _____ are used to detect defects of bone metabolism. **(Radio isotopes)**
140. Radio isotopes are used as _____ to diagnose the nature of circulatory disorders. **(tracers)**
141. _____ is used for the effective functioning of heart. **(Radio sodium (Na^{24}))**
142. _____ is used to cure goiter. **(Radio – Iodine (I^{131}))**
143. _____ is used to diagnose anemia. **(Radio – iron(Fe^{59}))**
144. _____ is used in the treatment of skin diseases. **(Radio phosphorous (P^{32}))**
145. _____ and _____ are used in the treatment of skin cancer. **(Radio cobalt (Co^{60}), radio – gold (Au^{198}))**
146. Radiations are used to _____ the surgical devices. **(sterilize)**
147. In industries, _____ are used as tracers to detect any manufacturing defects such as cracks and leaks. **(radioactive isotopes)**
148. An isotope of _____ is used in the airlines to detect the explosives in the luggage. **(californium (Cf^{252}))**
149. An isotope of _____ is used in many industries as a smoke detector. **(Americium (Am^{241}))**
150. The age of the Earth can be determined using _____. **(radio carbon dating)**
151. The safe limit of overall exposure to radiation is given as _____ milli Sievert per year. **(20)**
152. In terms of roentgen, the safe limit of receiving the radiation is about _____ mR per week. **(100)**
153. _____ is a device used to detect the levels of exposure to an ionizing radiation. **(Dosimeter)**
154. A _____ material is used as fuel in the nuclear reactor. **(fissile)**
155. _____ is the commonly used fuel material in the nuclear reactor. **(Uranium)**
156. The first nuclear reactor was built in 1942 at_____. **(Chicago)**
157. _____ and heavy water are the commonly used moderators. **(Graphite)**
158. Mostly _____ or _____ rods are used as control rods. **(boron, cadmium)**
159. A _____ is used to remove the heat produced in the reactor core, to produce steam. **(coolant)**
160. _____ was the first chairman of Indian Atomic Energy Commission. **(Dr. Homi Jahangir Bhaba)**
161. _____ is the fifth largest source of power in India. **(Nuclear power)**
162. _____ is India's first nuclear power station. **(Tarapur Atomic Power Station)**
163. In Tamilnadu, nuclear power stations are at _____ and _____. **(Kalpakkam, Kudankulam)**
164. _____ was the first nuclear reactor built in India. **(Apsara)**

7.ATOMS AND MOLECULES

KEY FORMULAE

1.	Number of moles	$\frac{\text{Mass}}{\text{Atomic mass}}$ $\frac{\text{Mass}}{\text{molecular mass}}$ $\frac{\text{Number of atoms}}{6.023\times10^{23}}$ $\frac{\text{Number of molecules}}{6.023\times10^{23}}$
	Number of moles	$\frac{\text{Given volume of element at S.T.P.}}{\text{Molar volume at S.T.P.}}$
2.	Mass of element	$\frac{\text{Molecular mass} \times \text{number of particles}}{\text{Avogadro's number}}$
3.	Number of atoms	$\frac{\text{Mass of an atom} \times \text{Avogadro's number}}{\text{Atomic mass of atom}}$
4.	Number of molecules	$\frac{\text{Avogadro number} \times \text{Given mass}}{\text{Gram molecular mass}}$
5.	Mass % of an element	$\frac{\text{Mass of that element in the compound}}{\text{Molar mass of the compound}} \times 100$
6.	Relative molecular mass	$2 \times$ Vapour density
7.	Mass	No. of moles $\times$ molecular mass
8.	Atomicity	$\frac{\text{Molecular mass}}{\text{Atomic mass}}$

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. 2g of He d. 1 mole atoms of He **Ans: b. 1 atom of He**
2. Which of the following is a triatomic molecule? **(GMQ - 2019, PTA - I)**
   a. Glucose b. Helium
   c. Carbon dioxide d. Hydrogen **Ans: c. Carbon dioxide**
   (Hint: Carbon dioxide - CO_2)
3. The volume occupied by 4.4g 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

(Hint: No. of moles $= \frac{4.4}{44} = 0.1$

Volume occupied by CO_2 at S.T.P

= no. of moles × molar volume

= 0.1 × 22.4 = 2.24 litre)

4. Mass of 1 mole of Nitrogen atom is
   a. 28amu b. 14amu c. 28g d. 14g **Ans: d. 14g**

5. Which of the following represents 1 amu?
   a. Mass of a C - 12 atom
   b. Mass of a hydrogen atom
   c. $\frac{1}{12^{th}}$ of the mass of a C - 12 atom
   d. Mass of O -16 atom

   Ans: c. $\frac{1}{12^{th}}$ of the mass of a C - 12 atom

6. Which of the following statement 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 - 2022)**
   a. 16g b. 18g c. 32g d. 17g **Ans: c. 32g**

10. 1 mole of any substance contains _____ molecules. **(APRIL - 2024)**
    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

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. **(PTA - VI, MAY - 2022)** ※※ **Ans: homo**

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

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

9. Atomicity of phosphorous is _____. **Ans: 4**

III. Match the following.

	Column - I			Column - II			Answers
1.	8 g of O_2	-	a.	4 moles	-	b.	0.25 moles
2.	4 g of H_2	-	b.	0.25 moles	-	c.	2 moles
3.	52 g of He	-	c.	2 moles	-	e.	13 moles
4.	112 g of N_2	-	d.	0.5 moles	-	a.	4 moles
5.	35.5 g of Cl_2	-	e.	13 moles	-	d.	0.5 moles

Hint:

	Column - I		Column - II
1.	8 g of O_2	-	No. of moles $= \frac{\text{mass in gram}}{\text{molar mass}} = \frac{8}{32} = 0.25$
2.	4 g of H_2	-	$\frac{4}{2} = 2$ moles (∵molar mass of $H_2 = 2$)
3.	52 g of He	-	$\frac{52}{4} = 13$moles (∵molar mass of He = 4)
4.	112 g of N_2	-	$\frac{112}{28} = 4$ moles (∵molar mass of $N_2 = 28$)
5.	35.5 g of Cl_2	-	$\frac{35.5}{70} = 0.5$ moles(∵molar mass of $Cl_2 = 70$)

IV. 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. **(JULY - 2024)**
   Ans: False
   Noble gases are **mono atomic**.

3. The gram atomic mass of an element has no unit.
Ans: False
The gram atomic mass of an element **has unit**.

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

5. Molar mass of CO_2 is 42g.
Ans: False
Molar mass of CO_2 is **44 g**. ($CO_2 = 12 + 32$)

V. Assertion and Reason.

1. **Assertion:** The relative atomic mass of aluminium is 27.

Reason : An atom of aluminium is 27 times heavier than $\frac{1}{12^{th}}$ of the mass of the C - 12 atom.

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

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

2. **Assertion:** The relative molecular mass of Chlorine is 35.5 a.m.u. **(PTA - III)**

Reason : The natural abundance of Chlorine isotopes are not equal.
i. A and R are correct, R explains the 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.

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

VI. Short answer questions.

※※※

1. **Define: Relative atomic mass.** **(JUNE - 2023, PTA - III, SEP - 2022)**

1. Relative atomic mass of an element is the ratio between the **average mass** of its isotopes to $\frac{1}{12^{th}}$ part of the mass of a carbon - 12 atom.
2. It is denoted as A_r.
3. It is otherwise called "**Standard Atomic Weight**".

Relative Atomic Mass:

$$A_r = \frac{\text{Average mass of the isotopes of the element}}{\frac{1}{12^{th}} \text{ of the mass of one Carbon - 12 atom}}$$

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

Isotopes of oxygen:

	Isotopes	% abundance
1.	$_8O^{16}$	99.757
2.	$_8O^{17}$	0.038
3.	$_8O^{18}$	0.205

3. **Define: Atomicity** ※※※ **(APR - 2023, SEP - 22, 21, MAY - 2022)**

1. The **number** of **atoms** present in the molecule is called its 'atomicity'.
2. A molecule can be classified into monoatomic, diatomic, triatomic or polyatomic depending on the number of atoms present.
3. **E.g:** Atomicity of Phosphorus - 4,
Atomicity of HCl - 2.

4. **Give any two examples for hetero diatomic molecules.** **(SEP - 2022)**

1. Hydrogen Chloride (HCl)
2. Carbon monoxide (CO)

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

1. One mole of any gas occupies **22.4 litre** or 22,400ml at **S.T.P.**
2. This volume is called as molar volume.

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

Solution:

Molar mass of NH_3 = (1 × atomic mass of nitrogen) + (3 × atomic mass of hydrogen)
$= (1 \times 14) + (3 \times 1)$
$= 14 + 3$
= 17g

Percentage of N in NH_3 $= \frac{\text{mass of nitrogen}}{\text{molar mass of } NH_3} \times 100$
$= \left(\frac{14}{17}\right) \times 100$
$= 0.8235 \times 100$

The percentage of nitrogen in ammonia= **82.35%**

VII. Long answer questions.

1. Calculate the number of water molecule present in one drop of water which weighs 0.18 g. ※※

Solution:

Avogadro number $= 6.023 \times 10^{23}$

Given Mass $= 0.18g$

Molecular weight of water (H_2O) = (2 × atomic number of H) +(1× atomic number of O)

$= (2 \times 1) + (1 \times 16) = 2 + 16$

$= 18g$

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

Number of molecules of one drop of water

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

$$= 6.023 \times 10^{23} \times 0.01$$

$$= 0.06023 \times 10^{23}$$

2. $N_2 + 3H_2 \longrightarrow 2NH_3$

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

1 mole of nitrogen (_____ g)+

3 moles of hydrogen (_____ g)⟶

2 moles of ammonia (_____ g)

Solution:

1. 1 mole of nitrogen= 1× 14g (Atomic mass of nitrogen =14)
2. 3 moles of hydrogen= 3× 1g (Atomic mass of hydrogen = 1)
3. 2 moles of ammonia

$2NH_3 = 2 \times 14 + 2(1 \times 3)$

$= 28 + 2 \times 3 = 28 + 6$

$= 34g$

So, the equation is $N_2 + 3H_2 \longrightarrow 2NH_3$

$(14)2 + (3)2 \longrightarrow 34$

28g +6 g ⟶ 34g

1 mole of nitrogen (28g) + 3 moles of hydrogen (6g) ⟶ 2 moles of ammonia (34g)

3. Calculate the number of moles in **(JULY - 2024, PTA - V)**

1. 27 g of Al

$$\text{Number of mole} = \frac{\text{Mass of the element}}{\text{Atomic mass of the element}}$$

$$= \frac{27}{27} \ (\because \text{Atomic mass of aluminium} = 27)$$

$= 1$ mole

2. 1.51×10^{23} molecules of NH_4Cl **(APRIL - 2024, PTA - V)**

$$\text{Number of moles} = \frac{\text{Number of molecules of } NH_4Cl}{\text{Avogadro Number}}$$

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

$$= \frac{1}{4}$$

$= 0.25$ moles of NH_4Cl ※※※

4. Give the salient features of "Modern atomic theory". **(JULY & APR - 2024)**

Salient features of Modern atomic theory: **(SEP - 20 & 22, PTA - V)**

1. An atom is no longer indivisible (after the discovery of the electron, proton and neutron).
2. The mass of an atom can be converted into **energy ($E = mc^2$)**.
3. Atom is the **smallest particle** that takes part in a chemical reaction.
4. Atoms of the same element may have different atomic mass. (discovery of **isotopes** $_{17}Cl^{35}$, $_{17}Cl^{37}$).
5. Atoms of different elements may have same atomic masses. (discovery of **Isobars** $_{18}Ar^{40}$, $_{20}Ca^{40}$).
6. Atoms of one element can be transmuted into atoms of other elements. In other words, atom is no longer indestructible (discovery of **artificial transmutation**).
7. 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)

5. Derive the relationship between Relative molecular mass and Vapour density. ※※※ **(GMQ - 2019, PTA - VI)**

Relative molecular mass:

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:

Vapour density is the ratio of the mass of a certain volume of a gas or vapour, to the mass of an equal volume of hydrogen, measured under the same conditions of temperature and pressure.

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

According to Avogadro's law, equal volumes of all gases contain equal number of molecules.

Thus, let the number of molecules in one volume = n, then

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

Cancelling 'n' which is common,

$$\text{V.D} = \frac{\text{Mass of 1 molecule of a gas or vapour at S.T.P}}{\text{Mass of '1' molecule of hydrogen}}$$

However, since hydrogen is diatomic

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

When you compare the formula of vapour density with relative molecular mass, they can be represented as

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

Relative molecular mass (hydrogen scale) =

$$\frac{\text{Mass of 1 molecule of a gas or vapour at S.T.P}}{\text{Mass of 1 atom of hydrogen}} \longrightarrow (2)$$

∴ substitute Eqn (2) in Eqn (1)

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

2 × vapour density = Relative molecular mass of a gas

Relative molecular mass = 2 × vapour density.

VIII. HOT question.

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

$$CaCO_3 \longrightarrow CaO + CO_2$$

Ans: $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

i. How many moles of Calcium carbonate are involved in this reaction?

Ans: 1 mole

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

Molecular mass of $CaCO_3$

Atomic mass of Ca -40, C -12, O -16

$= CaCO_3$

$= (1 \times 40) + (1 \times 12) + (3 \times 16)$

$= 40 + 12 + (48)$

$= 52 + 48$

= 100g /mole

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

Ans: One mole of CO_2

IX. Solve the following problems.

1. How many grams are there in the following? ※※※ **(PTA - IV)**

i. 2 moles of hydrogen molecule, H_2

Solution:

Mass = mole × molecular mass

$= 2 \times 2$ (molecular mass of $H_2 = 2 \times 1 = 2$)

= 4 g

ii. 3 moles of chlorine molecule, Cl_2

Solution:

Mass = mole × molecular mass

$= 3 \times 71$ ($Cl_2 = 2 \times 35.5 = 71$)

= 213 g

iii. 5 moles of sulphur molecule, S_8

Solution:

Mass = mole × molecular mass

$= 5 \times 256$ ($S_8 = 8 \times 32 = 256$)

= 1280 g

iv. 4 moles of phosphorous molecule, P_4

Solution:

Mass = mole × molecular mass

$= 4 \times 124$ ($P_4 = 4 \times 31 = 124$)

= 496 g

2. Calculate the % of each element in calcium carbonate. (Atomic mass: C - 12, O - 16, Ca - 40) **(JUNE - 2023, PTA - II)**

Solution:

Molar mass of $CaCO_3$ $= (1 \times 40) + (1 \times 12) + (3 \times 16)$

$= 40 + 12 + 48$

= 100 g

% of Calcium in $CaCO_3$ $= \frac{\text{Mass of calcium}}{\text{Molar mass of } CaCO_3} \times 100$

$= \frac{40}{100} \times 100$

=40%

% of Carbon in $CaCO_3$ $= \frac{12}{100} \times 100$

= 12%

% of Oxygen in $CaCO_3$ $= \frac{48}{100} \times 100$

= 48%

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

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

Atomic mass of Al =27

O =16

S =32

Molar mass of $Al_2(SO_4)_3 = (2 \times 27) + ((1 \times 32) + (4 \times 16))3$

$= 54 + (32 + 64)3$

$= 54 + (96)3$

$= 54 + 288$

= 342g

% of oxygen $= \frac{\text{Mass of oxygen}}{\text{Molar mass of } Al_2(SO_4)_3} \times 100$

$= 12$ oxygen atoms $\times \frac{16}{342} \times 100$

$= 12 \times (0.0467 \times 100)$

$== 12 \times (4.67)$

% of oxygen in $Al_2(SO_4)_3$ **== 56.56.04%%**

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

Solution:

Let B - 10 and B-11

B - 10 = x %

B - 11 $= (100 - x)\%$ ----------→ (1)

$= \frac{[X \times 10] + [(100 - X) \times 11]}{100}$

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

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

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

$= -x + 1100 = 1080.4$

$-x = 1080.4 - 1100$

$-x = -19.6$

$\therefore x$ **= 19.6%**

Substitute the x value in Eqn (1)

B -11 = (100 – 19.6)%

= 80.4%

Frequently asked question:

Calculate the molecular masses of

1. **H_2**
   Molecular mass of H_2 $= 2 \times$ atomic mass of H
   $= 2 \times 1 = 2$ g
2. **O_2**
   Molecular mass of O_2 $= 2 \times$ atomic mass of O
   $= 2 \times 16 = 32$ g
3. **Cl_2**
   Molecular mass of Cl_2 $= 2 \times$ atomic mass of Cl
   $= 2 \times 35.5 = 71$ g

4. **CO_2 (SEP - 21)**

Molecular mass of CO_2 $= 1\times$ atomic mass of C $+ 2\times$ atomic mass of O
$= (1 \times 12) + (2 \times 16)$
$= 12 + 32 = 44$ g

5. **CH_4**

Molecular mass of CH_4 $= 1\times$ atomic mass of C $+ 4\times$ atomic mass of H
$= (1 \times 12) + (4 \times 1)$
$= 12 + 4 = 16$ g

6. **C_2H_6**

Molecular mass of C_2H_6 $= 2\times$ atomic mass of C $+ 6\times$ atomic mass of H
$= (2 \times 12) + (6 \times 1)$
$= 24 + 6 = 30$ g

7. **C_2H_4**

Molecular mass of C_2H_4 $= 2\times$ atomic mass of C $+ 4\times$ atomic mass of H
$= (2 \times 12) + (4 \times 1)$
$= 24 + 4 = 28$ g

8. **NH_3**

Molecular mass of NH_3 $= 1\times$ atomic mass of N $+ 3\times$ atomic mass of H
$= (1 \times 14) + (3 \times 1)$
$= 14 + 3 = 17$ g

9. **CH_3OH**

Molecular mass of CH_3OH $= 1\times$ atomic mass of C $+ 4\times$ atomic mass of H $+ 1\times$ atomic mass of O
$= (1 \times 12) + (4 \times 1) + (1 \times 16)$
$= 12 + 4 + 16 = 32$ g

10. **H_2S**

Molecular mass of H_2S $= 2\times$ atomic mass of H $+ 1\times$ atomic mass of S
$= (2 \times 1) + (1 \times 32)$
$= 2 + 32 = 34$ g

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Choose the correct 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: a. i., ii. and iii. are correct

2. If a molecule is made of similar kind of atoms, then it is called **(PTA - 6)**
   a. mono atomic molecule b. hetero atomic molecule
   c. homo atomic molecule d. poly atomic molecule
   Ans: c. homo atomic molecule

II. Fill in the blank.

1. Atoms of different elements having same number of _____ are called isotones. **(PTA - 4)**
   Ans: Neutrons

III. Short answers.

1. **Write any two applications of "Avogadro's Law".** **(SEP - 2020 & APR - 2023)**
   1. It explains Gay - Lussac's law.
   2. Molecular formula of gases can be derived using Avogadro's law.
   3. It determines the relation between molecular mass and vapour density.
   4. It helps to determine gram molar volume of all gases (i.e., 22.4 litre at S.T.P.)

2. **Calculate the molecular mass of CO_2 (OR) Calculate the gram molecular mass of CO_2.** **(JULY - 2024, SEP - 2021)**

Molecular mass of CO_2 $= 1\times$ atomic mass of C $+ 2\times$ atomic mass of O
$= (1 \times 12) + (2 \times 16)$
$= 12 + 32 = \mathbf{44\ g}$

IV. Long answers.

1. **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 - 2024)**

Solution:

$$\text{Number of moles of } O_2 = \frac{\text{Volume of S.T.P}}{\text{Molar volume}}$$

$$= \frac{3}{22.4} = 0.1339 \text{ moles}$$

$$\text{Number of molecules} = \text{Number of moles} \times \text{Avagadro number}$$

$$= 0.1339 \times 6.023 \times 10^{23}$$

$$= 0.8064 \times 10^{23}$$

$$= 8.064 \times 10^{22}\ O_2 \text{ molecules}$$

$$\text{Number of moles of } Cl_2 = \frac{5}{22.4} = 0.2232 \text{ moles}$$

$$\text{Number of molecules} = 0.2232 \times 6.023 \times 10^{23}$$

$$= 1.344 \times 10^{23} \text{ molecules}$$

$$\text{Number of moles of } H_2 = \frac{6}{22.4} = 0.2678 \text{ moles}$$

$$\text{Number of molecules} = 0.2678 \times 6.023 \times 10^{23}$$

$$= 1.6129 \times 10^{23} \text{ molecules}$$

A. **Which has the highest number of molecules?**
   6 litre of H_2 has the highest number of molecules.

B. **Which has the lowest number of molecules?**
   3 litre of O_2 has the lowest number of molecules

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:

Mass percentage of Carbon = 27.28%

Mass percentage of Oxygen = 72.73%

Mass of Carbon $= 27.228g \times \frac{1 \text{mole of C}}{12g \text{ of C}}$

$= \frac{27.28}{12} = 2.27$

Mass of Oxygen $= 72.73 \times \frac{1 \text{mole of O}}{12g \text{ of O}}$

$= \frac{76.73}{16} = 4.54$

Ratio of C : O $= \frac{\text{moles of C}}{\text{moles of O}} = \frac{2}{4} = 2:4 = 1:2$

Empirical formula $= CO_2$

Molecular mass of CO_2 $= (1\times12)+(2\times16)$

$= 12 + 32$

$= 44g$

3. i. **Calculate the mass of 1.51×10^{23} molecule of H_2O.** **(GMQP - 2019)**

Solution:

Molecular mass of $H_2O = 18$

$$\text{Number of moles} = \frac{\text{Number of molecules of water}}{\text{Avogadro's number}}$$

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

$= 0.25$ mole

$$\text{Number of moles} = \frac{\text{mass}}{\text{molecular mass}}$$

$\therefore$ mass = No. of moles × molecular mass

mass = 0.25 × 18

mass = 4.5g

ii. **Calculate the moles of 46g sodium.** **(GMQP - 2019)**

Solution:

$$\text{Number of moles} = \frac{\text{Mass of the element}}{\text{Atomic mass of the element}}$$

$$= \frac{46}{23} = 2 \text{ moles of sodium}$$

iii. **Calculate the number of molecules present in the 36g water.** **(GMQP - 2019)**

Solution:

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

$$\text{Number of molecules of water} = \frac{6.023 \times 10^{23} \times 36}{18}$$

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

4. **Consolidate the major difference between atoms and molecules.** **(MAY - 2022)**

	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 a noble gas.	Molecules exists in a free state.
3.	Except some of noble gas, 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.

5. **Calculate the percentage of sulphur in H_2SO_4.** **(APR - 2023)**

Solution:

Molecular mass of H_2SO_4

$= (1\times2)+(32\times1)+(16\times4)$

$= 2+32+64$ **= 98 g**

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

$$\% \text{ of S in } H_2SO_4 = \frac{32}{98} \times 100 = \mathbf{32.65\%}$$

6. **In chemical industries the following chemical reaction is used to produce ammonia in large scale.** $N_2 + 3H_2 \rightleftharpoons 2NH_3$

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

Solution:

Mass of NH_3 produced = 1000 Kg = 10^6 g

Molecular mass of $NH_3 = 14 + (3 \times 1) = 17$ g

$$\text{No. of moles of } NH_3 = \frac{\text{Mass of } NH_3 \text{ produced}}{\text{Molecular mass of } NH_3} = \frac{10^6}{17}$$

2 moles of NH_3 is produced from 3 moles of H_2

$\therefore \frac{10^6}{17}$ moles of NH_3 is produced from 3 moles of H_2

$\therefore \frac{10^6}{17}$ moles of NH_3 is produced from $\frac{10^6}{17} \times \frac{3}{2}$ moles of H_2

Required mass of H_2 = No. of moles × molecular mass

$= \frac{10^6}{17} \times \frac{3}{2} \times (2\times1) = 176.47$Kg of H_2

2 moles of NH_3 is produced from one mole of N_2

$\frac{10^6}{17}$ moles of NH_3 is produced from one mole of N_2

$\therefore \frac{10^6}{17}$ moles of NH_3 is produced from $\frac{10^6}{17} \times \frac{1}{2}$ moles of N_2

Required mass of N_2 = No. of mole × molecular mass

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

$$= \frac{28}{34} \times 10^6 = 0.82353 \times 10^6 g$$

$$= 823.53 \times 10^3 Kg$$

∴ required amount of H_2 = 176.47 Kg

required amount of N_2 = 823.53 Kg

1000.00 Kg of NH_3

ADDITIONAL QUESTIONS

I. Match the following:

Column – I		Column - II		Answers
1. $_{17}Cl^{35}$, $_{17}Cl^{37}$	-	a. Mass of an atom	-	**d. Isotope**
2. $_{18}Ar^{40}$, $_{20}Ca^{40}$	-	b. Isotope of oxygen	-	**c. Isobar**
3. $E = mc^2$	-	c. Isobar	-	**a. Mass of an atom**
4. $_8O^{16}$	-	d. Isotope	-	**b. Isotope of oxygen**

Column - I		Column - II		Answers
1. O_3	-	a. Heterotriatomic	-	**c. Homotriatomic**
2. HCl	-	b. Homodiatomic	-	**d. Heterodiatomic**
3. H_2O	-	c. Homotriatomic	-	**a. Heterotriatomic**
4. O_2	-	d. Heterodiatomic	-	**b. Homodiatomic**

Column - I		Column - II		Answers
1. Avagadro Number	-	a. 273.15 K	-	**b. 6.023×10^{23}**
2. Molar volume	-	b. 6.023×10^{23}	-	**e. 22.4 litre**
3. S.T.P	-	c. 15 g	-	**a. 273.15 K**
4. l mole of N_2	-	d. 6.741 amu	-	**c. 15 g**
5. Lithium	-	e. 22.4 litre	-	**d. 6.741 amu**

II. Choose the correct answer:

1. Atoms with different atomic mass are called _____.
   a. Isobars b. Isotopes
   c. chemical reaction d. nuclear reaction **Ans: b. Isotopes**
2. Atomic mass expressed in grams is called _____.
   a. molecular mass b. total mass
   c. gram atomic mass d. gram molecular mass **Ans: c. gram atomic mass**
3. The relative atomic mass of nitrogen is _____.
   a. 24 b. 14 c. 12 d. 13 **Ans: b. 14**
4. A compound is a _____ molecule.
   a. homoatomic b. heteroatomic c. monoatomic d. polyatomic
   Ans: b. heteroatomic
5. Ozone is a _____ molecule.
   a. heterotriatomic b. homotriatomic
   c. polyatomic d. diatomic **Ans: b. homotriatomic**

6. One mole of an element contains _____ atoms. **(SEP - 2020)**
   a. 6.023×10^{-23} b. 60.23×10^{23}
   c. 66.023×10^{23} d. 6.023×10^{23} **Ans: d. 6.023×10^{23}**
7. One mole of any occupies _____ litre at S.T.P.
   a. 22.4 b. 2.24 c. 224 d. 0.24 **Ans: a. 22.4**
8. Molecular formula of gases can be derived using _____ law.
   a. Gay - Lussac b. Avogadro
   c. Boyle's d. None of the above **Ans: b. Avogadro**
9. The number of moles in 46g of sodium is _____.
   a. 0.2 b. 20 c. 2 d. 22 **Ans: c. 2**
10. _____ = 2 × vapour density.
   a. Atomic mass b. Molecular mass
   c. atomic weight d. molecular weight **Ans: b. Molecular mass**

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

1. Atoms of different elements having the same mass number, but different atomic number are called isotones.
   Ans: False
   Atoms of different elements having the same mass number, but different atomic number are called **isobars**.
2. Relative atomic mass of a molecule is the ratio between the mass of one molecule of the substance to $\frac{1}{12^{th}}$ mass of atom of carbon –12.
   Ans: False
   Relative **molecular** mass of a molecule is the ratio between the mass of one molecule of the substance to $\frac{1}{12^{th}}$ mass of atom of carbon –12.
3. Vapour density is the ratio of the weight of a certain volume of a gas or vapour, to the weight of an equal volume of hydrogen, measured under the same conditions of temperature and pressure.
   Ans: False
   Vapour density is the ratio of the **mass** of a certain volume of a gas or vapour, to the **mass** of an equal volume of hydrogen, measured under the same conditions of temperature and pressure.
4. Gram molecular mass of ammonia = 44g.
   Ans: False Gram molecular mass of ammonia =**17g**.
5. Gram atomic mass of carbon = 16g.
   Ans: False Gram atomic mass of **oxygen** = 16g.

IV. Assertion and Reason.

1. **Assertion:** Avogadro's law explains Gay - Lussac's law.
   Reason : It helps in the determination of atomicity of gases.
   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. if assertion is true, but reason is false.
   d. if assertion is false, but reason is true.
   Ans: b. if both assertion and reason are true, but reason is not the correct explanation of assertion.

2. **Assertion:** Avogadro value is 6.023×10^{23}.
Reason : One mole of a substance contains 6.023×10^{23} molecules.
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. if assertion is true, but reason is false.
d. if assertion is false, but reason is true.
Ans: a. if both assertion and reason are true and reason is the correct explanation of assertion.

3. **Assertion:** Relative Molecular Mass is only a ratio, it has no unit.
Reason : If the molecular mass of a compound is expressed in grams, it is called Gram Molecular Mass.
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. if assertion is true, but reason is false.
d. if assertion is false, but reason is true.
Ans: b. if both assertion and reason are true, but reason is not the correct explanation of assertion.

4. **Assertion:** Ozone is called homo triatomic molecule.
Reason : Ozone (O_3) contains three oxygen atoms.
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. if assertion is true, but reason is false.
d. if assertion is false, but reason is true.
Ans: a. if both assertion and reason are true and reason is the correct explanation of assertion.

V. Analog

1.	Isotopes	:	$_{17}C^{35}$, $_{17}C^{37}$	
	Isobars	:	_____	($_{18}Ar^{40}$, $_{20}Ca^{40}$)
2.	Homodiatomic	:	O_2, N_2	
	Heterodiatomic	:	_____	(HCl, CO)
3.	Atoms	:	highly reactive	
	Molecules	:	_____	(less reactive)
4.	1 Mole of atom	:	6.023×10^{23}	
	Molar volume	:	_____	(22.4 litre (STP))
5.	CO_2, H_2O	:	triatomic	
	S_8, P_4	:	_____	(polyatomic)
6.	Isotopes of oxygen	:	$_8O^{17}$, $_8O^{18}$	
	Isotopes of carbon	:	_____	($_6C^{13}$, $_6C^{14}$)

VI. Problem solving.

1. **How many molecules are present in 1 ml of water?**
Solution:
We know that density of water is 1 g /ml.
Hence, 1 g water = 1 ml water.
Now, we have molecular mass of water.
$H_2O = (1 \times 2) + 16 = 18$ g
18 g of water contain 6.023×10^{23}molecules.

1 g of water will contain $\frac{6.023 \times 10^{23}}{18}$

$= \frac{6.023 \times 10^{23}}{18} = 0.33 \times 10^{23}$ molecular

So the number of molecules of water in 1 ml = 3.3×10^{22}

2. **Find out:**
i. **The mass of a single oxygen atom.**
Solution:
1 Mole of oxygen atom = 16 g
= 6.023×10^{23} atoms
∴ Mass of one oxygen atom $= \frac{16}{6.022 \times 10^{23}}$
$= 2.65 \times 10^{-23}$ g

ii. **The mass of a single oxygen molecules.**
1 molecule oxygen = $O_2 = 2 \times 16 = 32$ amu

iii. **The mass of a mole of oxygen gas.**
1 mole of oxygen gas = $O_2 = 2 \times 16 = 32$ amu

3. **How many moles of SO_2 have same mass as 3 moles of oxygen?**
Solution:
Mass of 3 moles of oxygen = $3 \times 16 = 48$ g
Now, mass of $SO_2 = 32 + (2 \times 16)$
$= 32 + 32 = 64$ g
∴ 64 g of SO_2 = 1 mole
48 g $SO_2 = \left(\frac{1}{64}\right) \times 48 = 0.75$ mole

5. **Calculate the molar mass of HNO_3 (N = 14, O = 16, H = 1)**
Solution:
$H = 1 \times 1 = 1$, $N = 14 \times 1 = 14$, $O = 16 \times 3 = 48$
Total mass = 1 + 14 + 48 = 63 g
Molar mass of HNO_3 = 63 g

6. **Calculate the formula mass of $CaCl_2$(Ca - 40, Cl - 35.5)**
Solution:
1 Ca, 2 Cl
$(1 \times 40) + 2 \times (35.5) = 40 + 71 = 111$ amu

7. **Calculate the mass of 0.2 moles of water. (O = 16, H = 1)**
Solution:
Gram molecular weight of $H_2O = 2 \times 1 + 16 = 18$ g
Mole of water weight = 18 g
0.2 moles of water weight $= \frac{18}{1} \times 0.2 = 3.6$ g

8. **What is the volume of 7.1 g of chlorine at S.T.P (Cl = 35.5).**
Solution:
Gram molecular weight of Cl_2 (one mole)
$= 35.5 \times 2 = 71$ g

71 g of Cl_2 at S.T.P occupies 22.4 litre.

1.1 g of Cl_2 at S.T.P occupies $= \frac{22.4}{71} \times 7.1$

$= 2.24$ litre

9. **How many atoms are present in a H_2S molecule and PO_4^{3-} ion?**

i. In H_2S - 3 atoms are present.

ii. In PO_4^{3-} - 5 atoms are present.

10. **Calculate molar mass of sulphuric acid.**

Solution:

Formula of sulphuric acid = H_2SO_4

Molar mass of H_2SO_4 = 2 × mass of H + 1 × mass of S + 4 × mass of O

$= (2 \times 1) + (1 \times 32) + (4 \times 16)$

$= 2 + 32 + 64 = 98$ g mol^{-1}

11. **If one mole of carbon atoms weighs 12 gram. What is the mass (in gram) of 1 atom of carbon?**

Solution:

1 mole (6.023×10^{23} atoms) of carbon weighs = 12 g

$\therefore$ 1 atom of carbon weighs $= \frac{12}{6.023 \times 10^{23}}$

$= 1.99 \times 10^{-23}$ g

12. **What is the mass of**

a. **1 mole of nitrogen atoms?**

1 × gram atomic mass of nitrogen atom

$1 \times 14 = 14$ g

b. **10 moles of sodium sulphate (Na_2SO_3)**

=10 (2 × gram atomic mass of Na + 1 × gram atomic mass of sulphur + 3 × gram at mass of oxygen)

$=10\ (2 \times 23) + (1 \times 32) + (3 \times 16)$

$=10\ (46 + 32 + 48)$

$=10 \times 126 = 1260$ g

13. **Calculate the number of molecules of sulphur (S_8) present in 16 g of solid sulphur.**

Solution:

1 mole of sulphur (S_8) = 8 × 1 gram atomic mass of sulphur

$= 8 \times 32 = 256$ g

1 mole of S_8 molecules = 6.023×10^{23} molecules

256 g of S_8 molecules has = 6.023×10^{23}

16 g of S_8 molecules has $= \frac{6.023 \times 10^{23} \times 16}{256}$

$= 3.76 \times 10^{22}$ molecules.

VII. Short Answers:

1. **Define homoatomic and heteroatomic molecules?**

1. If the molecule is made of **similar** kind of atoms, then it is called homoatomic molecule.
2. The molecule that consists of atoms of **different** elements is called heteroatomic molecule.

2. **Define relative molecular mass.**

The relative molecular mass of a molecule is the ratio between the **mass of one molecule** of the substance to $\frac{1}{12^{th}}$ mass of an atom of Carbon −12.

3. **Define a mole.**

One mole is the amount of a substance that contains as many elementary entities (atoms, molecules or other particles) as there are atoms in exactly 12g (or 0.012 kg) of the carbon -12.

4. **State Avogadro's law.**

Equal volumes of all gases under similar conditions of temperature and pressure contain equal number of molecules.

VIII. Fill in the blanks.

1.	Matter is made up of _____.	**(atoms)**
2.	The first scientific theory of the atom was proposed by _____.	**(John Dalton)**
3.	Atoms of the same element may have different _____.	**(atomic mass)**
4.	Atoms of different elements may have _____ atomic masses.	**(same)**
5.	The mass of a proton or neutron is approximately _____ amu.	**(1)**
6.	Relative atomic mass is denoted as _____.	**(A_r)**
7.	_____ is the smallest particle that takes part in a chemical reaction.	**(Atom)**
8.	The mass of an atom can be converted into _____.	**(energy)**
9.	Anything that has mass and occupies space is called_____.	**(matter)**
10.	_____ are the building blocks of matter.	**(Atoms)**
11.	An atom contains _____ particles such as protons, neutrons and electrons.	**(subatomic)**
12.	Protons and neutrons have considerable _____.	**(mass)**
13.	Electrons don't have such a considerable _____.	**(mass)**
14.	The sum of the number of protons and neutrons of an atom is called its _____.	**(mass number)**
15.	The mass of an atom is measured in _____.	**(atomic mass unit)**
16.	Atomic mass unit is _____ of the mass of a carbon 12 atom.	**(one - twelth)**
17.	Isotope of carbon, contains _____ protons and _____ neutrons.	**(6,6)**
18.	Atomic mass is denoted by the symbol _____.	**(u)**
19.	The stable isotope of carbon (C - 12) has an atomic mass of _____.	**(12)**
20.	_____ is the modern method of determination of atomic mass.	**(Mass Spectrometry)**
21.	The relative atomic mass of sodium is _____.	**(23)**
22.	The relative atomic mass of magnesium is _____.	**(24)**
23.	The relative atomic mass of carbon is _____.	**(12)**
24.	The unit of relative atomic mass is _____.	**(no unit)**
25.	The atomic mass of an element expressed in grams is called as _____.	**(Gram Atomic Mass)**
26.	Gram Atomic Mass of hydrogen _____.	**(1g)**
27.	Gram Atomic Mass of carbon _____.	**(12g)**
28.	Gram Atomic Mass of nitrogen _____.	**(14g)**
29.	Gram Atomic Mass of oxygen _____.	**(16g)**
30.	The average atomic mass of carbon is _____ amu.	**(12.011)**
31.	The atomic mass of hydrogen is _____ amu	**(1.008)**
32.	The atomic mass of Helium is _____ amu	**(4.003)**
33.	The atomic mass of Lithium is _____ amu	**(6.941)**
34.	The atomic mass of Beryllium is _____ amu	**(9.012)**
35.	The atomic mass of Boron is _____ amu	**(10.811)**
36.	Oxygen is a mixture of _____ stable isotopes.	**(three)**
37.	Molecules made up of similar kinds of atoms are called _____ molecules.	**(homoatomic)**
38.	The atomicity of oxygen is _____.	**(2)**
39.	Since, both the atoms of oxygen are similar, oxygen is a_____ molecule.	**(homodiatomic)**

40. _____ is the most abundant element in the Earth's crust. **(Oxygen)**
41. The molecule that consist of atoms of different elements is called _____ molecules. **(heteroatomic)**
42. A compound is a _____ molecule. **(heteroatomic)**
43. Oxygen gas exists in _____ allotropic forms. **(two)**
44. Hydrogen and Helium are_____ molecules. **(diatomic)**
45. Ozone is a _____ molecule. **(homotriatomic)**
46. If a molecule contains more than three atoms, it is called _____ molecule. **(polyatomic)**
47. Hydrogen chloride is a _____ molecule. **(heterodiatomic)**
48. Water is a _____ molecule. **(heterotriatomic)**
49. Relative molecular mass is a _____. **(ratio)**
50. The unit of relative molecular mass is _____. **(no unit)**
51. An _____ is the smallest particle of an element . **(atom)**
52. A _____ is the smallest particle of an element or compound. **(molecule)**
53. _____ does not exist in free state. **(Atom)**
54. Molecule exists in a _____ state. **(free)**
55. _____ does not have a chemical bond. **(Atom)**
56. Atoms in a _____ are held by chemical bonds. **(molecule)**
57. _____ denotes the number of particles. **(Mole)**
58. The Standard Temperature is _____ K. **(273.15)**
59. The Standard Pressure is _____ atm. **(1.00)**
60. Atoms, molecules and other particles are _____ entities. **(elementary)**
61. Avogadro Number is named after _____. **(Amedeo Avogadro)**
62. 5 moles of oxygen molecule contain _____ molecules. **($5 \times 6.023 \times 10^{23}$)**
63. Standard molar volume of gas STP = _____ litre. **(22.4)**
64. The percentage composition of a compound represents the mass of each element present in _____ of the compound. **(100 g)**
65. _____ Law states that volume of any gas must be proportional to the number of molecules in it. **(Avagadro)**
66. Avogadro's Law can be represented by _____. **(V = constant × n)**
67. The mass percentage of H in H_2O is _____. **(11.11%)**
68. Avogadro Law explains _____ Law. **(Gay - Lussac's)**
69. _____ formula of gases can be derived using Avogadro law. **(Molecular)**
70. Avogadro's Law determines the relation between molecular mass and _____. **(vapour density)**
71. Equal volumes of all gases contain equal number of _____. **(molecules)**
72. Relative molecular mass = _____. **(2 × Vapour density)**
73. Elements having the same atomic number, but different mass number are called _____. **(Isotopes)**
74. Average atomic mass of an element is calculated by adding the masses of its _____. **(Isotopes)**
75. Atomicity of a monoatomic element is given by _____. **(Molecular Mass/Atomic Mass)**

8. PERIODIC CLASSIFICATION OF ELEMENTS

KEY FORMULAE

	Some examples of ionic, covalent bonds and both.	
1.	Ionic bond	NaBr, KBr, NaCl, NaI, KI, KCl, $CaCl_2$, K_2O and MgO.
2.	Covalent bond	PCl_3, HCl, H_2O, H_2, O_3, CH_4, NH_3, CO_2, PCl_5, SF_4 and C_2H_5OH.
3.	Both	$CaCO_3$, $BaSO_4$, Na_2SO_4, $AlBr_3$ Sodium acetate and Magnesium nitrate.

I. Choose the best answer.

1. The number of periods and groups in the periodic table are _____. **(SEP - 2022)**
   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 - I)**
   a. 17th b. 15th c. 18th d. 16th **Ans: a. 17th**
4. _____ is a relative periodic property. **(JULY - 2024)**
   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 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. ※※ **(GMQ - 2019, SEP - 2022)**
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 - V)** **Ans: ionic**
2. _____ is the longest period in the periodical 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**

   (Hint: radius of Cl atom is $= \frac{1.98}{2} = 0.99Å$)
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 Moseley**

   ※※※
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 ($Fe_2O_3 \cdot xH_2O$)**

III. Match the following. (PTA - VI)

	Column - I			Column - II			Answers
1.	Galvanisation	-	a.	Noble gas elements	-	b.	**Coating with Zn**
2.	Calcination	-	b.	Coating with Zn	-	e.	**Heating in the absence of air**
3.	Redox reaction	-	c.	Silver - tin amalgam	-	d.	**Alumino thermic process**
4.	Dental filling	-	d.	Alumino thermic process	-	c.	**Silver - tin amalgam**
5.	Group 18 elements	-	e.	Heating in the absence of air	-	a.	**Noble gas elements**

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

1. Moseley's periodic table is based on atomic mass.
   Ans: False
   Moseley's periodic table is based on atomic **number**.
2. Ionic radius increases across the period from left to right.
   Ans: False
   Ionic radius **decreases** across the period from left to right.
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
   Al wires are used as electric cables due to their **conductivity**.
5. An alloy is a heterogeneous mixture of metals.
   Ans: False
   An alloy is a **homogeneous** mixture of metals.

V. Assertion and Reason.

1. **Assertion:** The nature of bond in HF molecule is ionic. **(PTA - II)**
   Reason : The electronegativity difference between H and F is 1.9.

   a. A and R are correct, R explains A.
   b. A is correct, R is wrong.
   c. A is wrong, R is correct.
   d. A and R are correct, R doesn't explain A.

   Ans: c. A is wrong, R is correct.
2. **Assertion:** Magnesium is used to protect steel from rusting.
   Reason : Magnesium is more reactive than iron.

   a. A and R are correct, R explains A.
   b. A is correct, R is wrong.
   c. A is wrong, R is correct.
   d. A and R are correct, R doesn't explain A.

   Ans: a. A and R are correct, R explains A.
3. **Assertion:** An uncleaned copper vessel is covered with greenish layer. **(PTA - V)**
   Reason : Copper is not attacked by alkali.

   a. A and R are correct, R explains A.
   b. A is correct, R is wrong.
   c. A is wrong, R is correct.
   d. A and R are correct, R doesn't explain A.

   Ans: d. A and R are correct, R doesn't explain 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 - IV) ※※※

Ans:

1. A -reddish brown metal - **copper**
2. When copper is heated at < 1370 Kin the presence of oxygen, copper forms black colour **Copper II oxide** (CuO).

$$2Cu + O_2 \xrightarrow{<1370K} \underset{\text{(Copper II oxide - black)}}{2CuO}$$

3. When copper is heated at > 1370 Kin the presence of oxygen, copper forms red colour **Copper I oxide**(Cu_2O).

$$4Cu + O_2 \xrightarrow{>1370K} \underset{\text{(Copper I oxide - red)}}{2Cu_2O}$$

A - Copper (Cu)

B - Copper II oxide (CuO)

C - 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 - I)

Ans:

1. A - silvery white metal – **Aluminium**

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

2. **B - Aluminium oxide**

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

Rust: **(APRIL - 2024, JUNE - 2023, PTA - IV, SEP - 2021)**

1. When iron is exposed to **moist air**, it forms a layer of brown **hydrated ferric oxide** on its surface.
2. This compound is known as rust and the phenomenon of formation of rust is known as rusting.

$$4Fe + 3O_2 + xH_2O \longrightarrow \underset{\text{rust}}{2Fe_2O_3 \cdot xH_2O}$$

4. State two conditions necessary for rusting of iron. (JUNE - 2023)

The conditions necessary for rusting of iron are,

1. Moist air

2. Presence of oxygen
3. Presence of water

VII. Long answer questions.

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

1. Bauxite ore is finely ground and heated under pressure with a solution of concentrated caustic soda solution at 150°C to obtain sodium meta aluminate.

$$Al_2O_3 + 2NaOH \longrightarrow 2NaAlO_2 + H_2O$$

2. On diluting sodium meta aluminate with water, a precipitate of aluminium hydroxide is formed.

$$NaAlO_2 + 2H_2O \longrightarrow Al(OH)_3 + NaOH$$

3. The precipitate is filtered, washed, dried and ignited at 1000°C to get alumina.

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

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

1. Fluorspar.
2. It **lowers** the **fusion temperature** of electrolyte.

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

Given:

1. Electronic configuration of metal A - 2, 8, 18, 1
2. Metal A $\longrightarrow$ B (green)
3. $A \xrightarrow{Con\cdot H_2SO_4}$ C and D (gas) + water
4. A, B, C, D = ?

Solution:

1. Metal A is **Copper** (Cu)

2. Copper gets covered with a green layer of basic **copper carbonate** in the presence of CO_2 and moisture.

$$\underset{A}{2Cu} + O_2 + CO_2 + H_2O \longrightarrow \underset{B}{CuCO_3 \cdot Cu(OH)_2}$$

3. Copper reacts with con·H_2SO_4 with the liberation of **sulphur di oxide** gas and **copper sulphate**.

$$\underset{A}{Cu} + 2H_2SO_4 \longrightarrow \underset{C}{CuSO_4} + \underset{D}{SO_2\uparrow} + 2H_2O$$

4. A - Copper,

   B - Copper carbonate

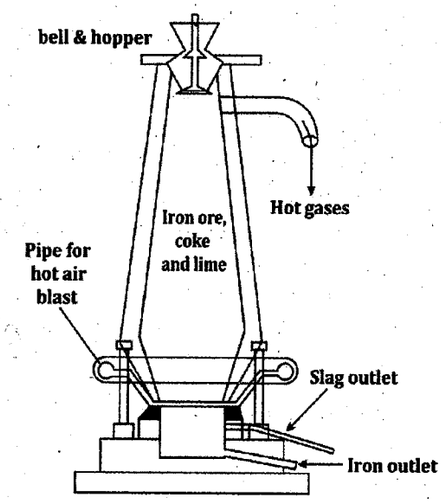
   C - Copper sulphate

   D - Sulphur dioxide gas

3. Explain smelting process. ※※※

Smelting:

Smelting is the process of **reducing** the **roasted metallic oxide** from the metal in its molten condition.



Blast Furnace

Smelting process in iron (in a Blast Furnace):

1. The charge consisting of **roasted ore, coke** and **limestone** in the ratio **8:4:1**is smelted in a blast furnace by introducing it through the cup and cone arrangement at the top.

2. There are **three** important regions in the furnace.

a. The Lower Region (Combustion Zone):

1. The temperature is at **1500°C.**

2. **Coke** burns with **oxygen** to form **CO_2** when the charge comes in contact with a hot blast of air.

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

b. The Middle Region (Fusion Zone):

1. The temperature prevails at **1000°C.**

2. CO_2 is reduced to **CO.**

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

3. Limestone decomposes to **calcium oxide** and **CO_2.**

$$CaCO_3 \xrightarrow[\Delta]{1000°C} CaO + CO_2 - Heat$$

4. Calcium oxide combines with **silica** to form **calcium silicate** slag.

$$CaO + SiO_2 \longrightarrow CaSiO_3$$

c. The Upper Region (Reduction Zone):

1. The temperature prevails at **400°C**

2. Carbon monoxide **reduces ferric oxide** to form a fairly pure spongy **iron.**

$$Fe_2O_3 + 3CO \xrightarrow{400°C} 2Fe + 3CO_2\uparrow$$

3. The molten iron is collected at the bottom of the furnace after removing the slag.

4. The iron thus formed is called **pig iron.**

VIII. HOT questions. **(PTA - III)**

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.

Ans:

1. Period 3 and group 13. So metal A is **aluminium.**
2. When steam is passed over red hot aluminium, hydrogen and **aluminium oxide** is produced.

$$\underset{A}{2Al} + \underset{steam}{3H_2O} \longrightarrow \underset{B}{Al_2O_3} + 3H_2 \uparrow$$

aluminium oxide

3. Aluminium reacts with strong caustic alkalis forming aluminates.

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

Sodium meta aluminate

4. A ⟶ aluminium
   B ⟶ aluminium oxide
   C ⟶ sodium meta aluminate

2. Name the acid that renders aluminium passive. Why? (APRIL - 24, PTA - III)

1. **Dilute** or **concentrated nitric acid** renders aluminium passive.
2. It is because nitric acid forms an **oxide film** on the surface of aluminium.

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

Ans: Covalent bond

b. What property forms the basis of identification?

Ans: Electronegativity

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

Electronegativity **increases** along the period and **decreases** along the group.

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Choose the correct answer.

1. Alloy used in the manufacturing of pressure cooker is _____. **(SEP - 2021)**
   a. Brass b. Bronze c. Magnalium d. Duralumin
   Ans: d. Duralumin

2. 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 Na atom
   b. The attractive force of nucleus is more in Na atom than Na^+ ion
   c. Number of protons present in Na atom is less than Na^+ ion
   d. Number of electrons present in Na^+ ion is more than Na atom
   Ans: a. The attractive force of nucleus is more in Na^+ ion than Na atom

II. Short answers.

1. i. 'X' is an element that 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)

1. X - Hydrogen
2. Chemical symbol - H.

ii. A is a metal and belongs to Boron family in modern periodic table 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)

1. A - Aluminium
2. When a mixture of aluminium powder and iron oxide is ignited. It reduces iron oxide into iron.

$$Fe_2O_3 + 2Al \longrightarrow 2Fe + Al_2O_3 + Heat$$

This process is known as aluminothermic process.

III. Long answers.

1. What are the methods of preventing Corrosion? (SEP - 2020 & 21, GMQP - 2019)

1. Alloying:

The metals can be alloyed to prevent from the process of corrosion. **E.g:** Stainless Steel

2. Surface coating:

It involves application of a protective coating over the metal. It is of the following types:

a. Galvanization:

It is process of coating zinc on iron sheets by using electric current.

b. Electroplating:

It is a method of coating one metal over another metal by passing electric current.

c. Anodizing:

It is an electrochemical process that converts the metal surface into a decorative, durable and corrosion resistant. Aluminium is widely used for anodizing process.

d. Cathodic protection:

It is the method of controlling corrosion of a metal surface protected is coated with the metal which is easily corrodible. The easily corrodible metal is called sacrificial metal to act as anode ensuring cathodic protection.

2. a. What is an alloy? (MAY - 2022)

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

b. Give the reasons for alloying. (MAY - 2022)

1. To modify appearance and colour.
2. To modify chemical activity.

3. To lower the melting point.
4. To increase hardness and tensile strength.
5. To increase resistance to electricity.

3. a. What is an amalgam? Give an example. (APR - 2023)

An amalgam is an **alloy of mercury** with **another metal**. These alloys are formed through **metallic bonding** with the electrostatic force of attraction between the **electrons** and the positively charged **metal ions**.

E.g: Silver tin amalgam is used for dental filling

b. Mention any two uses of copper. (APR - 2023)

1. It is extensively used in manufacturing electric cables and other electric appliances.
2. It is used for making utensils, containers, calorimeters and coins.
3. It is used in electroplating.
4. It is alloyed with gold and silver for making coins and jewels.

4. 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 stable electronic configuration.

Ans: 18th group elements.

b. These elements are mostly unreactive.

The atoms of the 'group 18' elements have stable electronic configuration ns^2np^6 in their valence shells and hence they are unreactive.

5. i. 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).

Electronegativity value of hydrogen is = 2.1 **(PTA - 2)**

Sodium = 1

[HF & NaH] Fluorine = 4

$[\because HF = 4 - 2.1 = 1.9]$ If the difference is greater than 1.7, the bond is considered to be **more ionic.**

NaH = 2.1 − 1 = 1.1 The difference is less than 1.7, the bond is to be **covalent** bond.

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

Reason:

1. The ore is wetted by the oil and gets separated from the gangue in the form of froth.
2. Since the ore is lighter, it comes on the surface with the forth and the impurities are left behind.
3. Hence, Copper pyrite is concentrated by froth floatation method.

7. 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)

1. A - Iron
2. **Reaction with steam:** When steam is passed over red hot iron, **magnetic oxide** is formed.

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

3. Iron (A) forms an alloy (C) with carbon and nickel.

Compound	Name
A	Iron
B	Magnetic oxide
C	Nickel steel

8. 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.

1. The atomic radius increases down a group due to the increase in the valence shell.
2. When the shell number increases, the distance between the valence shell and the nucleus increases.
3. Along the period, the shell number remains the same but the number of protons increases.
4. More and more positive charges impose a strong attraction over the electrons and thus the electron cloud shrinks towards the nucleus, which results in the decrease in the atomic size.

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

The atomic size increases and hence the valence electrons are loosely bound. They require relatively less energy for the removal.

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

As the atomic size decreases from left to right in a period, more energy is required to remove the electrons. So, the ionisation energy increases along the period.

ADDITIONAL QUESTIONS

I. Match the following:

1.	Periodic property	Periods	Groups	Options
1.	Atomic radius	- a. _____	- A. _____	increases, decreases
2.	Ionic radius	- b. _____	- B. _____	increases, decreases
3.	Electron affinity	- c. _____	- C. _____	increases, decreases
4.	Electronegativity	- d. _____	- D. _____	increases, decreases

Answers

	Periodic property		Periods		Groups
1.	Atomic radius	-	a. **Decreases**	-	A. **Increases**
2.	Ionic radius	-	b. **Decreases**	-	B. **Increases**
3.	Electron affinity	-	c. **Increases**	-	C. **Decreases**
4.	Electronegativity	-	d. **Increases**	-	D. **Decreases**

2.

	Column - I		Column - II		Answers
1.	Oxide ore	-	a. Magnesite	-	**b. Bauxite**
2.	Halide ore	-	b. Bauxite	-	**d. Rock salt**
3.	Carbonate ore	-	c. Iron pyrite	-	**a. Magnesite**
4.	Sulphide ore	-	d. Rock salt	-	**c. Iron pyrite**

3.

	Column - I		Column - II		Answers
1.	Brass	-	a. 2 - 4.5% carbon	-	**c. Copper**
2.	Duralumin	-	b. < 0.25% carbon	-	**d. Aluminium**
3.	Stainless steel	-	c. Copper	-	**e. Iron**
4.	Pig iron	-	d. Aluminium	-	**a. 2 - 4.5% carbon**
5.	Steel	-	e. Iron	-	**b. < 0.25% carbon**

4.

	Column - I		Column - II		Answers
1.	Aluminium	-	a. Hydrated ferric oxide	-	**e. Anodizing**
2.	Rust	-	b. easily corrodible	-	**a. Hydrated ferric oxide**
3.	Pamban bridge	-	c. protective coating	-	**d. corrosion free**
4.	Sacrificial metal	-	d. corrosion free	-	**b. easily corrodible**
5.	Surface coating	-	e. Anodizing	-	**c. protective coating**

II. Choose the correct answer:

1. Electronegativity is based on _____.
   a. atomic radius b. electron affinity c. protons d. electrons
   Ans: b. electron affinity

2. i. The distance between the centre of the nucleus to the influence of the electron cloud of an ion is called atomic radii
   ii. In non - metallic elements, their atomic radius is known as covalent radius.
   iii. There are 19 periods in the periodic table.
   iv. Atomic radius in metal atoms is known as metallic radius.
   a. i. is correct b. iv. is correct
   c. i. & iii. are correct d. ii. & iv. are correct
   Ans: d. ii. & iv. are correct

3. Lanthanides and Actinides are called _____.
   a. Halogens b. Noble gases
   c. Inner transition elements d. Chalcogens
   Ans: c. Inner transition elements

4. If the difference in electronegativity is less than _____ the bond is said to be covalent.
   a. 0.7 b. 1.7 c. 17 d. 0.17 **Ans: b. 1.7**

5. The rocky impurity associated with an ore is called _____.
   a. mineral b. ore c. gangue d. flux **Ans: c. gangue**

6. Iron pyrite is a _____ ore.
   a. oxide b. carbonate c. sulphide d. halide
   Ans: c. sulphide

7. Oxides are purified by _____ method.
   a. magnetic separation b. gravity separation

   c. froth floatation d. none of the above **Ans: b. gravity separation**

8. Metals are discharged at the cathode during _____.
   a. electrolysis b. electroplating
   c. Ionic formation d. none of the above **Ans: a. electrolysis**

9. _____ is the metal found most abundantly on the Earth's crust.
   a. Gold b. Magnesium c. Silver d. Aluminium
   Ans: d. Aluminium

10. The electrolytic reduction of alumina is carried out by_____.
    a. Froth floatation b. Hall's process
    c. Gravity separation d. None of the above **Ans: b. Hall's process**

11. The physical and chemical properties of elements are the periodic functions of their _____.
    a. mass numbers b. atomic numbers
    c. atomic radii d. number of electrons **Ans: b. atomic numbers**

12. The process of reducing roasted metallic oxide into metal in molten condition is called _____.
    a. mining b. Bessemerisation c. smelting d. ore extraction
    Ans. c. smelting

13. _____ is an alloy of mercury with another metal.
    a. Oxide b. Noble gas c. Amalgam d. Bauxite
    Ans. c. Amalgam

14. An example of ferrous alloy is _____.
    a. Nickel b. Aluminium c. Stainless steel d. Copper
    Ans. c. Stainless steel

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

1. Copper reacts with dil.HNO_3 with liberation of Hydrogen gas.
   Ans: False
   Copper reacts with dil.HNO_3 with liberation of **Nitric Oxide** gas.

2. Chlorine reacts with copper, resulting in the formation of copper (II) chloride.
   Ans: True

3. When iron is dipped in con. H_2SO_4 it becomes chemically passive or inert due to the formation of a layer of iron oxide on its surface.
   Ans: False
   When iron is dipped in con. **HNO_3** it becomes chemically passive or inert due to the formation of a layer of iron oxide on its surface.

4. Brass is an alloy of zinc and silver.
   Ans: False
   Brass is an alloy of zinc and **copper**.

5. The corrosive action in the absence of moisture is called wet corrosion
   Ans: False
   The corrosive action in the absence of moisture is called **dry** corrosion.

6. Iron is widely used for anodizing process
   Ans: False
   Aluminium is widely used for anodizing process.

7. Smelting is the process of reducing the roasted metallic oxide into metal in molten condition.
   Ans: True

8. An amalgam is an alloy of zinc with another metal.

Ans: False

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

IV. Assertion and Reason.

1. **Assertion:** Aluminium is a powerful oxidizing agent.
   Reason : Aluminium is used in making aeroplanes and other industrial machine parts.
   a. A and R are correct, R explains the A.
   b. A is correct, R is wrong.
   c. A is wrong, R is correct.
   d. A and R are correct, R doesn't explains A.
   Ans: c. A is wrong, R is correct

2. **Assertion:** The chief ore of copper is copper pyrite.
   Reason : The ore is crushed and the concentrated by froth floatation process.
   a. A and R are correct, R explains the A.
   b. A is correct, R is wrong.
   c. A is wrong, R is correct.
   d. A and R are correct, R doesn't explains A.
   Ans: d. A and R are correct, R doesn't explains A

3. **Assertion:** Blister copper contains 98% of pure copper and 2% of impurities and is purified by electrolytic refining.
   Reason : It is used to get a metal of high purity.
   a. A and R are correct, R explains the A.
   b. A is correct, R is wrong.
   c. A is wrong, R is correct.
   d. A and R are correct, R doesn't explains A.
   Ans: a. A and R are correct, R explains the A

4. **Assertion:** Copper is a reddish brown metal, with high luster, high density and high melting point (1356°C).
   Reason : Copper is not attacked by alkalis.
   a. A and R are correct, R explains the A.
   b. A is correct, R is wrong.
   c. A is wrong, R is correct.
   d. A and R are correct, R doesn't explains A.
   Ans: d. A and R are correct, R doesn't explains A

V. Analog

1.	Mendeleev's periodic table	:	atomic mass	
	Moseley modern table	:	_____	**(atomic number)**
2.	Periods	:	horizontal rows	
	Groups	:	_____	**(vertical column)**
3.	Hydrogen and Helium	:	first period	
	Lithium to Neon	:	_____	**(second period)**
4.	First period	:	shortest period	
	Sixth period	:	_____	**(longest period)**
5.	Group 17	:	halogens	
	Group 18	:	_____	**(noble gases)**
6.	Metal atom	:	metallic radius	
	Non metallic element	:	_____	**(covalent radius)**
7.	Cations	:	+ve charge	
	Anion	:	_____	**(–ve charge)**

8.	Oxide ores	:	bauxite	
	Carbonate ores	:	_____	**(magnesite)**
9.	Household utensils	:	aluminium	
	Electric appliance	:	_____	**(copper)**
10.	Duralumin	:	alloy	
	Mercury	:	_____	**(amalgam)**

VI. Problem solving.

1. **An element X which is a yellow solid at room temperature shows catenation and allotropy X forms two oxides which are also formed during the thermal decomposition of ferrous sulphate crystals and the major air pollutants.**
   a. Identify the element X.
   b. Write electronic configuration of X.
   c. Locate the position of the element in the modern periodic table.
   Ans:
   a. X is Sulphur.
   b. Electronic configuration of 'X' is 2, 8, 6.
   c. It belongs to Group 16 and 3rd period.

2. **A compound A is green in colour on heating it gives a gas B which turns limewater milky. The residue left C is black in colour identify A, B and C write the chemical involved.**
   Solution:
   Compound A is green colour. So compound A is $CuCO_3$
   $CuCO_3 + heat \longrightarrow CuO + CO_2$
   Compound A is copper carbonate
   B is carbon dioxide
   B which turns lime water milky is carbon dioxide
   C is – (CuO) copper II oxide

3. **A metal M does not liberate hydrogen from acids but reacts with oxygen to give a black coloured product. Identify M and black coloured product.**
   Solution:
   M is Copper (Cu).
   Copper does not react with acid but reacts with oxygen to from copper oxide. Black colour product is copper oxide (CuO).

4. **Give an example of a metal which**
   a. Is both malleable and ductile
   Aluminium is both malleable and ductile.
   b. Is best conductor of heat
   Silver is the best conductor of heat.
   c. Is a poor conductor of heat?
   Lead is the poor conductor of heat.

5. **a. Write the name of the products formed when Aluminium reacts with NaOH.**
   Product formed - Sodium meta aluminate and hydrogen
   b. Also write the balanced chemical equation for the reaction involved.
   $2Al + 2NaOH + 2H_2O \longrightarrow 2NaAlO_2 + 3H_2\uparrow$

6. Metal A is greyish white in colour and lustrous metal. A is heating in an air, forms B magnetic oxide black in colour. Identify A and B, write the chemical reaction.

1. Metal A is Fe (Iron).
2. $3Fe + 2O_2 \longrightarrow Fe_3O_4$

   A B (black)
3. B is ferrous oxide

VII. Short Answers:

1. Write the uses of Aluminium.

Aluminium is used in:

1. House hold utensils
2. Electrical cable industry
3. Making aeroplanes and other industrial machine parts.

2. Write the uses of iron.

1. Pig Iron:

It is used in making pipes, stoves, radiators, railings, manhole covers and drain pipes.

2. Steel:

It is used in the construction of buildings, machinery, transmission cable and T.V. towers and in making alloys.

3. Wrought Iron:

It is used in making springs, anchors and electromagnets.

3. What are the alloys of copper and write its uses?

	Alloys	Uses
1.	Brass (Cu, Zn)	Electrical fittings, medal, decorative items, hardware
2.	Bronze (Cu, Sn)	Statues, coins, bells, gongs

4. What are the alloys of aluminium and write its uses? **(SEP - 2021)**

	Alloys	Uses
1.	Duralumin (Al, Mg, Mn, Cu)	Aircrafts, tools, pressure cookers
2.	Magnalium (Al, Mg)	Aircraft, scientific instruments

5. What are the alloys of Iron and write its uses?

	Alloys	Uses
1.	Stainless steel (Fe, C, Ni, Cr)	Utensils, cutlery, automobile parts
2.	Nickel steel (Fe, C, Ni)	Cables, aircraft parts, propeller

6. State modern periodic law.

Modern periodic law states that, "the physical and chemical properties of the elements are the periodic functions of their atomic numbers".

7. Define mining.

The process of extracting the ores from the Earth's crust is called mining.

8. Define gangue or matrix.

The rocky impurity associated with an ore is called gangue or matrix.

9. Define metallurgy.

Metallurgy is a science of extracting metals from their ores and modifying the metals into alloys for various uses, based on their physical and chemical properties and their structural arrangement of atoms.

VIII. Long Answers:

1. Explain the chemical properties of metals.

1: Valence electrons:

Atoms of metals usually have 1, 2 or 3 electrons in their outermost shell.

2. Formation of ions:

Metals form positive ions by the loss of electrons and hence they are electro positive.

3. Discharge of ions:

Metals are discharged at the cathode during the electrolysis of their compounds.

4. Atomicity:

Molecules of metals in their vapour state are usually monoatomic.

5. Nature of oxides:

Oxides of metals are usually basic.

2. Explain the chemical properties of iron.

1. Reaction with air or oxygen:

Only on heating in air, iron forms magnetic oxide.

$$3Fe + 2O_2 \longrightarrow Fe_3O_4 \text{ (black)}$$

2. Reaction with moist air:

1. When iron is exposed to moist air, it forms a layer of brown hydrated ferric oxide on its surface.
2. This compound is known as rust and the phenomenon of formation of rust is known as rusting.

$$4Fe + 3O_2 + xH_2O \longrightarrow 2Fe_2O_3 \cdot xH_2O \text{ (rust)}$$

3. Reaction with steam:

When steam is passed over red hot iron, magnetic oxide is formed.

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

4. Reaction with chlorine:

Iron combines with chlorine to form ferric chloride

$$2Fe + 3Cl_2 \longrightarrow 2FeCl_3 \text{ (ferric chloride)}$$

5. Reaction with acids:

1. With dilute HCl and dilute H_2SO_4 it liberates H_2 gas.

$$Fe + 2HCl \longrightarrow FeCl_2 + H_2\uparrow$$

$$Fe + H_2SO_4 \longrightarrow FeSO_4 + H_2\uparrow$$

2. With dilute HNO_3 in cold condition it gives ferrous nitrate.

$$4\,Fe + 10\,HNO_3 \longrightarrow 4\,Fe(NO_3)_2 + NH_4NO_3 + 3\,H_2O$$

3. With con. H_2SO_4 it forms ferric sulphate.

$$2\,Fe + 6\,H_2SO_4 \longrightarrow Fe_2(SO_4)_3 + 3\,SO_2 + 6\,H_2O$$

4. When iron is dipped in con. HNO_3 it becomes chemically passive or inert due to the formation of a layer of iron oxide (Fe_3O_4) on its surface.

IX. Fill in the blanks.

1. _____ and _____ are two highly reactive metals. **(Lithium, sodium)**
2. The first period consists of _____ elements. **(two)**
3. The second period contains _____ elements. **(eight)**
4. Argon comes before _____ in the periodic table. **(potassium)**
5. _____ provided a better basis for the periodic arrangement of the elements. **(atomic number)**
6. Atomic number of an element is equal to the number of _____ and electrons. **(protons)**
7. The physical and chemical properties of the elements are the periodic functions of their _____ numbers. **(atomic)**
8. Elements are arranged in the _____ order of their atomic numbers. **(increasing)**
9. The _____ table is a tabular arrangement of elements in rows and columns. **(modern periodic)**
10. The third period consists of elements with atomic number _____ to _____. **(11,18)**
11. The fourth period contains _____ elements. **(18)**
12. The fifth period contains _____ normal and _____ transition elements. **(8,10)**
13. _____ rows are called periods. **(Horizontal)**
14. There are _____ periods in the periodic table. **(seven)**
15. First period is the _____ period. **(shortest)**
16. The _____ period includes 8 normal elements, 10 transition elements and 14 inner transition elements. **(6th)**
17. Elements from Lithium to Neon belong to the _____ period. **(second)**
18. Recently, four elements have been added in the _____ period. **(seventh)**
19. Lanthanides and Actinides form a part of group _____. **(3)**
20. All the elements present in each group have the same number of electrons in the valence shell except group _____. **(0)**
21. The elements having identical valence shell electronic configurations, possess similar _____ properties. **(chemical)**
22. _____ is half the distance between the nuclei of adjacent metal atoms. **(Metallic radius)**
23. The vertical columns in the periodic table are called _____. **(groups)**
24. There are _____ groups in the periodic table. **(18)**
25. Group 1 consists of _____. **(Alkali metals)**
26. The valency of all the alkali metals is _____. **(1)**
27. Oxygen family is also called _____ family. **(chalcogen)**
28. Halogens belong to group _____. **(17)**
29. The Boron family belong to group _____. **(13)**
30. Transition metals fall under groups _____ to _____. **(3,12)**
31. Some of the _____ properties of the elements are periodic. **(atomic)**
32. The distance between the centre of its nucleus and the outermost shell containing the valence electron is called _____. **(atomic radius)**

33. Atomic radius of metal atoms is known as _____ radius. **(metallic)**
34. Atomic radius is referred to as covalent radius or _____ radius. **(metallic)**
35. Atomic radius, ionic radius, electron affinity are called _____ properties. **(periodic)**
36. The atomic radius of non - metallic elements is known as _____. **(covalent radius)**
37. Along the period, from left to right, the _____ of the elements decreases. **(atomic radius)**
38. Along the groups, from the top to bottom, the atomic radius _____. **(increases)**
39. As the shell number increases, the distance between the valence shell and the nucleus _____. **(increases)**
40. More and more positive charges impose a strong _____ over the electrons. **(attraction)**
41. Electron cloud shrinks towards the _____. **(nucleus)**
42. The shrinking of electron cloud results in the decrease in the _____. **(atomic size)**
43. The distance between the centre of the nucleus to the influence of electron cloud of an ion is called _____. **(Ionic Radii)**
44. A positively charged ion is called _____. **(cation)**
45. Ionisation energy is measured in _____ /mol. **(KJ)**
46. Ionisation energy is also called _____. **(ionisation enthalpy)**
47. Ionic radii increases along the _____. **(group)**
48. Ions are formed when an atom lose or gain _____. **(electrons)**
49. Neutral atom loses an electron and becomes _____ charged. **(positively)**
50. The gain of an electron by a neutral atom charged ion called _____. **(anion)**
51. The size of a cation is always _____ than its corresponding neutral atom. **(smaller)**
52. The anion is _____ in size than its neutral atom. **(larger)**
53. Lithium and sodium lose the single electron from their outermost energy level to form _____. **(cations)**
54. Fluorine and chlorine become _____ ions by gaining an electron. **(negative)**
55. Ionic radii decreases along the _____ from left to right. **(period)**
56. _____ is the minimum energy required to remove an electron from a gaseous atom in its ground state to form a cation. **(Ionisation energy)**
57. If the difference in electronegativity between two elements is less than 1.7, the bond is considered to be _____. **(covalent)**
58. In an HCl molecule _____ has higher electronegativity. **(Cl)**
59. The ionization energy increases along the _____ in the periodic table. **(period)**
60. Ionisation energy _____ down the group. **(decreases)**
61. As the positive charge increases, the size of the cation _____. **(decreases)**
62. As the _____ charge increases the size of the anion increases. **(negative)**
63. _____ is the amount of energy released when a gaseous atom gains an electron to form its anion. **(Electron affinity)**
64. Noble gases show no tendency to accept _____. **(electrons)**
65. The electron affinities for noble gases is _____. **(zero)**
66. The tendency to attract a shared pair of electrons towards itself in a covalent bond is called _____. **(electronegativity)**
67. _____ is the science of extracting metals from ores and modifying them. **(Metallurgy)**
68. During metallurgy _____ is converted into metal. **(ore)**
69. The process of purification of metal is called _____. **(refining)**
70. Minerals from which metals are extracted are called _____. **(ores)**
71. Clay and bauxite are the two minerals of _____. **(aluminium)**
72. The process of extracting the ores from the Earth's crust is called _____. **(mining)**
73. The rocky impurity associated with an ore is called _____ or _____ **(gangue, matrix)**
74. _____is the substance added to the ore to reduce the fusion temperature. **(Flux)**
75. _____ is the fusible product formed when a flux reacts with a gangue. **(Slag)**
76. Flux + Gangue $\longrightarrow$ _____. **(Slag)**
77. Bauxite is an _____ ore. **(oxide)**
78. Siderite is a _____ ore. **(carbonate)**
79. Fluorspar is a _____ore. **(halide)**
80. Rock salt is a _____ ore. **(halide)**

81. Galena is a _____ ore. **(sulphide)**
82. Zinc blende is a _____ ore. **(sulphide)**
83. _____ process depends on the preferential wettability of the ore with oil and gangue. **(Froth floatation)**
84. _____ ore is found in Coimbatore and Salem district. **(Chromite)**
85. _____ is found in Madurai and Dindugal. **(Tungsten)**
86. All metals are _____ at room temperature. **(solids)**
87. Metals possess a high lustre called _____. **(metallic lustre)**
88. _____ and _____ are not solids at room temperature. **(Mercury, Gallium)**
89. _____ and _____ are metals which can be cut with a knife. **(Sodium,Potassium)**
90. Metals have _____ density. **(high)**
91. Metals are _____ conductors. **(good)**
92. _____ is a metal which is a non - conductor. **(Tungsten)**
93. _____ and _____ are non - malleable. **(Zinc, Mercury)**
94. Sodium and potassium are less dense than _____. **(water)**
95. Molecules of metals in their vapour state are usually _____. **(monoatomic)**
96. Oxides of metals are usually _____. **(basic)**
97. On diluting sodium meta aluminate with water, a precipitate of _____ is formed. **(aluminium hydroxide)**
98. $2Al(OH)_3 \xrightarrow{1000°C} ____ + 3H_2O$. **($Al_2O_3$)**
99. Aluminium is produced by the electrolytic reduction of fused _____ in the electrolytic cell. **(alumina)**
100. On heating at 800°C aluminium forms _____ and _____. **(Aluminium oxide, Aluminium nitride)**
101. _____ does not react with aluminium due to its layer of oxide. **(Water)**
102. When steam is passed over red hot aluminium _____ is produced. **(hydrogen)**
103. The density of Aluminium is _____. **(2.7g/cm³)**
104. The melting point of Aluminium is _____. **(660°C)**
105. Aluminium reacts with caustic alkalis to form _____. **(aluminates)**
106. _____ acid does not attack aluminium. **(Nitric)**
107. $Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3 + Heat$, the above equation is an example of _____ process. **(aluminothermic)**
108. Copper pyrite, copper glance and cuprite are ores of _____. **(copper)**
109. Copper pyrite yields nearly _____ % of the world production of copper. **(76)**
110. The chief ore of copper is _____. **(copper pyrite)**
111. Blister copper contains _____% of pure copper and _____% of impurities. **(98, 2)**
112. Blister copper is purified by _____. **(electrolytic refining)**
113. When electric current is passed through the electrolytic solution, pure copper gets deposited at the _____. **(cathode)**
114. The melting point of copper is _____. **(1356°C)**
115. $2Cu + O_2 \xrightarrow{below\ 1370K} ____$. **(2CuO)**
116. $4Cu + O_2 \xrightarrow{above\ 1370K} ____$. **($2Cu_2O$)**
117. Copper reacts with dil. HNO_3 with the liberation of _____ gas. **(Nitric Oxide)**
118. Haematite, magnetite and Iron pyrite are ores of _____. **(Iron)**
119. Chlorine reacts with copper, resulting in the formation of _____. **(copper (II) chloride)**
120. _____ is not attacked by alkalis. **(Copper)**
121. _____ is used in electroplating. **(Copper)**
122. _____ is the second most abundant metal available in the Earth's crust next to aluminium. **(Iron)**

9.SOLUTIONS

KEY FORMULAE

1.	Solubility	$\frac{\text{Mass of the solute}}{\text{Mass of the solvent}} \times 100$
2.	Mass percentage	$\frac{\text{Mass of the solute}}{\text{Mass of the solution}} \times 100$ $\frac{\text{Mass of the solute}}{\text{Mass of the solute} + \text{Mass of the solvent}} \times 100$
3.	Volume percentage	$\frac{\text{Volume of the solute}}{\text{Volume of the solution}} \times 100$
4.	Volume percentage	$\frac{\text{Volume of the solute}}{\text{Volume of the solute} + \text{Volume of the solvent}} \times 100$

I. Choose the correct answer.

1. A solution is a _____ mixture. ※※
   a. homogeneous b. heterogeneous
   c. homogeneous and heterogeneous d. non homogeneous
   Ans: a. homogeneous

2. The number of components in a binary solution is _____. **(MAY - 2022)**
   a. 2 b. 3 c. 4 d. 5 **Ans: a. 2**

3. Which of the following is the universal solvent? ※※※ **(APR - 2023)**
   a. Acetone b. Benzene c. Water d. Alcohol
   Ans: c. Water

4. A solution in which no more solute can be dissolved in a definite amount of solvent at a given temperature is called _____.
   a. Saturated solution b. Unsaturated solution
   c. Super saturated solution d. Dilute solution
   Ans: a. Saturated solution

5. Identify the non aqueous solution. **(SEP - 2020)**
   a. sodium chloride in water b. glucose in water
   c. copper sulphate in water d. sulphur in carbon - di - sulphide
   Ans: d. sulphur in carbon - di - sulphide

6. When pressure is increased at constant temperature the solubility of gases in liquid _____.
   a. No change b. increases c. decreases d. no reaction
   Ans: b. increases

7. Solubility of NaCl in 100ml water is 36g. If 25g of salt is dissolved in 100ml of water how much more salt is required for saturation _____.
   a. 12g b. 11g c. 16g d. 20g **Ans: b. 11g**

8. A 25% alcohol solution means **(PTA - IV)**
   a. 25ml alcohol in 100ml of water b. 25ml alcohol in 25ml of water
   c. 25ml alcohol in 75ml of water d. 75ml alcohol in 25ml of water
   Ans: c. 25ml alcohol in 75ml of water

9. Deliquescence is due to _____. ※※ **(PTA - V)**
   a. strong affinity to water b. less affinity to water
   c. strong hatred to water d. inertness to water
   Ans: a. strong affinity to water

10. Which of the following is hygroscopic in nature? **(JUNE - 2023)**
    a. ferric chloride b. copper sulphate penta hydrate
    c. silica gel d. none of the above **Ans: c. silica gel**

II. Fill in the blanks.

1. The component present in lesser amount, in a solution is called _____. **(GMQ - 2019)** ※※※ **Ans: solute**
2. Example for liquid in solid type solution is _____. **Ans: amalgam**
3. Solubility is the amount of solute dissolved in _____ g of solvent. **(JULY - 2024)** **Ans: 100**
4. Polar compounds are soluble in _____ solvents. **Ans: polar**
5. Volume percentage decreases with increases in temperature because _____. ※※ **(PTA - II)** **Ans: expansion of liquid**

III. Match the following.

	Column - I		Column - II		Answers		
1.	Blue vitriol	-	a.	$CaSO_4 \cdot 2H_2O$	-	c.	$CuSO_4 \cdot 5H_2O$
2.	Gypsum	-	b.	CaO	-	a.	$CaSO_4 \cdot 2H_2O$
3.	Deliquescence	-	c.	$CuSO_4 \cdot 5H_2O$	-	d.	NaOH
4.	Hygroscopic	-	d.	NaOH	-	b.	CaO

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

1. Solutions which contain three components are called binary solution.
   Ans: False
   Solutions which contain three components are called **ternary** solution.

2. In a solution the component which is present in lesser amount is called solvent. **(PTA - IV)**
   Ans: False
   In a solution the component which is present in lesser amount is called **solute**.

3. Sodium chloride dissolved in water forms a non - aqueous solution. **(PTA - IV)**
   Ans: False
   Sodium chloride dissolved in water forms an **aqueous** solution.

4. The molecular formula of green vitriol is $MgSO_4 \cdot 7H_2O$
   Ans: False
   The molecular formula of **epsom salt** is $MgSO_4 \cdot 7H_2O$

5. When Silica gel is kept open, it absorbs moisture from the air, because it is hygroscopic in nature. **(PTA - IV)**
   Ans: True

V. Short answers.

※※※

1. Define the term: Solution **(JULY - 2024)**

1. A solution is a **homogeneous mixture** of two or more substances.
   E.g: Sea water
2. In a solution, the component present in **lesser** amount by weight is called a **solute**.
3. The component present in a **larger** amount by weight is called a **solvent**.

2. What is meant by binary solution?

1. A solution must at least be consisting of **two components** a solute and a solvent.
2. Such solutions which are made of **one solute** and **one solvent** with two components are called binary solutions.
3. **E.g:** Addition of copper sulphate crystals to water.

3. Give an example each **(PTA - I)**

	Solute Solvent	Example
1.	Gas in liquid	Soda water (carbon - di - oxide dissolved in water)
2.	Solid in liquid	Sodium chloride dissolved in water
3.	Solid in solid	Alloys (copper dissolved in gold)
4.	Gas in gas	Mixture of Helium - Oxygen gases

4. What is aqueous and non - aqueous solution? Give an example.

Aqueous solution:

1. The solution in which **water** acts as a **solvent** is called an aqueous solution.
2. **E.g:** Common salt in **water**

Non - Aqueous solution:

1. The solution in which **any liquid**, other than water, acts as a solvent is called a non - aqueous solution.
2. **E.g:** Sulphur dissolved in carbon disulphide.

5. Define Volume percentage. ※※

Volume percentage is defined as the percentage by volume of **solute** (in ml) present in the given volume of the solution.

$$\text{Volume percentage} = \frac{\text{Volume of the solute}}{\text{Volume of the solute} + \text{Volume of the solvent}} \times 100$$

6. The aquatic animals live more in cold region. Why? **(PTA - V)**

Aquatic animals live more in cold regions because,

1. More amount of **dissolved oxygen** is present in the water of cold regions.
2. The **solubility of oxygen** in water is **more** at low temperatures.

7. Define Hydrated salt. ※※※ **(JULY - 2024)**

1. When ionic substances are dissolved in water to make their **saturated aqueous solution**, their ions attract water molecules and **attach chemically** in certain **ratio** in a process called hydration.
2. These ionic substances **crystallize** out from their saturated aqueous solution with a definite **number of molecules** of water.
3. The number of water molecules found in the crystalline substance is called **water of crystallization.**
4. Such salts are called **hydrated salts.**
5. **E.g:** Blue vitriol - $CuSO_4 \cdot 5H_2O$

8. A hot saturated solution of copper sulphate forms crystals as it cools. Why?

1. It is due to the water of crystallization.
2. Copper sulphate pentahydrate crystals when heated **loses** its **five water molecules** and becomes **colourless** anhydrous copper sulphate.
3. On **cooling**, the colourless anhydrous salt turns back into the blue coloured **hydrated** salt crystals.

9. Classify the following substances into deliquescent, hygroscopic. Conc. Sulphuric acid, Copper sulphate penta hydrate, Silica gel, Calcium chloride and Gypsum salt. **(SEP - 2022)**

Hygroscopic		Deliquescent	
1.	Conc. sulphuric acid	1.	Copper sulphate penta hydrate
2.	Silica gel	2.	Calcium chloride
		3.	Gypsum salt

VI. Long answer.

1. Write notes on. **(JUNE - 2023)** ※※

i. Saturated solution:

A solution in which **no more solute** can be dissolved in a definite amount of the **solvent** at a **given temperature** is called saturated solution.

E.g:

1. 36g of sodium chloride in 100g of water at 25°C forms saturated solution.
2. Further addition of sodium chloride, leave it **undissolved.**

ii. Unsaturated solution:

1. An unsaturated solution is one that contains **less solute** than that of the saturated solution at a given temperature.
2. **E.g:** 10g or 20g or 30g of Sodium chloride in 100g of water at 25°C forms an unsaturated solution. ※※※

2. Write notes on various factors affecting solubility. (JUNE - 2023, GMQ - 2019)

There are three main factors that affect solubility of a solute. They are,

1. Nature of the solute and solvent:

1. The nature of the solute and solvent plays an important role in solubility.
2. Although water dissolves an enormous variety of substances, both **ionic** and **covalent**, it does not dissolve everything.
3. Dissolving occurs when **similarities** exist between the solvent and the solute.
4. **E.g:** Common salt is a polar compound and dissolves readily in polar solvent like water.
5. Non - polar compounds are **soluble** in non - polar solvents.
   E.g: Fat dissolved in ether.
6. Non - polar compounds **do not dissolve** in polar solvents.
7. Polar compounds **do not dissolve** in non - polar solvents.

2. Effect of Temperature:

Solubility of Solids in Liquid:

1. Solubility of a solid solute in a liquid solvent increases with increase in temperature.

2. In **endothermic** process, solubility **increases** with increase in temperature.

3. **E.g:** Greater amount of sugar will dissolve in warm water than in cold water.

4. In **exothermic** process, solubility **decreases** with increase in temperature.

Solubility of Gases in liquid:

1. Solubility of gases in liquid **decrease** with increase in temperature.

2. **E.g:** When water is heated, the solubility of oxygen in water decreases, so oxygen escapes in the form of bubbles.

3. Effect of pressure:

1. Effect of pressure is observed only in the case of solubility of a **gas** in a **liquid**.

2. When the pressure is **increased**, the solubility of a gas in liquid increases.

3. **E.g:** carbonated beverages

3. a. What happens when $MgSO_4 \cdot 7H_2O$ is heated? Write the appropriate equation. **(AP - 24, PTA - IV,II, SEP - 21 & 22)**

1. The water of crystallization of $MgSO_4 \cdot 7H_2O$ is 7.

2. When magnesium sulphate heptahydrate crystals are gently heated, it loses **seven water molecules**, and becomes **anhydrous magnesium sulphate**.

$$\underset{\text{Magnesium sulphate heptahydrate}}{MgSO_4 \cdot 7H_2O} \underset{\text{Cooling}}{\overset{\text{Heating}}{\rightleftharpoons}} \underset{\text{Anhydrous Magnesium sulphate}}{MgSO_4 + 7H_2O}$$

b. Define - solubility. **(APRIL - 2024)**

Solubility is defined as the number of grams of a **solute** that can be dissolved in **100 g** of a **solvent** to form its **saturated solution** at a given temperature and pressure.

$$\text{Solubility} = \frac{\text{Mass of the solute}}{\text{Mass of the solvent}} \times 100$$

4. In what way hygroscopic substances differ from deliquescent substances.

	Hygroscopic substances		Deliquescence substances
1.	When exposed to the atmosphere at ordinary temperature, they **absorb moisture** and **do not dissolve**.	1.	When exposed to the atmospheric air at ordinary temperature, they **absorb moisture** and **dissolve**.
2.	They **do not change** their physical state on exposure to air.	2.	They **change** their physical state on exposure to air.
3.	They may be **amorphous solids** or liquids.	3.	They are **crystalline** solids.
4.	They are used as drying agents.	4.	They dissolve in water forming saturated solutions.
5.	E.g: Quick lime, silica gel	5.	E.g: Caustic soda, Caustic potash

5. A solution is prepared by dissolving 45g of sugar in 180g of water. Calculate the mass percentage of solute.

Solution:

Given:

Mass of solute = 45 g

Mass of the solvent = 180 g

$$\text{Mass percentage of solute} = \frac{\text{Mass of the solute}}{\text{Mass of the solute} + \text{Mass of the solvent}} \times 100$$

$$= \frac{45}{45+180} \times 100$$

$$= \frac{45}{225} \times 100$$

$$= \frac{4500}{225}$$

Mass percentage of solute = **20%**

6. 3.5 litres of ethanol is present in 15 litres of aqueous solution of ethanol. Calculate volume percent of ethanol solution. **(PTA - II)**

Solution:

Given:

Volume of aqueous solution of ethanol = 15 litre

Volume of ethanol = 3.5 litre

$$\text{Volume percentage} = \frac{\text{Volume of the solute}}{\text{Volume of the solution}} \times 100$$

$$= \frac{3.5}{15} \times 100$$

$$= 23.33\%$$

VII. HOT.

1. Vinu dissolves 50g of sugar in 250ml of hot water, Sarath dissolves 50g of same sugar in 250ml of cold water. Who will get faster dissolution of sugar? and Why? **(PTA - VI)**

Ans: Vinu will get a faster dissolution of sugar.

Reason:

1. Solubility of a solid solute in a liquid solvent increases with the increase in temperature.
2. Hence, a greater amount of sugar will dissolve in warm water than in cold water.

2. 'A' is a blue coloured crystalline salt. On heating it loses blue colour and to give 'B'. When water is added, 'B' gives back to 'A'. Identify A and B, write the equation. **(MAY - 2022)**

Solution:

1. A - blue colour crystalline salt - **Copper sulphate pentahydrate**
2. When blue coloured copper sulphate crystals are gently heated, it loses its five water molecules and becomes colourless anhydrous copper sulphate.

$$\underset{\text{(Copper sulphate pentahydrate)}}{CuSO_4 \cdot 5H_2O} \underset{\text{Cooling}}{\overset{\text{Heating}}{\rightleftharpoons}} \underset{\text{(Anhydrous copper sulphate)}}{CuSO_4 + 5H_2O}$$

3. B - **Anhydrous copper sulphate**

3. Will the cool drinks give more fizz at top of the hills or at the foot? Explain.

1. Cool drinks will give more fizz at top of the hills than at the foot due to decreased atmospheric pressure.
2. As pressure decreases the solubility of gas in a liquid also decreases.

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Choose the correct answer.

1. Volume percentage of solutions decreases with the increase in temperature due to (PTA - 2)
   a. thermal expansion of liquids
   b. cooling effect of liquids
   c. increase in concentration of solution
   d. decrease in concentration of solution **Ans: a. thermal expansion of liquids**

2. While doing a science practical experiment, a student left a bottle opened after usage which contained solid sodium hydroxide. When the student visited the laboratory again after few days and found only liquid sodium hydroxide in the bottle. This is due to _____ property of sodium hydroxide. **(PTA - 1)**
   a. Hygroscopic b. Deliquescence c. Dehydration d. Dissociation
   Ans: b. Deliquescence

II. Long answers.

1. A solution was prepared by dissolving 25g of sugar in 100g of water. Calculate the mass percentage of solute. **(SEP - 2020, APR - 2023)**

Solution:

Mass of the solute = 25g
Mass of the solvent = 100g

$$\text{Mass Percentage} = \frac{\text{Mass of the solute}}{\text{Mass of the solution}} \times 100$$

$$\text{Mass Percentage} = \frac{\text{Mass of the solute}}{\text{Mass of the solute} + \text{Mass of the solvent}} \times 100$$

$$= \frac{25}{25+100} \times 100$$

$$= \frac{25}{125} \times 100 = 20\%$$

2. True or false (If false give the correct statement). **(SEP - 2020)**

i. **In our daily life, solution of syrups, mouth wash, antiseptic solution, household disinfectants etc., the concentration of ingredients of solution is expressed as w/w.**
False.
In our daily life, solution of syrups, mouth wash, antiseptic solution, household disinfectants etc., the concentration of the ingredients is expressed as **v / v.**

ii. **In Oinments, antacids, soaps etc., the concentration of solution is expressed as v/v.**
False.
In ointments, antacid, soaps, etc., the concentration of solutions are expressed as **w / w.**

3. Analyse the following statement about the formation of solutions and explain with an example. "Like solvents dissolve like solutes". **(PTA - 1)**

1. The nature of the solute and solvent plays an important role in solubility.
2. Although water dissolves an enormous variety of substances, both ionic and covalent, it does not dissolve everything.

3. The phrase that scientists often use when predicting solubility is "like dissolves like".
4. This expression means that dissolving occurs when similarities exist between the solvent and the solute.
5. **E.g:** Common salt is a polar compound and dissolves readily in polar solvent like water.
6. Non - polar compounds are soluble in non - polar solvents.
7. **E.g:** Fat dissolved in ether.
8. But non - polar compounds, do not dissolve in polar solvents; polar compounds do not dissolve in non - polar solvents.

4. Calculate the solubility of a solute at 300 K by dissolving 10g of solute in 50g of solvent. **(PTA - 5)**

Solution:

Mass of the solute = 10 g
Mass of the solvent = 50 g

$$\text{Mass percentage} = \frac{\text{Mass of the solute}}{\text{Mass of the solution}} \times 100$$

$$= \frac{10}{\cancel{50}} \times \overset{2}{\cancel{100}} = 20g$$

5. Calculate the mass of water required in grams to dissolve 10 g of sucrose to produce the mass percentage of 10% solution. **(PTA - 3)**

Solution:

Mass of the sucrose = 10 g
Mass of the solution = 10 %
Mass of the water = x

$$\text{Mass percentage} = \frac{\text{Mass of the solute}}{\text{Mass of the solute} + \text{Mass of the solvent}} \times 100$$

$$= \frac{10}{x+10} \times 100$$

$$10 = \frac{10}{x+10} \times 100$$

$$x + 10 = 100$$

$$x = 100 - 10 = 90 \text{ g}$$

∴ Mass of water = **90 g.**

6. What will be the impact of temperature and pressure while dissolving carbon - di - oxide in water? **(PTA - 5)**

Impact of temperature:

Solubility of gases (CO_2) in liquid decrease with increase in temperature.

Impact of pressure:

When the pressure is increased the solubility of a gas (CO_2) in liquid increases.

7. Compound A is a colourless, crystalline, hydrated salt of magnesium. On heating it becomes an anhydrous salt. The number of water molecules lost by compound A is equal to number of water molecules present in green vitriol on heating. (PTA - 2)

i. Identify compound A.
ii. Give the chemical equation for this heating reaction.

Ans:

1. Compound A : Magnesium sulphate heptahydrate

4. $MgSO_4 \cdot 7H_2O \underset{\text{Cooling}}{\overset{\text{Heating}}{\rightleftharpoons}} MgSO_4 + 7H_2O$

ADDITIONAL QUESTIONS

I. Match the following:

Column - I		Column - II		Answers
1. Epsom salt	- a.	$FeSO_4.7H_2O$	- c.	$MgSO_4.7H_2O$
2. Green vitriol	- b.	$ZnSO_4.7H_2O$	- a.	$FeSO_4.7H_2O$
3. White vitriol	- c.	$MgSO_4.7H_2O$	- b.	$ZnSO_4.7H_2O$
4. Solution	- d.	two components	- e.	homogeneous
5. Binary	- e.	homogeneous	- d.	two components

Column - I	Column - II	Answers
1. Aqueous solution	- a carbon di sulphide	- e. water
2. Non - aqueous solution	- b blue	- a. carbon di sulphide
3. Copper sulphate pentahydrate	- c. colourless	- b. blue
4. Anhydrous copper sulphate	- d higher amount of solute	- c. colourless
5. Concentrated solution	- e water	- d. higher amount of solute

Column - I		Column - II		Answers
1. Endothermic process	- a.	effect of pressure	- b.	solubility increases
2. Exothermic process	- b.	solubility increases	- c.	solubility decreases
3. Henry's Law	- c.	solubility decreases	- a.	effect of pressure
4. Blue Vitriol	- d.	7 water molecules	- e.	5 water molecules
5. Epsom salt	- e.	5 water molecules	- d.	7 water molecules

II. Choose the correct answer:

1. The common name for copper sulphate pentahydrate is _____.
   a. Epsom salt b. Gypsum c. Blue vitriol d. Green vitriol
   Ans: c. Blue vitriol

2. _____ $\longrightarrow MgSO_4 + 7H_2O$
   a. $NaOH \cdot H_2O$ b. $CaSO_4 \cdot 5H_2O$ c. $MgSO_3 \cdot 2H_2O$ d. $MgSO_4 \cdot 7H_2O$
   Ans: d. $MgSO_4 \cdot 7H_2O$

3. The number of water molecules in blue vitriol is _____.
   a. 7 b. 3 c. 0 d. 5 **Ans: d. 5**

4. Which of the following statements are correct.
   i. Hydrated salts become alkaline on heating.
   ii. The water of crystallization of Epsom salt is 5.
   iii. The effect of pressure on solubility of gas in liquid is given by Henry's Law.
   iv. Non - polar compounds are soluble in non - polar solvents.
   a. i. is correct
   b. ii. & iii. are correct

c. iii. & iv. are correct
d. none of the above are correct **Ans: c. iii. & iv. are correct**

5. An aqueous solution has _____ as its solvent.
a. ether b. acetone c. water d. none of the above **Ans: c. water**

6. Uniform distribution of solute into solvent is called _____.
a. water of crystallization b. saturation
c. dissolution d. none of the above **Ans: c. dissolution**

7. Hygroscopic substance are used as _____ agents.
a. alternating b. cooling c. drying d. inducing **Ans: c. drying**

8. Nature of the solute and solvent, temperature and pressure are the factors affecting _____.
a. temperature b. salinity c. saturation d. solubility **Ans: d. solubility**

9. Solutions are classified into aqueous and non - aqueous based on the type of _____.
a. solute b. solvent c. solution d. none of the above **Ans: b. solvent**

10. Solutions are classified into saturated, unsaturated and supersaturated based on the type of _____.
a. solute b. solvent c. solution d. none of the above **Ans: a. solute**

11. When two solutes are dissolved in one solvent a _____ solution is formed.
a. primary b. binary c. ternary d. none of the above **Ans: c. ternary**

12. _____ is called the 'Universal Solvent'
a. Mercury b. Ethanol c. Methanol d. none of the above **Ans: d. none of the above**

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

1. Solute acts as a dissolving medium in a solution.
Ans: False
Solvent acts as a dissolving medium in a solution.

2. Chemical state is the primary factor which determine the characteristics of the solution.
Ans: False
Physical state is the primary factor which determine the characteristics of the solution.

3. All mixtures are solutions, but all solutions are not mixtures.
Ans: False
All **solutions** are **mixtures**, but all **mixtures** are not **solutions**.

4. When the pressure is increased, the solubility of a gas in liquid decreases.
Ans: False
When the pressure is increased, the solubility of a gas in liquid **increases**.

5. The effect of temperature on the solubility of a gas in liquid is given by Henry's law.
Ans: False
The effect of **pressure** on the solubility of a gas in liquid is given by Henry's law.

6. Deliquescence substances are used as drying agents
Ans: False
Hygroscopic substances are used as drying agents.

7. Deliquescent substances lose their crystalline shape and ultimately dissolve in the absorbed water forming a super saturated solution.
Ans: False

Deliquescent substances lose their crystalline shape and ultimately dissolve in the absorbed water forming a **saturated** solution.

IV. Assertion and Reason.

1. **Assertion:** Differentiating solutions as dilute and concentrated is a qualitative representation.
Reason : The extent of dissolution of a solute in a solvent can be better explained by its solubility.
a. A and R are correct, R explains A.
b. A is correct, R is wrong.
c. A is wrong, R is correct.
d. A and R are correct, R doesn't explain A.
Ans: d. A and R are correct, R doesn't explain A

2. **Assertion:** Non - polar compounds are soluble in polar solvents.
Reason : Solubility of a solid solute in a liquid solvent increases with increase in temperature.
a. A and R are correct, R explains A.
b. A is correct, R is wrong.
c. A is wrong, R is correct.
d. A and R are correct, R doesn't explain A.
Ans: c. A is wrong, R is correct

3. **Assertion:** The number of water molecules found in the crystalline substance is called water of crystallization.
Reason : On heating these hydrated crystalline salts, they lose their water of crystallization and become amorphous or lose their colour.
a. A and R are correct, R explains A.
b. A is correct, R is wrong.
c. A is wrong, R is correct.
d. A and R are correct, R doesn't explain A.
Ans: a. A and R are correct, R explains A

V. Analog

1.	Binary solutions	:	two components	
	Ternary solutions	:	_____	**(three components)**
2.	Epsom salt	:	$MgSO_4 \cdot 7H_2O$	
	Gypsum	:	_____	**($CaSO_4 \cdot 2H_2O$)**
3.	Hygroscopic	:	silica gel	
	Deliquescence	:	_____	**(caustic soda)**
4.	Aqueous solution	:	water	
	Non - aqueous solution	:	_____	**(benzene)**
5.	Green vitriol	:	Iron (II) sulphate heptahydrate	
	White vitriol	:	_____	**(zinc sulphate hepta hydrate)**
6.	Endothermic process	:	solubility increases	
	Exothermic process	:	_____	**(solubility decreases)**

VI. Problem solving.

1. **1.5 g solute is dissolved in 15 g of water to form a saturated solution at 298K. Find out the solubility of the solute at the temperature.**
Solution:

Mass of solute = 1.5g
Mass of the solvent = 15 g

$$\text{Solubility of the solute} = \frac{\text{Mass of the solute}}{\text{Mass of the solvent}} \times 100$$

$$\text{Solubility of the solute} = \frac{1.5}{15} \times 100$$

= 10 g

2. Find the mass of potassium chloride would be needed to form a saturated solution in 60 g of water at 303 K? Given that solubility of the KCl is $\frac{37}{100}$g at this temperature.

Solution:

Mass of potassium chloride in 100 g of water in saturated solution = 37 g

Mass of potassium chloride in $= \frac{37}{100} \times 60 =$ **22.2 g**

3. What is the mass of sodium chloride that would be needed to form a saturated solution in 50g of water at 30°C. Solubility of sodium chloride is 36g at 30°C?

Solution:

At 30°C, 36g of sodium chloride is dissolved in 100g of water.

∴ Mass of sodium chloride that would be need for 100g of water = 36g

∴ Mass of sodium chloride dissolved in 50g of water $= \frac{36 \times 50}{100} =$ **18g**

4. 16 grams of NaOH is dissolved in 100 grams of water at 25°C to form a saturated solution. Find the mass percentage of solute and solvent.

Solution:

Mass of the solute (NaOH) = 16g
Mass of the solvent H_2O = 100g

i. **Mass percentage of the solute:**

$$\text{Mass Percentage of solute} = \frac{\text{Mass of the solute}}{\text{Mass of the solute} + \text{Mass of the solvent}} \times 100$$

$$= \frac{16 \times 100}{16 + 100}$$

$$= \frac{1600}{116}$$

Mass percentage of solute = 13.79%

ii. Mass percentage of solvent = 100 − (Mass percentage of the solute)
= 100 − 13.79
= 86.21%

5. Find the amount of urea which is to be dissolved in water to get 500g of 10% w/w aqueous solution?

Solution:

$$\text{Mass Percentage (w/w)} = \frac{\text{Mass of the solute}}{\text{Mass of the solution}} \times 100$$

$$10 = \frac{\text{Mass of the urea}}{500} \times 100$$

Mass of urea = 50g

VII. Short Answers:

1. Distinguish between the saturated and unsaturated solution.

	Saturated solution	Unsaturated solution
1.	A solution in which no more solute can be dissolved in a definite amount of solvent at a given temperature is called a saturated solution.	Unsaturated solution is one that contains less solute than that of the saturated solution at a given temperature.
2.	**E.g:** 36 g of NaCl in 100 g water at 25°C	**E.g:** 10 g of NaCl in 100 g water at 25°C

2. What is super saturated solution?

1. Super saturated solution is one that contains more solute than the saturated solution at a given temperature.
2. **E.g:** 40 g of sodium chloride in 100 g of water at 25°C.

3. Define solute.

In a solution, the component present in **lesser** amount by weight is called solute.
E.g: Salt, sugar.

4. Define solvent.

In a solution, the component present in **larger** amount by weight is called solvent. **E.g:** Water

5. Define dissolution.

The process of **uniform distribution** of solute into solvent is called dissolution.

6. Define hygroscopy.

1. Certain substances, when exposed to the atmospheric air at ordinary temperature, **absorb moisture** without changing their physical state.
2. Such substances are called hygroscopic substances and this property is called hygroscopy.
3. **E.g:** Quick lime, Silica gel

7. State Henry's law.

Henry's law states that, "the solubility of a gas in a liquid is **directly proportional** to the **pressure** of the gas over the solution at a definite temperature".

8. Classify the following based on the type of solvent.
(benzene, water, CS_2, ether)

Answer:

i. Aqueous solvent : water
ii. Non - aqueous solvent: Benzene, CS_2, ether

9. What are the factors that affect solubility?

1. Nature of solute and solvent
2. Temperature
3. Pressure

10. Define concentration of a solution.

Concentration of a solution may be defined as the amount of **solute** present in a given amount of solution or solvent.

VIII. Long Answers:

1. Tabulate types of binary solutions with example.

	Solute	Solvent	Example
	Solid solution:		
1.	Solid	solid	copper dissolved in gold (Alloys)
2.	Liquid	solid	mercury with sodium (amalgam)
	Liquid solution:		
3.	Solid	liquid	sodium chloride dissolved in water
4.	Liquid	liquid	ethyl alcohol dissolved in water
5.	Gas	liquid	carbon dioxide dissolved in water (soda water)
	Gaseous solution:		
6.	Liquid	gas	water vapour in air (cloud)
7.	Gas	gas	mixture of Helium - Oxygen gases

2. Explain mass percentage.

1. Mass percentage of a solution is defined as the percentage by **mass** of the **solute** present in the **solution**.
2. It is mostly used when solute is solid and solvent is liquid.

$$\text{Mass Percentage} = \frac{\text{Mass of the solute}}{\text{Mass of the solution}} \times 100$$

$$\text{Mass Percentage} = \frac{\text{Mass of the solute}}{\text{Mass of the solute} + \text{Mass of the solvent}} \times 100$$

E.g: 5% sugar solution (by mass) means 5 g of sugar in 95 g of water.

Hence it is made 100 g of solution.

3. It is expressed as **w/w** (weight / weight).
4. Mass percentage is **independent** of **temperature**.

IX. Fill in the blanks.

1. The ability of water to form _____ is responsible for sustenance of life. **(solutions)**
2. The component, which is present in a larger amount is called _____. **(solvent)**
3. The solvent acts as a _____ medium in a solution. **(dissolving)**
4. The process of uniform distribution of solute into solvent is called _____. **(dissolution)**
5. A solution must be consisting of _____ components. **(two)**
6. Solutions which are made of one solute and one solvent are called _____. **(binary solutions)**
7. Solutions which contain three components are called _____ solutions. **(ternary)**
8. On adding copper sulphate crystals to water, _____ becomes the solute and _____ becomes the solvent. **(copper sulphate, water)**
9. When two solutes are dissolved in one solvent a _____ solution is formed. **(ternary)**
10. When a solute gets uniformly distributed in the solvent it forms a _____ mixture. **(homogeneous)**
11. When copper sulphate crystals are added to water, a solution of _____ is formed. **(copper sulphate)**
12. Solutions are classified based on the types of _____. **(solvent)**
13. _____ and _____ are the two types of solutions. **(Aqueous, Non - aqueous)**

14. Copper sulphate in water is an example of an _____ solution. **(aqueous)**
15. Sulphur dissolved in carbon disulphide is an example of _____ solution. **(Non - aqueous)**
16. _____ g of NaCl in 100g of water at 25°C forms saturated solution. **(36)**
17. _____ is called as Universal solvent. **(water)**
18. The solution in which water acts as a solvent is called _____ solution. **(aqueous)**
19. Ionic compounds are soluble in _____. **(water)**
20. The solution in which any liquid, other than water, acts as a solvent is called _____ solution. **(non - aqueous)**
21. Solvent other than water is referred to as _____ solvent. **(non - aqueous)**
22. Alcohol, benzene, ether etc are _____ solvents. **(non - aqueous)**
23. Solution containing higher amount of solute per given amount of solvent is called a _____ solution. **(concentrated)**
24. Solution containing lesser amount of solute per given amount of solvent is called a _____ solution. **(dilute)**
25. _____ solution is one that contains less solute than that of the saturated solution at a given temperature. **(unsaturated)**
26. 10g or 20g or 30g of Sodium chloride in 100g of water at 25°C forms an _____ solution. **(unsaturated)**
27. _____ solution is one that contains more solute than the saturated solution at a given temperature. **(Supersaturated)**
28. _____ of sodium chloride in 100g of water at 25°C forms super saturated solution. **(40g)**
29. _____ solutions are unstable. **(Super saturated)**
30. _____ is measure of how much of a solute can be dissolved in a specified amount of a solvent. **(Solubility)**
31. The solubility of calcium carbonate in water is _____ g /100g water. **(0.0013)**
32. The solubility of Ammonia in water is _____ g /100g water. **(48)**
33. The solubility of glucose in water is _____ g /100g water. **(91)**
34. The solubility of sodium iodide in water is _____g /100g water. **(184)**
35. Solubility can be mathematically expressed as _____. $\left(\frac{\text{Mass of the solute}}{\text{Mass of the solvent}} \times 100\right)$
36. The nature of the solute and solvent plays an important role in _____. **(solubility)**
37. _____ occurs when similarities exist between the solvent and the solute. **(Dissolving)**
38. Non - polar compounds are soluble in _____ solvents. **(non - polar)**
39. Non - polar compounds, do not dissolve in _____ solvents. **(polar)**
40. Polar compounds do not dissolve in _____ solvents. **(non - polar)**
41. Solubility of a solid solute in a liquid solvent increases with increase in _____. **(temperature)**
42. Greater amount of sugar will dissolve in _____ water than in _____ water. **(warm, cold)**
43. In _____ process, solubility increases with increase in temperature. **(endothermic)**
44. In _____ process, solubility decreases with increase in temperature. **(exothermic)**
45. Solubility of gases in liquid _____ with _____ in temperature. **(decrease, increase)**
46. Solubility of oxygen in water is _____ at low temperatures. **(more)**
47. _____ are examples for solubility of gas in liquids. **(carbonated beverages)**
48. The effect of pressure on the solubility of a gas in liquid is given by _____ law. **(Henry's)**
49. The solubility of a gas in a liquid is directly proportional to the _____ of the gas over the solution at a definite temperature. **(pressure)**
50. _____ of a solution is defined as the percentage by mass of the solute present in the solution. **(Mass percentage)**
51. Mass percentage is expressed as _____. **(w/w)**
52. Mass percentage is independent of _____. **(temperature)**
53. _____ percentage is defined as the percentage by volume of solute present in the given volume of the solution. **(Volume)**
54. 10% by volume of the solution of ethanol in water, means _____ of ethanol in 100ml of solution. **(10ml)**
55. _____ percentage decreases with increases in temperature. **(Volume)**

56. Concentration of the _____ is expressed as v/v. **(ingredients)**
57. The concentrations of _____ are expressed as w/w. **(solutions)**
58. Calculate the percentage of salt for 20g of salt in 80g of water_____. **(20%)**
59. We use the term _____ to quantify the solute in a solution. **(concentration)**
60. Anhydrous copper sulphate on cooling turns into _____colour. **(blue)**
61. The water of crystallization of Epsom salt is _____. **(7)**
62. The number of water molecules found in the crystalline substance is called _____. **(water of crystallization)**
63. On heating hydrated crystalline salts, they lose their water of crystallization and become _____. **(amorphous)**
64. The IUPAC name of Blue Vitriol is _____. **(Copper(II) sulphate pentahydrate)**
65. The common name of calcium sulphate dihydrate is _____. **(Gypsum)**
66. The number of water molecules in blue vitriol is _____. **(five)**
67. $CuSO_4.5H_2O \xrightarrow{Heating}$ _____. **($CuSO_4+5H_2O$)**
68. The molecular formula of white vitriol is _____. **($ZnSO_4 \cdot 7H_2O$)**
69. The molecular formula of Epsom salt is _____. **($MgSO_4 \cdot 7H_2O$)**
70. The number of molecules in blue vitriol is 5, the water of crystallization will be _____. **(5)**
71. When blue coloured copper sulphate crystals are heated it becomes _____copper sulphate. **(anhydrous)**
72. Anhydrous copper sulphate is _____ in colour. **(colourless)**
73. Substance which when exposed to atmospheric air at ordinary temperature are called _____ substances. **(hygroscopic)**
74. Hygroscopic substances are used as _____ agents. **(drying)**
75. Anhydrous calcium chloride is an ($CaCl_2$) example of a _____ substance. **(hygroscopic)**

10. TYPES OF CHEMICAL REACTIONS

KEY FORMULAE		
1.	$p^H + p^{OH} = 14$	
2.	P^{OH} of the solution	$-\log_{10}[OH^-]$
3.	P^H of the solution	$-\log_{10}[H^+]$
4.	Ionic product of water (K_w)	$[H_3O^+]\,[OH^-]$
	K_w	$[H^+]\,[OH^-]$

I. Choose the correct answer.

1. $H_{2(g)} + Cl_{2(g)} \longrightarrow 2HCl_{(g)}$ is a ※※※ **(JUNE - 2023)**
   a. Decomposition reaction b. Combination reaction
   c. Single Displacement Reaction d. Double Displacement reaction
   Ans: b. Combination reaction

2. Photolysis is a decomposition reaction caused by _____.
   a. heat b. electricity c. light d. mechanical energy
   Ans: c. light

3. A reaction between carbon and oxygen is represented by $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ + Heat. In which of the type(s), the above reaction can be classified?
   i. Combination reaction ii. Combustion reaction
   iii. Decomposition reaction iv. Irreversible reaction
   a. i. and ii. b. i. and iv.
   c. i. ii. and iii. d. i. ii. and iv.
   Ans: d. i. ii. and iv.

4. The chemical equation $Na_2SO_{4(aq)} + BaCl_{2(aq)} \longrightarrow BaSO_{4(s)}\downarrow + 2NaCl_{(aq)}$ represents which of the following types of reaction? ※※※
   a. Neutralisation b. Combustion
   c. Precipitation d. Single displacement
   Ans: c. Precipitation

5. Which of the following statements are correct about a chemical equilibrium?
   i. It is dynamic in nature
   ii. The rate of the forward and backward reactions are equal at equilibrium
   iii. Irreversible reactions do not attain chemical equilibrium
   iv. The concentration of reactants and products may be different
   a. i. ii. and iii. b. i.ii. and iv.
   c. ii. iii. and iv. d. i. iii. and iv.
   Ans: a. i. ii. and iii.

6. A single displacement reaction is represented by $X_{(s)} + 2HCl_{(aq)} \longrightarrow XCl_{2(aq)} + H_{2(g)}$. Which of the following(s) could be X.
   i. Zn ii. Ag iii. Cu iv. Mg
   Choose the best pair
   a. i. and ii. b. ii. and iii.
   c. iii. and iv. d. i. and iv. **Ans: d. i. and iv.**

7. Which of the following is not an "element + element $\longrightarrow$ compound" type reaction? **(APRIL - 2024, PTA - III)**
   a. $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ b. $2K_{(s)} + Br_{2(l)} \longrightarrow 2KBr_{(s)}$
   c. $2CO_{(g)} + O_{2(g)} \longrightarrow 2CO_{2(g)}$ d. $4Fe_{(s)} + 3O_{2(g)} \longrightarrow 2Fe_2O_{3(s)}$
   Ans: c. $2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$

8. Which of the following represents a precipitation reaction?
   a. $A_{(s)} + B_{(s)} \rightarrow C_{(s)} + D_{(s)}$ b. $A_{(s)} + B_{(aq)} \rightarrow C_{(aq)} + D_{(l)}$
   c. $A_{(aq)} + B_{(aq)} \rightarrow C_{(s)} + D_{(aq)}$ d. $A_{(aq)} + B_{(s)} \rightarrow C_{(aq)} + D_{(l)}$
   Ans: c. $A_{(aq)} + B_{(aq)} \rightarrow C_{(s)} + D_{(aq)}$

9. The pH of a solution is 3. Its (OH^-) concentration is ※※※
   a. 1×10^{-3} M b. 3 M c. 1×10^{-11} M d. 11 M
   Ans: c. 1×10^{-11} M

10. Powdered $CaCO_3$ reacts more rapidly than flaky $CaCO_3$ because of _____.
   a. large surface area b. high pressure
   c. high concentration d. high temperature
   Ans: a. large surface area

II. Fill in the blanks.

1. A reaction between an acid and a base is called _____. ※※※
   Ans: neutralisation
2. When lithium metal is placed in hydrochloric acid, _____ gas is evolved.
   Ans: hydrogen
3. The equilibrium attained during the melting of ice is known as _____.
   Ans: physical equilibrium
4. The pH of a fruit juice is 5.6. If you add slaked lime to this juice, its pH _____. (increase/decrease) ※※ **Ans: increases**
5. The value of ionic product of water at 25°C is _____.
   Ans: 1.00×10^{-14} mol²dm⁻⁶
6. The normal pH of human blood is _____. **Ans: 7.4**
7. Electrolysis is type of _____ reaction. **Ans: decomposition**
8. The number of products formed in a synthesis reaction is _____. **Ans: one**
9. Chemical volcano is an example for _____ type of reaction. ※※※
   Ans: decomposition

10. The ion formed by dissolution of H^+ in water is called _____.
   Ans: Hydronium ion

III. Match the following.

	REACTION			TYPE			Answers
1.	$NH_4OH_{(aq)} + CH_3COOH_{(aq)} \longrightarrow CH_3COONH_{4(aq)} + H_2O_{(l)}$	-	a.	Single displacement	-	c.	**Neutralisation**
2.	$Zn_{(s)} + CuSO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + Cu_{(s)}$	-	b.	Combustion	-	a.	**Single displacement**
3.	$ZnCO_{3(s)} \xrightarrow{Heat} ZnO_{(s)} + CO_{2(g)}$	-	c.	Neutralisation	-	d.	**Thermal decomposition**
4.	$C_2H_{4(g)} + 4O_{2(g)} \longrightarrow 2CO_{2(g)} + 2H_2O_{(g)} + Heat$	-	d.	Thermal decomposition	-	b.	**Combustion**

IV. True or False. (If false given the correct statement)

1. Silver metal can displace hydrogen gas from nitric acid.
   Ans: False
   Silver metal **cannot** displace hydrogen gas from nitric acid.
2. The pH of rain water containing dissolved gases like SO_3, CO_2, NO_2 will be less than 7.
   Ans: True **(JULY - 2024)**
3. At the equilibrium of a reversible reaction, the concentration of the reactants and the products will be equal.
   Ans: True
4. Periodical removal of one of the products of a reversible reaction increases the yield.
   Ans: True
5. On dipping a pH paper in a solution, it turns into yellow. Then the solution is basic.
   Ans: False
   On dipping a pH paper in a solution, it turns into **violet**. Then the solution is basic.

V. Short answer questions.

1. **When an aqueous solution of potassium chloride is added to an aqueous solution of silver nitrate, a white precipitate is formed. Give the chemical equation of this reaction.** **(PTA - VI)**
   Ans:
   $$KCl_{(aq)} + AgNO_{3(aq)} \longrightarrow AgCl_{(s)}\downarrow + KNO_{3(aq)}$$

2. Why does the reaction rate of a reaction increase on raising the temperature?

1. Most of the reactions go faster at higher temperature. **(JULY-24, GMQ-19, PTA- VI)**
2. Because adding heat to the reactants provides energy to **break more bonds** and thus speed up the reaction.

3. Define combination reaction. Give one example for an exothermic combination reaction. ※※※ **(MAY - 2022)**

1. A combination reaction is a reaction in which two or more reactants combine to form a compound.
2. It is otherwise called 'synthesis reaction' or 'composition reaction'.
3. **E.g:** Hydrogen gas combines with chlorine gas to form hydrogen chloride gas.

$$H_{2(g)} + Cl_{2(g)} \longrightarrow 2HCl_{(g)}$$

※※※

4. Differentiate reversible and irreversible reactions. **(JU, APR - 23, MAY-22, SEP-21, 22)**

	Reversible Reactions		Irreversible Reactions
1.	It can be reversed under suitable conditions.	1.	It cannot be reversed.
2.	It attains equilibrium.	2.	Equilibrium is not attained.
3.	It is relatively slow.	3.	It is fast.

VI. Answer in detail.

1. What are called thermolysis reactions? ※※ **(SEP - 2021)**

1. In thermal decomposition reactions, the reactant is decomposed by applying heat.
2. As the molecule is dissociated by the absorption of heat, it is otherwise called **'Thermolysis'**.
3. **E.g 1:** On heating mercury (II) oxide is decomposed into mercury metal and oxygen gas.
4. It is a class of compound to element /element decomposition.

$$2HgO_{(s)} \xrightarrow{Heat} 2Hg_{(l)} + O_{2(g)}$$

5. **E.g 2:** Similarly, when calcium carbonate is heated, it breaks down into calcium oxide and carbon dioxide.
6. It is a type of compound to compound/compound decomposition.

$$CaCO_{3(s)} \xrightarrow{Heat} CaO_{(s)} + CO_{2(g)}$$

7. In thermal decomposition reaction, heat is supplied to break the bonds.
8. Such reactions, in which heat is absorbed, are called **'Endothermic reactions'.**

2. Explain the types of double displacement reactions with examples. **(SEP-2020)**

Double displacement reaction: ※※※

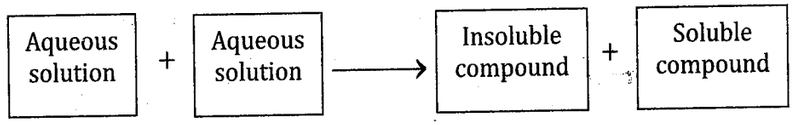
When two compounds react, if their ions are interchanged, then the reaction is called double displacement reaction.

Double displacement reactions are classified into two types,

1. Precipitation Reactions
2. Neutralization Reactions

Precipitation Reactions:

1. When aqueous solutions of two compounds are mixed, if they react to form an insoluble compound and a soluble compound, then it is called precipitation reaction.
2. Because the insoluble compound, formed as one of the products, is a precipitate.



Example:

When the clear aqueous solutions of potassium iodide and lead (II) nitrate are mixed, potassium and lead displace or replace one other and form a **yellow precipitate** of lead (II) iodide a double displacement reaction takes place between them.

$$Pb(NO_3)_{2(aq)} + 2KI_{(aq)} \longrightarrow PbI_{2(s)} \downarrow + 2KNO_{3(aq)}$$

Neutralization Reactions: **(APR - 2023)**

1. Acid reacts with the base to form a salt and water, is called 'neutralization reaction'.

$$Acid + Base \longrightarrow Salt + water$$

2. Reaction of sodium hydroxide with hydrochloric acid is a typical neutralization reaction.

E.g: Sodium replaces hydrogen from hydrochloric acid forming sodium chloride, a neutral soluble salt.

$$NaOH_{(aq)} + HCl_{(aq)} \longrightarrow NaCl_{(aq)} + H_2O_{(l)}$$

3. Explain the factors influencing the rate of a reaction. (PTA - V)

Important factors that affect rate of a reaction are,

1. Nature of the reactants:

1. The reaction of sodium with hydrochloric acid is faster than that with acetic acid.
2. Hydrochloric acid is a stronger acid than acetic acid and thus more reactive.
3. So, the nature of the reactants influences the reaction rate.

$$2Na_{(s)} + 2HCl_{(aq)} \longrightarrow 2NaCl_{(aq)} + H_{2(g)} \text{ (fast)}$$

$$2Na_{(s)} + 2CH_3COOH_{(aq)} \longrightarrow 2CH_3COONa_{(aq)} + H_{2(g)} \text{ (slow)}$$

2. Concentration of the reactants:

1. Changing the amount of the reactants also increases the reaction rate.
2. More the concentration, more particles per volume exist in it and hence faster the reaction.
3. Granulated zinc reacts faster with 2M hydrochloric acid than 1 M hydrochloric acid.

3. Temperature:

1. Most of the reactions go faster at higher temperature.
2. Adding heat to the reactants provides energy to break more bonds and thus speed up the reaction.

Eg: Calcium carbonate reacts faster with HCl on heating.

4. Pressure:

1. If the reactants are gases, increasing their pressure increases the reaction rate.
2. On increasing the pressure the reacting particles come closer and collide frequently.

5. Catalyst:

1. A catalyst is a substance which increases the reaction rate without being consumed in the reaction.

2. Catalyst speeds up the reaction.

Example:

1. On heating potassium chlorate, it decomposes into potassium chloride and oxygen gas, but at a slower rate.
2. If manganese dioxide is added, it increases the reaction rate.

6. Surface area of the reactants:

When solid reactants are involved in a reaction, their powdered form reacts more readily.

Eg: Powdered calcium carbonate reacts more readily with hydrochloric acid than marble chips.

4. How does pH play an important role in everyday life?

1. Our body works within the pH range of 7.0 to 7.8.
2. Different body fluids have different pH values.
3. For example, pH of blood ranges from 7.35 to 7.45.
4. Any increase or decrease in this value leads to diseases.
5. The ideal pH for blood is 7.4.

pH in our digestive system:

1. Our stomach produces hydrochloric acid which helps in the digestion of food without harming the stomach.
2. During indigestion the stomach produces too much acid and this causes pain and irritation.
3. pH of the stomach fluid is approximately 2.0

pH changes as the cause of tooth decay:

1. pH of the saliva normally ranges between 6.5 to 7.5.
2. White enamel coating of our teeth is calcium phosphate, the hardest substance in our body.
3. When the pH of the mouth saliva falls below 5.5, the enamel gets weathered.
4. Toothpastes, are generally basic and are used for cleaning the teeth that can neutralise the excess acid and prevent tooth decay.

pH of soil:

1. In agriculture, the pH of the soil is very important.
2. Citrus fruits require slightly alkaline soil.
3. While rice requires acidic soil.
4. Sugarcane requires neutral soil.

pH of rain water:

1. The pH of rain water is approximately 7, which means that it is neutral and also represents its high purity.
2. If the atmospheric air is polluted with oxide gases of sulphur and nitrogen, they get dissolved in the rain water and make its pH less than 7.
3. Thus, if the pH of rain water is less than 7, then it is called acid rain.
4. When acid rain flows into the rivers it lowers the pH of the river water also.

5. What is a chemical equilibrium? What are its characteristics? ※※※

Chemical equilibrium: **(JULY - 24, JU-23, PTA - III)**

It is state of a reversible chemical reaction in which no change in the amount of the reactants and products takes place. At equilibrium,

Rate of forward reaction = Rate of backward reaction

Characteristics of equilibrium:

1. In a chemical equilibrium, the rates of the forward and backward reactions are equal.
2. The observable properties such as pressure, concentration, colour, density, viscosity etc., of the system remain unchanged with time.
3. The chemical equilibrium is a dynamic equilibrium, because both the forward and backward reactions continue to occur even though it appears static externally.
4. In physical equilibrium, the volume of all the phases remain constant.

HOT questions.

A solid compound 'A' decomposes on heating into 'B' and a gas 'C'. On passing the gas 'C' through water, it becomes acidic. Identify A, b and C.

When calcium carbonate is heated, it breaks down in to calcium oxide and carbon dioxide.

$$\underset{A}{CaCO_{3(s)}} \xrightarrow{heat} \underset{B}{CaO_{(s)}} + \underset{C}{CO_{2(g)}}$$

$$CO_{2(g)} + H_2O_{(l)} \longrightarrow \underset{\text{Carbonic acid}}{H_2CO_{3(aq)}}$$

A - Calcium carbonate

B - Calcium oxide

C - Carbon - di - oxide

2. Can a nickel spatula be used to stir copper sulphate solution? Justify your answer. **(PTA - VI)**

1. No, a nickel spatula cannot be used to stir copper sulphate solution.
2. On stirring copper sulphate solution with Nickel, it displaces copper from its solution and copper will deposited on the Nickel spatula.

$$Ni_{(s)} + CuSO_{4(aq)} \longrightarrow NiSO_{4\,(aq)} + Cu_{(s)}$$

VIII. Solve the following problems.

1. Lemon juice has a pH 2, what is the concentration of H^+ ions? ※※

Solution:

Since, $pH = -\log [H^+]$

$-pH = \log [H^+]$

$[H^+] = 10^{-pH}$

$= 10^{-2}$

= 0.01 moles/litre

2. Calculate the pH of 1.0×10^{-4} molar solution of HNO_3. **(JULY-24, PTA-I, GMQ-19)**

Solution:

$HNO_3 \longrightarrow H^+ + NO_3^{2-}$

$pH = -\log_{10}[H^+]$

$H^+ = 1.0 \times 10^{-4}$

$pH = -\log_{10}10^{-4} = -(-4 \times \log_{10}10)$

$= -(-4 \times 1) = 4$

3. What is the pH of 1.0×10^{-5} molar solution of KOH? **(PTA - VI)**

Solution:

$KOH_{(aq)} \longrightarrow K^+_{(aq)} + OH^-_{(aq)}$

$[OH^-] = 1 \times 10^{-5}$ mol. litre $^{-1}$

$pOH = -\log_{10}[OH^-] = -\log_{10} \times 10^{-5}$

$= -(-5 \times \log_{10}10 = -(-5) = 5$

Since, $pH + pOH = 14$

$pH = 14 - pOH = 14 - 5$

$= 9$

4. The hydroxide ion concentration of a solution is 1×10^{-11}M. What is the pH of the solution? ※※※ **(PTA - V)**

$pOH = -\log_{10}[OH^-]$

$pOH = -\log_{10}[1 \times 10^{-11}]$

$pOH = -[\log_{10}1.0 + \log_{10}1.0^{-11}]$

$pOH = -[0 - 11 \log_{10}10]$

$pOH = -[0 - 11]$

$pOH = 11$

Thus

$pH + pOH = 14$

$pH = 14 - pOH$

$= 14 - 11$

$= 3$

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Choose the correct answer.

1. In a combustion reaction, **(PTA - 2)**
   a. oxygen gas in released b. nitrogen gas is released
   c. oxygen gas is utilised d. nitrogen gas is utilised
   Ans: c. oxygen gas is utilised

2. In a chemical equilibrium, the concentrations of reactants and products are _____. **(PTA - 5)**
   a. remain different b. remain same
   c. cannot be predicted d. are not equal **Ans: b. remain same**

II. Short answers.

1. **If the pH of a solution is 4.5, what is its pOH?** **(APRIL - 2024)**

   $pH + pOH = 14$

   $pOH = 14 - 4.5 = 9.5$

   $pOH = 9.5$

2. **If the pH value of a solution is zero then what will be the nature of the solution? Give reason.** **(PTA - 3)**

   Ans: Highly acidic solution.

   Reason: Acids have pH less than 7.

3. **From the value of ionic product of water at 25°C, find out the concentration of hydroxyl ions. (At 25°C concentration of hydrogen ions in water is 10^{-7} mol / dm^3)** **(PTA - 4)**

   $K_w = [H^+][OH^-]$ Its unit is mol^2dm^{-6}.

   At 25°C, its value is 1.00×10^{-14}.

   $[H^+] = [OH^-]$

   $\therefore [OH^-] = 1.00 \times 10^{-7}$ mol / dm^3

III. Long answers.

1. **Calculate the pH of 0.01M HNO_3.** **(GMQP - 2019, APR - 2023)**

   Solution:

   $[H^+] = 0.01$

   $pH = -\log_{10}[H^+]$

   $pH = -\log_{10}[0.01]$

   $pH = -\log_{10}[1 \times 10^{-2}]$

   $pH = -[\log_{10} 1 - 2 \log_{10}10]$

   $pH = 0 + 2 \times \log_{10}10$

   $pH = 0 + 2 \times 1 = 2$

   $pH = 2$

2. **Identify and write the type of following chemical reactions.** **(PTA - 2)**

   a. $NH_4OH_{(aq)} + CH_3COOH_{(aq)} \longrightarrow CH_3COONH_{4(aq)} + H_2O_{(l)}$

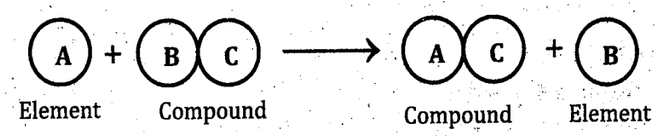
   Ans: Neutralization reaction

   b. $ZnCO_{3(s)} \longrightarrow ZnO_{(s)} + CO_{2(g)}$

   Ans: Thermal decomposition reaction

3. **Explain single displacement reaction with examples.** **(SEP - 2020)**

   1. Single displacement reaction. Between an element and a compound.
   2. When they react one of the element of the compound - reactant is replaced by the element - reactant to form a new compound and an element.
   3. Schematic representation of a single displacement reaction is given as



   4. 'A' displaces element 'B' from the compound 'BC' and hence a single displacement reaction occurs.

      E.g: 1. Zinc metal is placed in hydrochloric acid, hydrogen gas is evolved.

      2. Hydrogen is displaced by zinc metal and zinc chloride is formed.

$$Zn_{(s)} + 2HCl_{(aq)} \longrightarrow ZnCl_{2(aq)} + H_{2(g)}$$

3. Iron nail is placed in an aqueous solution of copper (ii) sulphate.
4. Iron displaces copper from its aqueous solution and the so formed copper deposits over the iron, nail.

$$Fe_{(s)} + CuSO_{4(aq)} \longrightarrow FeSO_{4(aq)} + Cu_{(s)}$$

4. Classify the following chemical reactions based on rearrangement of atoms and justify your answer. (PTA - 1)

1. $2KClO_3 \longrightarrow 2KCl + 3O_2$:

Ans: Decomposition reaction

On heating Potassium Chlorate it is decomposed into Potassium Chloride and Oxygen.

2. $Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$:

Ans: Single displacement reaction
When Zinc metal is placed in Copper Sulphate solution, Zinc is displaced by Copper and Zinc Sulphate is formed.

3. $2Mg + O_2 \longrightarrow 2MgO$:

Ans: Combination reaction

Magnesium metal combines with oxygen to form Magnesium Oxide. Here one of the reactant is a metal (Magnesium) and the other Oxygen is a non - metal.

4. $Na_2SO_4 + BaCl_2 \longrightarrow BaSO_4 + NaCl$:

Ans: Precipitation reaction

When the clear aqueous solutions of Barrium Chloride and Sodium Sulphate are mixed, a double displacement reaction takes place between them.

Sodium and Barrium displace (or) replace one other and form a white precipitate of Barrium Sulphate.

5. a. Which one of the following reactions is feasible? Give support to your answer. (PTA - 3)

$2NaCl + F_2 \longrightarrow 2NaF + Cl_2$ **b.** $NaF + Cl_2 \longrightarrow NaCl + F_2$

Ans:

a. $2NaCl_{(aq)} + F_{2(g)} \longrightarrow 2NaF_{(aq)} + Cl_{2(g)}$ b. $2NaF_{(aq)} + Cl_{2(g)} \longrightarrow NaCl_{(aq)} + F_{2(aq)}$

1. The first reaction involves the displacement of chlorine from NaCl, by fluorine.
2. In the second reaction, chlorine displaces fluorine from NaF. Out of these two, the second reaction will not occur.
3. Because, **fluorine is more active than chlorine** and occupies the upper position in the periodic table.
4. So, in displacement reactions, the activity of the elements and their relative position in the periodic table are the key factors to determine the feasibility of the reactions.

5. **More active** elements **readily displace** less active elements from their aqueous solution.

b. Write one example each for chemical reactions to be faster and chemical reactions to be slower in your daily life activities. (PTA - 3)

Example of faster reaction: Burning of petrol
Example of slower reaction: Rusting of iron

6. $CaCO_{3(s)} + Heat \longrightarrow CaO_{(s)} + CO_{2(g)}$ **(PTA - 4)**

$CaCO_{3(s)} + Heat \rightleftharpoons CaO_{(s)} + CO_{2(g)}$

Analyse the above chemical reactions. At what conditions (s) these reactions are feasible?

Ans:

a. $CaCO_{3(s)} + Heat \longrightarrow CaO_{(s)} + CO_{2(g)}$

In thermal decomposition reaction heat is supplied to break the bonds and it is a reversible reaction. It is carried out in an open vessel.

b. $CaCO_{3(s)} + Heat \rightleftharpoons CaO_{(s)} + CO_{2(g)}$ In thermal decomposition reaction heat is supplied to break the bonds. If it is carried out in a closed vessel it reaches a chemical reaction.

7. Does pure water conduct electricity? Justify your answer. (PTA - 6)

1. Pure water is often considered as a non - conductor of electricity, precise measurements show that it conducts electricity to a little extent.
2. This conductivity of water has resulted from the self - ionisation of water.

8. What is the role of manganese dioxide in the heating reaction of potassium chlorate for the production of oxygen gas. (PTA 6)

Role of manganese dioxide:

Manganese dioxide acts as a catalyst and increases the reaction rate.

9. Generally the rate of a chemical reaction increases on raising the temperature. Why? (PTA 6)

1. Most of the reactions go faster at higher temperature.
2. Because adding heat to the reactants provides energy to break more bonds and thus speed up the reaction.
3. Calcium carbonate reacts slowly with hydrochloric acid at room temperature.
4. When the reaction mixture is heated the reaction rate increases.

ADDITIONAL QUESTIONS

I. Match the following:

	Column - I	Column - II	Answers
1.	Iron	- a. Absorbs energy	- d. Rusting
2.	Bond breaking	- b. Releases energy	- a. Absorbs energy
3.	Bond formation	- c. White washing	- b. Releases energy
4.	Combination reactions	- d. Rusting	- e. Exothermic
5.	Slaked lime	- e. Exothermic	- c. White washing

Column - I	Column - II	Answers
1. Breaking of bonds	a. thermolysis	d. decomposition
2. Thermal decomposition	b. electrolysis	a. thermolysis
3. Electrolytic decomposition	c. metathesis	b. electrolysis
4. Photo decomposition	d. decomposition	e. photolysis
5. Double displacement	e. photolysis	c. metathesis

Column - I	Column - II	Answers
1. Combustion	a. Double arrow	e. Exothermic oxidation
2. Reversible reaction	b. Unidirectional	a. Double arrow
3. Neutralization reaction	c. Refrigerator	d. salt + water
4. Irreversible reaction	d. salt + water	b. Unidirectional
5. Less reaction rate	e. Exothermic oxidation	c. Refrigerator

II. Choose the correct answer:

1. Oxidation of iron causes _____.
   a. combustion b. hydration c. rusting d. ion formation
   Ans: c. rusting
2. Breaking of bondsis a major phenomenon of _____ reaction.
   a. reversible b. irreversible c. combustion d. decomposition
   Ans: d. decomposition
3. Thermal decomposition is otherwise called as _____.
   a. Thermostatics b. Thermodynamics
   c. Thermolysis d. Thermal energy **Ans: c. Thermolysis**
4. Displacement of copper is an example of _____ reaction.
   a. photo decomposition b. thermal decomposition
   c. single displacement d. double displacement
   Ans: d. double displacement
5. i. Thermal decomposition is otherwise called Thermolysis.
   ii. Sodium chloride decomposes into sodium and ammonium gas.
   iii. Single displacement reaction is also called metathesis.
   iv. In combustion, one of the reactants must be hydrogen.
   a. i. & iii. are correct b. ii. & iv. are correct
   c. i. is correct d. i. & iv. are correct **Ans: c. i. is correct**
6. $2H_2O_2 \rightarrow 2H_2O + O_2$, is an example of a _____ reaction.
   a. single displacement b. Neutralization
   c. irreversible d. none of the above **Ans: d. none of the above**
7. Acid + Base ⟶ salt + water, is the expression for a _____ reaction.
   a. Reversible b. Irreversible c. Combustion d. Neutralization
   Ans: d. Neutralization
8. The amount of substance present in certain volume of the solution is called _____.
   a. temperature b. concentration c. pressure d. none of the above
   Ans: b. concentration
9. The value of the ionic product of water at 25°C is _____.
   a. 0.1×10^{-14} b. 1.00×10^{14} c. 1.00×10^{-13} d. 1.00×10^{-14}
   Ans: d. 1.00×10^{-14}
10. _____ is a neutral solution.
   a. Ammonia water b. Sea water
   c. Rain water d. None of the above. **Ans: c. Rain water**
11. Combustion reactions mainly use _____ as their source.
   a. temperature b. heat c. pressure d. none of the above **Ans: b. heat**

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

1. All oxidation reactions are combustions but all combustion are not oxidations.
   Ans: False
   All **combustion** reactions are **oxidations** but all **oxidations** are not **combustions**.
2. Physical equilibrium is a state of a physical change at which the mass of all the phases remain unchanged.
   Ans: False
   Physical equilibrium is a state of a physical change at which the **volumes** of all the phases remain unchanged.
3. Hydronium ion is a strong base and hydroxyl ion is a strong acid.
   Ans: False
   Hydronium ion is a strong **acid** and hydroxyl ion is a strong **base**.
4. All photo decomposition reaction are exothermic reactions.
   Ans: False
   All photo decomposition reaction are **endothermic** reactions.
5. Temperature decreases the reaction rate.
   Ans: False
   Temperature **increases** the reaction rate.
6. If pH of rain water is above 7.6 is called acid rain.
   Ans: False If pH of rain water is **below 5.6** is called acid rain.

IV. Assertion and Reason.

1. **Assertion:** The pH of rain water is approximately 7.
   Reason : It is neutral and also represents its high purity.
   a. A and R are correct, R explains the A. b. A is correct, R is wrong.
   c. A is wrong, R is correct. d. A and R are correct, R doesn't explains A.
   Ans: a. A and R are correct, R explains the A.
2. **Assertion:** Temperature increases the reaction rate.
   Reason : Pressure decreases the reaction rate.
   a. A and R are correct, R explains the A. b. A is correct, R is wrong.
   c. A is wrong, R is correct. d. A and R are correct, R doesn't explains A.
   Ans: b. A is correct, R is wrong
3. **Assertion:** If hydrogen peroxide is poured on a wound, it decomposes into water and oxygen.
   Reason : The gaseous oxygen bubbles away as it is formed and thus prevent the formation of H_2O_2.
   a. A and R are correct, R explains the A. b. A is correct, R is wrong.
   c. A is wrong, R is correct. d. A and R are correct, R doesn't explains A.
   Ans: a. A and R are correct, R explains the A.

V. Analog

1. Thermal Decomposition : Thermolysis
   Electrolytic Decomposition : _____ **(Electrolysis)**
2. Energy is released : combination reaction
   Energy is absorbed : _____ **(decomposition reaction)**
3. Can be reversed : reversible reaction
   Cannot be reversed : _____ **(irreversible reaction)**

4. pH less than 7 : acid
   pH greater than 7 : _____ **(base)**
5. Aerobic : presence of oxygen
   Anaerobic : _____ **(absence of oxygen)**
6. pH 6.8 : human saliva
   pH 1 : _____ **(Stomach acid)**

VI. Problem solving.

1. Calculate the pH of 0.001 molar solution of HCl.

Solution:

HCl is a strong acid and is completely dissociated in its solutions according to the process:

$$HCl_{(aq)} \longrightarrow H^+_{(aq)} + Cl^-_{(aq)}$$

1. From this process it is clear that one mole of HCl would give one mole of H^+ions.
2. Therefore, the concentration of H^+ions would be equal to that of HCl, i.e., 0.001 molar or 1.0×10^{-3} mole litre $^{-1}$.

Thus, $(H^+) = 1\times 10^{-3}$ mole litre^{-1}

$pH = -\log_{10}(H^+) = -\log_{10}10^{-3}$

$= -(-3 \times 1\log_{10}) = -(3 \times 1) = 3$

Thus, **pH = 3**

2. What would be the pH of an aqueous solution of sulphuric acid which is 5×10^{-5} mol litre^{-1} in concentration.

Solution:

Sulphuric acid dissociates in water as:

$$H_2SO_{4(aq)} \longrightarrow 2H^+_{(aq)} + SO_4^{2-}{}_{(aq)}$$

1. Each mole of sulphuric acid gives two mole of H^+ ions in the solution.
2. One litre of H_2SO_4 solution contains 5×10^{-5} mole of H_2SO_4 which would give $2 \times 5 \times 10^{-5} = 10 \times 10^{-5}$ or 1.0×10^{-4} moles of H^+ ion in one litre of the solution.

Therefore,

$(H^+) = 1\times 10^{-4}$ mole litre^{-1}

$pH = -\log_{10}(H^+) = -\log_{10}10^{-4}$

$= -(-4 \times 1\log_{10}10)$

$= -(-4 \times 1) = 4$

3. Calculate the pH of 1×10^{-4} molar solution of NaOH.

Solution:

NaOH is a strong base and dissociates in its solution as:

$$NaOH_{(aq)} \longrightarrow Na^+_{(aq)} + OH^-_{(aq)}$$

One mole of NaOH would give one mole of OH^- ions.

Therefore,

$[OH^-] = 1\times 10^{-4}$ mole litre^{-1}

$pOH = -\log_{10}[OH^-] = -\log_{10}[10^{-4}]$

$= -(-4 \times 1\log_{10}10) = -(-4) = 4$

Since, $pH + pOH = 14$

$pH = 14 - pOH = 14 - 4$

$= 10$

4. Calculate the pH of a solution in which the concentration of the hydrogen ions is 1.0×10^{-8} mol litre^{-1}.

Solution:

1. Here, although the solution is extremely dilute, the concentration given is not of an acid or a base but that of H^+ ions.
2. Hence, the pH can be calculated from the relation.

$pH = -\log_{10}(H^+)$

given, $H^+ = 1.0 \times 10^{-8} = -(-8 \times 1\log_{10}10)$

$= -(-8 \times 1) = 8$

5. If the pH of a solution is 4.5, what is its pOH?

Solution:

$pH + pOH = 14$

$pOH = 14 - 4.5 = 9.5$

pOH = 9.5

6. What is the pH of a solution with $[H^+] = 1 \times 10^{-6}$m.

Solution:

pH is calculated by the formula

$pH = -\log[H^+]$

$pH = -\log(1\times10^{-6})$

$pH = -(-6)$

$pH = 6$

7. What is the p^{OH} of a 6×10^{-7} m aqueous solution of HCl?

$pH = -\log[H^+]$

$pH = -\log(6\times10^{-7}) = 6.2$

$pH + p^{OH} = 14$

$p^{OH} = 14 - pH$

$p^{OH} = 14 - 6.2 = 7.8$

The p^{OH} of the solution is 7.8

8. Calculate the pH for a specific $[H^+]$ calculate.

1. pH given $[H^+] = 1.4 \times 10^{-5}$ M.

$pH = -\log_{10}H^+$

$pH = -\log_{10}(1.4 \times 10^{-5})$

$pH = 4.85$

2. If pH = 8.5

$[H^+] = 10^{-pH}$

$H^+ = 10^{-8.5}$

$[H^+] = 3.2 \times 10^{-9}$ m.

9. Find the pH of a 0.03 m solution of hydrochloric acid (HCl).

Solution:

$[H^+] = 0.03$m

$pH = -\log(0.03)$

$pH = 1.5$

VII. Short Answers:

1. Difference between combination and decomposition reactions.

	Combination reaction	Decomposition reaction
1.	**One** or **more** reactants combine to form a single product	A **single** reactant is decomposed to form one or more products

2.	Energy is **released**	Energy is **absorbed**
3.	**Elements** or **compounds** may be the reactants	**Single** compound is the reactant

2. Define balanced chemical equation.

A balanced chemical equation is the simplified representation of a chemical reaction which describes the chemical composition, physical state of the reactants and the products, and the reaction conditions.

3. Define combustion reaction.

1. A combustion reaction is one in which the reactant rapidly combines with oxygen to form one or more oxides and energy (heat).
2. So in this reaction, one of the reactants must be oxygen.

4. Define equilibrium state.

When the rate of the **forward reaction** becomes **equal** to the rate of **backward reaction**, then no more product is formed. This stage of the reaction is called 'equilibrium state'.

5. Define chemical equilibrium.

It is a state of a reversible chemical reaction in which no change in the amount of the reactants and products takes place. At equilibrium,

Rate of forward reaction = Rate of backward reaction

6. Define ionic product of water.

1. The product of the concentration of the hydronium ion and the hydroxyl ion is called ionic product of water.
2. It is denoted as K_w.

$$K_w = [H_3O^+]\,[OH^-]$$

7. What is pH scale?

1. pH scale is a scale for measuring the **hydrogen ion** concentration in a solution.
2. pH scale is a set of numbers from **0 to 14** which is used to indicate whether a solution is acidic, basic or neutral.

$$pH = -\log_{10}[H^+]$$

8. Write pH value for acids, bases and neutral solutions.

1. Acids - pH less than 7
2. Bases - pH greater than 7
3. Neutral solution - pH equal to 7

VIII. Long Answers:

1. What is reaction rate and write its importance?

1. "Rate of a reaction is the change in the amount or concentration of any one of the reactants or products per unit time".
2. Consider the following reaction.

$$A \longrightarrow B$$

3. The rate of this reaction is given by

$$\text{Rate} = -\frac{d[A]}{dt} = +\frac{d[B]}{dt}$$

Where,
[A] - Concentration of A
[B] - Concentration of B

4. The negative sign indicates the decrease in the concentration of A with time.
5. The positive sing indicates the increase in the concentration of B with time.
6. '[ ] represents the concentration.
7. 'd' represents the infinitesimal change in the concentration.
8. Importance of reaction rate.
   i. Faster the reaction, more will be the amount of the product in a specified time.
   ii. So, the rate of reaction is important for a chemist for designing a process to get a good yield of a product.

Rate of reaction is also important for a food processor who hopes to slow down the reactions that cause food to spoil.

IX. Fill in the blanks.

1. Oxidation of _____ causes rusting. **(iron)**
2. The compounds or elements which undergo chemical reaction are called _____. **(reactants)**
3. The compounds formed during a chemical reaction are called _____. **(products)**
4. The arrow in a chemical reaction indicates _____. **(direction)**
5. In a chemical reaction, the atoms of the reacting molecules or elements are _____ to form new molecules. **(rearranged)**
6. Old chemical bonds between atoms are _____ and new chemical bonds are formed. **(broken)**
7. _____ absorbs energy during a chemical reaction. **(Bond breaking)**
8. _____ releases energy during a chemical reaction. **(Bond formation)**
9. The chemicals of a reaction are represented by their _____. **(chemical formulas)**
10. The number of atoms of the reactants and that of the products must be _____. **(equal)**
11. When solid potassium reacts with liquid water, it produces _____ gas and _____ solution **(hydrogen, potassium hydroxide)**
12. In a _____ reaction two or more reactants combine to form a compound. **(combination)**
13. Combination reaction is also known as _____ reaction. **(synthesis)**
14. When sodium reacts with chlorine it forms an edible compound named _____. **(sodium chloride)**
15. Most of the combination reactions are _____ in nature. **(exothermic)**
16. In a _____ reaction, a single compound splits into two or more simpler substances under suitable conditions. **(decomposition)**
17. _____ is the major phenomenon in a decomposition reaction. **(Breaking of bonds)**
18. A solution of _____ is used for white washing walls. **(slaked lime)**
19. _____ reacts slowly with the carbon dioxide in air to form a thin layer of calcium carbonate. **(Calcium hydroxide)**
20. The chemical formula for marble is _____. **($CaCO_3$)**
21. When calcium carbonate is heated, it breaks down in to _____ and _____. **(calcium oxide, carbon dioxide)**
22. Reactions in which heat is absorbed are called _____. **(Endothermic reactions)**
23. In decomposition reactions, _____ energy is used to bring about the reaction. **(electrical)**
24. Sodium chloride decomposes into metallic sodium and chlorine gas in a process called _____. **(electrolysis)**
25. When silver bromide is exposed to light, it breaks down into_____ and _____ gas.

(silver metal, bromine)

26. The reaction in which decomposition is caused by light is called _____ reaction. **(photo decomposition)**
27. Photo decomposition reaction is also known as _____. **(photolysis)**
28. If an iron nail is placed in an aqueous solution of copper (II) sulphate it displaces _____ from its aqueous solution. **(copper)**
29. 2NaCl+ F ⟶ 2NaF + Cl _____ is displaced by _____in the above equation. **(Cl, F)**
30. When two compounds react, if their ions are interchanged, then the reaction is called _____ reaction. **(double displacement)**
31. Ions of identical charges are only _____. **(interchanged)**
32. For a double displacement reaction to take place, one of the products must be a _____ or _____. **(precipitate, water)**
33. In _____ reaction one or more reactants combine to form a single product. **(combination)**
34. In _____ reaction a single reactant is decomposed to form one or more products. **(decomposition)**
35. A single compound is the reactant in _____. **(decomposition reaction)**
36. When clear aqueous solutions of potassium iodide and lead (II) nitrate are mixed, a _____ reaction takes place. **(double displacement)**
37. Double displacement reactions are also called _____ reactions. **(metathesis)**
38. A displacement reaction in which the acid reacts with the base to form a salt and water is called _____ reaction. **(neutralization)**
39. Acid + Base ⟶ _____ + water. **(salt)**
40. Ammonium hydroxide reacts with _____, to form ammonium nitrate and water. **(nitric acid)**
41. In combustion reactions, one of the reactants must be _____. **(PTA - II)** **(oxygen)**
42. Combustion reactions are majorly used as _____ sources. **(heat energy)**
43. Combustion may be called as an _____ oxidation. **(exothermic)**
44. Our mobile phone gets energy from its _____ battery by chemical reactions. **(lithium ion)**
45. On recharging the mobile _____ are reversed. **(chemical reactions)**
46. If a flame is formed during combustion, it is called _____. **(burning)**
47. In a _____ reaction the products can be converted back to the reactants. **(reversible)**
48. The decomposition of compounds in a reversible reaction is called _____ reaction. **(forward)**
49. The combination of products in a reversible reaction is called _____ reaction. **(backward)**
50. A reversible reaction is represented by a _____ arrow. **(double)**
51. The reaction that cannot be reversed is called _____ reaction. **(irreversible)**
52. _____ reactions are unidirectional. **(irreversible)**
53. Equilibrium is not attained in an _____ reaction. **(irreversible)**
54. The negative sign in the rate of a reaction indicates the decrease in the _____. **(concentration)**
55. The positive sign in the rate of a reaction indicates the _____ in the concentration. **(increases)**
56. The reaction of sodium with hydrochloric acid is _____ than that with acetic acid. **(faster)**
57. The amount of the substance present in a certain volume of the solution is called _____. **(concentration)**
58. Most of the reactions go faster at _____ temperature. **(higher)**
59. When the reaction mixture is heated the reaction rate _____. **(increases)**
60. If the reactants are gases, increasing their _____ increases the reaction rate. **(pressure)**
61. A _____ is a substance which increases the reaction rate without being consumed in the reaction. **(catalyst)**
62. A _____ speeds up the reaction. **(catalyst)**
63. On heating potassium chlorate, it decomposes into _____ and _____ gas. **(potassium chloride, oxygen)**
64. Equilibrium attained in a chemical reaction is called _____ equilibrium. **(chemical)**
65. Food kept at the refrigerator is safe for a longer period due to _____ reaction rate. **(lower)**
66. The state at which the rate of forward reaction becomes equal to the rate of backward reaction is called _____ state. **(equilibrium)**
67. The rate of a reaction is directly proportional to the _____. **(concentration)**

68. The rate of the forward reaction decreases with _____. **(time)**
69. The rate of the backward reaction _____ with time. **(increases)**
70. The decomposition of calcium carbonate into lime and carbon dioxide is a _____ reaction. **(reversible)**
71. The rate of decomposition of $CaCO_3$ = the rate of combination of_____. **(CaO and CO_2)**
72. In a chemical equilibrium, the rates of the forward and backward reactions are_____. **(equal)**
73. Aerated soft drinks contain dissolved _____ in a pop bottle. **(carbon dioxide)**
74. The observable properties of chemical equilibrium remain _____ with time. **(unchanged)**
75. Chemical equilibrium is a _____ equilibrium. **(dynamic)**
76. In physical equilibrium, _____ remains constant. **(volume)**
77. The unit of ionic product of water is _____. **($mol^2 dm^{-6}$)**
78. The value of ionic product of water at 25°C is _____. **(1.00×10^{-14})**
79. The concentration of _____ decide whether the solution is acidic or basic. **(ions)**
80. A_____ scale is used to indicate whether a solution is acidic, basic or neutral. **(pH)**
81. The pH of sour milk is _____. **(4.5)**
82. The pH of fresh milk is _____. **(5)**
83. The pH of sea water is _____. **(8)**
84. The pH of egg white is _____. **(8)**
85. The pH of HCl is _____. **(0)**
86. The pH of vinegar is _____. **(3)**
87. Conductivity of water has resulted from the _____of water. **(self - ionisation)**
88. _____ is a reaction in which two like molecules react to give ions. **(self - ionization)**
89. The ionic product of water can be expressed as _____. **($K_w = [H^+][OH^-]$)**
90. All the aqueous solutions may contain _____ and _____ ions. **(hydrogen, hydroxyl)**
91. pH scaleis a set of numbers from _____. **(0 to 14)**
92. Acids have pH _____ than 7. **(less)**
93. Bases have pH _____ than 7. **(greater)**
94. A neutral solution has pH _____ to 7. **(equal)**
95. Self ionisation is also called as _____. **(auto ionization)**
96. The ionic product of water is denoted by _____. **(K_w)**
97. All aqueous solutions may contain ions due to _____ of water. **(self - ionisation)**
98. The pH of a solution can be determined using a _____. **(pH indicator)**
99. Our body works within the pH range of _____ to _____. **(7.0, 7.8)**
100. The pH of blood is from _____ to _____. **(7.35, 7.45)**
101. The ideal pH for blood is _____. **(7.4)**
102. pH of the stomach fluid is approximately _____. **(2.0)**
103. White enamel coating of our teeth is _____. **(calcium phosphate)**
104. Citrus fruits require slightly _____ soil. **(alkaline)**
105. Rice requires _____ soil. **(acidic)**
106. Sugarcane requires _____ soil. **(neutral)**
107. The pH of rain water is approximately _____. **(7)**
108. If the pH of rain water is less than 7, then it is called _____. **(acid rain)**
109. An example of a neutral solution is _____. **(rain water)**
110. Aerobic: Presence of _____. **(oxygen)**
111. Anaerobic: _____ of oxygen. **(Absence)**
112. Most combination reactions are _____. **(exothermic)**
113. _____ decomposition reaction may occur in the presence of heat or light. **(Electrolytic)**
114. All photo decomposition reaction are _____ reactions. **(endothermic)**
115. Double displacement reaction or metathesis may occur by the _____ exchange of ions. **(mutual)**
116. _____ reaction are reactions between an acid and a base that forms salt and water. **(Neutralisation)**
117. _____ prevents tooth decay. **(Neutralisation)**
118. Most reactions in chemistry are _____ reactions. **(irreversible)**
119. Equilibrium is possible in a _____ system. **(closed)**
120. _____ increases the reaction rate. **(Temperature)**
121. The term pH means power of _____. **(hydrogen)**
122. Pure water is a _____ electrolyte. **(weak)**

11. CARBON AND ITS COMPOUNDS

KEY FORMULAE		
1.	Alkane	C_nH_{2n+2}
2.	Alkene	C_nH_{2n}
3.	Alkyne	C_nH_{2n-2}

How to calculate the number of carbon and hydrogen atoms in alkane, alkene and alkynes?

	Alkanes	Alkenes	Alkynes
i.	C_nH_{2n+2} If C = 3 $= C_3H_{2\times 3+2} = C_3H_{6+2}$ $= C_3H_8$	C_nH_{2n} $= C_3H_{2\times 3}$ $= C_3H_6$	C_nH_{2n-2} $= C_3H_{2\times 3-2}$ $= C_3H_{6-2}$ $= C_3H_4$
ii.	If C =4 $= C_4H_{2\times 4+2} = C_4H_{8+2}$ $= C_4H_{10}$	$= C_4H_{2\times 4}$ $= C_4H_8$	$= C_4H_{2\times 4-2}$ $= C_4H_{8-2}$ $= C_4H_6$
iii.	If C = 6 $= C_6H_{2\times 6+2} = C_6H_{12+2}$ $= C_6H_{14}$	$= C_6H_{2\times 6}$ $= C_6H_{12}$	$= C_6H_{2\times 6-2}$ $= C_6H_{12-2}$ $= C_6H_{10}$
iv.	If C =7 $= C_7H_{2\times 7+2} = C_7H_{14+2}$ $= C_7H_{16}$	$= C_7H_{2\times 7}$ $= C_7H_{14}$	$= C_7H_{2\times 7-2}$ $= C_7H_{14-2}$ $= C_7H_{12}$
v.	If C =8 $= C_8H_{2\times 8+2} = C_8H_{16+2}$ $= C_8H_{18}$	$= C_8H_{2\times 8}$ $= C_8H_{16}$	$= C_8H_{2\times 8-2}$ $= C_8H_{16-2}$ $= C_8H_{14}$
vi.	If C =9 $= C_9H_{2\times 9+2} = C_9H_{18+2}$ $= C_9H_{20}$	$= C_9H_{2\times 9}$ $= C_9H_{18}$	$= C_9H_{2\times 9-2}$ $= C_9H_{18-2}$ $= C_9H_{16}$
vii.	If $C = 10 = C_{10}H_{2\times 10+2}$ $= C_{10}H_{20+2} = C_{10}H_{22}$	$= C_{10}H_{2\times 10}$ $= C_{10}H_{20}$	$= C_{10}H_{2\times 10-2}$ $= C_{10}H_{20-2}$ $= C_{10}H_{18}$

I. Choose the best answer.

1. The molecular formula of an open chain organic compound is C_3H_6. The class of the compound is
   a. alkane b. alkene c. alkyne d. alcohol
   Ans: b. alkene

2. The IUPAC name of an organic compound is 3 - Methyl butan -1-ol. What type compound it is? **(SEP - 2021)**
   a. Aldehyde b. Carboxylic acid c. Ketone d. Alcohol
   Ans: d. Alcohol

3. The secondary suffix used in IUPAC nomenclature of an aldehyde is _____. **(APR - 2023)**
   a. - ol b. - oic acid c. - al d. - one
   Ans: c. - al

4. Which of the following pairs can be the successive members of a homologous series?
   a. C_3H_8 and C_4H_{10} b. C_2H_2 and C_2H_4
   c. CH_4 and C_3H_6 d. C_2H_5OH and C_4H_8OH **Ans: a. C_3H_8 and C_4H_{10}**

5. $C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$ is a **(SEP - 2020)**
   a. Reduction of ethanol b. Combustion of ethanol
   c. Oxidation of ethanoic acid d. Oxidation of ethanal
   Ans: b. Combustion of ethanol

6. Rectified spirit is an aqueous solution which contains about _____ of ethanol
   a. 95.5% b. 75.5% c. 55.5% d. 45.5% ※※※
   (JULY - 2024, MAY - 2022) **Ans: a. 95.5%**

7. Which of the following are used as anaesthetics?
   a. Carboxylic acids b. Ethers c. Esters d. Aldehydes
   Ans: b. Ethers

8. TFM in soaps represents _____ content in soap ※※ **(APRIL - 2024)**
   a. mineral b. vitamin c. fatty acid d. carbohydrate
   Ans: c. fatty acid

9. Which of the following statements is wrong about detergents?
   a. It is a sodium salt of long chain fatty acids
   b. It is sodium salts of sulphonic acids
   c. The ionic part in a detergent is $-SO_3^-Na^+$
   d. It is effective even in hard water
   Ans: a. It is a sodium salt of long chain fatty acids

II. Fill in the blanks.

1. An atom or a group of atoms which is responsible for chemical characteristics of an organic compound is called _____. ※※※ **Ans: functional group**
2. The general molecular formula of alkynes is _____. **Ans: C_nH_{2n-2}**
3. In IUPAC name, the carbon skeleton of a compound is represented by _____. (root word / prefix / suffix) **Ans: root word**
4. (Saturated / Unsaturated) _____ compounds decolourize bromine water. ※※※ **Ans: unsaturated**

5. Dehydration of ethanol by conc. Sulphuric acid forms _____. (ethene / ethane)
Ans: ethene

6. 100% pure ethanol is called _____. **Ans: absolute alcohol**

7. Ethanoic acid turns _____ litmus to _____. **Ans: blue, red**

8. The alkaline hydrolysis of fatty acids is termed as _____. ※※
Ans: saponification

9. Biodegradable detergents are made of _____ (branched / straight) chain hydrocarbons. **(PTA - III)** **Ans: straight**

III. Match the following. (PTA - II)

Column - I		Column - II		Answers	
1.	Functional group –OH	- a.	Benzene	- c.	**Alcohol**
2.	Heterocyclic	- b.	Potassium stearate	- d.	**Furan**
3.	Unsaturated	- c.	Alcohol	- e.	**Ethene**
4.	Soap	- d.	Furan	- b.	**Potassium stearate**
5.	Carbocyclic	e.	Ethene	a.	**Benzene**

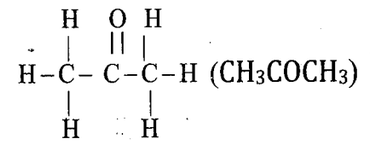
IV. Assertion and Reason. (PTA - IV)

1. **Assertion:** Detergents are more effective cleansing agents than soaps in hard water.
Reason : Calcium and magnesium salts of detergents are water soluble.
a. A and R are correct, R explains the A.
b. A is correct, R is wrong.
c. A is wrong, R is correct.
d. A and R are correct, R doesn't explains A.
Ans: a. A and R are correct, R explains the A.

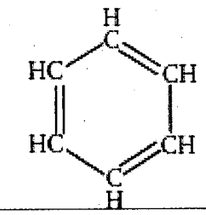
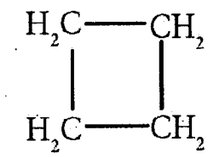
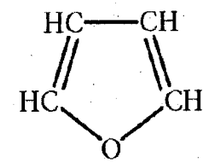
2. **Assertion:** Alkanes are saturated hydrocarbons.
Reason : Hydrocarbons consist of covalent bonds.
a. A and R are correct, R explains the A.
b. A is correct, R is wrong.
c. A is wrong, R is correct.
d. A and R are correct, R doesn't explains A.
Ans: d. A and R are correct, R doesn't explains A.

V. Short answer questions. (JUNE - 2023)

1. **Name the simplest ketone and give its structural formula.** **(PTA - II)**

Simplest ketone	Structural formula
Acetone	 (CH_3COCH_3)

2. **Classify the following compounds based on the pattern of carbon chain and give their structural formula:** ※※ **(PTA - I, MAY - 2022)**
i. Propane ii. Benzene iii. Cyclobutane iv. Furan

Name	Class		Structural formula
Propane	acyclic compounds		$CH_3 - CH_2 - CH_3$
Benzene	Cyclic compounds	Aromatic compound	
Cyclobutane		Alicyclic compound	
Furan		Hetrocyclic compound	

3. **How is ethanoic acid prepared from ethanol? Give the chemical equation.** ※※※

Ethanoic acid is prepared by the oxidation of ethanol in the presence of **alkaline potassium permanganate** or **acidified potassium dichromate.**

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[2[O]]{KMnO_4/OH^-} \underset{\text{Ethanoic acid}}{CH_3COOH} + H_2O$$

4. How do detergents cause water pollution? Suggest remedial measures to prevent this pollution? (APRIL - 2024, PTA - III)

1. Some detergents having a **branched hydrocarbon chain** are not fully biodegradable by micro - organisms present in water.
2. So, they cause water pollution.

Remedial measures.

Replacing detergents with branched hydro carbon chains with linear hydro - carbon chains which are biodegradable.

5. Differentiate soaps and detergents. (JULY - 24, SEP - 2020, GMQ - 2019, PTA - III)

	Soap	Detergent
1.	It is a sodium salt of long chain fatty acids	It is sodium salts of sulphonic acids
2.	It is prepared from animal fats or vegetable oils.	It is prepared from hydrocarbons obtained from crude oil.
3.	Soaps are biodegradable	Most of the detergents are non – biodegradable.
4.	It has poor foaming capacity	It has rich foaming capacity.
5.	It forms a scum in hard water	Does not form a scum in hard water.

VI. Long answer questions.

1. What is called homologous series? Give any three of its characteristics?

Homologous series:

1. Homologous series is a group or a class of organic compounds having **same general formula** and **similar chemical properties** in which the successive members differ by a **$-CH_2$ group**.
2. **E.g:** Methane - CH_4
   Ethane - CH_3CH_3
   Propane - $CH_3CH_2CH_3$

Characteristics: (APR - 2023)

1. All members of a homologous series contain the **same elements** and **functional group**.
2. They are represented by a **general molecular formula**.
   E.g: Alkanes, C_nH_{2n+2}

3. **Chemical properties** of the members of a homologous series are **similar**.
4. All the members can be prepared by a **common method**.

2. Arrive at, systematically, the IUPAC name of the compound: $CH_3-CH_2-CH_2-OH$.

Step - 1:

1. The parent chain consists of **3 carbon atoms**.
2. The root word is **'Prop'**.

Step - 2:

1. There are **single bonds** between the carbon atoms of the chain.
2. So, the primary suffix is **'ane'**.

Step - 3:

1. Since, the compound contains **–OH** group, it is an alcohol.
2. The carbon chain is numbered from the **end** which is closest to **–OH** group.

$$\overset{3}{CH_3}-\overset{2}{CH_2}-\overset{1}{CH_2}-OH$$

Step - 4:

1. The locant number of –OH group is **1** and thus the secondary suffix is **'1 –ol'**.
2. Terminal **'e'** of 'ane' is removed as per **Rules**.
3. The name of the compound is

   prop + ane + (1–ol) = Propan –1–ol.

3. How is ethanol manufactured from sugarcane? (JULY - 2024)

1. **Molasses** is a **dark coloured syrupy** liquid left after the crystallization of sugar from the concentrated sugarcane juice.
2. It contains about **30%** of **sucrose**, which cannot be separated by crystallization.

i. Dilution of molasses:

Molasses is first **diluted** with water to bring down the concentration of sugar to about **8 to 10 percent**.

ii. Addition of nitrogen source:

1. Molasses usually contains enough nitrogenous matter to act as food for yeast during the fermentation process.
2. If the nitrogen content of the molasses is poor, it may be fortified by the addition of **ammonium sulphate** or **ammonium phosphate.**

iii. Addition of yeast:

1. The mixture is added with **yeast** and it is kept at about **303K** for a few days.
2. During this period, the enzymes **invertase** and **zymase** present in yeast, convert **sucrose** into **ethanol.**

$$\underset{\text{Sugar}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{\text{invertase}} \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{fructose}}{C_6H_{12}O_6}$$

$$\underset{\text{glucose or fructose}}{C_6H_{12}O_6} \xrightarrow{\text{zymase}} \underset{\text{ethanol}}{2C_2H_5OH} + 2CO_2$$

3. The fermented liquid is technically called **wash.**

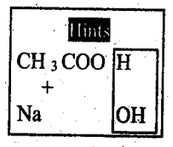
iv. Distillation of 'Wash':

1. Wash containing **15** to **18** percent alcohol, is now subjected to **fractional distillation.**
2. The main fraction drawn is an aqueous solution of ethanol which contains **95.5%** of ethanol and **4.5%** of water it is called **rectified spirit.**
3. This mixture is then **refluxed** over **quicklime** for about **5 to 6hours** and then allowed to stand for **12 hours.**
4. On **distillation** of this mixture, **pure alcohol 100%** is obtained.
5. This is called **absolute alcohol.**

4. Give the balanced chemical equation of the following reactions: (PTA - VI)

i. Neutralization of NaOH with ethanoic acid:

$$\underset{\text{Ethanoic acid}}{CH_3COOH} + NaOH \longrightarrow \underset{\text{Sodium ethanoate}}{CH_3COONa} + H_2O$$



ii. Evolution of carbon dioxide by the action of ethanoic acid with $NaHCO_3$:

$$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + CO_2\uparrow + H_2O$$

iii. Oxidation of ethanol by acidified potassium dichromate: (PTA - VI)

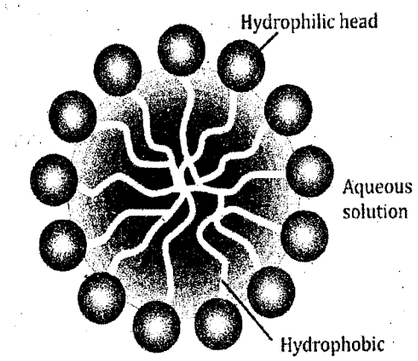
$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[2[O]]{K_2Cr_2O_7/H^+} \underset{\text{Ethanoicacid}}{CH_3COOH} + H_2O$$

iv. Combustion of ethanol:

$$\underset{\text{Ethanol}}{C_2H_5OH} + 3O_2 \longrightarrow \underset{\text{Carbondioxide}}{2CO_2} + 3H_2O$$

5. Explain the mechanism of cleansing action of soap. (APR - 2023, PTA - V,VI)

A soap molecule contains **two chemically distinct parts** that interact differently with water.



Cleansing action of soap

Hydrophilic:

1. This polar end is a **short head** with a **carboxylate group** (–COONa).
2. It is **water loving** in nature and this end is **attracted** towards water.
3. It makes the entire molecule soluble in water.

Hydrophobic:

1. This non - polar end having **long** tail made of the **hydrocarbon** chain.
2. It is **water hating** in nature and it is **attracted** towards **dirt** or **oil** on the cloth, but not attracted towards water.
3. Thus, this part of the soap molecule traps the **dirt.**

Mechanism:

1. When a soap is dissolved in water, the molecules join together as **clusters** called **'micelles'.**
2. Their long **hydrocarbon chains** attach themselves to the **oil** and **dirt.**
3. The **dirt** is thus surrounded by the **non-polar end.**

4. The charged **carboxylate** end makes the micelles **soluble** in water.

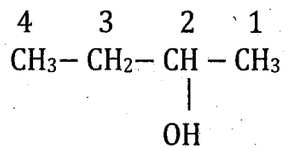
5. Thus, the dirt is **washed away** with soap.

VII. HOT questions.

1. The molecular formula of an alcohol is $C_4H_{10}O$. The locant number of its –OH group is 2. (PTA - I)

i. Draw its structural formula.

Ans:



ii. Give its IUPAC name.

Ans: 2 Butanol

iii. Is it saturated or unsaturated?

Ans: Saturated

2. 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'. (APRIL - 2024, PTA - V)

i. Identify the compound 'A'.

Ans: $C_2H_4O_2 \longrightarrow CH_3COOH$ (A)
A - Ethanoic acid

ii. Write the chemical equation for its reaction with ethanol to form compound 'B'.

Ans:
Ethanol reacts with ethanoic acid in the presence of Conc·H_2SO_4 to form ethyl ethanoate, as ester.

$$\underset{\text{Ethanol}}{C_2H_5OH} + \underset{\text{Ethanoic acid}}{CH_3COOH} \xrightarrow{Con.H_2SO_4} \underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5} + H_2O$$

Hint
CH_3COO H
+
C_2H_5 OH

iii. Name the process.

Ans: Esterfication

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Choose the correct answer:

1. Which of the following shows the right increasing order of reactivity?

a. $CH \equiv CH < CH_4 < CH_2 = CH_2$
b. $CH \equiv CH < CH_2 = CH_2 < CH_4$
c. $CH_4 < CH_2 = CH_2 < CH \equiv CH$
d. $CH_4 < CH \equiv CH < CH_2 = CH_2$

Ans: c. $CH_4 < CH_2 = CH_2 < CH \equiv CH$

II. Short answers.

1. Write a reaction which is used for the identification of alcohol. (SEP - 2020)

Ethanol is oxidized to **ethanoic acid** with **alkaline $KMnO_4$** or **acidified $K_2Cr_2O_7$**

$$CH_3CH_2OH \xrightarrow[2[O]]{K_2Cr_2O_7/H^+} \underset{\text{Ethanoic acid}}{CH_3COOH} + H_2O$$

During this reaction, the orange colour of $K_2Cr_2O_7$ changes to green. Therefore, this reaction can be used for the **identification** of **alcohols**.

2. Write any 2 uses of ethanol. (SEP - 2021)

1. In medical wipes, as an **antiseptic**.
2. As an **anti - freeze** in automobile radiators.

3. Write the functional group and the suffix used for the following class of compounds. (MAY - 2022)

Class of Compounds	Functional Group	Suffix used
Alcohol	–OH	–ol
Aldehyde	–CHO	–al
Ketone	$-\overset{\overset{O}{\|}}{C}-$	–one
Carboxylic Acid	–COOH	–olc acid

III. Long answers.

1. Why ethene is more reactive than ethane? (PTA - 1)

Ethene is more reactive than ethane because of the presence of a double bond between its two carbon atoms ($H_2C = CH_2$ ethene).

2. Compound A is a colourless liquid having burning taste. When the vapour of compound A is passed over heated copper at 573 K, it is dehydrogenated to acetaldehyde. What is compound 'A'? What is the role of copper in this chemical reaction? Write the balanced chemical equation of this reaction. (PTA - 6)

Compound A is ethanol (burning taste)

$$CH_3CH_2OH \xrightarrow[573\ K]{Cu} \underset{\text{Acetaldehyde}}{CH_3CHO} + H_2\uparrow$$

Role of Copper:

The copper helps to complete the dehydrogenation catalyst and here the copper helps to lose the hydrogen of ethyl alcohol and give an aldehyde (acetaldehyde).

3. Fill in the blanks in the table using IUPAC nomenclature of organic compounds. (PTA - 2)

Name of the compound	Structural formula	Functional group present
———	$CH_3-CH(OH)-CH_3$	– OH
Ethanal	$CH_3-C(=O)-H$	———
Butanone	———	$>C=O$
———	$CH_3-CH_2-CH_2-COOH$	– COOH

Ans:

Name of the compound	Structural formula	Functional group present
Propanol	$CH_3-CH(OH)-CH_3$	– OH
Ethanal	$CH_3-C(=O)-H$	CHO
Butanone	$CH_3COCH_2CH_3$	$>C=O$
Butanoic acid	$CH_3-CH_2-CH_2-COOH$	– COOH

4. Read and categorize the following statements that are suitable for ethanol and ethanoic acid. (PTA - 4)

a. 95.5% of this compound's water solution is called rectified spirit.

Ethanol:

b. Pure form of this compound change into ice like crystals of freezing.

Ethanoic acid

c. This compound undergoes decarboxylation on heating with sodalime.

Ethanoic acid

5. Applying IUPAC rules, derive the structural formula of the following compounds. (PTA - 2)

a. Pentanoic acid $\longrightarrow CH_3-CH_2-CH_2-CH_2-COOH$

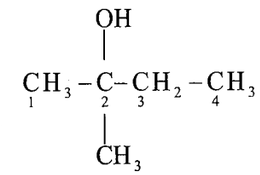
Step 1: The parent chain consist of **5 carbon** atoms. The root word is **pent.**

Step 2: All are **single bonds** between the carbon atoms of the chain. So the primary suffix is **"ane"**.

Step 3: Since the compound contains the –COOH group, it is a carboxylic acid. The secondary suffix is **'oic acid'**.

The name of the compound is Pent+ ane + (Oic acid) = Pentanoic acid.

b. 2 - Methly - butan - 2 -ol



Step 1: The longest chain contains **4 carbon** atoms and hence the root word is "**But**"..

Step 2: All are **single bonds** between the carbon atoms, and thus primary suffix is "**ane**".

Step 3: There is a substituent and attach "**OH**" to the second carbon. So the carbon chain is numbered from left end. Which is closest to the substituent. Hence the name of the compound is 2–methyl + But + ane + (2 -ol) → 2 –methyl–butan–2–ol.

ADDITIONAL QUESTIONS

I. Match the following:

Column - I	Column - II	Answers
1. Acyclic	a. Closed chain	c. Open chain
2. Cyclic	b. Carbocyclic rings	a. Closed chain
3. Alicyclic	c. Open chain	b. Carbocyclic rings
4. Aromatic	d. Isomerism	e. benzene rings
5. Organic compounds	e. benzene rings	d. Isomerism

Column - I	Column - II	Answers
1. Saturated compound	a. Benzene	d. Ethane
2. Unsaturated compound	b. Cyclobutane	c. Ethene
3. Heterocyclic compound	c. Ethene	e. Pyridine
4. Alicyclic compound	d. Ethene	b. Cyclobutane
5. Aromatic compound	e. Pyridine	a. Benzene

Column - I	Column - II	Answers
1. Alkane	a. C_nH_{2n}	b. C_nH_{2n+2}
2. Alkene	b. C_nH_{2n+2}	a. C_nH_{2n}
3. Alkyne	c. C_2H_6	e. C_nH_{2n-2}
4. Ethane	d. CH_4	c. C_2H_6
5. Methane	e. C_nH_{2n-2}	d. CH_4

Column - I	Column - II	Answers
1. Alcohol	a. R-O-R	c. R-OH
2. Aldehyde	b. R-COOH	d. R-CHO
3. Ketone	c. R-OH	e. R-CO-R
4. Ether	d. R-CHO	a. R-O-R
5. Carboxylic acid	e. R-CO-R	b. R-COOH

Column - I	Column - II	Answers
1. Ethanol	a. potassium	b. alcohol
2. Acetic acid	b. alcohol	d. food additive
3. Hard soap	c. caustic soda	c. caustic soda
4. Soft soap	d. food additive	a. potassium
5. Hydrophobic	e. water loving	f. water hating
6. Hydrophilic	f. water hating	e. water loving

II. Choose the correct answer:

1. Lower hydrocarbons are _____ at room temperature.
   a. solids b. liquids c. gases d. none of the above
   Ans: c. gases

2. _____ is used as a solvent for drugs.
   a. Methanol b. Ethanol c. Propanol d. Butanol
   Ans: b. Ethanol

3. The boiling point of ethanol is _____°C.
   a. 70 b. 78 c. 87 d. 90
   Ans: b. 78

4. Denatured spirit is ethanol mixed with _____.
   a. methanol b. acetic acid c. formic acid d. pyridine
   Ans: d. pyridine

5. i. Alkenes are least reactive when compared to other classes of hydrocarbons
   ii. Alkanes are unsaturated hydrocarbons
   iii. Alkynes are saturated hydrocarbons
   iv. Hydrocarbons are insoluble in water
   a. i. & iv. are correct b. ii. & iii. are correct
   c. i & iii. are correct d. iv. is correct
   Ans: d. iv. is correct

6. Each member of the homologous series differ from the other by one _____ group.
   a. Methylene b. Ethylene c. Propanol d. Butanol
   Ans: a. Methylene

7. The prefix used for substituent $-CH_3$ is _____
   a. Fluoro b. Bromo c. Ethyl d. none of the above
   Ans: d. none of the above

8. The root word for the parent hydrocarbon containing 8 carbon atoms is _____.
   a. Pent- b. Oct- c. Dec- d. Prop-
   Ans: b. Oct-

9. The number of carbon atoms in butane is _____.
   a. 1 b. 3 c. 4 d. 5
   Ans: c. 4

10. The IUPAC name of an organic compound is 3-methyl butan-1-ol. What type of compound it is?
    a. Aldehyde b. Carboxylic Acid c. Ketone d. Alcohol
    (SEP - 2021) **Ans: d. Alcohol**

11. Cyclobutane is an example of a _____ compound.
    a. Alicyclic b. Aromatic c. Cyclic d. Acyclic
    Ans: a. Alicyclic

12. Hydrocarbons containing carbon to carbon triple bonds are called _____.
    a. Alkanes b. Alkenes c. Alkynes d. none of the above
    Ans: c. Alkynes

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

1. If the chain contains carbon and other atoms these compounds are called carbocyclic compounds.
   Ans: False
   If the chain contains carbon and other atoms these compounds are called **heterocyclic** compounds.

2. Hydrocarbons which contain one or more C = C bonds are called alkynes.
   Ans: False Hydrocarbons which contain one or more C = C bonds are called **alkenes**.

3. The physical properties of an organic compound depend on its functional group.
   Ans: False
   The **chemical** properties of an organic compound depend on its functional group.

4. The members in each homologous series show a regular gradation with respect to their increase in atomic mass.
   Ans: False
   The members in each homologous series show a regular gradation with respect to their increase in **molecular** mass.

5. Acetic acid is manufactured in industries by the fermentation of molasses.
   Ans: False
   Ethanol is manufactured in industries by the fermentation of molasses.

6. Ester is highly inflammable liquid.
   Ans: False
   Ethanol is highly inflammable liquid.

7. Ethanol is a colourless liquid having an unpleasant odour.
   Ans: False
   Ethanoic acid is a colourless liquid having an unpleasant odour.

8. When a sodium salt of ethanoic acid is heated with soda lime, hydrogen gas is formed.
   Ans: False
   When a sodium salt of ethanoic acid is heated with soda lime, **methane** gas is formed.

9. Hard water contains sodium and magnesium ions (Ca^{2+} and Mg^{2+}) that limit the cleaning action of soap.
   Ans: False
   Hard water contains **calcium** and magnesium ions (Ca^{2+} and Mg^{2+}) that limit the cleaning action of soap.

IV. Assertion and Reason.

1. **Assertion:** Organic compounds are less reactive compared to inorganic compounds.
   Reason : The reactions involving organic compounds proceed at slower rates.
   a. A and R are correct, R explains A.
   b. A is correct, R is wrong.
   c. A is wrong, R is correct.
   d. A and R are correct, R doesn't explain A. **Ans: a.A and R are correct, R explains A.**

2. **Assertion:** Alkanes are unsaturated compounds.
   Reason : If one or more double bonds or triple bonds exist between the carbon atoms, then the compound is said to unsaturated.
   a. A and R are correct, R explains A.
   b. A is correct, R is wrong.
   c. A is wrong, R is correct.
   d. A and R are correct, R doesn't explain A. **Ans: c. A is wrong, R is correct**

3. **Assertion:** Chemical properties of the members of a homologous series are similar.
   Reason : All the members can be prepared by a common method.
   a. A and R are correct, R explains A.
   b. A is correct, R is wrong.
   c. A is wrong, R is correct.
   d. A and R are correct, R doesn't explain A.
   Ans: d. A and R are correct, R doesn't explain A.

4. **Assertion:** Ethanoic acid reacts with sodium hydroxide to form sodium ethanoate and water.
Reason : It is used as a food additive.
a. A and R are correct, R explains A.
b. A is correct, R is wrong.
c. A is wrong, R is correct.
d. A and R are correct, R doesn't explain A.

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

V. Analog

1.	Propane	:	saturated compound	
	Benzene	:	_____	**(unsaturated compound)**
2.	Ester	:	R - COOR	
	Ketones	:	_____	**(R - CO)**
3.	Ethanol	:	alcohol	
	Methanal	:	_____	**(aldehyde)**
4.	95% ethanol	:	methylated spirit	
	95.5% ethanol	:	_____	**(rectified spirit)**
5.	Ethers	:	anaesthetic agents	
	Aldehydes	:	_____	**(disinfectant)**
6.	Hard soap	:	fats with caustic soda	
	Soft soap	:	_____	**(fats with potassium salts)**
7.	Straight hydrocarbon	:	biodegradable	
	Branched hydrocarbon	:	_____	**(non - biodegradable)**
8.	Soap	:	vegetable oil	
	Detergent	:	_____	**(crude oil)**
9.	Polar end	:	hydrophilic	
	Non - polar end	:	_____	**(hydrophobic)**
10.	Carbocyclic compounds	:	cyclobutane	
	Hetrocyclic compounds	:	_____	**(furan)**

VI. Problem solving.

1. **Identify and name the functional groups present in the following compounds.**

	Compounds	Functional group	Name
1.	$CH_3-CH_2-CH_2-CH_2-OH$	- OH	**Alcohol**
2.	$CH_3-CH_2-CH_2-\overset{\overset{O}{\|\|}}{C}-OH$	$-\overset{\overset{O}{\|\|}}{C}-OH$	**Carboxylic acid**
3.	$CH_3-CH_2-\overset{\overset{O}{\|\|}}{C}-CH_2-CH_3$	$-\overset{\overset{O}{\|\|}}{C}-$	**Ketone**
4.	$CH_3-CH_2-CH=CH_2$	$-\overset{\overset{\|}{}}{C}=C-$	**Alkene**

2. **A compound X is formed by the reaction of a carboxylic acid $C_2H_4O_2$ and an alcohol in presence of a few drops of H_2SO_4. The alcohol on oxidation with alkaline $KMnO_4$followed by**

acidification gives the same carboxylic acid as used in this reaction. Give the names and structure.

Answer:

a. Carboxylic acid is ethanoic acid (CH_3COOH)

b. Alcohol is ethanol (C_2H_5OH)

c. 'X' is ethyl ethanoate ($CH_3COOC_2H_5$)

$$\underset{\text{Ehanoic acid}}{CH_3COOH} + \underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow{\text{Conc. } H_2SO_4} \underset{\substack{(X)\\ \text{Ethyl ethanoate}}}{CH_3COOC_2H_5} + H_2O$$

$$CH_3CH_2OH + 2(O) \xrightarrow[KMnO_4]{\text{Alkaline}} CH_3COONa \xrightarrow{H^+} \underset{\text{Ethanoic acid}}{CH_3COOH}$$

3. **A gas is evolved when ethanol reacts with sodium. Name the gas evolved and also write the balanced chemical equation of the reaction involved.**

Answer: Hydrogen gas is evolved

$$\underset{\text{Ethanol}}{2C_2H_5OH} + \underset{\text{Sodium}}{2Na} \longrightarrow \underset{\text{Sodium ethoxide}}{2C_2H_5ONa} + H_{2(g)}$$

4. **The molecular formula of an alcohol is $C_5H_{12}O$. The locant number of its –OH is 3.**
   1. **Draw its structural formula.**

      Ans:

      $$CH_3-CH_2-\underset{\underset{OH}{|}}{CH}-CH_2CH_3$$

   2. **Give its IUPAC name.**

      Ans: 3 Pentanol

   3. **Is it saturated or unsaturated.**

      Ans: It is saturated

5. **The molecular formula of an compound C_4H_8.**
   1. **Draw its structural formula.**

      $$\begin{array}{ccc} H_2C & - & CH_2 \\ | & & | \\ H_2C & - & CH_2 \end{array} \quad \text{(or)} \quad \square$$

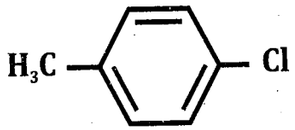
   2. **Give it IUPAC name.**

      Ans: Cyclobutane

   3. **Is it carbocyclic compounds (or) Hetrocyclic compounds.**

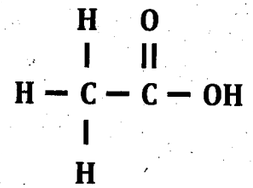
      Ans: It is carbocyclic compound

6. **Write the IUPAC name of the following compound.**

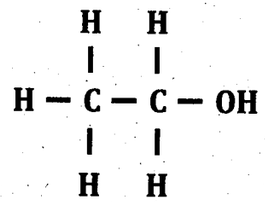


1 - chloro 4- methyl benzene

- **Draw the structure of CH_3COOH molecule and ethanol.**



Ethanoic acid



(or) $CH_3\,CH_2OH$

Ethanol

VII. Short Answers:

1. List out the physical properties of ethanol.

1. Ethanol is a **colourless** liquid, having a **pleasant smell** and a **burning taste**.
2. It is a **volatile** liquid.
3. Its boiling point is **78°C**(351K), which is much higher than that of its corresponding alkane, i.e, ethane (Boiling Point = 184 K).
4. It is completely **miscible** with water in all proportions.

2. Write the uses of Ethanoic acid.

1. In the manufacture of plastic.
2. In making dyes, pigments and paint.
3. In printing on fabrics.
4. As a laboratory reagent.
5. For coagulating rubber from latex.
6. In the production of pharmaceuticals.

3. What is called TFM?

1. TFM - TOTAL FATTY MATTER.
2. It is the one of the important factors to be considered to assess the quality of soap.
3. A soap, which has **higher TFM**, is a good bathing soap.

4. What is called hydrocarbons?

The organic compounds that are composed of **only carbon** and **hydrogen** atoms are called hydrocarbons.

5. What are hard soap and soft soap?

Hard soap:

1. Soaps, which are prepared by the saponification of oils or fats with caustic soda (sodium hydroxide), are known as hard soaps.
2. They are usually used for washing purposes.

Soft soap:

1. Soaps, which are prepared by the saponification of oils or fats with potassium salts, are known as soft soaps.
2. They are used for cleansing the body.

6. Write a short note on esterification.

The reaction of an alcohol with a carboxylic acid gives a compound having fruity odour.

1. This compound is called an ester and the reaction is called esterification.
2. Ethanol reacts with ethanoic acid in the presence of conc·H_2SO_4 to form ethyl ethanoate, an ester.

$$\underset{\text{Ethanol}}{C_2H_5OH} + \underset{\text{Ethanoic acid}}{CH_3COOH} \xrightarrow{\text{conc.}H_2SO_4} \underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5} + H_2O$$

VIII. Long Answers:

1. IUPAC name of various classes of compound.

1. Alcohols

	Molecular formula	IUPAC Name
1.	CH_3OH	Methanol
2.	CH_3CH_2OH	Ethanol
3.	$CH_3CH_2CH_2OH$	Propanol
4.	$CH_3CH_2CH_2CH_2OH$	Butanol
5.	$CH_3CH_2CH_2CH_2CH_2OH$	Pentanol

2. Aldehydes:

	Molecular formula	IUPAC Name
1.	$HCHO$	Methanal
2.	CH_3CHO	Ethanal
3.	CH_3CH_2CHO	Propanal
4.	$CH_3CH_2CH_2CHO$	Butanal
5.	$CH_3CH_2CH_2CH_2CHO$	Pentanal

3. Ketones:

	Molecular formula	IUPAC Name
1.	CH_3COCH_3	Propanone
2.	$CH_3COCH_2CH_3$	Butanone
3.	$CH_3COCH_2CH_2CH_3$	Pentanone

4. Carboxylic acid:

	Molecular formula	IUPAC Name
1.	$HCOOH$	Methanoic acid
2.	CH_3COOH	Ethanoic acid
3.	CH_3CH_2COOH	Propanoic acid
4.	$CH_3CH_2CH_2COOH$	Butanoic acid
5.	$CH_3CH_2CH_2CH_2COOH$	Pentanoic acid

2. Tabulate the classification of organic compounds based on functional group.

Class of the compound		Functional group	Common formula	Examples
1.	Alcohols	$-OH$	$R-OH$	Ethanol, CH_3CH_2OH
2.	Aldehydes	$-\overset{O}{\overset{\|\|}{C}}-H$	$R-CHO$	Acetaldehyde, CH_3CHO
3.	Ketones	$-\overset{O}{\overset{\|\|}{C}}-$	$R-CO-R$	Acetone CH_3COCH_3
4.	Carboxylic acids	$-\overset{O}{\overset{\|\|}{C}}-OH$	$R-COOH$	Acetic acid, CH_3COOH
5.	Ester	$-\overset{O}{\overset{\|\|}{C}}-OR$	$R-COOR$	Methyl acetate, CH_3COOCH_3
6.	Ether	$-O-R$	$R-O-R$	Dimethyl ether, CH_3OCH_3

2. Explain general characteristics of organic compounds.

1. Organic compounds have a **high molecular weight** and a complex structure.
2. They are mostly **insoluble** in water, but soluble in organic solvents such as ether, carbon tetrachloride, toluene, etc.,
3. They are **highly inflammable** in nature.
4. They are **less reactive** compared to inorganic compounds.
5. Hence, the reactions involving organic compounds proceed at **slower rates.**
6. Mostly organic compounds form **covalent bonds** in nature.
7. They have **lower melting point** and **boiling point** when compared to inorganic compounds.
8. They exhibit the phenomenon of **isomerism**, in which a single molecular formula represents several organic compounds that differ in their physical and chemical properties.
9. They are **volatile** in nature.
10. They can be prepared in the laboratory.

3. Write briefly about the characteristics of hydrocarbons: ※※※

1. Lower hydrocarbons are **gases** at room temperature. **E.g:** methane, ethane.
2. They are **colourless** and **odourless.**
3. The boiling point of hydrocarbons increases with an increase in the number of carbon atoms.
4. They undergo **combustion** reaction with oxygen to form CO_2, and water

5. **Alkanes** are **least reactive** when compared to other classes of hydrocarbons.
6. **Alkynes** are the **most reactive** due to the presence of the triple bond.
7. **Alkanes** are **saturated** whereas alkenes and alkynes are unsaturated.
8. They are **insoluble** in water.

4. Explain the chemical properties of ethanol. ※※※

1. Dehydration (Loss of water):

When ethanol is heated with con.H_2SO_4 at 443K, it loses a water molecule i.e., dehydrated to form **ethene.**

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[443K]{Conc.H_2SO_4} \underset{\text{Ethene}}{CH_2=CH_2} + H_2O$$

2. Reaction with sodium:

Ethanol reacts with sodium metal to form **sodium ethoxide** and **hydrogen gas.**

$$2C_2H_5OH + 2Na \longrightarrow \underset{\text{Sodium ethoxide}}{2C_2H_5ONa} + H_2\uparrow$$

3. Oxidation:

1. Ethanol is oxidized to **ethanoic acid** with **alkaline $KMnO_4$** or **acidified $K_2Cr_2O_7$**

$$CH_3CH_2OH \xrightarrow[2[O]]{K_2Cr_2O_7/H^+} \underset{\text{Ethanoic acid}}{CH_3COOH} + H_2O$$

2. During this reaction, the orange colour of $K_2Cr_2O_7$ changes to green.
3. Therefore, this reaction can be used for the **identification** of **alcohols.**

4. Esterification:

1. The reaction of an alcohol with a carboxylic acid gives a compound having **fruity odour.**
2. This compound is called an **ester** and the reaction is called esterification.
3. Ethanol reacts with ethanoic acid in the presence of **conc·H_2SO_4** to form ethyl ethanoate, an ester.

$$\underset{\text{Ethanol}}{C_2H_5OH} + \underset{\text{Ethanoic acid}}{CH_3COOH} \xrightarrow{conc.H_2SO_4} \underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5} + H_2O$$

5. Dehydrogenation:

When the vapour of ethanol is passed over heated **copper**, used as a catalyst at **573 K**, it is dehydrogenated to **acetaldehyde.**

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[573K]{Cu} \underset{\text{Acetadehyde}}{CH_3CHO} + H_2\uparrow$$

6. Combustion:

1. Ethanol is **highly inflammable** liquid.
2. It burns with oxygen to form **carbon - di - oxide** and **water.**

$$\underset{\text{Ethanol}}{C_2H_5OH} + 3O_2 \longrightarrow \underset{\text{Carbon dioxide}}{2CO_2} + \underset{\text{Water}}{3H_2O\uparrow}$$

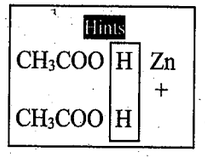
5. Write uses of Ethanol:

1. In medical wipes, as an **antiseptic**.
2. As an **anti – freeze** in automobile radiators.
3. For effectively killing microorganisms like bacteria, fungi, etc., by including it in many hand sanitizers.
4. As an antiseptic to sterilize wounds in hospitals.
5. As a solvent for drugs, oils, fats, perfumes, dyes, etc.,
6. To prepare methylated spirit, rectified spirit, power alcohol and denatured spirit.
7. To enhance the flavor of food extracts.

6. Explain the chemical properties of Ethanoic acid.

1. Reaction with metal:

Ethanoic acid reacts with active metals like Na, Zn, etc., to liberate hydrogen and form sodium ethanoate.

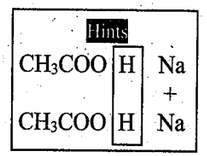


$$2CH_3COOH + Zn \longrightarrow (CH_3COO)_2Zn + H_2\uparrow$$

$$2CH_3COOH + 2Na \longrightarrow 2CH_3COONa + H_2\uparrow$$

2. Reaction with carbonates and bicarbonates:

Ethanoic acid reacts with sodium carbonate and sodium bicarbonate, which are weaker bases and liberates CO_2, with brisk effervescence.

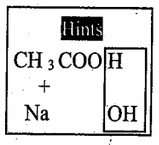


$$2CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + CO_2\uparrow + H_2O$$

$$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + CO_2\uparrow + H_2O$$

3. Reaction with base:

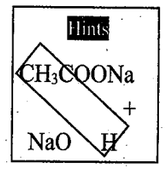
Ethanoic acid reacts with sodium hydroxide to form sodium ethanoate and water.



$$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$$

4. Decarboxylation (Removal of CO_2):

When a sodium salt of ethanoic acid is heated with soda lime (solid mixture of 3 parts of NaOH and 1 part of CaO) methane gas is formed.



$$CH_3COONa \xrightarrow{NaOH/CaO} CH_4\uparrow + Na_2CO_3$$

7. Explain the advantages of detergents over soaps. ※※※

Detergents are better than soaps because they;

1. Can be used in **both hard** and **soft water** and can clean more effectively in hard water than soap.
2. Can also be used in **saline** and **acidic water**.

3. Do not leave any soap scum on the tub or clothes.
4. **Dissolve freely** even in cool water and rinse freely in hard water.
5. Can be used for washing woolen garments, whereas soap cannot be used.
6. Have a linear hydrocarbon chain, which is biodegradable.
7. Are active emulsifiers of motor grease.
8. Do an effective and safe cleansing, keeping even synthetic fabrics brighter and whiter.

IX. Fill in the blanks.

1. Organic compound have a _____ structure. **(complex)**
2. Organic compounds are _____ reactive when compared to inorganic compounds. **(less)**
3. Most of the organic compound form _____ bonds. **(covalent)**
4. Organic compound have _____ melting point when compared to inorganic compounds. **(lower)**
5. Acyclic compounds are also called _____. **(open chain compounds)**
6. _____ compound has one or more double or triple bonds exist between carbon atoms. **(unsaturated)**
7. $CH_3-CH=CH_2$, is a/an _____ carbon compound. **(unsaturated)**
8. Cyclic carbon compounds which contain only carbon atoms are called _____ compounds. **(carbocyclic)**
9. _____ rings contain alternate double lands between carbon atoms. **(Benzene)**
10. _____ compounds are also called closed chain compounds. **(Cyclic)**
11. Organic chemistry is the chemistry of _____ carbon compounds. **(catenated)**
12. If all the carbon atoms in the chain are connected by single bonds, the compound is called as _____. **(saturated)**
13. Organic compounds in which the chain of carbon atoms is closed or cyclic are called _____ compounds. **(cyclic)**
14. Carbocyclic compounds are further subdivided into _____and _____ compounds. **(alicyclic, aromatic)**
15. Alicyclic compounds contain one or more _____ rings. **(carbocyclic)**
16. Aromatic compounds contain one or more _____ rings. **(benzene)**
17. The carbon atoms in organic compounds are linked through _____ bonds. **(covalent)**
18. Ethane is an example of a/an _____carbon compound. **(saturated)**
19. Ethene CH=CH, is an example of a/an _____ carbon compound. **(unsaturated)**
20. The general formula for Alkynes is _____. **(C_nH_{2n-2})**
21. The organic compounds that are composed of only carbon and hydrogen atoms are called _____. **(hydrocarbons)**
22. _____ are hydrocarbons, which contain only single bonds. **(Alkanes)**
23. Hydrocarbons which contain one or more C=C bonds are called _____. **(alkenes)**
24. Hydrocarbons containing carbon to carbon triple bond are called _____. **(alkynes)**
25. _____ is the simplest alkyne. **(Acetylene)**
26. The general formula of Alkanes is _____. **(C_nH_{2n+2})**
27. _____ is the simplest alkane. **(Methane)**
28. The general formula for alkenes is _____ . **(C_nH_{2n})**
29. Lower hydrocarbons are _____ at room temperature. **(gases)**
30. The boiling point of hydrocarbons increases with the number of _____ atoms. **(carbon)**
31. _____ are least reactive when compared to other classes of hydrocarbons. **(Alkanes)**
32. _____ are saturated hydrocarbons. **(Alkanes)**
33. Alkenes and Alkynes are _____. **(hydrocarbons)**
34. The chemical properties of an organic compound depend on its _____ group. **(functional)**
35. A series of compounds containing the same functional group is called a _____ compounds. **(class of organic)**
36. _____ is a group or a class of organic compounds having same general formula and similar chemical properties. **(Homologous series)**
37. Each member of the homologous series differ from the preceding or succeeding member by one _____ group. **(methylene)**

38. Each member of the homologous series differ from the preceding or succeeding member by a molecular mass of _____. **(14 amu)**
39. All members of a homologous series contain the _____ elements. **(same)**
40. The members of the homologous series are represented by a general molecular formula _____. **(C_nH_{2n+2})**
41. The members in each homologous series show a regular gradation in physical properties with an increase in _____. **(molecular mass)**
42. _____ properties of the members of a homologous series are similar. **(Chemical)**
43. Homologous series differ by a _____ group. **(CH_2)**
44. The _____ acid was initially obtained by distillation of 'red ants'. **(formic)**
45. The root words for the parent chain of hydrocarbons containing 1 carbon atom is _____. **(Meth-)**
46. The root words for the parent chain of hydrocarbons containing 6 carbon atom is _____. **(Hex-)**
47. The root words for the parent chain of hydrocarbons containing 9 carbon atom is _____. **(Non-)**
48. Prefix + _____ + Suffix ⟶ IUPAC Name. **(Root word)**
49. A _____ is the basic unit which described the carbon selection. **(root word)**
50. The prefix used for IUPAC substituent -F is _____. **(Fluoro)**
51. The prefix used for IUPAC substituent $-NH_2$ is _____. **(Amino)**
52. The prefix used for IUPAC substituent $-CH_2CH_3$ is _____. **(Ethyl)**
53. The _____ suffix comes after the root world. **(primary)**
54. If all the bonds between the carbon atoms of the parent chain are single, then suffix _____ is used. **(ane)**
55. The secondary suffix describes the _____ group of the compound. **(functional)**
56. The suffix used for class of the compound aldehydes is _____. **(–al)**
57. The suffix used for class of the compound ketones is _____. **(–one)**
58. Ethanol is commonly known as _____. **(alcohol)**
59. All alcoholic beverages and some cough syrups contain _____. **(ethanol)**
60. The molecular formula of ethanol is _____. **(C_2H_5OH)**
61. Ethanol is manufactured by the fermentation of _____. **(molasses)**
62. _____ is a dark coloured syrupy liquid left after the crystallization of sugar from the concentrated sugarcane juice. **(Molasses)**
63. If the nitrogen content of the molasses is poor, it may be fortified by the addition of _____ or _____. **(ammonium sulphate, ammonium phosphate)**
64. The fermented liquid during the formation of ethanol is called _____. **(wash)**
65. The fermented liquid in the formation of ethanol contains 15 to 18% of _____. **(alcohol)**
66. _____ is conversion of complex organic molecules into simpler molecules by the action of enzymes. **(Fermentation)**
67. Curding of milk is an example of _____. **(Fermentation)**
68. The boiling point of ethanol is _____°C. **(78)**
69. When ethanol is heated with con H_2SO_4 at 443K, it loses a _____ molecule. **(water)**
70. Ethanol reacts with _____ metal to form sodium ethoxide and hydrogen gas. **(sodium)**
71. _____ is used in medical wipes, as an antiseptic. **(Ethanol)**
72. Ethanol is used as an _____ in automobile radiators. **(anti - freeze)**
73. Methylated spirit is a mixture of 95% of _____ and 5% of _____. **(ethanol, methanol)**
74. Rectified spirit is mixture of _____ ethanol and _____ of water. **(95.5%, 4.5%)**
75. Power alcohol is a mixture of _____ and ethanol. **(petrol)**
76. Denatured spirit is ethanol mixed with _____. **(pyridine)**
77. Ethanoic acid is also called as _____ acid. **(acetic)**
78. The molecular formula of ethanoic acid is _____. **($C_2H_4O_2$)**
79. On cooling, pure ethanoic acid is _____ to form ice like flakes. **(frozen)**
80. When a sodium salt of ethanoic acid is heated with soda lime _____ gas is formed. **(methane)**
81. _____ acid, in lower concentration, is used as a food additive. **(Acetic)**
82. Ethanoic acid is an important member in the _____ family. **(carboxylic acid)**
83. Ethanoic acid is _____ in taste. **(sour)**
84. _____ acid is also known as glacial acetic acid. **(Ethanoic)**

85. _____ acid is used in the manufacture of plastic. **(Ethanoic)**
86. All the cooking oils and lipids contain _____. **(esters)**
87. _____ is a cleaning agent that is composed of one or more salts of fatty acids. **(Soap)**
88. _____ is a chemical compound or a mixture of chemical compounds, which is used as a cleaning agent. **(Detergent)**
89. Soaps are sodium or potassium salts of some long chain carboxylic acids, called _____ acids. **(fatty)**
90. Soap requires two major raw materials _____ and _____. **(fat, alkali)**
91. The alkali commonly used in the preparation of soap is _____. **(sodium hydroxide)**
92. A _____ based soap creates a more water soluble product than a sodium based soap. **(Potassium)**
93. _____ soaps are used for washing purposes. **(Hard)**
94. _____ soaps are used for cleansing the body. **(Soft)**
95. _____ process is the oldest method in the manufacturing of soap. **(Kettle)**
96. _____, which prevents the corrosion and ensures that the detergent does not damage the washing machine. **(Sodium silicate)**
97. The polar end of a soap molecule is _____ in a nature. **(hydrophilic)**
98. The non - polar end of a soap molecule _____ in a nature. **(hydrophobic)**
99. The _____ part of the soap molecule traps the dirt. **(hydrophobic)**
100. The _____ part of a soap molecule entire molecule soluble in water. **(hydrophilic)**
101. When a soap or detergent is dissolved in water, the molecules join together as clusters called _____. **(micelles)**
102. _____ can be used in both hard and soft water. **(Detergents)**
103. _____ can clean more effectively in hard water than soap. **(Detergents)**
104. _____ do not leave any soap scum on the tub or clothes. **(Detergents)**
105. _____ have a linear hydrocarbon chain, which is biodegradable. **(Detergents)**
106. Detergents are active _____ of motor grease. **(emulsifiers)**
107. _____ have straight hydrocarbon chains, which can be easily degraded by bacteria. **(Biodegradable detergents)**

12. PLANT ANATOMY AND PLANT PHYSIOLOGY

I. Choose the correct answer.

1. Casparian strips are present in the _____ of the root **(JUNE - 2023, GMQ - 2019)**
   a. cortex b. pith c. pericycle d. endodermis
   Ans: d. endodermis

2. The endarch condition is the characteristic feature of ※※ **(APRIL - 2024, MAY & SEP - 2022)**
   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 **(SEP - 2020, GMQ - 2019)**
   a. Carbohydrate b. Ethyl alcohol
   c. Acetyl CoA d. Pyruvate **Ans: b. Ethyl alcohol**

5. Kreb's cycle takes place in ※※ **(APR - 2023, PTA - III)**
   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 - IV)**
   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 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 _____. ※※ **(PTA - V)** **Ans: Cytoplasm**
4. The source of O_2 liberated in photosynthesis is _____. **Ans: 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
   Xylem tissue is involved in the transport of water in plant.
2. The waxy protective covering of a plant is called as cuticle.
   Ans: True

3. In monocot stem cambium is present in between xylem and phloem.
   Ans: False
   In **dicot** stem cambium is present in between xylem and phloem.
4. Palisade parenchyma cells occur below upper epidermis in dicot root.
   Ans: False
   Palisade parenchyma cells occur below upper epidermis in dicot **leaf**.
5. Mesophyll contains chlorophyll.
   Ans: True
6. Anaerobic respiration produces more ATP than aerobic respiration.
   Ans: False
   Anaerobic respiration produces **less** ATP than aerobic respiration.

IV. Match the following.

	Column - I			Column - II			Answers
1.	Amphicribal	-	a.	*Dracaena*	-	c.	**Fern**
2.	Cambium	-	b.	Translocation of food	-	d.	**Secondary growth**
3.	Amphivasal	-	c.	Fern	-	a.	***Dracaena***
4.	Xylem	-	d.	Secondary growth	-	e.	**Conduction of water**
5.	Phloem	-	e.	Conduction of water	-	b.	**Translocation of food**

V. Answer in a sentence.

1. **What is collateral vascular bundle?** ※※
   Ans: A vascular bundle in which **xylem** lies towards the **centre** and **phloem** lies towards the **periphery** is called collateral vascular bundle.
2. **Where does the carbon that is used in photosynthesis come from?**
   Ans: Atmospheric Carbon - di - oxide (CO_2)
3. **What is the common step in aerobic and anaerobic pathway? (PTA - V)**
   Ans: Glycolysis
   ※
4. **Name the phenomenon by which carbohydrates are oxidized to release ethyl alcohol.**
   Ans: Anaerobic respiration or Fermentation

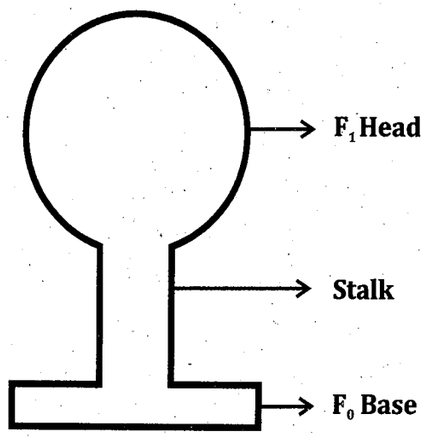
VI. Short answer questions.

1. **Give an account on vascular bundle of dicot stem.**
   1. Vascular bundles of dicot stem are **conjoint**, **collateral**, **endarch** and **open**.
   2. They are arranged in the form of a **ring** around the pith.

2. Write a short note on mesophyll.

1. The tissue present between the **upper** and **lower epidermis** is called mesophyll.
2. It is differentiated into **Palisade** parenchyma and **Spongy** parenchyma in a dicot leaf.
3. Palisade parenchyma are elongated cells with more number of **chloroplasts** and take part in **photosynthesis**.
4. Spongy parenchyma are spherical cells with **intercellular spaces** and helps in **gaseous exchange**.

3. Draw and label the structure of Oxysomes. ※※※ **(JULY - 24, JUNE - 2023)**



Structure of Oxysomes

4. Name the three basic tissue systems in flowering plants. ※ **(APR - 2023)**

1. Dermal or Epidermal tissue system
2. Ground tissue system
3. Vascular tissue system

5. What is photosynthesis and where in a cell does it occur? ※※

Photosynthesis: **(JULY - 24, PTA - III, SEP - 2021)**

1. Photosynthesis is a process by which autotrophic organisms like green plants, algae and chlorophyll containing bacteria utilize the energy from **sunlight** to synthesize their **own food**.

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

2. Photosynthesis takes place in the **chloroplast** of the cell.
3. Photosynthesis occurs in all green parts of the plant especially in green leaves.

6. What is respiratory quotient? ※※ **(AP - 24, PTA - I, SEP - 21 & 22, MAY - 22)**

Respiratory quotient is the ratio of **volume** of **carbon - di - oxide** liberated and the **volume** of **oxygen** consumed during respiration. It is expressed as,

$$RQ = \frac{\text{Volume of } CO_2 \text{ liberated}}{\text{Volume of } O_2 \text{ consumed}}$$

7. Why should the light dependent reaction occur before the light independent reaction? **(APRIL - 2024)**

1. The light independent reactions use the end products **ATP and NADPH+H⁺** of the light dependent reactions to produce Glucose.
2. Light independent reactions use the **energy** (ATP) derived from light dependent reactions.
3. Hence, the light dependent reaction occur before the light independent reaction.

8. Write the reaction for photosynthesis? ※ **(MAY - 2022)**

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

Carbon dioxide + Water ⟶ Glucose + Water + Oxygen

VII. Long answer questions.

1. Differentiate the following ※※※

a. Monocot root and Dicot root **(SEP - 2020, GMQ - 2019)**

	Tissues	Monocot root	Dicot root
1.	Number of Xylem	Polyarch	Tetrarch
2.	Cambium	Absent	Present (During secondary growth only)
3.	Secondary Growth	Absent	Present
4.	Pith	Present	Absent
5.	Conjunctive tissue	Sclerenchyma	Parenchyma
6.	Example	Maize	Bean

b. Aerobic and Anaerobic respiration. ※※ (GMQ - 2019, SEP - 21 & 22)

	Aerobic Respiration		Anaerobic Respiration
1.	Aerobic respiration is a type of cellular respiration that takes place **with** the help of **oxygen**.	1.	Anaerobic respiration takes place **without oxygen**.
2.	Glucose is broken down into carbon - di - oxide, water and energy.	2.	Glucose is converted into **ethanol** by yeast or lactic acid in some bacteria.
3.	It is a complex process.	3.	It is a simpler process.
4.	$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + ATP$	4.	$C_6H_{12}O_6 \longrightarrow 2CO_2 + 2C_2H_5OH + Energy$ (ATP)

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

Cellular respiration:

The biochemical process occurring within cells where the food is oxidized to obtain energy is known as cellular respiration.

Stages of Aerobic respiration:

1. Glycolysis (Glucose splitting):

i. It is the breakdown of **one** molecule of **glucose** (6 carbon) into **two** molecules of **pyruvic acid** (3 carbon).

ii. It takes place in **cytoplasm** of the cell.

2. Krebs cycle:

i. It occurs in the **mitochondrial** matrix.

ii. At the end of glycolysis, 2 molecules of pyruvic acid enter into the mitochondria.

iii. The **oxidation** of pyruvic acid into CO_2 and water takes place through this cycle.

iv. It is also called **Tricarboxylic Acid** cycle.

3. Electron Transport Chain:

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

ii. **NADH+H⁺** and **FADH₂** molecules formed during glycolysis and Krebs cycle are oxidised to **NAD⁺** and **FAD** to release the energy via electrons.

iii. The electrons, move through the system and release energy which is trapped by ADP to synthesize ATP.

iv. This is called **oxidative phosphorylation**.

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

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + ATP$$

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?

Ans: ※

a. Difference between Light dependent and Light independent reactions.

	Light dependent Reaction		Light Independent Reaction
1.	It requires sunlight.	1.	It does not require sunlight.
2.	It takes place in the thylakoid membranes (grana) of the chloroplast.	2.	It takes place in the stroma of the chloroplast.
3.	These reactions use light energy to make ATP and $NADPH+H^+$.	3.	CO_2 is reduced into carbohydrates with the help of ATP and $NADPH+H^+$.

b. Reactants and End products:

	Reactants	End products
Light dependent	Photosynthetic pigment, light, H_2O	ATP, $NADPH+H^+$, $O_2\uparrow$, H_2O
Light independent	CO_2, ATP, $NADPH+H^+$	Glucose

c. Place of occurrence:

Light Dependent : Thylakoid membranes (grana) of the chloroplast.

Light Independent : Stroma of the chloroplast.

VIII. Higher Order Thinking Skills (HOTS).

1. The reactions of photosynthesis make up a biochemical pathway. (PTA - V)

a. What are the end products of light and dark reaction of photosynthesis?

	End products
Light reaction	ATP, NADPH+H$^+$, $O_2\uparrow$, H_2O
Dark reaction	Glucose

b. Explain how the biochemical pathway of photosynthesis recycles many of its own reactions and identify the recycled reactants.

1. The end products ADP, NADP of the light independent reaction are the reactants of the light dependent reaction.
2. ATP and NADPH+H$^+$ formed from light reaction are further converted to ADP and NADP through Calvin cycle.
3. Both **ADP** and **NADP** are recycled back into the light reaction.
4. Recycled reactants - **ADP and NADP**

2. Where do the light dependent reaction and the Calvin cycle occur in the chloroplast?

1. The Light dependent reaction takes place in the **thylakoid membranes (grana)** of the chloroplast.
2. The Calvin cycle takes place in the **stroma** of the chloroplast.

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Short answers.

1. What is vascular bundle? (PTA - 1)

1. Xylem and phloem tissues are present in the form of bundles called vascular bundles.
2. **Xylem** conducts water and minerals to different parts of the plant.
3. **Phloem** conducts food materials to different parts of the plant.

II. Long answers.

1. What are the factors affecting photosynthesis? (SEP - 2022, APR - 2023)

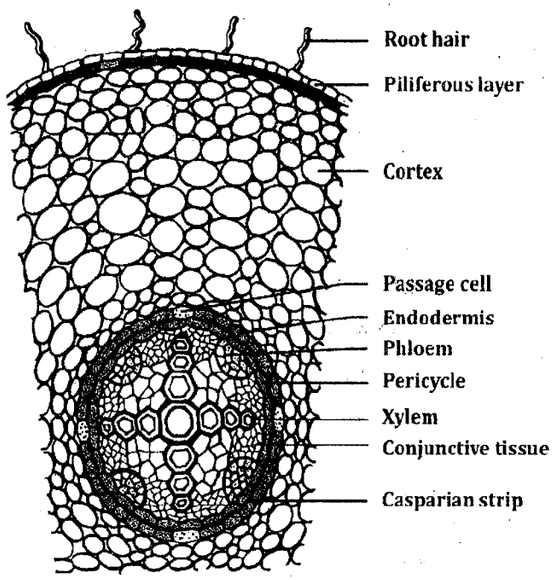
I. Internal Factors:

1. Pigments
2. Leaf age
3. Accumulation of carbohydrates
4. Hormones

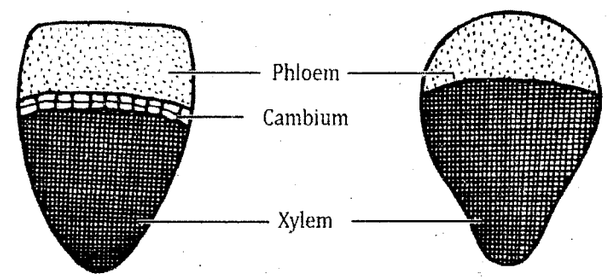
II. External Factors:

1. Light
2. Carbon dioxide
3. Temperature
4. Water
5. Mineral elements

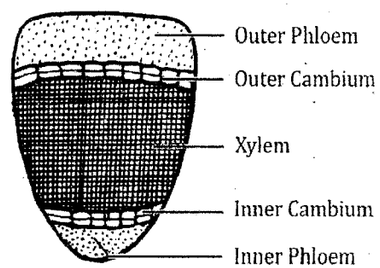
2. Draw the structure of a dicot root and label the parts. (PTA - 6)



3. Draw and label the different types of conjoint vascular bundles. (PTA - 4)



Conjoint, collateral and open **Conjoint, collateral and closed**



Conjoint , Bicollateral

ADDITIONAL QUESTIONS

I. Match the following:

	Column - I		Column - II		Answers
1.	Dermal tissue	- a.	photosynthesis	- d.	**prevention of water loss**
2.	Ground tissue	- b.	dicot stem	- a.	**photosynthesis**
3.	Vascular tissue	- c.	monocot stem	- e.	**transport of food**
4.	Open collateral bundle	- d.	prevention of water loss	- b.	**dicot stem**
5.	Closed collateral bundle	- e.	transport of food	- c.	**monocot stem**

	Column - I		Column - II		Answers
1.	Light reaction	- a.	Green plants	- d.	**ATP**
2.	Calvin cycle	- b.	Power house	- c.	**Glucose**
3.	Photosynthesis	- c.	Glucose	- a.	**Green plants**
4.	Mitochondria	- d.	ATP	- b.	**Power house**
5.	Epidermis	- e.	Epiblema	- f.	**Bulliform cells**
6.	Rhizodermis	f.	Bulliform cells	e.	**Epiblema**

	Column - I		Column - II		Answers
1.	Stroma	- a.	chlorophyll	- b.	**70 Sribosomes**
2.	Chloroplast	- b.	70 S ribosomes	- a.	**chlorophyll**
3.	Thylakoids	- c.	colourless	- d.	**grana**
4.	Grana	- d.	grana	- e.	**Stroma lamella**
5.	Leucoplast	- e.	Stroma lamella	- c.	**colourless**

II. Choose the correct answer:

1. _____ is called the Father of Plant Anatomy.
   a. Sachs b. Robin Hill c. Melvin Calvin d. Nehemiah Grew
   Ans: d. Nehemiah Grew
2. The _____ tissue system consists of Xylem and Phloem.
   a. ground b. dermal c. vascular d. none of the above
   Ans: c. vascular
3. An example of amphicribral vascular bundle is _____.
   a. Dracaena b. Fern c. Cucurbita d. none of the above
   Ans: b. Fern
4. In monocot root casparian strips in the endodermis are bands like thickening made up of _____.
   a. glycogen b. cytoplasm c. suberin d. grana
   Ans: c. suberin
5. All the tissues inner to the endodermis of root constitute the _____.
   a. Cortex b. Epiblema c. Rhizoderm d. Stele
   Ans: d. Stele
6. In a dicot stem, the_____ occurs between vascular bundle and endodermis.
   a. pericycle b. stele c. pith d. epidermis
   Ans: a. pericycle
7. i. In a dicot stem, the hypodermis consists of collenchymatous cells.
   ii. In a monocot stem, the hypodermis consists of sclerenchymatous cells.
   iii. In a dicot stem, pith is absent
   iv. In a monocot stem, pith is present
   a. ii. & iv. are correct b. iii. is correct

   c. i. & ii. are correct d. i. & iii. are correct
   Ans: c. i. & ii. are correct
8. Chloroplasts are present in the _____ cells.
   a. guard b. bulliform c. vascular d. bundle sheath
   Ans: a. guard
9. The vascular bundle is surrounded by a sheath of parenchymatous cells called _____.
   a. bulliform cells b. bundle sheath
   c. protoxylem lacuna d. ground tissue **Ans: b. bundle sheath**
10. The grana in chloroplasts are interconnected by _____.
   a. fret channels b. vascular bundles
   c. accessory pigments d. epidermis **Ans: a. fret channels**
11. Photosynthesis takes place inside the _____.
   a. chloroplast b. mitochondria c. parenchyma d. mesophyll
   Ans: a. chloroplast

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

1. In bicollateral bundle, the xylem is present on both outer and inner side of phloem.
   Ans: False
   In bicollateral bundle, the **phloem** is present on both outer and inner side of **xylem**.
2. In exarch, Protoxylem lies towards the centre and meta xylem lies towards the periphery.
   Ans: False
   In **endrach**, Protoxylem lies towards the centre and meta xylem lies towards the periphery.
3. Thylakoids forms a stack of disc like structures called stroma.
   Ans: False
   Thylakoids forms a stack of disc like structures called **grana**.
4. The inner mitochondrial membrane gives rise to finger like projections called oxysomes.
   Ans: False
   The inner mitochondrial membrane gives rise to finger like projections called **cristae**.
5. Biochemical process occurs within cells where the food is oxidized to obtain energy, this is known as external respiration.
   Ans: False
   Biochemical process occurs within cells where the food is oxidized to obtain energy, this is known as **cellular respiration**.
6. The oxidation of pyruvic acid into CO_2 and water takes place through calvin cycle.
   Ans: False
   The oxidation of pyruvic acid into CO_2 and water takes place through **krebs** cycle.
7. Light reaction takes place in the ribosome of the chloroplast
   Ans: False
   Light reaction takes place in the **grana** of the chloroplast.

IV. Assertion and Reason.

1. **Assertion:** Krebs cycle occurs in the mitochondria matrix.
   Reason : The electrons, as they move through the system, release energy which is trapped by ADP to synthesize ATP.
   a. A and R are correct, R explains A. b. A is correct, R is wrong.
   c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
   Ans: d. A and R are correct, R doesn't explain A.
2. **Assertion:** A cell cannot get its energy directly from glucose.
   Reason : In respiration the energy released from glucose is used to make ATP.

a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.

Ans: a. A and R are correct, R explains A.

3. **Assertion:** Monocot leaf has upper and lower epidermis.
Reason : Each vascular bundle is surrounded by parenchymatous bundle sheath.
a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.

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

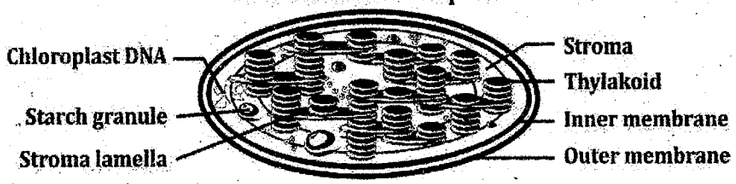
V. Analog

1. Conducts water and minerals : Xylem
   Conducts food materials : _____ **(Phloem)**
2. Xylem surrounds phloem : Amphivassal
   Phloem surrounds xylem : _____ **(amphicribal)**
3. proto xylem lies towards centre : Endarch
   Proto xylem lies towards periphery : _____ **(Exarch)**
4. Four xylem group : tetrarch
   Many xylem group : _____ **(polyarch)**
5. Takes part in photosynthesis : Palisade parenchyma
   Takes part in gaseous exchange : _____ **(Spongy parenchyma)**

VI. To label the parts in the given diagram.

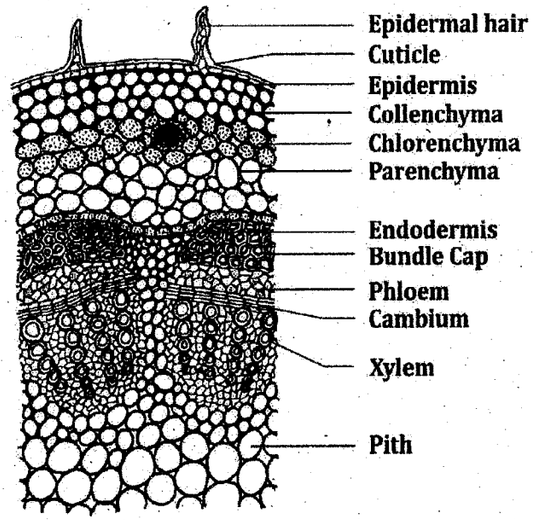
1. Draw the chloroplast and label the parts.

Structure of Chloroplast

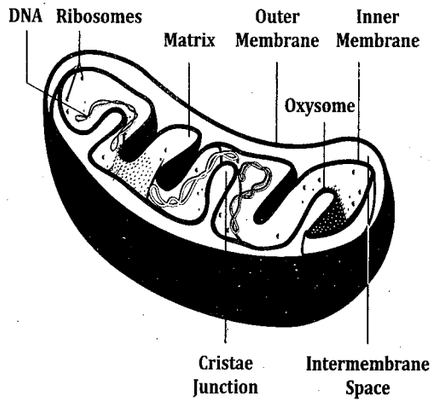


2. Draw the ground plan of T.S. of Dicot stem and label the parts.

Transverse section of Dicot stem

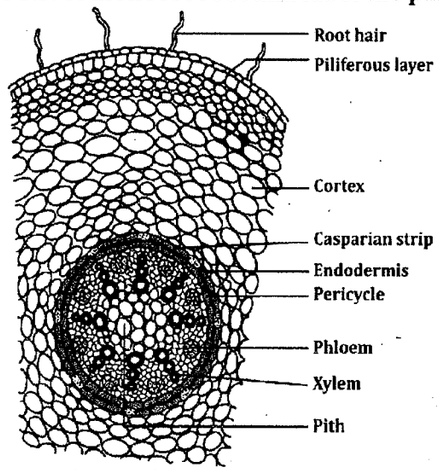


3. Draw the structure of Mitochondria and label the parts.



Structure of Mitochondria

4. Draw the ground plan of T.S. of monocot root and label the parts.



A sector enlarged

Transverse section of Monocot root

VII. Short Answers:

1. Define tissue and mention its types.

1. Tissues are the group of cells that are similar or dissimilar in structure and origin but perform similar function.
2. Plant tissues can be classified into two types,
   1. Meristematic tissue
   2. Permanent tissue

2. Write the functions of epidermal tissue system.

1. Epidermis protects the inner tissues.
2. Stomata helps in transpiration.
3. Root hairs help in absorption of water and minerals.

3. What is concentric bundles? Mention their types.

Vascular bundle in which xylem completely surrounds the phloem or vice versa is called concentric vascular bundle. It is two types:

1. **Amphivasal:**
   Xylem surrounds phloem. **E.g:** Dracaena
2. **Amphicribral:**
   Phloem surrounds xylem. **E.g:** Ferns

4. Differentiate dicot and monocot leaf.

	Dicot leaf	Monocot leaf
1.	It is also known as Dorsiventral leaf.	It is also known as Isobilateral leaf
2.	Mesophyll is differentiated into palisade and spongy parenchyma.	Mesophyll is not differentiated into palisade and spongy parenchyma.

5. What are plastids? Mention its functions and types.

1. Plastids are double membrane bound organelles found in plants and some algae.
2. They are responsible for preparation and storage of food.
3. There are three types of plastids.
   i. Chloroplast - green coloured plastids
   ii. Chromoplast - yellow, red, orange coloured plastids
   iii. Leucoplast - colourless plastids

6. What are the functions of chloroplast?

1. Photosynthesis
2. Storage of starch
3. Synthesis of fatty acids
4. Storage of lipids
5. Formation of chloroplasts.

7. What are the functions of mitochondria?

1. Mitochondria is the main organelle of cell respiration.
2. They produce a large number of ATP molecules.
3. So they are called as power houses of the cell or ATP factory of the cell.
4. It helps the cells to maintain normal concentration of calcium ions.
5. It regulates the metabolic activity of the cell.

8. Write a short note on Anaerobic respiration.

1. Anaerobic respiration takes place without oxygen.
2. Glucose is converted into ethanol or lactic acid.

$$C_6H_{12}O_6 \longrightarrow 2CO_2 + 2C_2H_5OH + \text{Energy (ATP)}$$

9. How does the endarch differ from exarch?

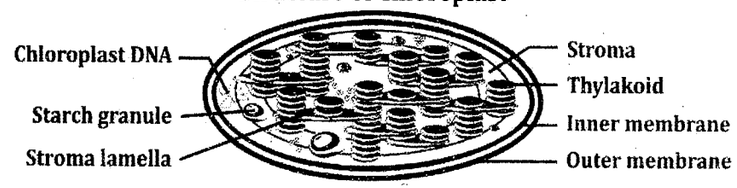
	Endarch	Exarch
1.	Protoxylem lies towards the centre and meta - xylem lies towards the periphery.	Protoxylem lies towards the periphery and meta - xylem lies towards the centre.
2.	**E.g:** Stem	**E.g:** Roots

VIII. Long Answers:

1. Explain the structure of chloroplast.

1. Chloroplasts are green plastids containing green pigment called chlorophyll.
2. Chloroplasts are oval shaped organelles having a diameter of 2 - 10 micrometer and a thickness of 1 - 2 micrometer.

Structure of Chloroplast



a. Envelope:

Chloroplast envelope has outer and inner membranes which is separated by intermembrane space.

b. Stroma:

i. Matrix present inside to the membrane is called stroma.
ii. It contains DNA, 70 S ribosomes and other molecules required for protein synthesis.

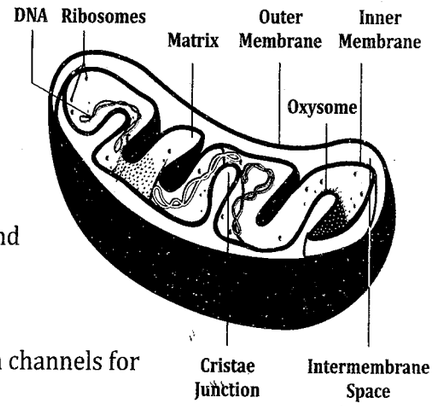
c. Thylakoids:

i. It consists of thylakoid membrane that encloses thylakoid lumen.
ii. Thylakoids forms a stack of disc like structures called a grana (singular - granum).

d. Grana:

i. Thylakoids are arranged in the form of discs stacked one above the other called granum.
ii. They are interconnected by Stroma lamella.

2. Explain the structure of Mitochondria.



Structure of Mitochondria

a. Mitochondrial membranes:

1. It consists two membranes called inner and outer membrane.
2. Each membrane is 60 - 70 Å thick.
3. Outer mitochondrial membrane is smooth and freely permeable to most small molecules.
4. It contains enzymes, proteins and lipids.
5. It has porin molecules (proteins) which form channels for passage of molecules through it.
6. Inner mitochondrial membrane is semi permeable membrane and regulates the passage of materials into and out of the mitochondria.
7. It is rich in enzymes and carriers proteins.

8. It consists of 80% proteins and lipids.

b. Cristae:

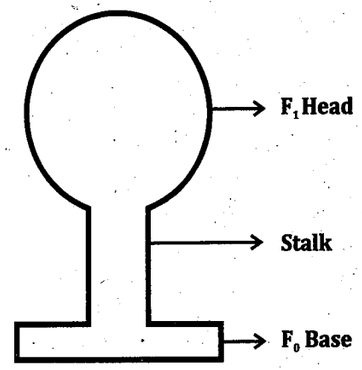
1. The inner mitochondrial membrane gives rise to finger like projections called cristae.
2. These cristae increase the inner surface area (fold in inner membrane) of the mitochondria to hold variety of enzymes.

c. Oxysomes:

1. The inner mitochondrial membrane bear minute regularly spaced tennis racket shaped particles known as oxysomes (F_1 particle).
2. They involve in ATP synthesis.

d. Mitochondrial matrix:

1. It is a complex mixture of proteins and lipids.
2. Matrix contains enzymes for Krebs cycle, mitochondrial ribosomes (70 S), tRNAs and mitochondrial DNA.



Structure of Oxysomes

3. Differentiate dicot and monocot stem.

	Tissues	Dicot stem	Monocot stem
1.	Hypodermis	collenchymatous	sclerenchymatous
2.	Ground tissue	Differentiated into cortex, endodermis, pericycle and pith	undifferentiated
3.	Vascular bundles	1. Less in number 2. uniform in size 3. arranged in a ring 4. open 5. bundle sheath absent	1. numerous 2. smaller near periphery, bigger in the centre 3. scattered 4. closed 5. bundle sheath present
4.	Secondary growth	present	mostly absent
5.	Pith	present	absent
6.	Medullary rays	present	absent

4. Explain the T.S. of a dicot root with suitable diagram. (PTA - VI)

I. Epiblema:

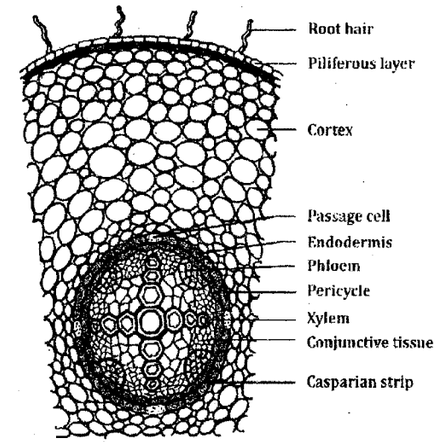
1. It is the outermost layer.
2. Cuticle and stomata are absent.
3. It is also known as rhizodermis or piliferous layer.

II. Cortex:

1. It is a multilayered, made up of thin walled parenchymatous cells with intercellular spaces.
2. It stores food and water.

III. Endodermis:

1. It is the innermost layer of cortex made up of barrel - shaped, closely packed cells.
2. Band like thickenings on their radial and inner tangential walls called "Casparian strips".
3. It helps in the movement of water from cortex to xylem.



Transverse section of Dicot root

IV. Stele:

It includes pericycle and vascular bundle.

a. Pericycle:

1. Inner to endodermis lies a single large of pericycle.
2. It is the site of origin of lateral roots.

b. Vascular bundle:

1. It is radial, xylem tissue and phloem tissue in alternate radii.
2. Xylem is tetrach and exarch.
3. The parenchyma tissue present between xylem and phloem is called conjunctive tissue.

c. Pith: Pith is present in young root and absent in old root.

IX. Fill in the blanks.

1. _____is the study of internal structure of plants. **(Plant anatomy)**
2. _____ are the group of cells that are similar or dissimilar in structure and origin, but perform similar function. **(Tissues)**
3. The first account on internal structure of plants was published by _____. **(Nehemiah Grew)**
4. _____ is called the Father of Plant Anatomy. **(Nehemiah Grew)**
5. Sachs classified tissue system of plants into _____ types. **(three)**
6. Dermal tissue is also called the _____ tissue. **(epidermal)**
7. The epidermal tissue system consists of epidermis, stomata and _____. **(epidermal outgrowths)**
8. _____ is the outermost layer of the tissue system. **(Epidermis)**
9. Parenchyma, collenchyma and sclerenchyma are present in the _____ tissue system. **(ground)**
10. Xylem and phloem are _____ tissues. **(vascular)**
11. The _____ tissue system helps in the transport of water and food. **(vascular)**
12. The _____ tissue system helps in protection and prevention of water loss. **(dermal)**
13. The _____ is present on the outer wall of the epidermis. **(cuticle)**
14. The _____ checks the evaporation of water. **(cuticle)**
15. _____ and root hairs are the epidermal outgrowths. **(Trichomes)**
16. Radial, conjoint and concentric are the types of _____ bundles. **(vascular)**
17. An example of an open collateral bundle is _____. **(dicot stem)**
18. An example of a closed collateral bundle is _____. **(monocot stem)**
19. In a closed collateral bundle, the cambium is _____. **(absent)**
20. _____ bundles are divided into amphivasal and amphicribral. **(Concentric)**
21. When the xylem surrounds the phloem it is called _____ bundle. **(amphivasal)**
22. When the phloem surrounds the xylem it is called _____ bundle. **(amphicribral)**
23. A vascular tissue bundle is called _____ if the protoxylem lies towards the centre and metaxylem towards the periphery. **(endarch)**
24. A vascular tissue bundle is called _____ if the protoxylem lies towards the periphery and metaxylem towards the centre. **(exarch)**

25. The epidermis protects the _____ tissues. **(inner)**
26. Stomata helps in _____. **(transpiration)**
27. _____ help in absorption of water and minerals. **(Root hairs)**
28. The vascular tissue system consists of _____ and _____ tissues. **(xylem, phloem)**
29. There are _____ different types of vascular bundles. **(three)**
30. An example of an endarch tissue system is _____. **(stem)**
31. An example of an amphivasal bundle is _____. **(dracaena)**
32. The outermost layer of a dicot root is called Rhizodermis or _____ layer. **(piliferous)**
33. The _____ is a multilayered large zone of thin walled parenchymatous cells with intercellular spaces. **(cortex)**
34. The _____ is the inner most layer of the cortex. **(endodermis)**
35. The cells of the endodermis show band like thickenings on their radial and inner tangential walls called _____. **(casparian strips)**
36. In a dicot root, the xylem is _____ and _____. **(exarch, tetrach)**
37. In a dicot root, the conjunctive tissue is made up of _____. **(parenchyma)**
38. In young roots pith is _____. **(present)**
39. All tissues inner to endodermis of a dicot root constitute _____. **(stele)**
40. The stele in a dicot root includes the _____ and _____. **(pericycle, vascular bundle)**
41. The _____ in dicot roots is the site of origin of lateral roots. **(pericycle)**
42. The tissue present between xylem and phloem is called _____ tissue. **(conjunctive)**
43. The hypodermis in dicot stem consists of 3 - 6 layers of _____ cells. **(collenchyma)**
44. In a dicot stem, the _____ cells provide mechanical support. **(collenchyma)**
45. Casparian strips in the endodermis are band like thickening made of _____. **(suberin)**
46. All the tissues inner to endodermis of root constitute _____. **(stele)**
47. The stele in monocot roots consists of pericycle, vascular tissues and _____. **(pith)**
48. In monocot roots, xylem and phloem are arranged _____. **(radially)**
49. The _____ of a dicot stem is protective in function. **(epidermis)**
50. The cortex of a dicot stem is divided into _____ regions. **(three)**
51. The_____ in monocot roots contain starch grains. **(pith)**
52. The middle cortex in a dicot stem consists of _____ cells. **(chlorenchyma)**
53. The endodermis in a dicot stem is also known as _____. **(starch sheath)**
54. The _____ in dicot stem is multilayered, parenchymatous with alternating patches of sclerenchyma. **(pericycle)**
55. In a monocot stem, the _____ cells provide mechanical support. **(sclerenchyma)**
56. _____ is the inner most layer of cortex in a dicot stem. **(Endodermis)**
57. The _____ occurs between vascular bundle and endodermis. **(pericycle)**
58. The large central parenchymatous zone with intercellular spaces is called _____. **(pith)**
59. _____ are skull shaped vascular tissues, found scattered in the ground tissue. **(Vascular bundles)**
60. Each vascular bundle is surrounded by few layer sclerenchyma cells called_____. **(bundle sheath)**
61. In mature vascular bundle, the lower most protoxylem disintegrates and forms a cavity called _____. **(protoxylem lacuna)**
62. Phloem consists of _____ elements and _____ cells. **(sieve tube, companion)**
63. In a dicot leaf, the _____ is the outermost layer made of single layered parenchymatous tissues. **(upper epidermis)**
64. Chloroplasts are present only in _____ cells. **(guard)**
65. The tissue present between the upper and lower epidermis of a dicot leaf is called _____. **(mesophyll)**
66. In a dicot leaf, each vascular bundle consists of _____ lying towards the upper epidermis and _____ towards the lower epidermis. **(xylem, phloem)**
67. A monocot leaf is also known as _____. **(isobilateral leaf)**
68. A dicot leaf is also known as _____ leaf. **(dorsiventral)**
69. In a dicot leaf, the _____parenchyma take part in photosynthesis. **(palisade)**
70. In a dicot leaf, the _____ parenchyma helps in gaseous exchange. **(spongy)**
71. The mesophyll in a dicot leaf is differentiated into _____ and _____ parenchyma. **(palisade, spongy)**
72. The mesophyll of a monocot leaf contains _____. **(chloroplasts)**

73. In a monocot leaf, the upper epidermis of some cells are large and thin walled, known as _____ cells. **(bulliform)**
74. _____ are double membrane bound organelles found in plants and some algae. **(Plastids)**
75. _____ are responsible for preparation and storage of food. **(Plastids)**
76. There are _____ types of plastids. **(three)**
77. _____ are green coloured plastids. **(Chloroplast)**
78. _____ are colourless plastids. **(Leucoplast)**
79. Chloroplasts are green plastids containing green pigment called _____. **(chlorophyll)**
80. Chloroplasts are _____ shaped organelles. **(oval)**
81. _____ forms a stack of disc like structures called a grana. **(Thylakoids)**
82. The stacks of grana are interconnected to each other by _____ channels. **(fret)**
83. The chloroplasts have a diameter of _____ micrometer. **(2 - 10)**
84. The outer and inner membrane of a chloroplast are separated by a _____ space. **(intermembrane)**
85. The matrix of a chloroplast contains _____ S ribosomes. **(70)**
86. In _____ carbon dioxide combines with water in the presence of sunlight and chlorophyll to form carbohydrates. **(photosynthesis)**
87. During photosynthesis _____ is released as a byproduct. **(oxygen)**
88. _____ occurs in green parts of the plant such as leaves. **(Photosynthesis)**
89. Pigments involved in photosynthesis are called _____. **(photosynthetic pigments)**
90. _____is the primary pigment that traps solar energy and converts it into electrical and chemical energy. **(Chlorophyll a)**
91. Pigments such as chlorophyll b and carotenoids are called _____. **(accessory pigments)**
92. Reaction centres and the accessory pigments together are called _____. **(photosystems)**
93. The entire process of photosynthesis takes place inside the _____. **(chloroplast)**
94. Hill's reaction was discovered by _____. **(Robin Hill)**
95. Light reaction takes place in the presence of light energy in _____ membranes of the chloroplasts. **(thylakoid)**
96. In respiration the energy released from _____ is used to make ATP. **(glucose)**
97. Calvin cycle is carried out in the _____ of light. **(absence)**
98. Mitochondria was first discovered by _____. **(Kolliker)**
99. _____ are organelles within eukaryotic cells that produce ATP. **(Mitochondria)**
100. _____ is referred to as the Power house of the cell. **(Mitochondria)**
101. Mitochondria contains_____% protein. **(60 - 70)**
102. The _____ mitochondrial membrane is semi permeable membrane and regulates the passage of materials into and out of the mitochondria. **(inner)**
103. _____ was conferred the Bharat Ratna for his contribution of artificial photosynthesis. **(C.N.R. Rao)**
104. The inner mitochondrial membrane gives rise to finger like projections called _____. **(cristae)**
105. The inner mitochondrial membrane bear minute regularly spaced tennis racket shaped particles known as _____. **(oxysomes)**
106. The mitochondrial matrix is a complex mixture of _____ and _____. **(proteins, lipids)**
107. Mitochondria is the main organelle of _____. **(cell respiration)**
108. The _____ regulates the metabolic activity of the cell. **(mitochondria)**
109. Krebs cycle occurs in _____ matrix. **(mitochondria)**
110. _____ means glucose splitting. **(Glycolysis)**
111. Glycolysis is the breakdown of one molecule of glucose into two molecules of _____. **(pyruvic acid)**
112. The movement of electrons in the electron transport chain is called _____. **(oxidative phosphorylation)**
113. Krebs cycle is also called _____. **(Tricarboxylic Acid Cycle)**
114. Anaerobic respiration takes place without _____. **(oxygen)**
115. _____ is the ratio of volume of carbon dioxide liberated and the volume of oxygen consumed during respiration. **(Respiratory quotient)**
116. During anaerobic respiration _____ is converted into ethanol or lactic acid. **(glucose)**
117. Light reaction takes place in _____ of chloroplast. **(grana)**
118. Dark reaction takes place in _____ of chloroplast. **(stroma)**
119. _____ involves both external and cellular respiration. **(Respiration)**

13. STRUCTURAL ORGANISATION OF ANIMALS

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 _____.**Ans: sanguivorous (PTA - V)**

5. _____ separate nitrogenous waste from the blood in rabbit. ※※
   Ans: kidney

6. _____ spinal nerves are present in rabbit. ※※ **Ans: 37 pairs**

III. Identify whether the statements are True or False. Correct the false statement.

1. An anticoagulant present in saliva of leech is called heparin.
   Ans: False
   An anticoagulant present in saliva of leech is called **hirudin**.

2. The vas deferens serves to transport the ovum. **(PTA - VI)**
   Ans: False
   The vas deferens serves to transport the **sperm**.

3. Diastema is a gap between premolar and molar teeth in rabbit.
   Ans: False
   Diastema is a gap between premolar and **incisor** teeth in rabbit.

4. The cerebral hemispheres of rabbit are connected by band of nerve tissue called corpora quadrigemina. **(PTA - VI)**
   Ans: False
   The cerebral hemispheres of rabbit are connected by band of nerve tissue called **corpus callosum**.

IV. Match the following. (PTA - II)

Organs		Membranous covering			Location		
1.	Brain	-	a.	pleura	-	A.	abdominal cavity
2.	Kidney	-	b.	capsule	-	B.	mediastinum
3.	Heart	-	c.	meninges	-	C.	enclosed in thoracic cavity
4.	Lungs	-	d.	pericardium	-	D.	cranial cavity

Answers.

Organs		Membranous covering			Location		
1.	Brain	-	**c.**	**meninges**	-	**D.**	**cranial cavity**
2.	Kidney	-	**b.**	**capsule**	-	**A.**	**abdominal cavity**
3.	Heart	-	**d.**	**pericardium**	-	**B.**	**mediastinum**
4.	Lungs	-	**a.**	**pleura**	-	**C.**	**enclosed in thoracic cavity**

V. Answer in a sentence.

1. Give the common name of the *Hirudinaria granulosa*. ※※※

Ans: Indian Cattle Leech

2. How does leech respire? **(PTA - I)**

Ans: Respiration takes place through the **skin** in leech.

3. Write the dental formula of rabbit. ※※ **(APRIL - 2024, GMQ - 2019)**

Ans: Dental formula is $I\frac{2}{1}, C\frac{0}{0}, PM\frac{3}{2}, M\frac{3}{3}$ in rabbit. It is written as $\frac{2033}{1023}$

4. How many pairs of testes are present in leech?

Ans: **Eleven** pairs

5. How is diastema formed in rabbit? ※ **(PTA - VI)**

1. Due to the **absence** of **canines**, a gap is formed.
2. The **gap** in between the **incisors** and **premolar** is called diastema.

6. What organs are attached to the two bronchi?

Ans: Lungs.

7. Which organ acts as suction pump in leech?

Ans: Muscular pharynx.

8. What does CNS stand for? **(JULY - 2023)**

Ans: CNS - Central nervous system

9. Why is the teeth of rabbit called heterodont? **(PTA - IV)**

In rabbit the teeth are of **different** types. Hence, the dentition is called heterodont.

10. How does leech suck blood from the host? ※※ **(PTA - II)**

1. The leech makes a **triradiate** or Y shaped incision in the skin of the host by the jaws protruded through its mouth.
2. The blood is sucked by **muscular pharynx** and the salivary secretion **hirudin** is poured.

VI. Short answer questions. ※

1. Why are the rings of cartilages found in trachea of rabbit? **(SEP - 2020, PTA - IV)**

Tracheal walls are supported by rings of cartilage which help in the **free passage of air**.

2. List out the parasitic adaptations in leech. **(APR - 2023, GMQ - 2019)**

1. Blood is sucked by **pharynx** and stored in the **crop**.
2. The three jaws inside the mouth, causes a painless **Y - shaped** wound in the skin of the host.
3. **Anterior** and **posterior** ends of the body are provided with sucker by which the animal attaches itself to the body of the host.
4. The salivary glands produce **hirudin** which does not allow the blood to coagulate. – to become thick or partly solid
5. Thus, a **continuous supply** of the blood is maintained.

VII. Long answer questions.

1. How is the circulatory system designed in leech to compensate the heart structure?

Circulatory system:

1. In leech, circulation is brought about by **haemocoelic** system.
2. There are **no true** blood vessels.
3. The blood vessels are replaced by channels called **haemocoelic channels** or canals filled with blood like fluid.
4. The coelomic fluid contains **haemoglobin**.
5. There are **four** longitudinal channels.
6. **First channel** - lies **above** the alimentary canal.
7. **Second channel** - lies **below** the alimentary canal.
8. **Third and Fourth channels:**

   They lie on **either side** of the **alimentary** canal which serves as **heart** and **inner** valves.
9. All the four channels are connected together posteriorly in the **26th segment**.

2. How does locomotion take place in leech? ※※ **(PTA - V)**

Locomotion in leech takes place by

1. Looping or crawling movement:

1. This type of movement is brought about by the **contraction** and **relaxation** of **muscles.**
2. The **two suckers** serve for attachment during **movement** on a substratum.

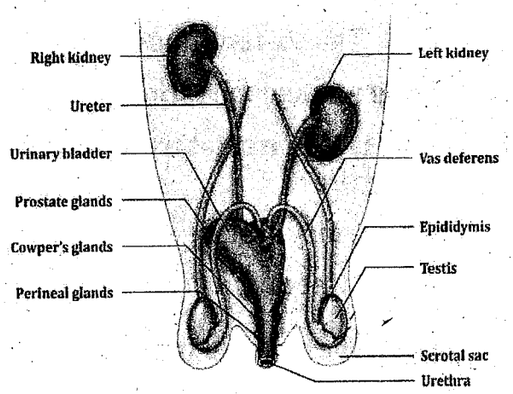
2. Swimming movement:

Leeches swim **very actively** and perform **undulating** movement in water.

3. Explain the male reproductive system of rabbit with a labelled diagram. ※※※

Male reproductive system:

1. Consists of a **pair** of **testes** which are **ovoid** in shape.
2. Testes are enclosed by **scrotal sacs** in the abdominal cavity.
3. Each testis consists of numerous fine tubules called **seminiferous tubules.**
4. This network of tubules lead into a coiled tubule called **epididymis.**



Male reproductive system of Rabbit

5. It leads into the sperm duct called **vas deferens.**
6. The vas deferens join into the urethra just below the **urinary bladder.**
7. The urethra runs backward and passes into the penis.
8. There are three accessory glands namely
   i. **prostate gland**
   ii. **cowper's gland**
   iii. **perineal gland**
9. 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?

1. Leeches inject an anaesthetic substance that prevents the host from feeling their bite.
2. Hence the leech bite could not be felt as soon as it attaches to the skin.

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?

1. Grandfather explained, in rabbit the teeth are of different types. They are
2. Incisors (I), Premolar (PM) and Molars (M)
3. Canines are absent.
4. The gap between the incisors and premolar is called diastema.
5. It helps in mastication and chewing of food in rabbit.

IX. Value based questions.

1. Leeches do not have an elaborate secretion of digestive juices and enzymes - Why?

1. The Blood sucked by the leech is stored in the crop.
2. It gives nourishment to the leech for several months.
3. Due to this reason, leeches do not have an elaborate secretion of the digestive juices and enzymes. **(PTA - III)**

2. How is the digestive system of rabbit suited for herbivorous mode of feeding?

Digestive system of rabbit suited for herbivorous mode of feeding due to the following reasons,

1. Absence of Canines.
2. The gap between the incisors and premolar called diastema, helps in mastication and chewing of food in herbivorous animals.
3. Further the caecum contains bacteria that helps in the digestion of cellulose.

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

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**

II. Short answers.

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.

ADDITIONAL QUESTIONS

I. Match the following:

I.	Column - I	Column - II	Answers
1.	Larynx	a. wind pipe	c. voice box
2.	Trachea	b. active	a. wind pipe
3.	Inspiration	c. voice box	b. active
4.	Expiration	d. pericardium	e. passive
5.	Heart	e. passive	d. pericardium

II.	Column - I	Column - II	Answers
1.	Lungs	a. tricuspid valve	c. pleura
2.	Auriculoventricular aperture	b. mitral valve	a. tricuspid valve
3.	Bicuspid valve	c. pleura	b. mitral valve
4.	Prosencephalon	d. hindbrain	e. forebrain
5.	Mesencephalon	e. forebrain	f. midbrain
6.	Rhombencephalon	f. midbrain	d. hindbrain

III.	Column – I	Column - II	Answers
1.	Accessory gland	a. prosencephalon	d. cowper's gland
2.	Forebrain.	b. hirudin	a. prosencephalon
3.	Blood clotting	c. skin	b. hirudin
4.	Digestion	d. cowper's gland	e. proteolytic enzyme
5.	Respiration	e. proteolytic enzyme	c. skin

IV.	Column - I	Column - II	Answers
1.	Mouth	a. haemocoelic	e. triradiate
2.	Circulation	b. egg case	a. haemocoelic
3.	Excretion	c. ejaculatory duct	d. nephridia
4.	Epididymis	d. nephridia	c. ejaculatory duct
5.	Cocoon	e. triradiate	b. egg case

V.	Column - I	Column - II	Answers
1.	Salivary gland	a. mesencephalon	b. Hirudin
2.	Oryctolagus cuniculus	b. Hirudin	c. Rabbit
3.	Hirudinaria granulosa	c. Rabbit	e. Indian cattle leech
4.	Midbrain	d. medulla oblongata	a. mesencephalon
5.	Hindbrain	e. Indian cattle leech	d. medulla oblongata

II. Choose the correct answer:

1. The animals which give birth to young ones are
   a. Oviparous b. Viviparous
   c. Ovoviviparous d. All the above **Ans: b. Viviparous**
2. The _____ region of a leech consists of 12th - 22nd segments.
   a. cephalic b. clitellar c. pre - clitellar d. middle
   Ans: d. middle
3. The body wall of a leech comprises of _____ layers
   a. four b. five c. three d. two **Ans: b. five**
4. The salivary secretion of leech contains _____.
   a. blood b. crop c. hirudin d. proteolytic enzyme
   Ans: c. hirudin
5. Which statement is / are incorrect?
   i. The stomach of a leech is a triradiate aperture.
   ii. The buccal cavity of a leech leads into a muscular larynx.
   iii. Crop is the smallest portion of the alimentary canal in a leech.
   iv. The last chamber of crop in a leech, opens into the anus.
   a. i is incorrect b. all are incorrect
   c. i & iii are incorrect d. ii & iv are incorrect **Ans: b. all are incorrect**
6. The epididymis in a leech leads to a small duct called _____.
   a. genital atrium b. vas deferens
   c. ejaculatory duct d. none of the above **Ans: c. ejaculatory duct**
7. _____ is a technique of bleeding in a patient to remove the toxic impurities caused due to leech bite.
   a. Blood circulation b. Blood fusion
   c. Blood transfusion d. Blood letting **Ans: d. Blood letting**
8. The _____ glands in a rabbit secrete milk and nourish the young ones.
   a. sweat b. salivary c. mammary d. sebaceous
   Ans: c. mammary
9. On the lower side of the thoracic cavity, is the dome shaped _____.
   a. lungs b. liver c. heart d. diaphragm
   Ans: d. diaphragm
10. The lungs of a rabbit are enclosed by a membrane called _____.
    a. cardiac muscle b. pleura c. pericardium d. meninges
    Ans: b. pleura
11. The peripheral nervous system in a rabbit consists of _____ pairs of cranial nerves.
    a. 21 b. 14 c. 12 d. 37 **Ans: c. 12**
12. The right and left hemispheres in the brain of a rabbit are connected by _____.
    a. diencephalon b. corpus callosum
    c. duramater d. none of the above **Ans: b. corpus callosum**

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

1. In leech the chambers communicate with one another through circular apertures called rectum.
   Ans: False
   In leech the chambers communicate with one another through circular apertures called **sphincters**.
2. In leech, excretion takes place by segmentally arranged paired tubules called neurons.
   Ans: False
   In leech, excretion takes place by segmentally arranged paired tubules called **nephridia**.

3. In rabbit from each side of the upper lip pinnae project outwards.
   Ans: False In rabbit from each side of the upper lip **vibrissae** project outwards.
4. In rabbit, breathing movements are brought by the movement of the diaphragm.
   Ans: True
5. In rabbit, oesophagus opens into the stomach followed by large intestine.
   Ans: False In rabbit, oesophagus opens into the stomach followed by **small** intestine.
6. In rabbit, each lung is enclosed by a double membranous pleura.
   Ans: True
7. A pair of Cowper's gland and perineal gland are the accessory glands present in the male reproductive system.
   Ans: False
   A pair of Cowper's gland and perineal gland are the accessory glands present in the **female** reproductive system.
8. Canine are present in rabbit.
   Ans: False Canine are **absent** in rabbit.

IV. Assertion and Reason.

1. **Assertion:** Mouth is a transverse slit bounded by upper and lower lips.
   Reason : It leads into the buccal cavity.
   a. If both A and R are true and R is correct explanation of A.
   b. If both A and R are true but R is not the correct explanation of A.
   c. A is true but R is false.
   d. Both A and R are false.
   Ans: a. If both A and R are true and R is correct explanation of A.
2. **Assertion:** The secretions of digestive glands help in digestion of food in the alimentary canal.
   Reason : Teeth are hard bone - like structures used to cut, tear and grind food materials.
   a. If both A and R are true and R is correct explanation of A.
   b. If both A and R are true but R is not the correct explanation of A.
   c. A is true but R is false.
   d. Both A and R are false.
   Ans: b. If both A and R are true but R is not the correct explanation of A.
3. **Assertion:** The gap between the canines and premolar is called diastema.
   Reason : It helps in mastication and chewing of food in herbivorous animals.
   a. If both A and R are true and R is correct explanation of A.
   b. If both A and R are true but R is not the correct explanation of A.
   c. A is false but R is true.
   d. Both A and R are false. **Ans: c. A is false but R is true.**
4. **Assertion:** Tracheal walls are supported by rings of cartilage.
   Reason : It helps in the free passage of air.
   a. If both A and R are true and R is correct explanation of A.
   b. If both A and R are true but R is not the correct explanation of A.
   c. A is true but R is false.
   d. Both A and R are false.
   Ans: a. If both A and R are true and R is correct explanation of A.

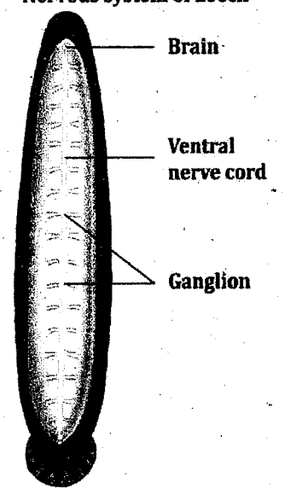
V. Analog

1. Male genital spore : 10th segment
   Female genital spore : _____ **(11th segment)**

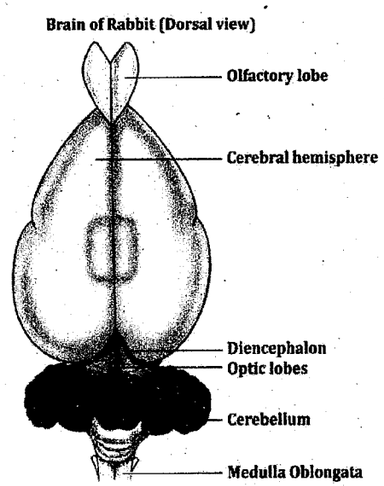
2. First five segments : anterior sucker
   Last seven segments : _____ **(posterior sucker)**
3. Right side heart : Tricuspid valve
   Left side heart : _____ **(Bicuspid valve)**
4. Precaval : Superior vena cava
   Post caval : _____ **(Inferior vena cava)**
5. Outer region of brain : duramater
   Inner region of brain : _____ **(piamater)**
6. Fore brain : prosencephalon
   Hind brain : _____ **(rhombencephalon)**

VI. To label the parts in the given diagram.

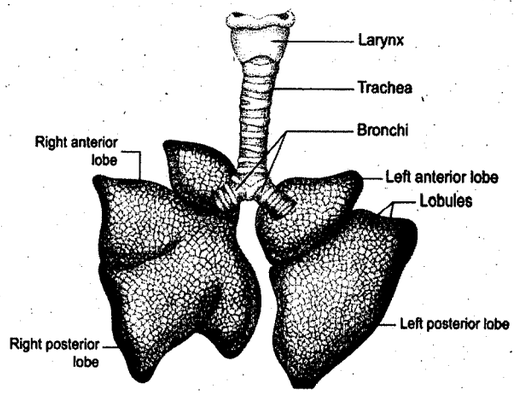
1. **Draw the structure of Leech Nervous system and label its parts.**



2. **Draw the structure of Rabbit brain and label its parts.**



3. Draw the structure of Rabbit lungs and label its parts



Lungs of Rabbit

VII. Short Answers:

1. Write the taxonomic position in leech.

Phylum - Annelida
Class - Hirudinea
Order - Gnathobdellida
Genus - *Hirudinaria*
species - *granulosa*

2. List out the various regions of a leech with respect to their segments.

	Region	Segments
1.	Cephalic region	1st- 5th
2.	Pre - clitellar region	6th, 7th and 8th
3.	Clitellar region	9th, 10th and 11th
4.	Middle region	12th - 22nd
5.	Caudal region	23rd - 26th
6.	Posterior sucker	27th - 33rd

3. What is called Hirudin?

Leeches prevent **blood clotting** by secreting a **protein** called Hirudin.

4. What is called nephridia?

1. In leech, excretion take place by segmentally arranged paired tubules called nephridia.
2. There are 17 pairs of nephridia which open out by nephridiopores from 6th to 22nd segments.

5. Mention the important medicinal value of leech?

1. They can be used to treat cardiovascular disease.
2. Bio chemical substances derived from leech saliva are used for preparation of pharmaceutical drugs that can treat hypertension.

6. Write the taxonomic position of rabbit.

1.	Phylum	Chordata
2.	Sub phylum	Vertebrata
3.	Class	Mammalia
4.	Order	Lagomorpha
5.	Genus	*Oryctolagus*
6.	Species	*cuniculus*

7. What are the three regions present in the rabbit's brain?

The brain of a rabbit is divided into,

1. Fore brain - Prosencephalon
2. Mid brain - Mesencephalon
3. Hindbrain - Rhombencephalon

8. What is called corpus callosum in rabbit?

The right and left cerebral hemispheres of the brain are connected by transverse band of nerve tissue called corpus callosum.

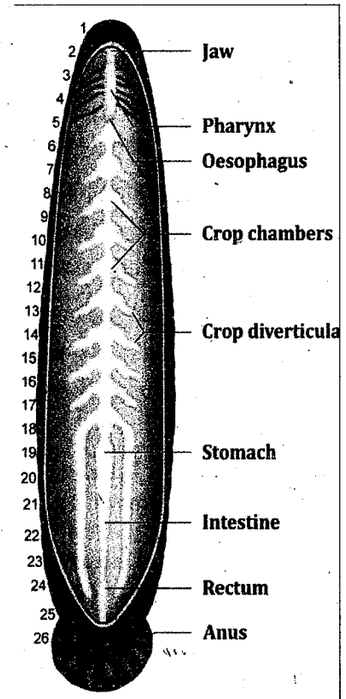
VIII. Long Answers:

1. Describe the structure of digestive system in leech.

The digestive system includes the long alimentary canal and the digestive glands.

Alimentary canal:

1. The alimentary canal of leech is a straight tube running from the mouth to the anus.
2. Mouth is a triradiate aperture situated in the middle of the anterior sucker that leads into the small buccal cavity.
3. The wall of the buccal cavity bears three jaws with single row of minute teeth.
4. The jaws are provided with papillae which bear the openings of salivary glands.
5. Mouth and buccal cavity occupy the first five segments.
6. The buccal cavity leads into muscular pharynx.



Digestive system of Leech

Pharynx:

1. It is surrounded by salivary glands.
2. The secretion of saliva contains hirudin.
3. It prevents the coagulation of blood and leads into crop through a short and narrow oesophagus.

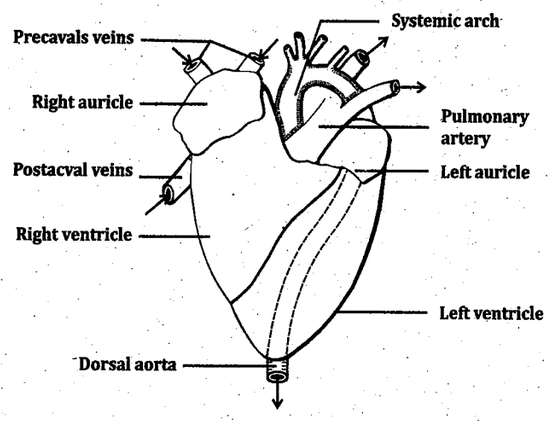
Crop:

1. Crop is the largest portion of the alimentary canal. It is divided into a series of 10 chambers.
2. The chambers communicate with one another through circular apertures surrounded by sphincters.

3. A pair of lateral, backwardly directed caecae arise as blind outgrowth from each chamber known as caeca or diverticula.
4. Crop and its diverticula can store large amount of blood which can be slowly digested.
5. The last chamber of crop opens into stomach.
6. The stomach leads into intestine which is a small straight tube that opens into rectum. The rectum opens to the exterior by anus.

2. Describe the functions of the rabbit heart with a suitable diagram.

1. The circulatory system of rabbit is formed of blood, blood vessels and heart.
2. The heart is pear shaped and lies in the thoracic cavity in between the lungs.
3. It is enclosed by pericardium, a double layered membrane.
4. The heart is four chambered with two auricles and two ventricles.
5. The right and left auricles are separated by interauricular septum.
6. Similarly, right and left ventricles are separated by interventricular septum.



Heart of Rabbit

7. The right auricle opens into the right ventricle by right auriculoventricular aperture, guarded by a tricuspid valve.
8. The left auricle opens into the left ventricle by left auriculoventricular aperture guarded by a bicuspid valve or mitral valve.
9. The opening of the pulmonary artery and aorta are guarded by three semilunar valves.
10. The right auricle receives deoxygenated blood through two precaval (superior vena cava) and one postcaval (inferior vena cava) vein from all parts of the body.
11. The left auricle receives oxygenated blood from the pulmonary veins.
12. From the right ventricle arises pulmonary trunk which carries the deoxygenated blood to the lungs and from the left ventricle arises the systemic arch (aorta) which supplies oxygenated blood to all parts of the body.

IX. Fill in the blanks.

1. Kingdom Animalia is divided into two groups, _____ and _____. **(Invertebrates, chordates)**
2. The scientific name of the Indian cattle leech is _____. **(Hirudinaria granulosa)**
3. _____ are metamerically segmented worms with well-developed organ systems. **(Annelids)**
4. The scientific name of the common rabbit is _____. **(Oryctolagus cuniculus)**
5. _____ occupy the highest group in the animal kingdom. **(Mammals)**
6. The _____ gland in females is the most striking feature of a mammal. **(Mammary)**
7. Leeches belong to phylum _____. **(annelida)**
8. Rabbits belong to phylum _____. **(chordata)**
9. Rabbits belong to class _____. **(mammalia)**
10. Each segment of a leech is superficially subdivided into rings or_____. **(annuli)**
11. The _____ of a leech produce a cocoon during breeding season. **(clitellum)**
12. The dorsal side of a leech has _____ pairs of eyes. **(five)**

13. The mouth of a leech is located in the middle of the _____sucker. **(anterior)**
14. The male genital pore of a leech is located between the 2nd and 3rd annuli of the _____ segment. **(10th)**
15. The body of a leech is soft,_____, elongated and _____. **(vermiform, segmented)**
16. Leeches may grow to a length of _____. **(35 cm)**
17. _____ is the segmentation of the body of a leech. **(Metamerism)**
18. The body of leech is metamerically divided into _____ segments. **(33)**
19. A temporary _____ is formed on segments 9 - 11, in a leech. **(clitellum)**
20. Each segment of a leech bears a number of sensory projections called _____. **(receptors)**
21. _____ are located in each annulus of a leech. **(Annular receptors)**
22. The _____ are located on the first annulus of each segment in a leech. **(segmental receptors)**
23. Leeches have _____ suckers. **(two)**
24. The sucker located at the anterior end of a leech is called _____ sucker. **(anterior)**
25. The posterior sucker of a leech is formed by the fusion of the last _____ segments. **(seven)**
26. The anterior sucker helps in _____. **(feeding)**
27. Both the suckers of a leech in a leech help in _____ and _____. **(attachment, locomotion)**
28. Nephridia in leech opens to the exterior by 17 pairs of _____. **(nephridiopores)**
29. The body of a leech becomes _____ shaped when extended. **(ribbon)**
30. Leeches are _____ in nature. **(sanguivorous)**
31. Leeches are _____ as they feed on the blood of fish. **(ectoparasitic)**
32. In leech the female genital pore lies between second and third annuli of _____ segment. **(11th)**
33. The body of leech is divided into _____ regions. **(six)**
34. The _____ region in a leech consists of 1st - 5th segments. **(cephalic)**
35. The clitellar region in a leech consists of _____ segments. **(9th, 10th and 11th)**
36. The _____ region in a leech consists of 23rd - 26th segments. **(caudal)**
37. The digestive system of a leech includes the alimentary canal and the _____. **(digestive glands)**
38. The mouth of a leech is a _____ aperture situated in the middle of the anterior sucker. **(triradiate)**
39. The secretion of saliva in a leech contains _____. **(hirudin)**
40. _____ is the largest portion of the alimentary canal in a leech. **(Crop)**
41. Crop and its diverticula in a leech can store large amount of _____ which can be slowly digested. **(blood)**
42. The last chamber of crop in a leech opens into _____. **(stomach)**
43. The _____ layer in the body wall of a leech is formed of circular muscles. **(muscular)**
44. The _____ tissue in the body wall of a leech lies beneath longitudinal muscles. **(botryoidal)**
45. The _____ movement of a leech is brought by contraction and relaxation of muscles. **(looping (or) crawling)**
46. _____ in a leech prevents coagulation of blood. **(Hirudin)**
47. The leech feeds by sucking the _____ of cattle and other domestic animals. **(blood)**
48. During feeding the leech attaches itself to its victim strongly by the _____ sucker. **(posterior)**
49. The blood is sucked by _____ pharynx of a leech. **(muscular)**
50. Digestion in a leech takes place in stomach by the action of _____ enzyme. **(proteolytic)**
51. Respiration in leech takes place through the _____. **(skin)**
52. A leech sucks blood through the _____ pharynx. **(muscular)**
53. In leech, circulation is brought about by _____ system. **(haemocoelic)**
54. The blood vessels of a leech are replaced by channels called _____ channels. **(haemocoelic)**
55. The coelomic fluid of a leech contains _____. **(haemoglobin)**
56. The central nervous system of leech consists of a _____ and a paired ventral nerve cord. **(nerve ring)**
57. The nerve ring of a leech surrounds the pharynx and is formed of _____ (brain), circumpharyngeal connective and _____. **(suprapharyngeal ganglion, subpharyngeal ganglion)**
58. The _____ ganglion lies below the pharynx and is formed by the fusion of four pairs of ganglia. **(subpharyngeal)**
59. In leech, excretion takes place by segmentally arranged paired tubules called _____. **(nephridia)**
60. There are _____ pairs of nephridia in a leech. **(17)**

61. Leeches are _____ as both the male and female reproductive organs are present in the same animal. **(hermaphrodites)**
62. The epididymis of a leech leads to a short duct called _____ duct. **(ejaculatory)**
63. The ejaculatory ducts of a leech on both sides join to form the _____. **(genital atrium)**
64. The cocoon in a leech is also known as _____. **(egg case)**
65. Leeches are effective in increasing _____. **(blood circulation)**
66. Blood sucked by a leech is stored in the _____. **(crop)**
67. _____ is a technique of bleeding in a patient to remove toxic impurities from the body caused due to leech bite. **(Blood letting)**
68. A cocoon in leech contains _____ embryos. **(1 to 24)**
69. Leeches are effective in breaking _____. **(blood clots)**
70. Biochemical substances derived from leech saliva can treat _____. **(hypertension)**
71. The _____ rabbit was listed as a threatened species in Washington in 1990. **(pygmy)**
72. The trunk of a rabbit is divisible into an anterior _____ and a posterior _____. **(thorax, abdomen)**
73. The trunk of a rabbit bears two pairs of _____ limbs. **(pentadactyl)**
74. The body of a rabbit is divisible into _____ cavity and _____ cavity. **(thoracic, abdominal)**
75. Diaphragm is the characteristic feature of _____. **(mammals)**
76. Lungs and heart of a rabbit lie in the _____ cavity. **(thoracic)**
77. The head of a rabbit bears a _____ snout. **(truncate)**
78. The testes of a male rabbit are enclosed by _____. **(scrotal sacs)**
79. The _____ of a rabbit opens into the stomach followed by small intestine. **(Oesophagus)**
80. _____ contains bacteria that helps in digestion of cellulose in a rabbit. **(Caecum)**
81. The existence of two sets of teeth in the life of an animal is called _____ dentition. **(diphyodont)**
82. In rabbit the teeth are of different types, milk teeth and permanent teeth. Hence, the dentition is called _____. **(heterodont)**
83. _____ is the simple method of representing the teeth of a mammal. **(Dental formula)**
84. The gap between the incisors and premolar is called _____. **(diastema)**
85. On the lower side of the thoracic cavity of a rabbit, is the dome shaped _____. **(diaphragm)**
86. Each lung of a rabbit is enclosed by a double membraneous _____. **(pleura)**
87. The anterior part of the wind pipe is enlarged to form the _____. **(larynx (or) voice box)**
88. The _____ prevents the entry of food into the trachea through the glottis. **(epiglottis)**
89. The trachea divides into two branches called the _____. **(bronchi)**
90. In a rabbit, the right and left auricles of the heart are separated by _____. **(interauricular septum)**
91. In a rabbit, the right auricle opens into the right ventricle by _____ aperture. **(rightauriculoventricular)**
92. The bronchi of a rabbit are further divided into _____. **(bronchioles)**
93. The bronchioles end in _____. **(alveoli)**
94. The central nervous system of a rabbit consists of _____ and _____. **(brain, spinal cord)**
95. The peripheral nervous system is formed of 12 pairs of _____ nerves. **(cranial)**
96. The _____ nervous system comprises of sympathetic and parasympathetic nerves. **(autonomic)**
97. Brain is situated in the _____ cavity. **(cranial)**
98. The _____ consists of a pair of olfactory lobes, cerebral hemispheres and diencephalon. **(forebrain)**

14. TRANSPORTATION IN PLANTS AND CIRCULATION IN ANIMALS

I. Choose the correct answer.

1. Active transport involves ※※
   a. movement of molecules from lower to higher concentration
   b. expenditure of energy
   c. it is an uphill task
   d. all of the above **Ans: d. all of the above**

2. Water which is absorbed by roots is transported to aerial parts of the plant through
   a. cortex b. epidermis c. phloem d. xylem **Ans: d. xylem**

3. During transpiration there is loss of ※※ **(SEP - 2022)**
   a. carbon dioxide b. oxygen
   c. water d. none of the above **Ans: c. water**

4. Root hairs are **(PTA - IV)**
   a. cortical cell b. projection of epidermal cell
   c. unicellular d. both b and c **Ans: d. both b and c**

5. Which of the following process requires energy? **(PTA - III)**
   a. active transport b. diffusion
   c. osmosis d. all of them **Ans: a. active transport**

6. The wall of human heart is made of
   a. Endocardium b. Epicardium
   c. Myocardium d. All of the above **Ans: d. All of the above**

7. Which is the correct sequence of blood flow ※※ **(APRIL - 2024)**
   a. ventricle - atrium - vein - arteries
   b. atrium - ventricle - veins - arteries
   c. atrium - ventricle - arteries – vein
   d. ventricles - vein - atrium – arteries **Ans: c. atrium - ventricle - arteries - vein**

8. A patient with blood group O was injured in an accident and has blood loss. Which group of blood should be used by doctor for transfusion? **(JUNE - 23, GMQ - 2019)**
   a. O group b. AB group
   c. A or B group d. all blood group **Ans: a. O group**

9. 'Heart of heart' is called ※ **(JULY - 2024)**
   a. SA node b. AV node
   c. Purkinje fibres d. Bundle of His **Ans: a. SA node**

10. Which one of the following shows correct composition of blood

a. Plasma - Blood + Lymphocyte
b. Serum - Blood + Fibrinogen
c. Lymph - Plasma + RBC + WBC
d. Blood - Plasma + RBC + WBC + Platelets

Ans: d. Blood - Plasma + RBC + WBC + Platelets

II. Fill in the blanks.

1. _____ involves evaporative loss of water from aerial parts. **Ans: Transpiration**
2. Water enters into the root hair cell through _____ membrane. **Ans: semi permeable**
3. Part of the root that absorbs water from the soil is _____. **Ans: root hairs**
4. Normal blood pressure is _____. ※※ **(PTA - VI)** **Ans: 120 / 80 mm Hg**
5. The normal human heartbeat rate is about _____ time per minute. **Ans: 72 - 75**

III. Match the following.

Section - I

	Column - I			Column - II			Answers
1.	Symplastic pathway	-	a.	Leaf	-	b.	**Plasmodesmata**
2.	Transpiration	-	b.	Plasmodesmata	-	a.	**Leaf**
3.	Osmosis	-	c.	Pressure in xylem	-	d.	**Pressure gradient**
4.	Root pressure	-	d.	Pressure gradient	-	c.	**Pressure in xylem**

Section - II

	Column - I			Column - II			Answers
1.	Leukemia	-	a.	Thrombocytes	-	d.	**Blood cancer (PTA - IV)**
2.	Platelets	-	b.	Phagocyte	-	a.	**Thrombocytes**
3.	Monocytes	-	c.	Decrease in leucocytes	-	b.	**Phagocyte**
4.	Leucopenia	-	d.	Blood cancer	-	c.	**Decrease in leucocytes**
5.	AB blood group	-	e.	Allergic condition	-	h.	**Absence of antibody**
6.	O blood group	-	f.	Inflammation	-	g.	**Absence of antigen**
7.	Eosinophil	-	g.	Absence of antigen	-	e.	**Allergic condition**
8.	Neutrophils	-	h.	Absence of antibody	-	f.	**Inflammation**

IV. State whether True or False. If false write the correct statement.

1. The phloem is responsible for the translocation of food.
Ans: True

2. Plants lose water by the process of transpiration.
Ans: True

3. The form of sugar transported through the phloem is glucose.
Ans: False
The form of sugar transported through the phloem is **sucrose**.

4. In apoplastic movement the water travels through the cell membrane and enter the cell.
Ans: False
In **symplastic** movement the water travels through the cell membrane and enter the cell.

5. When guard cells lose water the stoma opens.
Ans: False
When guard cells lose water the stoma **closes**.

6. Initiation and stimulation of heart beat take place by nerves.
Ans: False
Initiation and stimulation of heart beat take place by **muscle-fibres**.

7. All veins carry deoxygenated blood.
Ans: False
All veins carry deoxygenated blood **except pulmonary vein**.

8. WBC defend the body from bacterial and viral infections.
Ans: True

9. The closure of the mitral and tricuspid valves at the start of the ventricular systole produces the first sound 'LUBB'.
Ans: True

V. Answer in a word or sentence.

1. **Name two layered protective covering of human heart.** ※※
Ans: Pericardium

2. **What is the shape of RBC in human blood?**
Ans: Biconcave and disc shaped.

3. **Why is the colour of the blood red?** ※※ **(SEP - 2022)**
Ans: The RBC's impart red colour to the blood due to presence of respiratory pigment **haemoglobin.**

4. Which kind of cells are found in the lymph?

Ans: White Blood Corpuscles

5. Name the heart valve associated with the major arteries leaving the ventricles.

Ans: Semilunar valves

6. Mention the artery which supplies blood to the heart muscle.

Ans: Coronary artery

VI. Short answer questions.

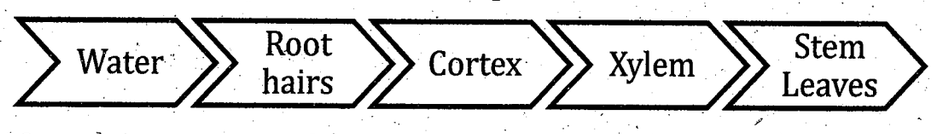
1. What causes the opening and closing of guard cells of stomata during transpiration?

1. The opening and closing of the stomata is due to the **change** in **turgidity** of the guard cells.
2. When water enters into the guard cells, they become **turgid** and the stoma **open**.
3. When the guard cells lose water, it becomes **flaccid** and the stoma **closes**.

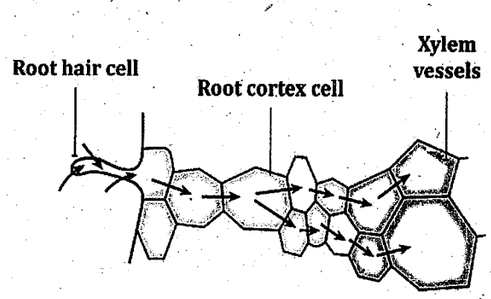
2. What is cohesion? (PTA - I)

The force of **attraction** between molecules of water is called cohesion.

3. Trace the pathway followed by water molecules from the time it enters a plant root to the time it escapes into the atmosphere from a leaf.



1. Once the water enters the root hairs, the concentration of water molecules in the root hair cells become more than that of the cortex.
2. Thus water from the root hair moves to the cortical cells by osmosis and then reaches the xylem.
3. From there the water is transported to the stem and leaves.



T. S. of the root showing movement of water from soil to xylem

4. What would happen to the leaves of a plant that transpires more water than its absorption in the roots?

1. When the leaves of a plant transpires more water than its absorption, it results in **excessive transpiration.**

2. This leads to the loss of necessary moistures from the plant body resulting in **wilting or drying of leaves**.
3. It may also lead to **death** of a plant.

5. Describe the structure and working of the human heart.

Structure:

1. The human heart is made up of **cardiac muscles** and is enclosed by the **pericardium**.
2. It is **four** chambered. The two upper chambers are called **auricles** and the two lower chambers are called **ventricles**.
3. The **tricuspid** valve is located between the right auricle and right ventricle.
4. The **bicuspid** valve is located between the left auricle and left ventricle.

Working:

1. The heart is a muscular **pumping organ** that pumps out blood into the blood vessels.
2. The right and left **auricles** pump blood into the right and left **ventricles** respectively.
3. The right and left **pulmonary arteries** supply **deoxygenated** blood to the lungs.
4. The **oxygenated** blood is supplied by the **aorta** to various organs of the body.
5. The **coronary arteries** supply blood to the heart.
6. The **valves** regulate the flow of blood in a **single direction** and prevent back flow of blood.

6. Why is the circulation in man referred to as double circulation? ※ (PTA - I)

1. In man, the blood circulates **twice** through the heart **in one complete cycle.** So, it is called double circulation.
2. In double circulation the oxygenated blood **does not mix** with the deoxygenated blood.

7. What are heart sounds? How are they produced? ※※

1. The rhythmic closure and opening of the valves causes sound of the heart.
2. The first sound **LUBB** is of longer duration and is produced by the **closure** of the **tricuspid** and **bicuspid** valves after the beginning of ventricular systole.
3. The second sound **DUPP** is of a shorter duration and produced by the **closure** of **semilunar valves** at the end of ventricular systole.

8. What is the importance of valves in the heart? ⁘⁘ (PTA - II, MAY - 2022)

1. They regulate the flow of blood in a **single direction.**
2. They **prevent** the **backflow** of blood.

9. Who discovered Rh factor? Why was it named so? (PTA - VI)

1. Rh factor was discovered by **Landsteiner** and **Wiener** in 1940 in **Rhesus monkey**.
2. The Rh name was derived from the name of the Rhesus monkey. So it was called as Rh factor.

10. How are arteries and veins structurally different from one another? (APRIL - 2024, PTA - V)

	Arteries	Veins
1.	Distributing vessel	Collecting vessel
2.	Pink in colour	Red in colour
3.	Deep location	Superficial in location
4.	Wall of artery is strong, thick and elastic.	Wall of vein is weak, thin and non - elastic.

11. Why is the sinoatrial node called the pacemaker of heart? (APRIL - 2024, GMQ - 19, PTA-V)

1. Sinoatrial node is called the pacemaker of the heart as it is capable of initiating impulses which can stimulate the heart muscles to **contract.**
2. The impulse from this node spreads as a **wave** of contraction over the **right** and **left atrial wall** pushing the blood through the atrioventricular valves into the ventricles.
3. The wave of contraction from SA node reaches the atrioventricular (AV) node which is stimulated to emit an impulse of contraction spreading to the ventricular muscle via the **atrioventricular bundle** and the **Purkinje fibres.**

12. Differentiate between systemic circulation and pulmonary circulation. (PTA-2)

	Systemic circulation		Pulmonary circulation
1.	Circulation of oxygenated blood from the left ventricle of the heart to various organs of the body and return of deoxygenated blood to the right atrium.	1.	Pulmonary artery arises from the right ventricle and reaches the lungs with deoxygenated blood.

2.	Aorta carries oxygenated blood to all the organs of the body.	2.	Pulmonary veins collect the oxygenated blood from the lungs and supplies it to the left atrium of the heart.

13. The complete events of cardiac cycle last for 0.8 sec. What is the timing for each event?

Each cardiac cycle lasts for about 0.8 seconds. The events during a single cardiac cycle involves,

a.	**Atrial systole:**	Contraction of auricles	- 0.1 sec
b.	**Ventricular systole:**	Contraction of ventricles	- 0.3 sec
c.	**Ventricular diastole:**	Relaxation of ventricles	- 0.4 sec
		Total duration	- 0.8 sec

VII. Give reasons for the following statements.

1. Minerals cannot be passively absorbed by the roots. ⁘⁘⁘

Reason:

1. Minerals are present in the soil as **charged particles** (ions) that cannot move across the cell membranes.
2. The concentration of minerals in the soil is usually **lower** than the concentration of minerals in the root.
3. Most minerals enter the root by **active** absorption.

2. Guard cells are responsible for opening and closing of stomata. (SEP - 21)

Reason:

1. The opening and closing of the stomata is due to the change in **turgidity** of the guard cells.
2. When water **enters** into the guard cells, they become turgid and the stoma **open.**
3. When the guard cells **lose water**, it becomes flaccid and the stoma **closes.**

3. The movement of substances in the phloem can be in any direction. (PTA - IV)

Reason:

1. Phloem **transports food** (sucrose) from a source to a sink.
2. The source is part of the plant that synthesize food i.e., the leaf. The sink, is the part that needs or stores the food.

3. The source and sink may be **reversed** depending on the **season**, or the **plant's need**.

4. Since the source - sink relationship is variable, the direction of movement in the phloem can be upwards or downwards, i.e., bidirectional.

4. Minerals in the plants are not lost when the leaf falls. ※※ **(PTA - II)**

Reason:

1. Minerals are **remobilised** from older dying leaves to younger leaves.
2. This phenomenon can be seen in **deciduous plants**.
3. Elements like phosphorus, sulphur, nitrogen and potassium are easily mobilised, while elements like calcium are not remobilized.
4. Small amounts of material exchange takes place between xylem and phloem.
5. Hence, minerals in the plants are not lost when the leaf falls.

5. The walls of the right ventricle are thicker than the right auricles.

Reason:

1. The right ventricles have thick walls because the ventricles have to **pump out blood with force** away from the heart.
2. From the right ventricle arises the pulmonary trunk which bifurcates to form right and left pulmonary arteries.

6. Mature RBC in mammals do not have cell organelles. ※※ **(PTA - IV)**

Reason:

1. Mammalian RBC **lack nucleus** and makes the cells biconcave and increase surface area for **oxygen binding**.
2. The lack of mitochondria allows the RBC to **transport** all the **oxygen** to tissues and loss of endoplasmic reticulum allows more **flexibility** for RBC to move through the narrow capillaries.

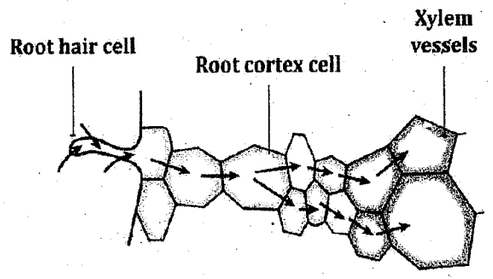
VIII. Long answer questions.

1. How do plants absorb water? Explain.

1. There are millions of root hairs on the tip of the root which absorb water and minerals by diffusion.
2. Root hairs are thin walled, slender extension of epidermal cell that increase the surface area of absorption.

Pathway of water absorbed by roots:

1. Once the water enters the root hairs, the concentration of water molecules in the root hair cells become more than that of the cortex.
2. Thus water from the root hair moves to the cortical cells by **osmosis** and then reaches the xylem.
3. From there the water is transported to the stem and leaves.



T. S. of the root showing movement of water from soil to xylem

Types of movement of water into the root cells:

Once water is absorbed by the root hairs, it can move deeper into root layers by two distinct pathways.

a. Apoplast pathway b. Symplast pathway

a. Apoplast pathway:

1. The apoplastic movement of water occurs exclusively **through** the **inter cellular spaces** and the walls of the cells.
2. Apoplastic movement **does not** involve **crossing** the **cell membrane**. This movement is dependent on the gradient.

b. Symplast pathway:

1. In symplastic movement, water molecules move to the adjacent cells, through the plasma membrane, cytoplasm and plasmodesmata.
2. This method of transport is slow as water moves through plasma membrane. It is in accordance to the concentration gradient.

2. What is transpiration? Give the importance of transpiration.

Transpiration: **(JULY - 24, SEP - 22)**

Transpiration is the **evaporation** of water in plants through **stomata** in the leaves.

Importance of Transpiration:

1. Creates **transpirational pull** for transport of water.
2. **Supplies water** for photosynthesis.
3. Transports **minerals** from soil to all parts of the plant.
4. **Cools** the surface of the leaves by evaporation.
5. Keeps the cells **turgid**; hence, maintains their **shape**.

3. Why are leucocytes classified as granulocytes and agranulocytes? Name each cell and mention its functions. ※※※

White blood corpuscles (or) Leucocytes:

1. Based on the **presence** of **granules** in the cytoplasm of leucocytes it is classified into two categories.
2. They are,
   1. Granulocytes
   2. Agranulocytes

Granulocytes:

1. They contain granules in their cytoplasm.
2. They are classified into,
   1. **Neutrophils:**
      Their numbers are increased during **infection** and **inflammation**.
   2. **Eosinophils:**
      1. Their number increases during conditions of **allergy** and **parasitic infections**.
      2. It brings about **detoxification** of toxins.

   3. **Basophils:**
      They release **chemicals** during the process of inflammation.

Agranulocytes:

1. They do not contain granules in their cytoplasm.
2. They are classified into,
   1. **Lymphocytes:**
      They produce **antibodies** during bacterial and viral infections
   2. **Monocytes:**
      They are **phagocytic** and can **engulf bacteria**

4. Differentiate between systole and diastole. Explain the conduction of heart beat.

	Systole		Diastole
1.	Systole is the contraction phase of the heart.	1.	Diastole is the relaxation phase of the heart.
2.	The blood pressure of 120 mm is considered normal in systolic pressure.	2.	The blood pressure of 80 mm is considered normal in diastolic pressure.
3.	It consists of two events, 1. Atrial systole 2. Ventricular systole	3.	It consists of two events, 1. Atrial diastole 2. Ventricular diastole

Initiation and conduction of Heart beat:

1. The human heart is myogenic in nature.
2. Contraction is initiated by a specialized portion of the heart muscle, the sino - atrial (SA) node which is situated in the wall of the right atrium near the opening of the superior vena cava.
3. The SA node is broader at the top and tapering below and it is made up of thin fibres.
4. Sino - atrial node acts as the 'pacemaker' of the heart as it is capable of initiating impulse which can stimulate the heart muscles to contract.

5. The impulse from the sinoatrial node spreads as a wave of contraction over the right and left atrial wall pushing the blood through the atrioventricular valves into the ventricles.

6. The wave of contraction from SA node reaches the atrioventricular (AV) node which is stimulated to emit an impulse of contraction spreading to the ventricular muscle via the atrioventricular bundle and the Purkinje fibres.

5. Enumerate the functions of blood. ※※※ (APR - 2023, SEP - 2021, 22)

1. Transport of **respiratory gases** (Oxygen and CO_2).
2. Transport of **digested food** materials to the different body cells.
3. Transport of **hormones**.
4. Transport of **nitrogenous** excretory **products** like ammonia, urea and uric acid.
5. It is involved in **protection** of the body and defense against diseases.
6. It acts as **buffer** and also helps in regulation of **pH** and body temperature.
7. It maintains proper **water balance** in the body.

IX. Assertion and Reasoning.

1. Assertion: RBC plays an important role in the transport of respiratory gases.

Reason : RBC do not have cell organelles and nucleus.

a. If both A and R are true and R is correct explanation of A.
b. If both A and R are true but R is not the correct explanation of A.
c. A is true but R is false.
d. Both A and R are false.

Ans: a. If both A and R are true and R is correct explanation of A.

2. Assertion: Persons with AB blood group are called an universal recipients, because they can receive blood from all groups.

Reason : Antibodies are absent in persons with AB blood group.

a. If both A and R are true and R is correct explanation of A.
b. If both A and R are true but R is not the correct explanation of A.
c. A is true but R is false.
d. Both A and R are false.

Ans: a. If both A and R are true and R is correct explanation of A.

X. Higher Order Thinking Skills (HOTS).

1. When any dry plant material is kept in water, they swell up. Name and define the phenomenon involved in this change.

1. The phenomenon involved in the given demonstration is **imbibition**.
2. Imbibition is a type of diffusion in which a solid plant material absorbs water and gets swelled up.

   E.g: Absorption of water by dry seeds and grapes.

2. Why are the walls of the left ventricle thicker than the other chambers of the heart?

The left and right ventricles have thick walls because the ventricles have to pump out blood with force away from the heart.

3. Doctors use stethoscope to hear the sound of the heart. Why?

1. A stethoscope is used to detect the sound produced by the internal organs of human body.
2. The heart sound is heard by placing the stethoscope on the chest.
3. They can be used to hear a patient's heart and lung clearly even in high noisy environment and even through layers of clothing.
4. It is a useful diagnostic tool to identify and **localize health problems** and **diagnose disease**.

4. How does pulmonary artery and pulmonary vein differ in their function when compared to a normal artery and vein?

1. All arteries carry oxygenated blood except the pulmonary artery which carry deoxygenated blood to the lungs.
2. All veins carry deoxygenated blood except the pulmonary vein which carry oxygenated blood from the lungs to the heart.

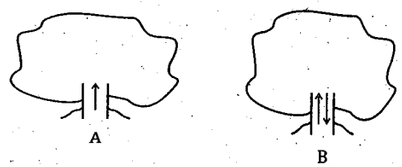
5. Transpiration is a necessary evil in plants. Explain. (PTA - III)

1. Transpiration is the evaporation of water from the aerial parts of the plant.
2. But, excessive transpiration, may lead to excessive loss of water from the leaves which results in **drying** or **wilting** of plant parts.
3. Excessive transpiration can also result in **death** of plants.
4. Hence, transpiration is termed as a necessary evil.

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Choose the correct answer.

1. Who is regarded as the "Father of Modern Physiology"? **(SEP - 2020)**
   a. His - Atrio b. William Harvey
   c. Karl Landsteiner d. Edward C. Kendal **Ans: b. William Harvey**
2. The concept of blood group is derived by _____. **(SEP - 2021)**
   a. Wiener b. Karl Landsteiner c. William Harvey d. His
   Ans: b. Karl Landsteiner
3. The heart of fishes possess _____ chambers. **(MAY & SEP - 2022)**
   a. 3 b. 4 c. 2 d. 5 **Ans: c. 2**
4. The heart of amphibians possess _____ chambers. **(APR - 2023)**
   a. 3 b. 4 c. 2 d. 5 **Ans: a. 3**
5. Identify the conducting tissues by using the arrow marks **(PTA - 2)**
   a. A is phloem, B is xylem
   b. A is xylem, B is phloem
   c. Both A and B are xylem
   d. Both A and B are phloem

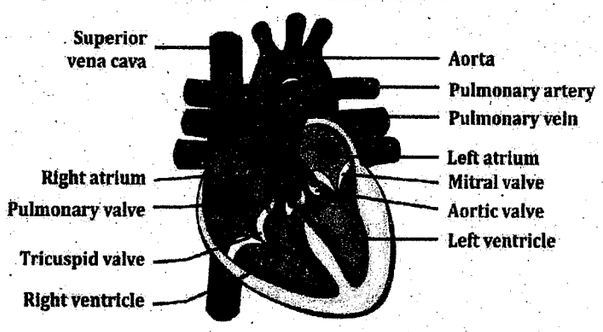


Ans: b. A is xylem, B is phloem

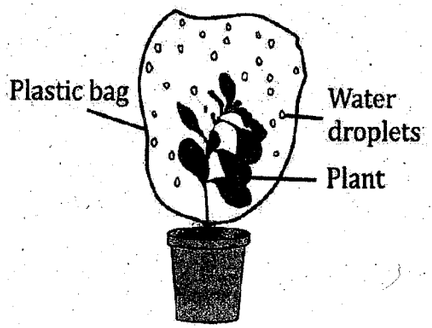
II. Long answers.

1. **Draw the external structure of human heart and label the parts.** **(SEP - 2020)**

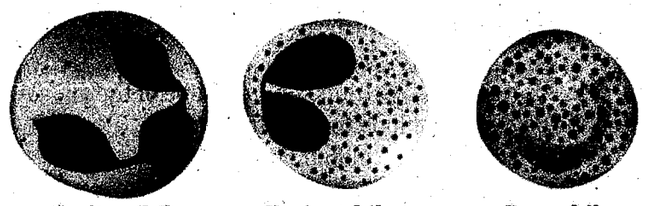
External structure of human heart



2. a. **Draw and label the parts of process of transpiration.** **(MAY - 2022)**



b. **Draw the pictures of Granulocytes.** **(MAY, SEP - 2022)**



Neutrophil **Eosinophil** **Basophil**

ADDITIONAL QUESTIONS

I. Match the following:

	Column - I		Column - II		Answers
1.	Translocation	-	a. circulating fluids	-	**c. vascular tissue**
2.	Circulatory system	-	b. shrinkage of cell membrane	-	**a. circulating fluids**
3.	Diffusion	-	c. vascular tissue	-	**d. passive process**
4.	Osmosis	-	d. passive process	-	**e. semi permeable membrane**
5.	Plasmolysis	-	e. semi permeable membrane	-	**b. shrinkage of cell membrane**

2.	**Column - I**		**Column - II**		**Answers**
1.	Lymphocytes	-	a. Phagocytic	-	**d. Antibodies**
2.	Monocytes	-	b. Father of modern physiology	-	**a. Phagocytic**
3.	Sinuses	-	c. Vertebrates	-	**e. Haemocoel**
4.	Open circulatory system	-	d. Antibodies	-	**f. Arthropods**
5.	Closed circulatory system	-	e. Haemocoel	-	**c. Vertebrates**
6.	William Harvey	-	f. Arthropods **(SEP - 2020)**	-	**b. Father of modern physiology**

3.	**Column - I**		**Column - II**		**Answers**
1.	Diffusion	-	a. uphill	-	**c. passive process**
2.	Active Transport	-	b. leaves	-	**a. uphill**
3.	Plasmolysis	-	c. passive process	-	**d. shrinkage of cell membrane**
4.	Imbibition	-	d. shrinkage of cell membrane	-	**f. seeds**
5.	Transpiration	-	e. sieve plates	-	**b. leaves**
6.	Cytoplasmic strands	-	f. seeds	-	**e. sieve plates**

4.	**Column - I**		**Column - II**		**Answers**
1.	Phloem	-	a. Unidirectional	-	**c. Bidirectional**
2.	Xylem	-	b. Erythrocytes	-	**a. Unidirectional**
3.	Guttation	-	c. Bidirectional	-	**e. Hydathodes**
4.	RBC	-	d. Thrombocytes	-	**b. Erythrocytes**
5.	WBC	-	e. Hydathodes	-	**f. Leucocytes**
6.	Blood platelets	-	f. Leucocytes	-	**d. Thrombocytes**

II. Choose the correct answer:

1. The movement of water molecules from higher to lower concentration without the utilization of energy is called _____.

a. Diffusion b. Osmosis c. Active transpiration d. Plasmolysis
Ans: a. Diffusion

2. The movement of water outside the cell which results in the shrinkage of cell membrane is called _____.
a. Osmosis b. Plasmolysis c. Diffusion d. None of the above **Ans:b. Plasmolysis**

3. The _____ bring the oxygenated blood to the left atrium.
a. pulmonary artery b. pulmonary vein
c. inferior vena cava d. coronary sinus **Ans: b. pulmonary vein**

4. The chambers of the heart are separated by _____.
a. pulmonary trunk b. aorta c. septum d. inferior vena cava
Ans: c. septum

5. The _____ valve has three thin leaf like flaps.
a. Bicuspid b. Mitral c. Tricuspid d. none of the above
Ans: c. Tricuspid

6. When an individual receives a mismatched blood group from the donor _____ occur.
a. antigens b. antibodies c. agglutination d. none of the above
Ans: c. agglutination

7. Persons with blood group 'O' are called _____.
a. universal recipient b. universal donors
c. both a and b d. none of the above **Ans: b. universal donor**

8. _____ in the lymph defend the body from infection.
a. Capillaries b. Vessels c. Nodes d. Lymphocytes
Ans: d. Lymphocytes

9. _____ is the evaporation of water in plants.
a. Evaporation b. Condensation c. Transpiration d. Circulation
Ans: c. Transpiration

10. The supply of blood to the heart muscles is called _____ circulation.
a. thoracic b. pulmonary c. coronary d. none of the above
Ans: c. coronary

11. _____ is expressed as systolic and diastolic pressure.
a. Heart beat b. Blood pressure
c. Coronary circulation d. none of the above **Ans: b. Blood pressure**

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

1. The movement of molecules in liquid and solids from a region of higher concentration to a region of their lower concentration without the utilization of energy is called Osmosis.
Ans: False
The movement of molecules in liquid and solids from a region of higher concentration to a region of their lower concentration without the utilization of energy is called **diffusion**.

2. Transpiration is a type of diffusion in which a solid absorbs water and gets swelled up.
Ans: False
Imbibition is a type of diffusion in which a solid absorbs water and gets swelled up.

3. The symplastic movement of water occurs exclusively through the intercellular spaces and the walls of the cells.
Ans: False
The **apoplastic** movement of water occurs exclusively through the intercellular spaces and the walls of the cells.

4. Cohesiontakes place through specialized cells called Hydathodes.
Ans: False
Guttation takes place through specialized cells called Hydathodes.

5. Basophil numbers are increased during infection and inflammation.
Ans: False
Neutrophil numbers are increased during infection and inflammation.

6. Decrease in number of erythrocytes is called leukopenia.
Ans: False
Decrease in number of erythrocytes is called **anemia**.

7. Capillaries are narrow tubes formed by branching of arterioles which the unite to form the venules and veins.
Ans: True

8. The supply of blood to the heart muscles (cardiac muscles) is called aspulmonary circulation.
Ans: False
The supply of blood to the heart muscles (cardiac muscles) is called as **coronary** circulation.

IV. Assertion and Reason.

1. **Assertion:** AB blood group are called universal recipient.
Reason : Can receive blood from persons with any blood group.
a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
Ans: a. A and R are correct, R explains A.

2. **Assertion:** Decrease in blood pressure is termed as hypotension.
Reason : Can increase the risk of heart attack and stroke.
a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
Ans: d. A and R are correct, R doesn't explain A.

3. **Assertion:** Blood acts as buffer and also helps in regulation of pH and body temperature.
Reason : Veins are thin and non - elastic vessels that transport blood to the heart from the different organs.
a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
Ans: d. A and R are correct, R doesn't explain A

V. Analog

1. Absorption : roots
Transpiration : _____ **(leaves)**

2. Low concentration to high concentration : active transport
High concentration to low concentration : _____ **(osmosis)**

3. Inter cellular spaces : apoplast
Plasmodesmata : _____ **(symplast)**

4. Xylem : water transport
Phloem : _____ **(food transport)**

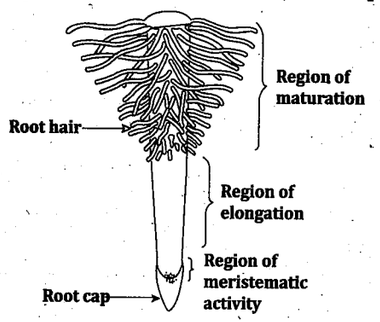
5. Upward movement : unidirectional
Upward and downward movement: _____ **(bidirectional)**

6. Red blood cells : Erythrocytes

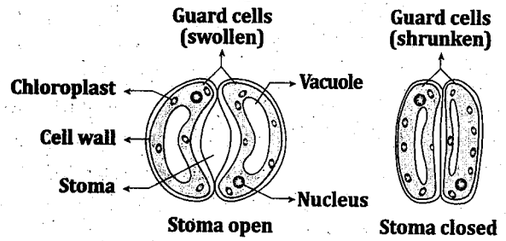
	White blood cells	:	_____	**(leucocytes)**
7.	Lymphocytes	:	antibodies	
	Monocytes	:	_____	**(phagocytes)**
8.	Left side valve	:	bicuspid	
	Right side valve	:	_____	**(tricuspid)**
9.	Artery	:	distributing vessel	
	Collecting vessel	:	_____	**(vein)**
10.	Neurogenic heart beat	:	nerves	
	Myogenic heart beat	:	_____	**(muscles)**

VI. To label the parts in the given diagram.

1. Draw the structure of root tip with root hairs and label its parts.

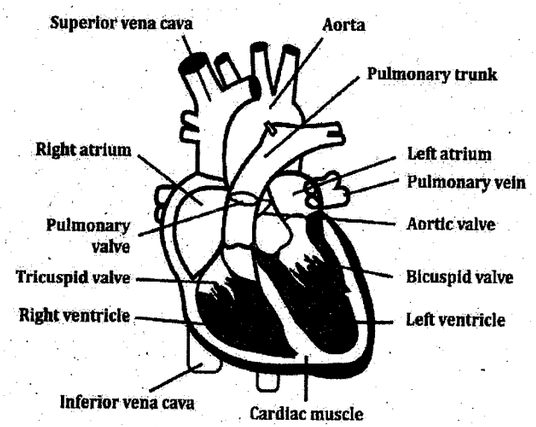


2. Draw the structure of guard cells in turgid and flaccid conditions and label its parts



Guard cell in turgid and flaccid condition

3. Draw the internal structure of human heart and label its parts.



Internal structure of human heart

VII. Short Answers:

1. Define diffusion.

The movement of molecules in liquid, solids and gaseous molecules from a region of **higher** concentration to a region of their **lower** concentration **without** the utilization of **energy** is called diffusion.

2. Define osmosis.

Osmosis is the movement of solvent or water molecules from the region of **higher** concentration to the region of **lower** concentration through a **semi - permeable membrane**.

3. Differentiate apoplast from symplast pathway.

	Apoplast		Symplast
1.	Movement of water occurs exclusively through the **intercellular spaces** and the walls of the cells.	1.	Movement of water travels through the cells **cytoplasm** and intercellular movement is through the **plasmodesmata**.
2.	It **does not** involve crossing the **cell membrane**.	2.	It **enters** the cell through the **cell membrane**.

4. Differentiate the two types of circulatory system.

	Open type		Closed type
1.	In open type the blood is pumped by heart into blood vessels that open into blood spaces called **sinuses**.	1.	In closed type, the blood flows in a **complete circuit** around the body through specific **blood vessels**.
2.	Capillary system is **absent**.	2.	Capillary system is **present**.
3.	**E.g:** Arthropods, Mollusca.	3.	**E.g:** Vertebrates

5. Define pulse.

1. When the heart beats, the blood is forced into the arteries.
2. The **expansion** of the **artery** every time the blood is forced into it is called pulse.
3. Normal pulse rate ranges from **70 - 90/min.**

6. What is cardiac cycle?

1. The **sequence** of **events** occurring from the beginning to the completion of one heart beat is called cardiac cycle.
2. During cardiac cycle, blood flows through the chambers of the heart in a **specific direction**.
3. Each cardiac cycle lasts about **0.8 second**.

7. Differentiate Neurogenic from myogenic heartbeat.

	Neurogenic heart beat		Myogenic heart beat
1.	It is initiated by a nerve impulse caused from a nerve ganglion situated near the heart.	1.	It is initiated by a specialized group of modified heart muscle fibres.
2.	**E.g:** Annelids, most arthropods	2.	**E.g:** Mollusca and vertebrates

VIII. Long Answers:

1. What is blood? Write the components of blood and explain RBC.

Blood is the main circulatory medium in the human body. It is a red coloured fluid connective tissue.

Components of blood:

1. The blood consists of two main components.
2. The fluid plasma and the formed elements (blood cells) which are found suspended in the plasma.

Plasma:

1. It is slightly alkaline, containing non - cellular substance which constitutes about 55% of the blood.
2. Organic substances like proteins, glucose, urea, enzymes, hormones, vitamins and minerals are present in the plasma.

Formed elements of blood:

Blood corpuscles are of three types.

1. Red blood corpuscles (RBC) or Erythrocytes.
2. White blood corpuscles (WBC) or Leucocytes.
3. Blood platelets or Thrombocytes.

Red blood corpuscles (Erythrocytes):

1. They are the most abundant cells in the human body.
2. They are formed in bone marrow.
3. They impart red colour to the blood due to presence of respiratory pigment haemoglobin.
4. Matured mammalian RBCs do not have cell organelles and nucleus.
5. They are biconcave and disc - shaped.
6. Their life span is about 120 days.

Erythrocytes

2. Write a detailed account on human blood groups.

1. The concept of blood grouping was developed by Karl Landsteiner (1900). He identified blood groups A, B and O.
2. AB blood group was recognized by Decastello and Sturli (1902).
3. Human blood contains certain specific substances called agglutinogens or antigens (Ag) and agglutinins or antibodies (Ab).
4. Antigens are found on the membrane surface of RBC. Antibodies are present in blood plasma.
5. Based on the presence or absence of antigen and antibodies human blood group is classified into four groups called A, B, AB and O.
6. An individual has one of the four blood groups.

I. 'A' group individuals:

Antigen A is present on the surface of RBC and antibody b (anti - b) is present in the plasma.

II. 'B' group individuals:

Antigen B is present on the surface of RBC and antibody a (anti - a) is present in the plasma.

III. 'AB' group individuals:

Antigens A and B are present on the surface of RBC and both the antibodies are absent in the plasma.

IV. 'O' group individuals:

Antigen A or B are absent on the surface of RBC. However, the plasma contains both the antibodies a and b (anti - a and b).

Blood group	Antigens on RBC	Antibodies in plasma	Can donate to	Can receive from
A	Antigen A	anti - b	A and AB	A and O
B	Antigen B	anti - a	B and AB	B and O
AB	Antigen A and B	No antibody	AB	A, B, AB and O (Universal Recipient)
O	No Antigen	Both anti a and b	A, B, AB and O (Universal Donor)	O

IX. Fill in the blanks.

1. Every cell gets its energy by the breakdown of _____. **(glucose)**
2. Water is absorbed by the _____ in plants. **(root)**
3. Water and mineral salts absorbed by the roots reach all parts of the plant through the _____. **(xylem)**
4. The bulk movement of substance through the vascular tissue is called _____. **(translocation)**
5. Food is synthesized by the _____ in plants. **(leaves)**
6. The transport of materials in and out of the cells is carried out by _____. **(diffusion)**
7. _____ is a type of diffusion in which a solid absorbs water and gets swelled. **(Imbibition)**
8. The proteins which use energy to carry substances across the cell membrane are called as _____. **(pumps)**
9. Water from the root hair moves to the cortical cells by _____. **(osmosis)**
10. The _____ movement of water occurs exclusively through the intercellular spaces and the walls of the cells. **(apoplastic)**
11. In _____ movement, the water travels through the cells. **(symplastic)**
12. _____ is the evaporation of water in plants through stomata in the leaves. **(Transpiration)**
13. Stomata are _____ in the day and _____ at night. **(open, closed)**
14. The opening and closing of the stomata is due to the change in _____ of the guard cells. **(turgidity)**
15. Water evaporates from _____ cells of leaves. **(mesophyll)**
16. Root hairs are the extension of _____ cells. **(epidermal)**
17. _____ creates a transpirational pull for transport of water. **(Transpiration)**
18. Transpiration cools the surface of the leaves by _____. **(evaporation)**
19. _____ responsible for pushing water to smaller height of the stem. **(root pressure)**
20. Plants depend on _____ from soil for its nutritional requirements. **(minerals)**
21. The concentration of minerals in the soil is usually _____ than the concentration of minerals in the root. **(lower)**
22. Most minerals enter the root by _____ absorption. **(active)**
23. Phloem tissue is composed of _____ tubes. **(sieve)**
24. _____ pass through the pores in the sieve plates. **(Cytoplasmic strands)**

25. The direction of movement in the phloem can be upwards or downwards and is called as _____. **(bidirectional)**
26. The movement is always _____ in xylem. **(unidirectional)**
27. Glucose prepared at source (by photosynthesis) is converted to _____. **(sucrose)**
28. Most minerals enter the root through the _____ of epidermal cells. **(cytoplasm)**
29. The translocation of mineral ions can be seen in _____ plants. **(deciduous)**
30. Water from soil enters the root hairs due to _____. **(osmosis)**
31. The force of attraction between molecules of water is called _____. **(cohesion)**
32. The force of attraction between molecules of different substances is called _____. **(adhesion)**
33. Water molecules stick to a xylem because of force of _____. **(adhesion)**
34. Guttation which takes place through specialized cells called _____. **(Hydathodes)**
35. _____ is the main circulatory medium in the human body. **(Blood)**
36. _____ is a red coloured fluid connective tissue. **(Blood)**
37. Sucrose moves into the sieve tube cells by _____ transport. **(active)**
38. The movement of sucrose into the phloem produces a _____ condition in the phloem. **(hypertonic)**
39. The rising up of water or any liquid in the capillary tube is called _____. **(capillary action)**
40. _____ are the most abundant cells in the human body. **(Red blood corpuscles)**
41. RBCs are formed in the _____. **(bone marrow)**
42. The RBCs impart _____ colour to the blood. **(red)**
43. The life span of RBC is about _____ days. **(120)**
44. The _____ contain granules in their cytoplasm. **(granulocytes)**
45. Red Blood corpuscles are also called as _____. **(Erythrocytes)**
46. White Blood corpuscles are also called as _____. **(Leucocytes)**
47. Blood platelets are also called as _____. **(Thrombocytes)**
48. _____ brings about detoxification of toxins. **(Eosinophils)**
49. _____ form 0.5% - 1.0% of the total leucocytes. **(Basophils)**
50. _____ produce antibodies during bacterial and viral infections. **(Lymphocytes)**
51. _____ are the largest of the leucocytes. **(Monocytes)**
52. _____ are phagocytic and can engulf bacteria. **(Monocytes)**
53. _____ play an important role in clotting of blood. **(Blood platelets)**
54. _____ form a clot at the site of injury and prevent blood loss. **(Platelets)**
55. _____ acts as buffer and helps in regulation of pH. **(Blood)**
56. _____ maintains proper water balance in the body. **(Blood)**
57. Blood vessels are a network of branched tubes that transport _____. **(blood)**
58. _____ are thick and elastic vessels that carry blood away from the heart. **(Arteries)**
59. All arteries carry oxygenated blood except the _____ artery. **(pulmonary)**
60. _____ are thin and non – elastic vessels that transport blood to the heart. **(Veins)**
61. Capillaries are about _____ µm in diameter. **(8)**
62. Capillaries are formed of single layer of _____ cells. **(endothelial)**
63. Decrease in the number of thrombocytes is called _____. **(Thrombocytopenia)**
64. The heart is made of specialized type of muscle called the _____ muscle. **(cardiac)**
65. The heart is enclosed in a double walled sac called _____. **(pericardium)**
66. The pericardial fluid reduces _____ during heart beat and protects the heart from mechanical injuries. **(friction)**
67. The lower thick walled chambers of human heart are called _____. **(ventricles)**
68. The human heart is _____ chambered. **(four)**
69. The chambers of the human heart are separated by partition called _____. **(septum)**
70. The two auricles of the heart are separated from each other by _____. **(interatrial septum)**
71. _____veins bring oxygenated blood to the left atrium from the lungs. **(Pulmonary)**
72. The two ventricles are separated from each other by an _____ septum. **(interventricular)**
73. The right and left pulmonary arteries supply _____ blood to the lungs. **(deoxygenated)**
74. The heart contains _____ types of valves. **(three)**
75. The left ventricle gives rise to _____. **(aorta)**
76. The _____ valve is located between the right auricle and right ventricle. **(Right atrioventricular)**
77. The muscular projection in the ventricle wall of the heart known as _____ muscles. **(papillary)**

78. The _____ valves prevent backward flow of blood into the ventricles. **(semilunar)**
79. _____ carries oxygenated blood to all the organs of the body. **(Aorta)**
80. The path of pulmonary circulation starts in the _____ ventricle. **(right)**
81. The supply of blood to the heart muscles is called as _____. **(coronary circulation)**
82. Cardiac muscles receive oxygenated blood from _____. **(coronary arteries)**
83. Deoxygenated blood from the cardiac muscles drains into the right atrium by the _____. **(coronary sinuses)**
84. When the blood circulates twice through the heart in one complete cycle it is called _____. **(double circulation)**
85. The right atrioventricular valve is also called as _____. **(tricuspid valve)**
86. The circulation in which oxygenated and deoxygenated blood are mixed is called _____. **(single circulation)**
87. The coronary arteries originate from the _____. **(aortic arch)**
88. Heart normally beats _____ times per minute. **(72 - 75)**
89. _____ heart beat is initiated by a nerve impulse caused from a nerve ganglion situated near the heart. **(Neurogenic)**
90. _____ heart beat is initiated by a specialized group of modified heart muscle fibres. **(Myogenic)**
91. The human heart is _____ in nature. **(myogenic)**
92. _____ node acts as the 'pacemaker' of the heart. **(Sino - atrial)**
93. Atrioventricular bundle was discovered by _____. **(His)**
94. The expansion of the artery every time the blood is forced into it is called _____. **(pulse)**
95. Normal pulse rate ranges from _____ / min. **(70 - 90)**
96. Atrioventricular bundle is also called as _____. **(Bundle of His)**
97. The sequence of events occurring from the beginning to the completion of one heart beat is called _____. **(cardiac cycle)**
98. Each cardiac cycle lasts about _____ second. **(0.8)**
99. Relaxation of ventricles (0.4 sec) is called as _____. **(ventricular diastole)**
100. The _____ sound is produced by the closure of tricuspid and bicuspid valves. **(LUBB)**
101. The DUPP sound is produced by the closure of the _____. **(semilunar)**
102. A prolonged or constant elevation of blood pressure is a condition known as _____. **(hypertension)**
103. Decrease in blood pressure is termed _____. **(hypotension)**
104. The contraction of auricles lasts for _____ sec. **(0.1)**
105. _____ is a clinical instrument used to measure blood pressure. **(Sphygmomanometer)**
106. When an individual receives a mismatched blood group from the donor _____ of blood occurs. **(agglutination)**
107. Persons with 'AB' blood group are called _____. **(Universal Recipient)**
108. Persons with 'O' blood group are called _____. **(Universal Donar)**
109. The Rh factor was first discovered in _____. **(Rhesus monkey)**
110. Antibodies developed against this Rh antigen is called _____. **(Rh antibodies)**
111. _____ is the fluid that flows through the lymphatic system. **(Lymph)**
112. The lymphatic capillaries unite to form large _____. **(lymphatic vessels)**

15. NERVOUS SYSTEM

I. Choose the correct answer.

1. Bipolar neurons are found in ※※ **(APR - 2023)**
   a. retina of eye b. cerebral cortex
   c. embryo d. respiratory epithelium **Ans: a. retina of eye**

2. Site for processing of vision, hearing, memory, speech, intelligence and thought is
   a. kidney b. ear c. brain d. lungs
   Ans: c. brain

3. In reflex action, the reflex arc is formed by
   a. brain, spinal cord, muscle
   b. receptor, muscle, spinal cord
   c. muscle, receptor, brain
   d. receptor, spinal cord, muscle **Ans: d. receptor, spinal cord, muscle**

4. Dendrites transmit impulse _____ cell body and axon transmit impulse _____ cell body.
   a. away from, away from b. towards, away from
   c. towards, towards d. away from, towards
   Ans: b. towards, away from

5. The outer most of the three cranial meninges is
   a. arachnoid membrane b. piamater
   c. duramater d. myelin sheath **Ans: c. duramater**

6. There are _____ pairs of cranial nerves and _____ pairs of spinal nerves.
   a. 12, 31 b. 31,12 c. 12, 13 d. 12,21 **(JUNE - 2023)**
   ※※ **Ans: a. 12,31**

7. The neurons which carries impulse from the central nervous system to the muscle fibre.
   a. afferent neurons b. association neuron
   c. efferent neuron d. unipolar neuron **Ans: c. efferent neuron**

8. Which nervous band connects the two cerebral hemispheres of brain? **(PTA - V)**
   a. thalamus b. hypothalamus c. corpus callosum d. pons
   Ans: c. corpus callosum

9. Node of Ranvier is found in **(SEP - 2020)**
   a. muscles b. axons c. dendrites d. cyton
   Ans: b. axons

10. Vomiting centre is located in **(JULY - 2024)**
    a. medulla oblongata b. stomach
    c. cerebrum d. hypothalamus
    Ans: a. medulla oblongata

11. Nerve cells do not possess ※※
    a. neurilemma b. sarcolemma c. axon d. dendrites
    Ans: b. sarcolemma

12. A person who met with an accident lost control of body temperature, water balance, and hunger. Which of the following part of brain is supposed to be damaged?
    a. Medulla oblongata b. cerebrum
    c. pons d. hypothalamus **Ans: d. hypothalamus**

II. Fill in the blanks.

1. _____ is the longest cell in our body. ※※ **Ans: Neuron**
2. Impulses travels rapidly in _____ neurons. **Ans: Myelinated**
3. A change in the environment that causes an animal to react is called _____.
   Ans: reaction or response
4. _____ carries the impulse towards the cell body. **Ans: Dendrites**
5. The two antagonistic component of autonomic nervous system are _____ and _____. **Ans: sympathetic, parasympathetic**
6. A neuron contains all cell organelles except _____. **Ans: centriole**
7. _____ maintains the constant pressure inside the cranium. ※※
   Ans: Cerebro spinal fluid
8. _____ and _____ increases the surface area of cerebrum. ※
   Ans: Gyri, sulci
9. The part of human brain which acts as relay center is _____. **(PTA - I)**
   Ans: thalamus

III. State whether true or false, if false write the correct statement.

1. Dendrons are the longest fibres that conducts impulses away from the cell body.
   Ans: False
   Axons are the longest fibres that conducts impulses away from the cell body.
2. Sympathetic nervous system is a part of central nervous system. ※ **(PTA - III)**
   Ans: False
   Sympathetic nervous system is a part of **autonomic** nervous system.
3. Hypothalamus is the thermoregulatory centre of human body.
   Ans: True
4. Cerebrum controls the voluntary actions of our body.
   Ans: False
   Cerebellum controls the voluntary actions of our body.
5. In the central nervous system myelinated fibres form the white matter.
   Ans: True ※※

6. All the nerves in the body are covered and protected by meninges. **(PTA - III)**

Ans: False

Brain is covered and protected by meninges.

7. Cerebrospinal fluid provides nutrition to brain.
Ans True

8. Reflex arc allows the rapid response of the body to a stimulus. ※
Ans: True

9. Pons helps in regulating respiration.
Ans: True

IV. Match the following.

Column - I		Column - II		Answers		
1.	Nissil's granules	- a.	Forebrain	- c.	**Cyton**
2.	Hypothalamus	- b.	Peripheral nervous system	- a.	**Forebrain**
3.	Cerebellum	- c.	Cyton	- d.	**Hindbrain**
4.	Schwann cell	- d.	Hindbrain	- b.	**Peripheral nervous system**

V. Understand the assertion statement. Justify the reason given and choose the correct choice.

1. **Assertion:** Cerebrospinal fluid is present throughout the central nervous system.

Reason : Cerebrospinal fluid has no such functions.

a. Assertion is correct and reason is wrong.
b. Reason is correct and the assertion is wrong.
c. Both assertion and reason are correct.
d. Both assertion and reason are wrong.

Ans: a. Assertion is correct and reason is wrong.

2. **Assertion:** Corpus callosum is present in space between the duramater and piamater.

Reason : It serves to maintain the constant intracranial pressure.

a. Assertion is correct and reason is wrong.
b. Reason is correct and the assertion is wrong.
c. Both assertion and reason are correct.
d. Both assertion and reason are wrong.

Ans: d. Both assertion and reason are wrong.

VI. Short answer questions.

1. Define stimulus. ※※

1. 'Stimulus' refers to the **changes** in the **environmental condition**, that are detected by **receptors** present in the body.
2. A **receptor** is a cell or a group of cells that **receives** the stimuli.
3. An **effector** is a part of the body which can **respond** to a stimulus.

2. Name the parts of the hind brain. **(APRIL - 2024, PTA - II)**

The hind brain is formed of three parts,

1. Cerebellum
2. Pons
3. Medulla oblongata

3. What are the structures involved in the protection of brain? (APR - 23, PTA-4)

Brain is covered by three connective tissue membranes called meninges. They are,

1. Outer Duramater
2. Middle Arachnoid membrane
3. Inner Piamater

4. Give an example for conditioned reflexes.

1. Playing harmonium by striking a particular key on seeing a music note is an example of conditioned reflexes.
2. It requires conscious training effort. ※※※

5. Which acts as a link between the nervous system and endocrine system?

The **Hypothalamus** of the forebrain controls the secretion of **hormones** from **anterior pituitary gland** and is an important **link** between the nervous system and endocrine system.

6. Define reflex arc. ※ **(PTA - IV)**

The **pathway** taken by the **nerve impulse** to accomplish reflex action is called reflex arc.

VII. Differentiate between.

1. Voluntary and involuntary actions. (PTA - V)

	Voluntary actions		Involuntary actions
1.	Voluntary actions are initiated by our **own will.**	1.	A reflex action is **not** under the control of **our will.**
2.	**Cerebral cortex, cerebellum** controls voluntary functions.	2.	**Hypothalamus** controls involuntary functions.
3.	**E.g:** Walking	3.	**E.g:** Heart beat

2. Medullated and non - medullated nerve fibre. (PTA - III)

	Medullated nerve fibre or myelinated nerve fibre		Non - medullated nerve fibre or non - myelinated never fibre
1.	The axon is **covered** with **myelin sheath.**	1.	The axon is **not covered** with myelin sheath.
2.	It forms the **white matter** of our brain.	2.	It forms the **grey matter** of our brain.

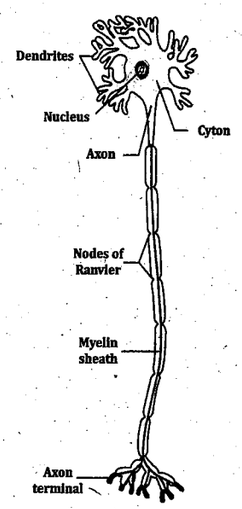
VIII. Long answer questions.

1. With a neat labelled diagram explain the structure of a neuron. (GMQ - 2019)

Neuron:

A neuron is the **structural** and **functional unit** of the nervous system. A neuron consists of **three** basic parts,

1. Cyton or Cell body or Perikaryon
2. Dendrites
3. Axon



Structure of Neuron

I. Cyton or Cell body or Perikaryon:

1. It has a central **nucleus** with abundant cytoplasm called **neuroplasm.**
2. The cytoplasm has large granular body called **Nissl's granules** and the other cell organelles like mitochondria, ribosomes, lysosomes and endoplasmic reticulum.

3. Neurons **do not** have the ability to **divide.**
4. Several neurofibrils help in transmission of **nerve impulses** to and from the cell body.

II. Dendrites:

1. These are the **numerous** branched **cytoplasmic** processes that project from the **surface** of the cell body.
2. They conduct nerve impulses **towards** the cyton.
3. The branched projections **increase** the **surface** area for receiving the **signals** from other nerve cells.

III. Axon:

1. The axon is a single **elongated slender** projection.
2. The end of axon terminates into knob like swellings called **synaptic knob.**
3. **Axolemma:** The **plasma membrane** of axon.

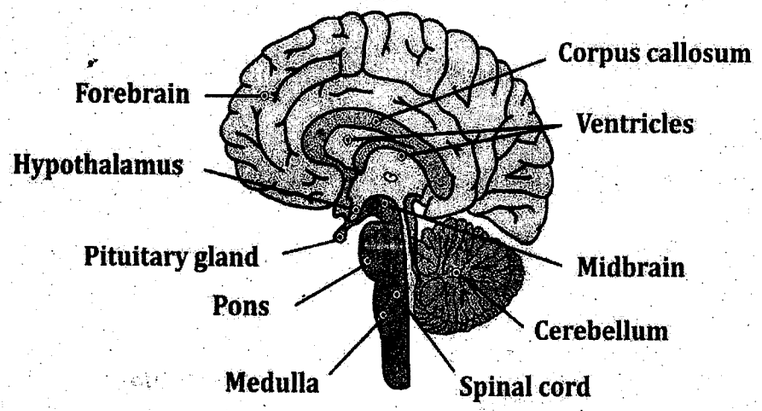
   Axoplasm : The **cytoplasm** of axon.
4. It carries impulses **away** from the cyton.

Myelin sheath:

1. The **protective sheath** of axon.
2. It is covered by a layer of **Schwann cells** called **neurilemma.**
3. It breaks at intervals by depressions called **Nodes** of **Ranvier.**
4. It acts as an **insulator** and ensures **rapid** transmission of nerves impulses.

2. Illustrate the structure and functions of brain.

1. Brain is covered by three connective tissue membrane or meninges.
2. A human brain is formed of **three** major parts forebrain, midbrain and hindbrain.



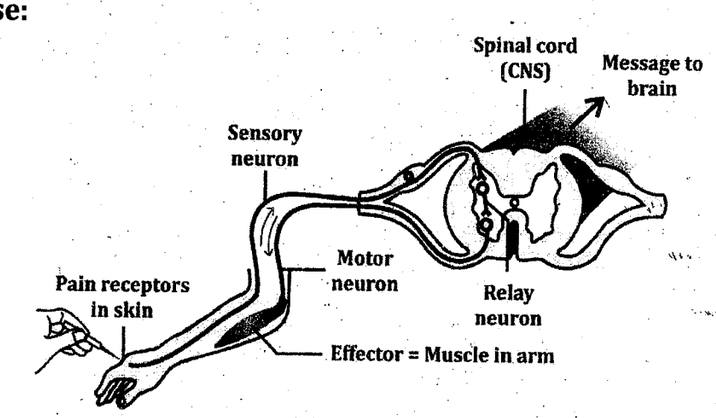
Structure of Brain

Major parts	Sub Divisions	Structure	Functions
Forebrain	i. Cerebrum	1. It is longitudinally divided into two halves as right and left **cerebral hemispheres** by a deep cleft called **median cleft**. 2. Two cerebral hemispheres are interconnected by **corpus callosum**. 3. Outer **grey** portion-cerebral cortex inner **white** portion - cerebral medulla. 4. The cortex is folded forming elevations called **gyri** with depressions called as **sulci**.	Thinking, intelligence, consciousness, memory, imagination, reasoning and will power.
	ii. Thalamus	It is present in cerebral medulla.	1. It is a major conducting centre for **sensory** and **motor** signalling. 2. Acts as a **relay centre**.
	iii. Hypothalamus	1. It lies at the **base** of the **thalamus**.	1. It controls **involuntary**

			functions like **thirst**, **hunger** etc., 2. Acts as a **thermoregulatory** centre. 3. Important link between **nervous system** and **endocrine system**.
Mid brain	Corpora quadrigemina	It is located between **thalamus** and **hindbrain**.	Controls **visual** and **auditory** reflexes.
Hindbrain	i. Cerebellum	It is **second largest** part of the brain formed of two large sized **hemispheres** and **middle vermis**.	Maintenance of **posture** and **balance**, coordinates **voluntary** muscle activity.
	ii. Pons	It is a bridge of nerve fibre that connects the lobes of **cerebellum**.	**Respiration** and **sleep** cycle.
	iii. Medulla oblongata	It is the posterior most part of the brain that connects **spinal cord** and various parts of **brain**.	**Cardiovascular**, **respiratory** and **digestive** control centers.

3. **What will you do if someone pricks your hand with a needle? Elucidate the pathway of response with a neat labelled diagram.**
Ans: I will immediately **withdraw** my hand.
Reflex arc:
The **pathway** taken by **nerve impulse** to accomplish reflex action is called reflex arc.

Pathway of response:

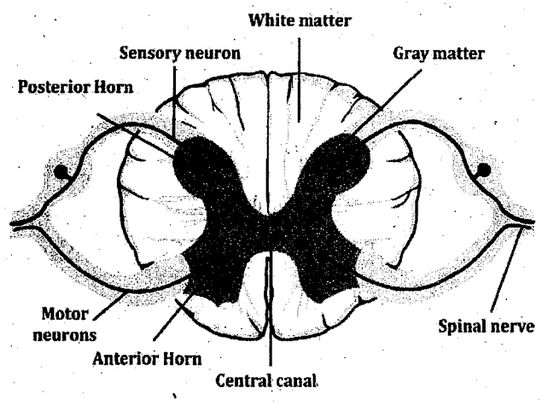


Relex action and its pathway

1. When someone pricks our hand with a needle the **stimulus, pain** is sensed by receptor called as pain receptors in our hand.
2. This stimulus (pain) in turn triggers an impulse in the **sensory neuron**.
3. The sensory neuron **transmits** the message to the **spinal cord**.
4. The spinal cord interprets the stimulus and the impulse is passed on to the **relay neuron** which in turn transmits it to a **motor neuron**.
5. Motor neurons carry the command from the **spinal cord** to **our arm**.
6. The muscles in our arm **contracts** and we withdraw our hand immediately from the needle.

4. Describe the structure of spinal cord. ※※

Spinal cord:



1. Spinal cord is a **cylindrical structure** lying in the neural canal of the vertebral column.
2. It is covered by **meninges**.
3. It extends from the **lower end** of **medulla oblongata** to the **first lumbar** vertebra.
4. The posterior most region tapers into a thin fibrous thread like structure called **filum terminale**.
5. The spinal cord contains a cerebrospinal fluid filled cavity known as the **central canal**.
6. The **white matter** is external and have bundle of **nerve tracts**.

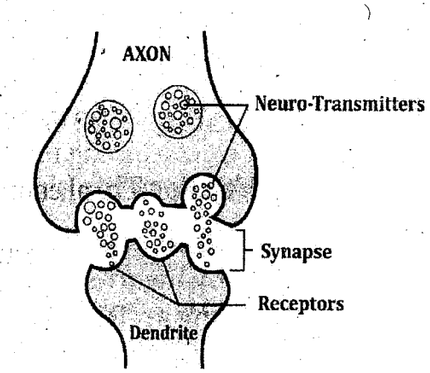
H shaped part:

1. The grey matter of spinal cord is **'H'** shaped.
2. The **upper** end of letter 'H' forms **posterior** horns and **lower** end forms **anterior** horns.
3. A bundle of fibres pass into the **posterior** horn forming **dorsal** or **afferent root**.
4. Fibres pass outward from the **anterior** horn forming **ventral** or **efferent root**.
5. These two roots joins to form **spinal nerves**.

5. How nerve impulses are transferred from one neuron to next neuron?

Transmission of nerve impulse:

1. All the information from the environment are detected by the **receptors** located in our **sense organs** such as the eyes, the nose, the skin etc.,
2. Information from the receptors is transmitted as **electrical impulse** and is received by the dendritic tips of the neuron.
3. This impulse travels from the **dendrite** to the cell body and then along the **axon** to its terminal end.
4. On reaching the axonal end, it causes the nerve endings to release a chemical substance called **neurotransmitter**.
5. This diffuses across a **synapse** and starts a similar electrical impulse in the dendrites of the next neuron, then to their cell body to be carried along the axon.
6. In this way, the electrical signal **reaches** the **brain** or spinal cord.



Nerve impulse transmission

7. The response from brain or spinal cord is similarly passed on to the **effector organs** such as the muscle or gland cell that undergoes the desired response.
8. The flow of nerve impulses from axonal end of one neuron to dendrite of another neuron through a synapse is called **synaptic transmission**.

Neurotransmitters:

They are the chemicals which allow the transmission of nerve impulse from the axon terminal of one neuron to the dendron of another neuron or to an effector organ.

6. Classify neurons based on its structure. (APRIL - 2024, JU - 23, SEP - 20) ※※

Neurons are classified into three types based on their structure. They are,

1. Unipolar neurons:

Only **one nerve process** arises from the cyton which acts as both axon and Dendron.

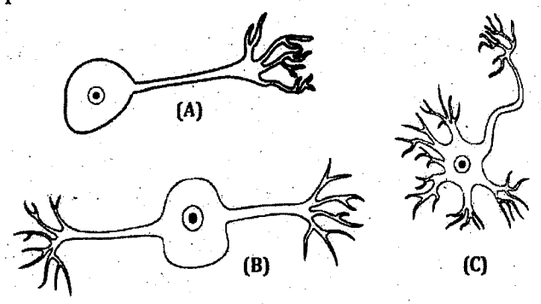
Location:

Found in early embryos but not in adult.

2. **Bipolar neurons:**

The cyton gives rise to **two** nerve processes of which one acts as an axon while another as a Dendron.

Location:
Found in retina of eye and olfactory epithelium of nasal chambers.



Unipolar (A), Bipolar (B) and multipolar (C) neurons

3. **Multipolar neurons:**

The cyton gives rise to **many dendrons** and an axon.

Location: Found in cerebral cortex of brain.

IX. Higher Order Thinking Skills(HOTS)

1. 'A' is a cylindrical structure that begins from the lower end of medulla and extend downwards. It is enclosed in bony cage 'B' and covered by membranes 'C'. As many as 'D' pairs of nerves arise from the structure 'A'. (PTA - VI)

1. **What is A?**

   Ans: A - Spinal cord

2. **Name (a) bony cage 'B' and (b) membrane 'C'**

   Ans: B - Vertebral column
   C - Meninges

3. **How much is D?**

   31 pairs of spinal nerves

2. Our body contains a large number of cells 'L' which are the longest cells in the body. L has long and short branch called as 'M' and 'N' respectively. There is a gap 'O' between two 'L' cells, through which nerve impulse transfer by release of chemical substance 'P'.

1. **Name the cells L.**

   Ans: Neuron or nerve cell

2. **What are M and N?**

   Ans: **M** - Axon
   N - dendrites

3. **What is the gap O?**

   Ans: Synapse (synaptic junction)

4. **Name the chemical substance P.**

   Ans: Neurotransmitters - Acetyl choline

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Short answers.

1. **Write the functions of cerebellum.** **(PTA - 6)**

   Cerebellum - Maintenance of posture and balance, coordinate voluntary muscle activity.

II. Long answers.

1. **Describe the types of neuron on the basis of their functions.** **(PTA - 3)**

   1. **Sensory or afferent neurons:**

      It carries impulses from the sense organ to the central nervous system.

   2. **Motor or efferent neurons:**

      It carries impulses from the central nervous system to effector organ such as the muscle fibre or the gland.

   3. **Association neurons:**

      It conduct impulses between sensory and motor neurons.

ADDITIONAL QUESTIONS

I. Match the following:

Column - I	Column - II	Answers
1. Cyton	a. axoplasm	d. perikaryon
2. Plasma membrane	b. neurilemma	c. axolemma
3. Cytoplasm	c. axolemma	a. axoplasm
4. Myelin sheath	d. perikaryon	e. protective
5. Schwann cells	e. protective	b. neurilemma

Column - I	Column - II	Answers
1. Myelinated	a. Grey matter	c. White matter
2. Non - Myelinated	b. Embryo	a. Grey matter
3. Unipolar	c. White matter	b. Embryo
4. Bipolar	d. Cerebral cortex	e. Retina
5. Multipolar	e. Retina	d. Cerebral cortex

Column - I	Column - II	Answers
1. Sensory	a. efferent	e. afferent
2. Motor	b. neuron	a. efferent
3. Association neuron	c. glial cells	d. conducts impulse

4. Neuroglia	-	d. conducts impulse	-	c.	**glial cells**
5. Nerve cell	-	e. afferent	-	b.	**neuron**

Column - I		Column - II		Answers	
1. Neurotransmitter	-	a. Brain	-	d.	**Acetylcholine**
2. Meninges	-	b. Cerebral cortex	-	a.	**Brain**
3. Forebrain	-	c. Cerebral medulla	-	e.	**Diencephalon**
4. Grey matter	-	d. Acetylcholine	-	b.	**Cerebral cortex**
5. White matter	-	e. Diencephalon	-	c.	**Cerebral medulla**

II. Choose the correct answer:

1. _____ is the outermost covering of the brain
   a. Piamater b. Duramater
   c. Archnoid membrane d. Pons **Ans: b. Duramater**
2. The important neurotransmitter released by neurons is _____.
   a. Acetylchloride b. Aceticchloride
   c. Acetylcholine d. Aceticcholine **Ans: c. Acetylcholine**
3. The _____ acts as a centre for information processing and control.
   a. CNS b. PNS c. ANS d. Medulla oblongata **Ans: a. CNS**
4. _____ is an inflammation of the meninges.
   a. Meningitis b. Lack of CFS
   c. None of the above d. All the above **Ans: a. Meningitis**
5. The _____ is formed of cerebrum and diencephalon.
   a. midbrain b. hindbrain c. forebrain d. pons
   Ans: c. forebrain
6. Maintenance of posture is a function of the _____.
   a. Cerebral cortex b. Thalamus
   c. Hypothalamus d. Cerebellum **Ans: d. Cerebellum**
7. _____ acts as a relay station.
   a. Cerebral cortex b. Thalamus
   c. Hypothalamus d. Cerebellum **Ans: b. Thalamus**
8. i. Pons is a bridge of nerve fibre that connects the cerebellum.
   ii. The cerebrum coordinates voluntary movements and maintains body balance.
   iii. The afferent and efferent roots of the spinal cord join to form the central canal.
   iv. Nerves arising from the spinal cord are called cranial nerves.
   a. i. & ii. are correct b. i. is correct
   c. ii. & iv. are correct d. i. & iii. are correct **Ans: b. i. is correct**

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

1. In human brain, piamater is the middle, thin vascular membrane providing web like cushion.
   Ans: False
   In human brain, **arachnoid** is the middle, thin vascular membrane providing web like cushion.
2. Meningitis is an inflammation of the thalamus.
   Ans: False
   Meningitis is an inflammation of the **meninges**.
3. The hindbrain is formed of cerebrum and diencephalon.
   Ans: False
   The **forebrain** is formed of cerebrum and diencephalon.

4. The human brain constitutes nearly 40 percent of fat.
   Ans: False
   The human brain constitutes nearly **60** percent of fat.
5. Electroencephalogram (EEG) is an instrument which records the electrical impulses of heart.
   Ans: False
   Electroencephalogram (EEG) is an instrument which records the electrical impulses of **brain**.

IV. Assertion and Reason.

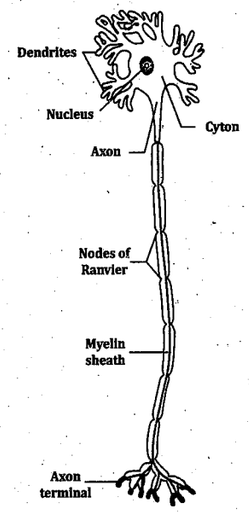
1. **Assertion:** CNS consists of the brain and the spinal cord.
   Reason : The CNS acts as centre for information processing and control.
   a. If both A and R are true and R is correct explanation of A.
   b. If both A and R are true but R is not the correct explanation of A.
   c. A is true but R is false.
   d. Both A and R are false.
   Ans: a. If both A and R are true and R is correct explanation of A.
2. **Assertion:** Meningitis is an inflammation of the meninges.
   Reason : The inflammation is caused due to viral and bacterial infections.
   a. If both A and R are true and R is correct explanation of A.
   b. If both A and R are true but R is not the correct explanation of A.
   c. A is true but R is false.
   d. Both A and R are false.
   Ans: a. If both A and R are true and R is correct explanation of A.
3. **Assertion:** Medulla oblongata is the posterior most part of the brain that connects spinal cord and various parts of brain.
   Reason : It controls respiration and sleep cycle.
   a. If both A and R are true and R is correct explanation of A.
   b. If both A and R are true but R is not the correct explanation of A.
   c. A is true but R is false.
   d. Both A and R are false.
   Ans: b. If both A and R are true but R is not the correct explanation of A.

V. Analog.

1.	Plasma membrane of axon	:	axolemma	
	Cytoplasm of axon	:	_____	**(axoplasm)**
2.	One nerve process	:	unipolar neurons	
	Two nerve process	:	_____	**(bipolar neurons)**
3.	Sense organ to CNS	:	_____	**(Afferent neuron)**
	CNS to muscle fibres	:	Efferent neuron	
4.	Outer most layer of brain	:	duramater	
	Innermost layer of brain	:	_____	**(piamater)**
5.	Intelligence	:	cerebrum	
	Body balance	:	_____	**(cerebellum)**
6.	Creativity	:	Cerebral cortex	
	Role in sleep	:	_____	**(pons)**
7.	Relay centre	:	Thalamus	
	Thermoregulatory center	:	_____	**(Hypothalamus)**

VI. To label the parts in the given diagram.

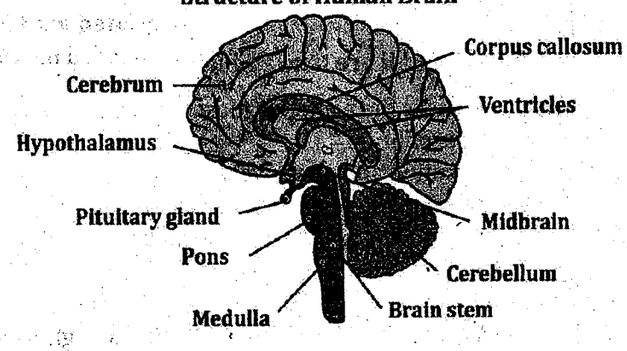
1. Draw the structure of neuron and label its parts.



Structure of Neuron

2. Draw the structure of human brain and label its parts.

Structure of Human Brain



VII. Short Answers:

1. What is homeostasis?

The coordination between the various cells and organs is essential for their diverse activities to maintain physiological balance is called homeostasis.

2. What is called synoptic knob?

1. The axon is a single, elongated slender projection.
2. The end of axon terminates as fine branches which terminate into knob like swelling called synaptic knob.

3. What is called synaptic junction?

A junction between synaptic knob of axon of one neuron and dendron of next neuron is called synaptic junction.

4. Differentiate between the unipolar neurons and bipolar neurons.

	Unipolar neurons		Bipolar neurons
1.	Only one nerve process arises from the cyton which acts as both axon and dendron.	1.	The cyton gives rise to two nerve processes of which one acts as an axon while another as a dendron.
2.	Found in early embryos but not in adult.	2.	Found in retina of eye and olfactory epithelium of nasal chambers.

5. Classify neurons based on its function.

1. **Sensory or afferent neurons:**
   It carries impulses from the sense organ to the central nervous system.
2. **Motor or efferent neurons:**
   It carries impulses from the central nervous system to effector organ such as the muscle fibre or the gland.
3. **Association neurons:**
   Conduct impulses between sensory and motor neurons.

6. Name the part of the brain which regulates heart beat and respiration. Where is it located in the brain?

Ans: Medulla oblongata
It is located in the hindbrain.

7. What is corpora quadrigemina? Name the function associated with it.

The dorsal portion of the mid brain consists of four rounded bodies called corpora quadrigemina.

Function: It controls visual and auditory (hearing) reflexes.

8. What are the divisions of human nervous system?

1. The central nervous system (CNS)
2. The peripheral nervous system (PNS)
3. The autonomic nervous system (ANS)

9. What is called corpus callosum?

1. The cerebrum is longitudinally divided into two halves as right and left cerebral hemispheres.
2. Two cerebral hemispheres are interconnected by thick band of nerve fibres called corpus callosum.

10. What are nerve fibres?

1. Nerve fibres are the long slender processes of neurons.
2. A number of nerve fibres are bundled up together to form nerves.

VIII. Long Answers:

1. Describe peripheral nervous system.

Peripheral nervous system:
Peripheral nervous system is formed by the nerves arising from the brain and the spinal cord.

Cranial nerves:

1. The nerves arising from the brain are called cranial nerves.
2. In man, there are 12 pairs of cranial nerves.
3. Some of the cranial nerves are sensory.

E.g: 1. Optic nerve which innervates the eye.
2. Some are motor nerves which helps in rotation of eyeball.
3. It also innervates the eye muscles, muscle of iris and tear gland.

Spinal nerves:

1. Nerves arising from spinal cord are called spinal nerves.
2. There are 31 pairs of spinal nerves.
3. It has a dorsal sensory root and the ventral motor root.
4. The direction of impulses in dorsal spinal root is towards the spinal cord and in ventral spinal root away from the spinal cord.

2. Write short note on autonomic nervous system.

1. Autonomic nervous system (ANS) is also called as visceral nervous system.
2. It regulates the function of internal visceral organs of our body through its two antagonistic (opposite) components sympathetic and parasympathetic.
3. They enable the body to perform rapid and specific visceral activities in order to maintain a steady state.
4. It controls the involuntary functions of the visceral organs.

IX. Fill in the blanks.

1. _____ refers to the changes in the environmental condition, that are detected by receptors present in the body. **(Stimulus)**
2. Relevant changes in the activities of organisms to a particular stimuli are called their _____. **(reactions (or) responses)**
3. The nervous system is made up of _____ tissues. **(nervous)**
4. The working together of organs to produce proper response to various stimuli is called _____. **(coordination)**
5. The nervous system is made up of _____, _____ and nerve fibres. **(neurons, neuroglia)**
6. _____ is called the co - ordination of cells and organs entail to maintain physiological balance. **(Homeostasis)**
7. A neuron is also called as _____. **(nerve cell)**
8. A _____ is the longest cell of the human body. **(neuron)**
9. The length of a neuron is _____ µm. **(100)**
10. _____ are also called as glial cells. **(Neuroglia)**
11. _____ are the non - exciting cells of the nervous system. **(Neuroglia)**
12. A cyton has a central nucleus with abundant cytoplasm called _____. **(neuroplasm)**
13. The end of an axon terminates into knob like structures called _____. **(synaptic knob)**
14. The protective sheath of an axon is covered by a layer of cells called _____. **(Schwann cells)**
15. The information from one neuron passes to the other neuron through _____. **(neurotransmitters)**
16. Information is conducted through neurons in the form of _____ from one part of the body to another. **(electrical impulses)**
17. A number of nerve fibres are bundled up together to form _____. **(nerves)**
18. Cyton is also called cell body or _____. **(perikaryon)**
19. The cytoplasm has large granular body called _____ granules. **(Nissl's)**
20. Neurons do not have the ability to _____. **(divide)**
21. The _____ present in the cytoplasm help in transmission of nerve impulses to and from the cell body. **(neurofibrils)**
22. The plasma membrane of axon is called _____. **(axolemma)**
23. The cytoplasm of axon is called _____. **(axoplasm)**
24. The axons are covered by a protective sheath called _____. **(myelin sheath)**
25. Myelin sheath breaks at intervals by depressions called _____. **(Nodes of Ranvier)**
26. The region between the nodes is called as _____. **(internode)**
27. Myelin sheath acts as an _____. **(insulator)**

28. A junction between synaptic knob of axon of one neuron and dendron of next neuron is called _____. **(synaptic junction)**
29. _____ neurons are found in early embryos. **(Unipolar)**
30. The retina of the eye is made up of _____ neurons. **(bipolar)**
31. _____ neurons are found in the cerebral cortex of the brain. **(Multipolar)**
32. _____ nerve fibres form the white matter of the brain. **(Myelinated)**
33. Non - myelinated nerve fibres form the _____ matter of the brain. **(grey)**
34. In a _____ neuron only one nerve process arises from the cyton. **(unipolar)**
35. In _____ neuron the cyton gives rise to many dendrons and an axon. **(multipolar)**
36. _____ neurons conduct impulses between sensory and motor neutrons. **(Association)**
37. Myelinated and non - myelinated nerve fibres form the _____ matter and _____ matter of the brain. **(white, grey)**
38. The _____ acts as a centre for information processing and control. **(central nervous system)**
39. The autonomic nervous system is formed is formed of _____ and _____ nerves. **(sympathetic, parasympathethic)**
40. The flow of nerve impulses from axonal end of one neuron to dendrite of another neuron through a synapse is called _____. **(synaptic transmission)**
41. Each neuron can transmit _____ nerve impulses per second. **(1000)**
42. _____ are the chemicals which allows the transmission of nerve impulse from the axon terminal of one neuron to the dendron of another neuron. **(Neurotransmitters)**
43. The important neurotransmitter released by neurons is called _____. **(Acetylcholine)**
44. _____ is the outermost thick fibrous membrane of the brain. **(Duramater)**
45. The _____ membrane is the middle thin vascular membrane providing a web like cushion of the brain. **(arachnoid)**
46. The _____ is the innermost membrane of the brain. **(piameter)**
47. The _____ membranes protect the brain from mechanical injury. **(Meningeal)**
48. The _____ acts as a thermoregulatory centre of the body. **(hypothalamus)**
49. The forebrain is formed of _____ and _____. **(cerebrum, diencephalon)**
50. The _____ is the largest position of the brain. **(cerebrum)**
51. Two cerebral hemispheres of the brain are interconnected by thick band of nerve fibres called _____. **(corpus callosum)**
52. The outer portion of each cerebral hemisphere of the brain is formed of grey matter and is called _____. **(cerebral cortex)**
53. The inner or deeper part of the brain is formed of white matter and is called _____. **(cerebral medulla)**
54. The cortex is extremely folded and forms elevations called _____. **(gyri)**
55. The _____ lies at the base of the thalamus. **(hypothalamus)**
56. The dorsal portion of the mid brain consists of four rounded bodies called _____. **(corpora quadrigemina)**
57. The human brain constitutes nearly _____ % of fat. **(60)**
58. The most crucial molecules that determine our brain's integrity and the ability are called _____ acids. **(Essential Fatty)**
59. The depressions in the cerebrum of the brain are called _____. **(sulci)**
60. Spinal cord lies in the _____ of the vertebral column. **(neural canal)**
61. _____ is a bridge of nerve fibre that connects the lobes of cerebellum. **(Pons)**
62. _____ controls respiration and sleep cycle. **(Pons)**
63. _____ is an instrument which records the electrical impulses of brain. **(Electroencephalogram)**
64. _____can detect abnormalities in the brain waves. **(EEG)**
65. The posterior most region of spinal cord tapers into a thin fibrous thread like structure called _____. **(filum terminale)**
66. The spinal cord contains a cerebrospinal fluid filled cavity known as the _____. **(central canal)**
67. _____ controls reflex actions of the body. **(Spinal cord)**
68. The _____ of the brain coordinates voluntary movements and maintains body balance. **(cerebellum)**
69. _____ is also responsible for maintaining a constant pressure inside the cranium. **(cerebrospinal fluid)**
70. A _____ is any response that occurs automatically without consciousness. **(reflex)**
71. The pathway taken by nerve impulse to accomplish reflex action is called _____. **(reflex arc)**

16. PLANT AND ANIMAL HORMONES

I. Choose the correct answer.

1. Gibberellins cause:
   a. shortening of genetically tall plants b. elongation of dwarf plants
   c. promotion of rooting d. yellowing of young leaves
   Ans: b. elongation of dwarf plants

2. The hormone which has positive effect on apical dominance is: ※※
   a. Cytokinin b. Auxin c. Gibberellin d. Ethylene
   Ans: b. Auxin

3. Which one of the following hormones is naturally not found in plants: ※ **(SEP - 22)**
   a. 2, 4-D b. GA3 c. Gibberellin d. IAA
   Ans: a. 2, 4 - D

4. Avena coleoptile test was conducted by
   a. Darwin b. N. Smit c. Paal d. F.W. Went
   Ans: d. F.W. Went

5. LH is secreted by **(JULY - 2024)**
   a. Adrenal gland b. Thyroid gland
   c. Anterior pituitary d. Hypothalamus
   Ans: c. Anterior pituitary

6. Identify the exocrine gland **(SEP - 22)**
   a. Pituitary gland b. Adrenal gland
   c. Salivary gland d. Thyroid gland
   Ans: c. Salivary gland

7. Which organ acts as both exocrine gland as well as endocrine gland **(PTA - III)**
   a. Pancreas b. Kidney c. Liver d. Lungs
   ※※
   Ans: a. Pancreas

8. Which one is referred as "Master Gland"? ※※ **(JUNE - 2023, PTA - II, MAY - 22) (APRIL - 2024)**
   a. Pineal gland b. Pituitary gland
   c. Thyroid gland d. Adrenal gland **Ans: b. Pituitary gland**

II. Fill in the blanks.

1. _____ causes cell elongation, apical dominance and prevents abscission.
   ※※ **Ans: Auxin**
2. _____ is a gaseous hormone involved in abscission of organs and acceleration of fruit ripening. **Ans: Ethylene**
3. _____ causes stomatal closure. **Ans: Abscisic acid**
4. Gibberellins induce stem elongation in _____ plants. **Ans: Rosette**

5. The hormone which has negative effect on apical dominance is _____.
   ※※ **Ans: Cytokinins**
6. Calcium metabolism of the body is controlled by _____. **Ans: parathormone**
7. In the islets of Langerhans, beta cells secrete _____. **(PTA - VI) Ans: insulin** ※※
8. The growth and functions of thyroid gland is controlled by _____.
   Ans: Thyroid stimulating hormone (TSH)
9. Decreased secretion of thyroid hormones in the children leads to _____.
   Ans: cretinism

III. a. Match the column I with columns II and III.

Column - I		Column - II			Column - III		
1.	Auxin	-	a.	*Gibberella fujikuroi*	-	A.	Abscission
2.	Ethylene	-	b.	Coconut milk	-	B.	Internodal elongation
3.	Abscisic acid	-	c.	Coleoptile tip	-	C.	Apical dominance
4.	Cytokinin	-	d.	Chloroplast	-	D.	Ripening
5.	Gibberellins	-	e.	Fruits	-	E.	Cell division

Answers.

Column - I		Column - II			Column - III		
1.	Auxin	-	**c.**	**Coleoptile tip**	-	**C.**	**Apical dominance**
2.	Ethylene	-	**e.**	**Fruits**	-	**D.**	**Ripening**
3.	Abscisic acid	-	**d.**	**Chloroplast**	-	**A.**	**Abscission**
4.	Cytokinin	-	**b.**	**Coconut milk**	-	**E.**	**Cell division. (SEP - 20)**
5.	Gibberellins	-	**a.**	***Gibberella fujikuroi***	-	**B**	**Internodal elongation**

b. Match the following hormones with their deficiency states.

Hormones		Disorders			Answers		
1.	Thyroxine	-	a.	Acromegaly	-	**c.**	**Simple goitre**
2.	Insulin	-	b.	Tetany	-	**e.**	**Diabetes mellitus**
3.	Parathormone	-	c.	Simple goitre	-	**b.**	**Tetany**
4.	Growth hormone	-	d.	Diabetes insipidus	-	**a.**	**Acromegaly**
5.	ADH	-	e.	Diabetes mellitus	-	**d.**	**Diabetes insipidus**

IV. State whether True or false, if false write the correct statement.

1. A plant hormone concerned with stimulation of cell division and promotion of nutrient mobilization is cytokinin.
   Ans: True

2. Gibberellins cause parthenocarpy in tomato.
   Ans: True

3. Ethylene retards senescence of leaves, flowers and fruits. ※※
   Ans: False
   Ethylene **hastens** senescence of leaves, flowers and fruits.

4. Exopthalmic goitre is due to the over secretion of thyroxine.
   Ans: True

5. Pituitary gland is divided into four lobes.
   Ans: False
   Pituitary gland is divided into **two** lobes.

6. Estrogen is secreted by corpus luteum. ※※
   Ans: False
   Estrogen is secreted by **graafian follicles**.

V. Assertion and Reasoning.

1. **Assertion (A):** Application of cytokinin to marketed vegetables can keep them fresh for several days.

   Reason (R) : Cytokinins delay senescence of leaves and other organs by mobilisation of nutrients.

   a. If both A and R are true and R is correct explanation of A.
   b. If both A and R are true but R is not the correct explanation of A.
   c. A is true but R is false.
   d. Both A and R are false.

   Ans: a. If both A and R are true and R is correct explanation of A

2. **Assertion (A):** Pituitary gland is referred as "Master gland".

   Reason (R) : It controls the functioning of other endocrine glands.

   a. If both A and R are true and R is correct explanation of A.
   b. If both A and R are true but R is not the correct explanation of A.
   c. A is true but R is false.
   d. Both A and R are false.

   Ans: a. If both A and R are true and R is correct explanation of A.

3. **Assertion (A):** Diabetes mellitus increases the blood sugar levels.

   Reason (R) : Insulin decreases the blood sugar levels.

   a. If both A and R are true and R is correct explanation of A.
   b. If both A and R are true but R is not the correct explanation of A.
   c. A is true but R is false.
   d. Both A and R are false.

   Ans: b. If both A and R are true but R is not the correct explanation of A.

VI. Answer in a word or sentence.

1. **Which hormone promotes the production of male flowers in Cucurbits?**
   Ans: Gibberellins

2. **Write the name of a synthetic auxin.** ※※
   Ans: 2, 4D (2, 4 Dichlorophenoxy Acetic Acid)

3. **Which hormone induces parthenocarpy in tomatoes? (APR - 2023)**
   Ans: Gibberellins

4. **What is the hormone responsible for the secretion of milk in female after child birth?** ※※
   Ans: Prolactin **(PTA - V)**

5. **Name the hormones which regulates water and mineral metabolism in man.**
   Ans: Mineralocorticoids - Aldosterone

6. **Which hormone is secreted during emergency situation in man?** ※
   Ans: Epinephrine, Norepinephrine

7. **Which gland secretes digestive enzymes and hormones?**
   Ans: Pancreas

8. **Name the endocrine glands associated with kidneys.**
   Ans: Adrenal gland

VII. Short answer questions.

1. **What are synthetic auxins? Give examples.** ※※ **(AP - 24, PTA - IV, MAY - 22)**
   1. **Artificially synthesized** auxins that have properties like auxins are called as synthetic auxins.
   2. **E.g:** 2, 4D (2,4 Dichlorophenoxy Acetic Acid)

2. **What is bolting? How can it be induced artificially?** ※※※ **(GMQ - 2019)**
   1. The **sudden shoot elongation** of a plant followed by flowering is called bolting.
   2. It can be induced artificially by the **treatment** of **gibberellins** on rosette plant.

3. Bring out any two physiological activities of abscisic acid.

1. ABA promotes the process of **abscission** (separation of leaves, flowers and fruits from the branch).
2. During water stress and drought conditions ABA causes **stomatal closure**.

4. What will you do to prevent leaf fall and fruit drop in plants? Support your answer with reason.

Ans:

Treating plants with **auxin** will prevent leaf fall and fruit drop.

Reason: **Auxins** prevent the formation of abscission layer in plants.

5. What are chemical messengers?

1. The chemical messengers are known as **hormones** which are produced by endocrine glands.
2. Physiological processes such as digestion, metabolism, growth, development and reproduction are controlled by hormones.
   E.g: Growth hormone

6. Write the differences between endocrine and exocrine gland. ※※

	Endocrine gland	Exocrine gland
1.	These are **ductless** glands	These glands are with **specific ducts.**
2.	Secretions are **directly** diffused into the **bloodstream.**	Secretions are passed through the specific ducts.
3.	Secrete **hormones.**	Secrete **enzymes.**
4.	**E.g:** Pituitary gland, thyroid gland	**E.g:** Salivary glands, sweat glands.

7. What is the role of parathormone?

1. The parathormone regulates **calcium** and **phosphorus** metabolism in the body.
2. They act on bone, kidney and intestine to maintain **blood calcium levels.**

8. What are the hormones secreted by posterior lobe of the pituitary gland? Mention the tissues on which they exert their effect. ※※ **(PTA - II)**

	Hormones	Tissues
1.	Vasopressin or Antidiuretic hormone (ADH)	Kidney tubules
2.	Oxytocin	1. Smooth muscles of uterus 2. Milk ejection from the mammary gland

9. Why are thyroid hormones referred as personality hormone? ※※

(APR - 2023, GMQ - 19, SEP - 22)

1. Thyroid hormone is essential for **normal physical, mental** and **personality** development.
2. Hence, it is referred to as personality hormone.

10. Which hormone requires iodine for its formation? What will happen if intake of iodine in our diet is low?

1. **Thyroid hormone** - requires iodine for its formation.
2. If intake of iodine in our diet is low, it leads to the enlargement of thyroid gland which protrudes as a marked swelling in the neck and is called as **goitre**.

VIII. Long answer questions. ※※

1. a. Name the gaseous plant hormone. Describe its three different actions in plants. **(SEP - 2021)**

Ans:

Gaseous plant hormone - **Ethylene**

physiological process

Action of Ethylene hormone: **(PTA - III)**

1. Ethylene promotes the **ripening** of **fruits.**
   E.g: Tomato
2. It inhibits the **elongation** of stem and root in dicots.
3. It hastens **senescence** of leaves and flowers.

b. Which hormone is known as stress hormone in plants? Why?

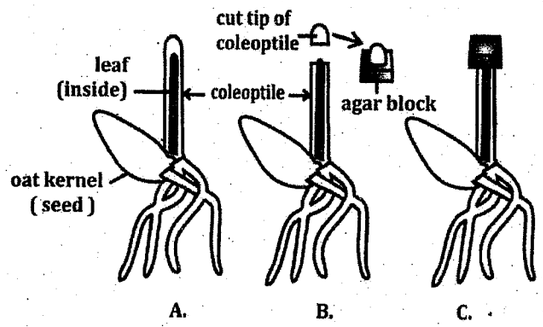
Ans: Stress hormone - **Abscisic acid**

Reason:

It increases the **tolerance** of plants to various kinds of stress.

2. Describe an experiment which demonstrates that growth stimulating hormone is produced at the tip of coleoptile. ※※※

1. **Frits Warmolt Went** demonstrated the existence and effect of **auxin** in plants.
2. He did a series of experiments in **Avena coleoptiles**.



A. Germination of an oat seed.
B. Decapitate tip of coleoptile and place on agar block.
C. Agar block is placed on top of the decapitated tip of the seeding.

Went's Experiment

First experiment:

1. He **removed** the **tips** of Avena coleoptiles.
2. The cut tips **did not grow** indicating that the tips produced something essential for growth.

Second experiment:

1. He **placed** the **agar blocks** on the decapitated coleoptile tips.
2. The coleoptile tips **did not show any response**.

Third experiment:

1. He placed the detached coleoptile **tips on agar blocks**.
2. After an hour, he **discarded** the **tips** and placed this agar block on the decapitated coleoptile.
3. It **grew** straight up indicating that some **chemical** had diffused from the cut coleoptile tips into the agar block which stimulated the growth.

Conclusion:

1. He concluded that a chemical diffusing from the tip of coleoptiles was responsible for growth.
2. He named it as "**Auxin**" meaning "**to grow**".

3. Write the physiological effects of gibberellins. ※ **(JULY - 2024)**

1. Application of gibberellins on plants stimulate extraordinary **elongation** of **internode**.

   E.g: Corn

2. Treatment of rosette plants with gibberellin induces sudden **shoot elongation** followed by flowering. This is called **bolting**.
3. It promotes the production of **male flowers** in monoecious plants.

   E.g: Cucurbits
4. It **breaks dormancy** of potato tubers.
5. It is efficient than auxins in inducing the formation of **seedless fruit** parthenocarpic fruits.

   E.g: Tomato

4. Where are estrogens produced? What is the role of estrogens in the human body? ※※

Ans:

Estrogen - **Graafian follicles** of the ovary.

Functions of estrogens:

1. Estrogens bring about the changes that occur during **puberty**.
2. It initiates the process of **oogenesis.**
3. It stimulates the **maturation of ovarian follicles** in the ovary.
4. It promotes the development of **secondary sexual characters** (breast development, high pitched voice etc).

5. What are the conditions which occur due to lack of ADH and insulin? How are the conditions different from one another?

Ans:

Lack of ADH - Diabetes insipidus

Lack of insulin - Diabetes mellitus

	Diabetes insipidus	Diabetes mellitus
1.	Deficiency of ADH reduces **reabsorption** of **water**.	Deficiency of insulin reduces the conversion of **glucose** into **glycogen**.
2.	It causes an **increase** in **urine output**.	It causes an **increase** in **glucose** in the **urine**.

IX. Higher Order Thinking Skills (HOTS)

1. What would be expected to happen if

a. **Gibberellin is applied to rice seedlings.**

1. Gibberellin is applied to rice seedling as it causes **internodal elongation.**
2. This causes **Bakanae disease** or foolish seedling disease.

b. **A rotten fruit gets mixed with unripe fruits.**

When a rotten fruits gets mixed with unripe fruits, the **ethylene gas** produced from rotten fruits will **promote** the **ripening** of unripe fruits.

c. **When cytokinin is not added to culture medium.**

1. When cytokinin is not added to culture medium, cell division does not take place.
2. There is **no** formation of **new organs** from the callus in tissue culture.

2. A plant hormone was first discovered in Japan when rice plants were suffering from Bakanae disease caused by Gibberella fujikoroi. Based on this information answer the following questions.

a. **Identify the hormone involved in this process.**

Ans: Gibberellin

b. **Which property of this hormone causes the disease?**

Internodal elongation of the hormone causes Bakanae disease.

c. **Give two functions of this hormone.**

1. Gibberellins **break dormancy** of potato tubers.
2. They induce the formation of **seedless fruits** - parthenocarpic fruits.

E.g: Tomato

3. Senthil has high blood pressure, protruded eyeball and an increased body temperature. Name the endocrine gland involved and hormone secretion responsible for this condition.

1. Endocrine gland - Thyroid gland.
2. Hormone - Tyrosine hormone
   A. Tri iodothyronine (T_3)
   B. Tetra iodothyronine or Thyroxine (T_4)

4. Sanjay is sitting in the exam hall. Before the start of the exam, he sweats a lot, with increased rate of heart beat. Why does this condition occur?

Reason:

1. Because, Sanjay is in stress and fright condition in the exam hall.

2. Due to this condition emergency hormones **epinephrine** and **nor epinephrine** are secreted.
3. Hence, he sweats a lot, with increased rate of heart beat.

5. Susan's father feels very tired and frequently urinates. After clinical diagnosis he was advised to take an injection daily to maintain his blood glucose level. What would be the possible cause for this? Suggest preventive measures.

Ans: Cause - Diabetes mellitus.

Preventive measures:

1. Maintenance of normal body weight through adoption of healthy nutritional habits and physical exercise.
2. Intake of low carbohydrate and fibre rich diets are more appropriate.

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Choose the correct answer.

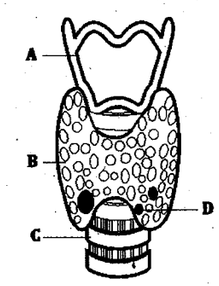
1. _____ is found abundantly in liquid endosperm of coconut. **(SEP - 2020)**
   a. Auxin b. Cytokinin c. Gibberellins d. Ethylene
   Ans: b. Cytokinin

II. Short answers.

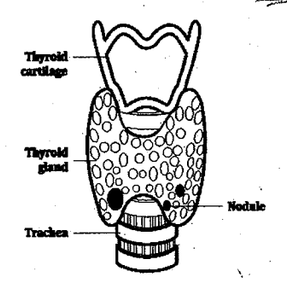
1. Identify the disorder with which the person shown in the figure is suffering. (PTA - 1)

1. Goitre
2. It is caused due to the inadequate supply of iodine in our diet.

2. Identify the parts A, B, C and D in the given figure. Picture. (APRIL - 2024, SEP - 2020)



Ans:



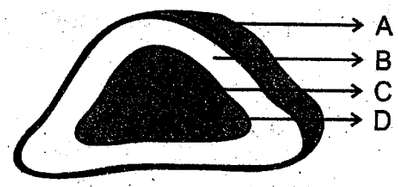
3. What is parthenocarpic fruit? Give an example. (PTA - 6)

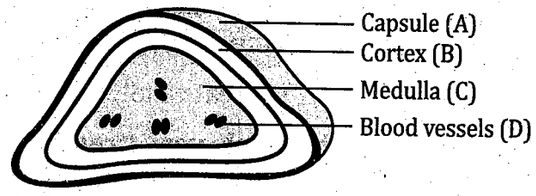
Gibbberllins are efficient than auxins in inducing the formation of seedless fruit - **Parthenocarpic fruits**. Development of fruits without fertilization.

E.g: Tomato

4. Identify the parts A, B, C, D in the given figure. (MAY - 2022)

Ans:





ADDITIONAL QUESTIONS

I. Match the following:

Column - I	Column - II	Answers
1. Auxin	a. cell division	d. plant hormone
2. Endocrine gland	b. growth inhibitor	c. vertebrates
3. Cytokinin	c. vertebrates	a. cell division
4. Gibberellin	d. plant hormone	f. bakanae disease
5. Abscisic acid	e. gaseous hormone	b. growth inhibitor
6. Ethylene	f. bakanae disease	e. gaseous hormone

Column - I	Column - II	Answers
1. Parthenocarpic fruit	a. Auxin	c. Gibberellin
2. Apical dominance	b. Cytokinin	a. Auxin
3. Richmond Lang Effect	c. Gibberellin	b. Cytokinin
4. Bolting	d. Abscisic acid	e. Gibberellin
5. Stomatal closure	e. Gibberellin	d. Abscisic acid

Column – I	Column - II	Answers
1. Ripening of fruits	a. Islets of langerhans	b. Ethylene
2. Muscle spasm	b. Ethylene	d. Tetany
3. Pancreas	c. Insulin	a. Islets of langerhans
4. Alpha cells	d. Tetany	e. Glucagon
5. Beta cells	e. Glucagon	c. Insulin

Column – I	Column - II	Answers
1. Polyuria	a. increased thirst	d. frequent urination
2. Polydipsia	b. increased blood sugar	a. increased thirst
3. Polyphagia	c. corticosteroids	f. increased appetite
4. Hyperglycemia	d. excess glucose in urine	e. increased blood sugar
5. Glycosuria	e. frequent urination	b. excess glucose in urine
6. Adrenal cortex	f. increased appetite	c. corticosteroids

II. Choose the correct answer:

1. To increase the sugar production in sugarcanes they are sprayed with _____.
   a. Auxin b. Cytokinin c. Gibberellins d. Ethylene
   Ans: c. Gibberellins

2. _____ is produced at the tip of stems and root.
   a. Gibberellins b. Abscisic acid c. Ethylene d. Auxin
   Ans: d. Auxin

3. _____ causes cell enlargement.
   a. Auxin b. cytokinin c. ethylene d. Gibberellin
   Ans: b. cytokinin

4. The formation of new organs from the callus in tissue culture is called _____.
   a. Spermatogenesis b. Oogenesis

   c. morphogenesis d. none of the above **Ans: c. morphogenesis**

5. _____ is the most abundantly found plant hormone.
   a. Auxin b. Gibberellin c. Ethylene d. Cytokinin
   Ans: b. Gibberellin

6. Gibberellins break the _____ of potato tubers.
   a. growth b. dormancy c. ripening d. flowering **Ans: b. dormancy**

7. _____ is also called stress hormone.
   a. Auxin b. Abscisic acid c. Gibberellin d. Ethylene **Ans: b. Abscisic acid**

8. i. Abscisic acid is a growth regulator.
   ii. Ethylene delays ripening of fruits.
   iii. Auxins induce root formation.
   iv. Cytokinins promote cell division.
   a. i. & ii. are correct b. iii. & iv. are correct
   c. iii. & ii. are correct d. i. & iv. are correct **Ans: b. iii. & iv. are correct**

9. The _____ forms the major endocrine gland in vertebrates.
   a. adrenal gland b. pituitary gland
   c. thyroid gland d. none of the above **Ans: b. pituitary gland**

10. The _____ hormone promotes the development and enlargement of tissues in the body.
    a. thyroid b. Adrenocorticotropic
    c. gonadotropic d. none of the above **Ans: d. none of the above**

11. In female, the _____ hormone stimulates the growth of the ovarian follicles.
    a. gonadotropic b. follicle stimulating
    c. luteinizing d. prolactin **Ans: b. follicle stimulating**

12. Deficiency of antidiuretic hormone causes _____.
    a. goitre b. Diabetes insipidus
    c. pancreatic disorder d. hyperthyroidism **Ans: b. Diabetes insipidus**

13. Tyrosine and iodine are involved in the formation of _____ hormone.
    a. adrenaline b. growth c. parathyroid d. thyroid
    Ans: d. thyroid

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

1. Over secretion of growth hormone leads to dwarfism in children.
   Ans: False
   Over secretion of growth hormone leads to **gigantism** in children.

2. Parathyroid hormone controls growth of the body and bone formation.
   Ans: False
   Thyroid hormone controls growth of the body and bone formation.

3. Thymosin is the hormone secreted by thymus.
   Ans; True

4. Cretinism is caused by deficiency of thyroid hormones in adults.
   Ans: False
   Myxoedema is caused by deficiency of thyroid hormones in adults.

5. Insulin helps in the breakdown of glycogen to glucose in the liver.
   Ans: False
   Glucagon helps in the breakdown of glycogen to glucose in the liver.

6. Epinephrine causes dilation of the pupil in eye.
   Ans: True

7. The adrenaline hormones of adrenal cortex serves to maintain the body in living condition and recover it from the severe effects of stress reactions.

Ans: False

The **cortisol** hormones of adrenal cortex serves to maintain the body in living condition and recover it from the severe effects of stress reactions.

IV. Assertion and Reason.

1. **Assertion:** Auxins promote the elongation of stems and coleoptiles which makes them to grow.
   Reason : It induces root formation at low concentration and inhibits it at higher concentration.
   a. A and R are correct, R explains A. b. A is correct, R is wrong.
   c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
   Ans: a. A and R are correct, R explains A

2. **Assertion:** Cytokinin induces cell division in the presence of auxins.
   Reason : Cytokinins does not promote the growth of lateral buds.
   a. A and R are correct, R explains A. b. A is correct, R is wrong.
   c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
   Ans: b. A is correct, R is wrong

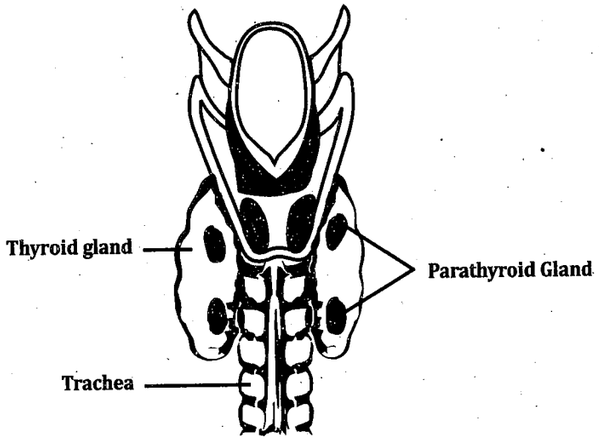
3. **Assertion:** Myxoedema is caused by deficiency of thyroid hormones in adults.
   Reason : They are mentally sluggish, increase in body weight, puffiness of the face and hand, oedematous appearance.
   a. A and R are correct, R explains A. b. A is correct, R is wrong.
   c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
   Ans: a. A and R are correct, R explains A.

V. Analog

1.	Indole - 3 - Acetic acid	natural auxins	
	2,4 Dichlorophenoxy acetic acid	_____	**(synthetic auxins)**
2.	Apical dominance	auxin	
	Richmond lang effect	_____	**(cytokinins)**
3.	Break the dormancy of potato	gibberellins	
	Break the dormancy of buds	_____	**(ethylene)**
4.	Over secretion of growth hormone	gigantism	
	Decreased secretion of growth hormone	_____	**(dwarfism)**
5.	Calcium and phosphorus metabolism	parathormone	
	Electrolyte balance	_____	**(aldosterone)**
6.	Alpha cell	glucagon	
	Beta cell	_____	**(insulin)**
7.	Frequent urination	polyuria	
	Increased thirst	_____	**(polydipsia)**
8.	Cortisol and corticosterone	glucocorticoids	
	Aldosterone	_____	**(mineralocarticoids)**
9.	Estrogen	graafian follicles	
	Progesterone	_____	**(corpus luteum)**
10.	Maturation of ovarian follicles	estrogen	
	Implantation of embryo	_____	**(progesterone)**
11.	Deficiency of insulin	Diabetes mellitus	
	Deficiency of ADH	_____	**(Diabetes insipidus)**

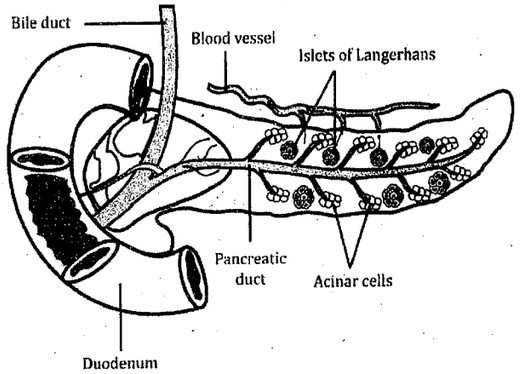
VI. To label the parts in the given diagram.

1. **Draw the structure of Parathyroid gland and label its parts.**



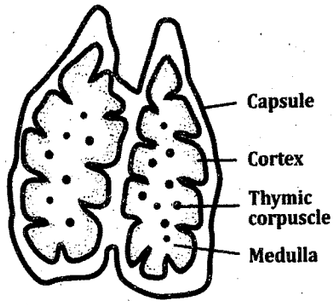
Parathyroid Gland

2. **Draw the structure of Pancreas and label its parts.**



Pancreas

3. **Draw the structure of Thymus gland and label its parts.**



VII. Short Answers:

1. **What are plant hormones? Give examples.**
   1. The function of **control** and **coordination** in **plant** is performed by **chemical substances** produced by the plants called plant hormones.
   2. **E.g:** Auxin, Cytokinin, Gibberellin, Abscisic acid, Ethylene

2. **Define - apical dominance.**

The **auxins** produced by the apical buds suppress growth of **lateral buds**. This is called apical dominance.

3. What is morphogenesis?

The formation of **new organs** from the **callus** in tissue culture is known as **morphogenesis**.

4. What is Richmond Lang effect?

Application of **cytokinin delays** the process of ageing in **plant**. This is called Richmond Lang effect.

5. Write a short note on lactogenic hormone.

1. **Prolactin** is also called **Lactogenic hormone**.
2. This hormone initiates the development of mammary glands during pregnancy and stimulates the production of milk after child birth.

6. What is personality hormone? Which is involved in the formation of the hormone?

1. Personality hormone is **thyroid hormones**.
2. An amino acid **tyrosine** and **iodine** are involved in the formation of thyroid hormone.

7. What is tetany?

1. Muscle spasm known as tetany.
2. Sustained contraction of muscles in face, larynx, hands and feet.

8. Pancreas acts as a exocrine and endocrine gland in nature. Justify your answer.

1. The **exocrine** pancreas secretes **pancreatic juice** which plays a role in digestion while, the **endocrine** portion is made up of Islets of langerhans.
2. It consists of two types of cells namely **alpha cells** and **beta cells**.
3. The alpha cells secrete **glucagon** and beta cells secrete **insulin**.
4. A balance between insulin and glucagon production is necessary to **maintain blood glucose concentration**.

9. Which is called as life - saving hormone.

1. Cortisol is called as life - saving hormone because they serve to maintain the body in living condition and recover it from the severe effects of stress reactions.
2. Thus an increased output of cortisol is **'life saving'** in **"shock conditions"**.
3. So it is called as life - saving hormone.

10. Which is called as flight, fright and fight hormone? Why is it called so?

1. The flight, fright and fight hormone is adrenal medulla hormones. It secretes two hormones namely,
   a. Epinephrine (Adrenaline)
   b. Norepinephrine (noradrenaline)
2. They are together produced during conditions of stress and emotion. Hence, it is called so.

11. Write the functions of thymosin.

1. It has a stimulatory effect on the immune function.
2. It stimulates the production and differentiation of lymphocytes.

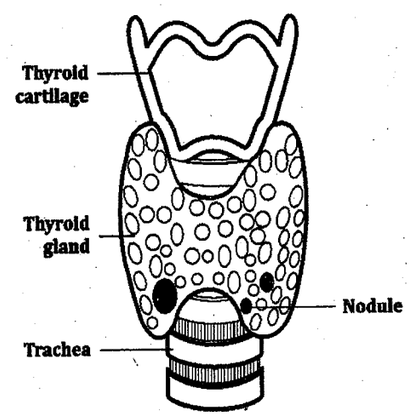
VIII. Long Answers:

1. Write the physiological effects of gibberellins.

1. Application of gibberellins on plants stimulate extraordinary elongation of internodes.
2. Treatment of rosette plants with gibberellins induce sudden shoot elongation followed by flowering. This is called bolting.
3. Gibberellins promote the production of male flowers in monoecious plants (Cucurbits).
4. Gibberellins break dormancy of potato tubers.
5. Gibberellins are efficient than auxin in inducing the formation of seedless fruit parthenocarpic fruits. (Development of fruits without fertilization)
6. **E.g:** Tomato

2. Write the structure and function of thyroid gland.

1. The thyroid gland is composed of two distinct lobes lying one on either side of the trachea.
2. The two lobes are connected by means of a narrow band of tissue known as the isthmus.
3. This gland is composed of glandular follicles and lined by cuboidal epithelium.
4. The follicles are filled with colloid material called thyroglobulin.
5. An amino acid tyrosine and iodine are involved in the formation of thyroid hormone.
6. The hormones secreted by the thyroid gland are,
   a. Triiodothyronine (T_3)
   b. Tetraiodothyronine (or) Thyroxine (T_4)



Thyroid Gland

Functions of thyroid hormones:

1. Production of energy by maintaining the Basal Metabolic Rate (BMR) of the body.
2. Helps to maintain normal body temperature.
3. Influences the activity of central nervous system.
4. Controls growth of the body and bone formation.
5. Essential for normal physical, mental and personality development.
6. It is also known as personality hormone.
7. Regulates the cell metabolism.

3. What is parathyroid gland. Mention its functions and dysfunctions.

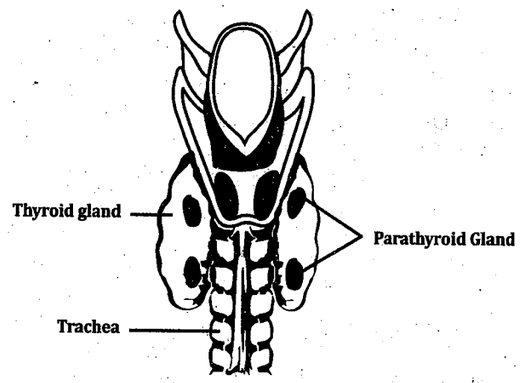
The parathyroid glands are four small oval bodies that are situated on posterior surface of the thyroid lobes. The chief cells of the gland are mainly concerned with secretion of parathormone.

Functions of parathormone:

1. The parathormone regulates calcium and phosphorus metabolism in the body.
2. They act on bone, kidney and intestine to maintain blood calcium levels.

Parathyroid Dysfunction:

1. The secretion of parathyroid hormone can be altered due to the following condition.
2. Removal of parathyroid glands during thyroidectomy (removal of thyroid) causes decreased secretion of parathormone. The conditions are,
   i. Muscle spasm known as Tetany.
   ii. Painful cramps of the limb muscles.



Parathyroid Gland

4. Write the functions of pancreatic hormones.

A balance between insulin and glucagon production is necessary to maintain blood glucose concentration.

Insulin:

1. Insulin helps in the conversion of glucose into glycogen which is stored in liver and skeletal muscles.
2. It promotes the transport of glucose into the cells.
3. It decreases the concentration of glucose in blood.

Glucagon:

1. Glucagon helps in the breakdown of glycogen to glucose in the liver.
2. It increases blood glucose levels.

Diabetes mellitus:

The deficiency of insulin causes diabetes mellitus. It is characterised by

1. Increase in blood sugar level (Hyperglycemia).
2. Excretion of excess glucose in the urine (Glycosuria).
3. Frequent urination (Polyuria).
4. Increased thirst (Polydipsia).
5. Increase in appetite (Polyphagia).

IX. Fill in the blanks.

1. Plant hormones are _____ molecules that are produced at extremely low concentration. **(organic)**
2. _____ are the chemical substances which perform control and coordination of plants. **(Plant hormones)**
3. _____ promotes elongation in stems and coleoptiles. **(Auxins)**
4. _____ induce root formation at low concentration. **(Auxins)**
5. Auxins produced by the apical buds suppress growth of _____. **(lateral buds)**
6. Auxins prevent the formation of _____ layer. **(abscission)**
7. _____ are plant hormones that promote cell division. **(Cytokinins)**
8. Cytokinins are isolated from _____ sperm. **(fish)**
9. _____ was the cytokinin isolated from Zea mays. **(Zeatin)**
10. Cytokinin is found abundantly in liquid endosperm of _____. **(coconut)**
11. Cytokinin induces cell division in the presence of _____. **(auxins)**
12. _____ promote the growth of lateral buds even in the presence of apical bud. **(Cytokinin)**
13. _____ delays the process of ageing in plants. **(Cytokinin)**
14. _____ are the most abundantly found plant hormones. **(Gibberellins)**
15. The internodal elongation in rice was caused by fungus _____. **(Gibberella fujikuroi)**
16. The active substance responsible for the internodal elongation in rice was identified as _____. **(Gibberellic acid)**
17. Application of gibberellins on plants stimulate extraordinary elongation of _____. **(internodes)**
18. Treatment of rosette plants with gibberellin results in _____. **(bolting)**
19. In _____, the auxins produced by the apical buds suppress growth of lateral buds. **(apical dominance)**
20. _____ promote the production of male flowers in monoecious plants. **(Gibberellins)**
21. _____ break dormancy of potato tubers. **(Gibberellins)**
22. _____ are efficient than auxins in inducing the formation of Parthenocarpic fruits. **(Gibberellins)**
23. Abscisic acid (ABA) is a growth _____. **(inhibitor)**
24. _____ regulates abscission and dormancy. **(Abscisic acid)**
25. _____ is also called as stress hormone. **(Abscisic acid)**
26. During water stress and drought conditions ABA causes _____. **(stomatal closure)**
27. Abscisic acid promotes _____ in leaves. **(senescence)**
28. _____ is a gaseous plant hormone. **(Ethylene)**
29. Ethylene promotes the _____ of fruits. **(ripening)**
30. Ethylene stimulates the formation of _____ zone in leaves. **(abscission)**
31. _____ and _____ are two kinds of glands found in animals. **(Exocrine, endocrine)**
32. The formation of abscission zone in leaves leads to _____. **(premature shedding)**
33. _____ are called ductless glands. **(Endocrine glands)**
34. The branch of biology which deals with the study of the endocrine glands and its physiology is known as _____. **(Endocrinology)**
35. _____ is known as the Father of Endocrinology. **(Thomas Addison)**
36. English physiologists W.M. Bayliss and E.H. Starling introduced the term _____ in 1909. **(hormone)**
37. _____ is caused by decreased secretion of growth hormone in children. **(Dwarfism)**
38. The _____ forms the major endocrine gland in most vertebrates. **(pituitary gland)**
39. Over secretion of growth hormone leads to _____ in children. **(gigantism)**
40. _____ is the excess secretion of growth hormone in adults. **(Acromegaly)**
41. The _____ gland is a compact mass of cells located at the base of the midbrain. **(pituitary)**
42. The pituitary gland is attached to the _____ by a pituitary stalk. **(hypothalamus)**
43. _____ hormone controls cell metabolism. **(growth)**
44. W. M. Bayliss and E.H. Starling discovered the first hormone called _____. **(secretin)**
45. The anterior lobe of the pituitary gland is called _____. **(adenohypophysis)**
46. Suppression of _____ has been implicated in sleep disturbances. **(melatonin)**
47. _____ controls the growth of thyroid gland. **(Thyroid stimulating hormone)**
48. In female the _____ hormone initiates the growth of ovarian follicles. **(follicle stimulating hormone(FSH))**
49. _____ is also called lactogenic hormone. **(Prolactin)**

50. The two lobes of the thyroid gland are connected by means of a narrow band of tissue known as the _____. **(isthmus)**
51. The _____ hormones are essential for the normal development of gonads. **(gonadotropic)**
52. _____ is known as time messenger. **(Melatonin)**
53. Deficiency of antidiuretic hormone causes an increase in _____ output. **(urine)**
54. The follicles of the thyroid gland are filled with colloidal material called _____. **(thyroglobulin)**
55. Amino acids _____ and _____ are involved in the formation of thyroid hormone. **(tyrosine, iodine)**
56. _____ is also known as personality hormone. **(Thyroid hormone)**
57. When the thyroid gland fails to secrete the normal level of hormones, the condition is called _____. **(thyroid dysfunction)**
58. The chief cells of the parathyroid gland are mainly concerned with secretion of _____. **(parathormone)**
59. The failure of the thyroid glands to secret normal level of hormones is called as _____. **(thyroid dysfunction)**
60. Decreased secretion of thyroid hormone in children causes _____. **(cretinism)**
61. Decreased secretion of thyroid hormone in adults causes _____. **(myxoedema)**
62. The _____ regulates calcium and phosphorus metabolism in the body. **(parathormone)**
63. _____ is exocrine and endocrine in nature. **(Pancreas)**
64. The exocrine pancreas secretes _____ juice. **(pancreatic)**
65. The endocrine portion of the pancreas is made up of _____. **(Islets of Langerhans)**
66. _____ was first used in treatment of diabetes on 11th January 1922. **(Insulin)**
67. The alpha cells secrete _____. **(glucagon)**
68. The beta cells secrete _____. **(insulin)**
69. _____ helps in the conversion of glucose into glycogen. **(Insulin)**
70. _____ decreases the concentration of glucose in the blood. **(Insulin)**
71. The deficiency of insulin causes _____. **(Diabetes mellitus)**
72. The adrenal glands are located above each _____. **(kidney)**
73. The outer part of the adrenal gland is the _____. **(adrenal cortex)**
74. The inner part of the adrenal gland is the _____. **(adrenal medulla)**
75. _____ are also called supra renal glands. **(Adrenal glands)**
76. The hormones secreted by the adrenal cortex are _____. **(corticosteroids)**
77. The glucocorticoids secreted by the zona fasciculata are _____ and _____. **(cortisol, corticosterone)**
78. The mineralocorticoids secreted by zona glomerulosa is _____. **(aldosterone)**
79. _____ causes increased excretion of potassium ions. **(Mineralocorticoids)**
80. _____ regulates electrolyte balance. **(Mineralocorticoids)**
81. The adrenal medulla is composed of _____ cells. **(chromaffin)**
82. The hormones of the adrenal medulla are called as _____ hormones. **(emergency)**
83. _____ promotes the conversion of glycogen to glucose in liver and muscles. **(Adrenaline)**
84. _____ causes dilation of the pupil in eye. **(Adrenaline)**
85. _____ is known as lifesaving hormone. **(Cortisol)**
86. Most of the actions of norepinephrine are similar to those of _____. **(epinephrine)**
87. The testes are present in _____. **(male)**
88. The ovaries are present in _____. **(female)**
89. _____ is referred as flight, fright and fight hormone. **(Adrenal medulla)**
90. _____ is produced by the graafian follicles of the ovary. **(Estrogen)**
91. Testes are the _____ glands of the males. **(reproductive)**
92. _____ cells form the endocrine part of the testes. **(Leydig)**
93. Leydig cells secrete the male sex hormone called_____. **(testosterone)**
94. Testosterone influences the process of _____. **(spermatogenesis)**
95. _____ are the female gonads located in the pelvic cavity of the abdomen. **(ovaries)**
96. _____ from the corpus luteum is formed in the ovary from the ruptured follicle during ovulation. **(Progesterone)**
97. _____ initiates the process of oogenesis. **(Estrogen)**
98. _____ prepares the uterus for the implantation of the embryo. **(Progesterone)**
99. _____ is partly an endocrine gland and partly a lymphoid gland. **(Thymus)**

17. REPRODUCTION IN PLANTS AND ANIMALS

I. Choose the correct answer.

1. The plant which propagates with the help of its leaves is _____.
   a. Onion b. Neem c. Ginger d. *Bryophyllum*
   Ans: d. *Bryophyllum*

2. Asexual reproduction takes place through budding in _____.
   a. Amoeba b. Yeast c. Plasmodium d. Bacteria
   Ans: b. Yeast

3. Syngamy results in the formation of _____. ※ **(APR - 2023, SEP - 2021)**
   a. Zoospores b. Conidia c. Zygote d. Chlamydospores
   Ans: c. Zygote

4. The essential parts of a flower are _____. ※※
   a. Calyx and Corolla b. Calyx and Androecium
   c. Corolla and Gynoecium d. Androecium and Gynoecium
   Ans: d. Androecium and Gynoecium

5. Anemophilous flowers have _____. ※※
   a. Sessile stigma b. Small smooth stigma
   c. Colored flower d. Large feathery stigma
   Ans: d. Large feathery stigma

6. Male gametes in angiosperms are formed by the division of _____. **(MAY - 22)**
   a. Generative cell b. Vegetative cell
   c. Microspore mother cell d. Microspore
   Ans: a. Generative cell

7. What is true of gametes?
   a. They are diploid b. They give rise to gonads
   c. They produce hormones d. They are formed from gonads
   Ans: d. They are formed from gonads

8. A single highly coiled tube where sperms are stored, get concentrated and mature is known as _____.
   a. Epididymis b. Vasa efferentia
   c. Vas deferens d. Seminiferous tubules **Ans: a. Epididymis**

9. The large elongated cells that provide nutrition to developing sperms are ※※ **(SEP - 2021)**
   a. Primary germ cells b. Sertoli cells
   c. Leydig cells d. Spermatogonia **Ans: b. Sertoli cells**

10. Estrogen is secreted by
    a. Anterior pituitary b. Primary follicle
    c. Graffian follicle d. Corpus luteum **Ans: c. Graffian follicle**

11. Which one of the following is an IUCD?
a. Copper - T b. Oral pills c. Diaphragm d. Tubectomy
Ans: a. Copper - T

II. Fill in the blanks.

1. The embryo sac in a typical dicot at the time of fertilization is _____.
Ans: seven cells and eight nuclei
2. After fertilization the ovary develops into _____. **Ans: fruit**
3. Planaria reproduces asexually by _____. **Ans: regeneration**
4. Fertilization is _____ in humans. **Ans: internal**
5. The implantation of the embryo occurs at about _____ day of fertilization.
Ans: 6 - 7
6. _____ is the first secretion from the mammary gland after child birth.
Ans: Colostrum
7. Prolactin is a hormone produced by _____. **Ans: anterior pituitary**

III. a. Match the following.

Column - I		Column - II			Answers		
1.	Fission	-	a.	Spirogyra	-	b.	**Amoeba**
2.	Budding	-	b.	Amoeba	-	c.	**yeast**
3.	Fragmentation	-	c.	yeast	-	a.	**Spirogyra**

b. Match the following terms with their respective meanings.

Column - I		Column - II			Answers		
1.	Parturition	-	a.	Duration between pregnancy and birth	-	c.	**Delivery of baby from uterus**
2.	Gestation	-	b.	Attachment of zygote to endometrium	-	a.	**Duration between pregnancy and birth**
3.	Ovulation	-	c.	Delivery of baby from uterus	-	d.	**Release of egg from Graafian follicle**
4.	Implantation	-	d.	Release of egg from Graafian follicle	-	b.	**Attachment of zygote to endometrium**

IV. State whether the following statements are True or False. Correct the false statement.

1. Stalk of the ovule is called pedicle.
Ans: False
Stalk of the ovule is called **funicle**.

2. Seeds are the product of asexual reproduction.
Ans: False
Seeds are the product of **sexual** reproduction
3. Yeast reproduces asexually by means of multiple fission.
Ans: False
Yeast reproduces asexually by means of **budding**.
4. The part of the pistil which serves as a receptive structure for the pollen is called as style.
Ans: False
The part of the pistil which serves as a receptive structure for the pollen is called as **stigma**.
5. Insect pollinated flowers are characterized by dry and smooth pollen.
Ans: False
Wind pollinated flowers are characterized by dry and smooth pollen.
6. Sex organs produce gametes which are diploid.
Ans: False
Sex organs produce gametes which are **haploid**.
7. LH is secreted by the posterior pituitary.
Ans: False
LH is secreted by the **anterior** pituitary.
8. Menstrual cycle ceases during pregnancy.
Ans: True
9. Surgical methods of contraception prevent gamete formation.
Ans: False
Surgical methods of contraception prevent **fertilization**.
10. The increased level of estrogen and progesterone is responsible for menstruation.
Ans: False
The **decreased** level of estrogen and progesterone is responsible for menstruation.

V. Answer in a word or sentence.

1. **If one pollen grain produces two male gametes, how many pollen grains are needed to fertilize 10 ovules?**
Ans: 10 pollen grains
2. **In which part of the flower germination of pollen grains takes place?**
Ans: Stigma

3. Name two organisms which reproduces through budding.

Ans: Yeast, Hydra

4. Mention the function of endosperm. ※※

Ans: Endosperm provides food to the developing embryo.

5. Name the hormone responsible for the vigorous contractions of the uterine muscles. ※

Ans: Oxytocin

6. What is the enzyme present in acrosome of sperm? ※※

Ans: Hyaluronidase

7. When is World Menstrual Hygiene Day observed?

Ans: May 28th

8. What is the need for contraception?

Ans: It is a birth control measure

9. Name the part of the human female reproductive system where the following occurs.

a. Fertilization:

Ans: Fallopian tube

b. Implantation:

Ans: Uterus

VI. Short answer questions.

1. What will happen if you cut planaria into small fragments?

1. If we cut a planaria each small fragment gives rise to a **whole new organism.**
2. This takes place by the process of **regeneration.**

(PTA - I)

2. Why is vegetative propagation practiced for growing some type of plants?

1. Vegetative propagation helps us to introduce plants in new areas where seed germination fails to produce plants due to conditions of environment.
2. Vegetative propagation is the only method of multiplication in plants like banana, seedless grapes and orange that have lost their capacity to produce seeds through sexual reproduction.

3. How does binary fission differ from multiple fission? ※※

	Binary fission	Multiple fission
1.	Two daughter cells are produced from a single parent cell.	Two or multiple daughter cells are produced from a single parent cell.
2.	Cytoplasm divides after each nuclear division.	Cytoplasm does not divide after each nuclear division.
3.	It occurs in favourable conditions.	It occurs in unfavourable conditions.
4.	Eg: Amoeba	Eg: Plasmodium

4. Define triple fusion. ※※※ **(GMQ - 2019, MAY - 22)**

1. During double fertilization one sperm fuses with the egg and forms a diploid zygote.
2. The other sperm fuses with the **secondary nucleus** to form the **primary endosperm** nucleus which is **triploid** in nature. This is called triple fusion.

5. Write the characteristics of insect pollinated flowers. **(PTA - VI)**

1. To attract insects these flowers are **brightly coloured**, have **smell** and **nectar**.
2. The pollen grains are **larger** in **size**, the exine is **pitted**, **spiny** etc., so they can be adhered firmly on the sticky stigma.

6. Name the secondary sex organs in male. **(MAY - 2022)**

1. Vas deferens
2. Epididymis
3. Seminal vesicle
4. Prostate gland
5. Penis

※※

7. What is colostrum? How is milk production hormonally regulated?

(AP - 2024, PTA - II)

1. The milk produced from the breast during the first **2 to 3 days** after child birth is called colostrum.
2. Milk production from alveoli of mammary glands is stimulated by **prolactin** secreted from the **anterior pituitary**.
3. The ejection of milk is stimulated by **posterior** pituitary hormone **oxytocin**.

8. How can menstrual hygiene be maintained during menstrual days? (PTA - IV)

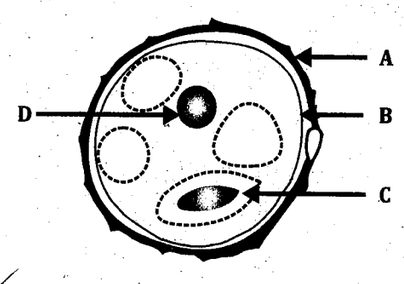
1. Sanitary pads should be **changed regularly**, to avoid infections due to microbes from vagina and sweat from genitals.
2. Use of **warm water** to clean genitals helps to get rid of **menstrual cramps.**
3. Wearing **loose clothing** rather than tight fitting clothes will ensure the **airflow** around the genitals and prevent sweating.

(PTA - VI) ※※

9. How does developing embryo gets its nourishment inside the mother's body?

1. Developing embryo gets its nourishment inside the mother's body through **placenta.**
2. It allows the exchange of food materials and diffusion of oxygen from the mother to developing embryo.
3. The **umbilical cord** contains blood vessels that connects the placenta with the foetus.

10. Identify the parts A, B, C and D. (APR - 2023, GMQ - 2019, SEP - 2022)



Ans:

A - Exine
B - Intine
C - Generative cell
D - Vegetative nucleus

(JULY - 24, JUNE - 23)

11. Write the events involved in the sexual reproduction of a flowering plant.

Events involved in the sexual reproduction of a flowering plant are,

1. Pollination
2. Fertilization

a. Discuss the first event and write the types.

Ans: Pollination:

The transfer of pollen grains from anther to stigma of a flower is called as pollination.

It is of two types,

1. Self - pollination
2. Cross pollination

b. Mention the advantages and the disadvantages of that event.

Ans: Advantages of self - pollination:

1. Self - pollination is possible in certain **bisexual flowers.**
2. Flowers do not depend on agents for pollination.
3. There is **no wastage** of pollen grains.

Disadvantages of self - pollination:

1. The **seeds** are **less** in numbers
2. The **endosperm** is **minute.** Therefore, the seeds produce weak plants.
3. New varieties of plants **cannot** be produced.

Advantages of cross pollination:

1. The seeds produced as a result of **crosspollination** develop and germinate properly and grow into better plants i.e., cross pollination leads to the **production** of **new varieties.**
2. More **viable seeds** are produced.

Disadvantages of cross - pollination:

1. Pollination may fail due to distance barrier.
2. **More wastage** of pollen grains.
3. It may introduce some unwanted characters.
4. Flowers depend on the external agencies for pollination.

12. Why are the human testes located outside the abdominal cavity? Name the pouch in which they are present. ※※

1. Testes are located outside the abdominal cavity because sperm formation requires a **lower temperature** than the **normal body temperature.**
2. The pouch in which they are present is called **scrotum.**

13. Luteal phase of the menstrual cycle is also called the secretory phase. Give reason.

1. After ovulation, the corpus luteum slowly increases in size and releases progesterone.
2. The progesterone acts on endometrium of uterus, preparing it to receive the fertilized ovum.
3. To maintain pregnancy and to prevent the contraction of uterus, the progesterone hormone is highly essential.
4. So the luteal phase of the menstrual cycle is also called the secretory phase.

14. Why are family planning methods not adopted by all the people of our country?

1. Lack of awareness among the people of our country is the foremost reason for not adopting family planning.
2. **Hormonal methods:**

   It creates hormonal imbalance and can cause side effects to our body.
3. **Intra - Uterine Devices:**

   Devices like Lippe's Loop and copper - T causes irritation in the uterus.
4. **Surgical methods:**

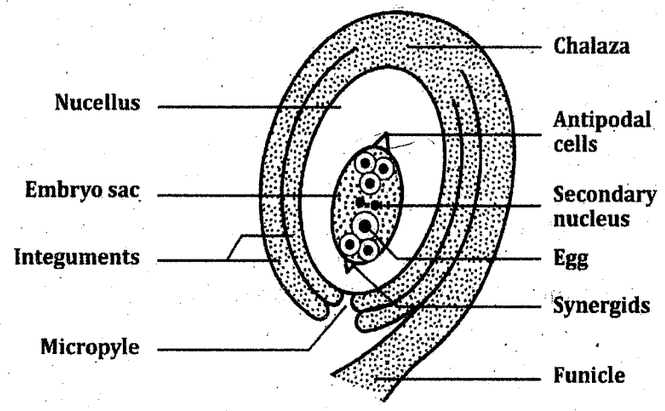
   These cause infections and other problems if not performed properly.
   So family planning methods are not adopted by all the people of our country.

VII. Long answer questions.

1. With a neat labelled diagram describe the parts of a typical angiospermic ovule. (APRIL - 2024, PTA - V)

Structure of the ovule:

1. The main part of the ovule is the **nucellus** which is enclosed by two integuments leaving an opening called as **micropyle**.
2. The ovule is attached to the ovary wall by a stalk known as **funiculus**.
3. **Chalaza** is the basal part.
4. The embryo sac contains **seven cells** and the **eighth nuclei** located within the nucellus.



Structure of an Ovule

5. Three cells at the microphylar end form the **egg apparatus**.
6. The three cells at the chalaza end are the **antipodal cells**.
7. The remaining two nuclei are called **polar nuclei** found in the centre.
8. In the egg apparatus one is the egg cell (female gamete) and the remaining two cells are the **synergids**.

2. What are the phases of menstrual cycle? Indicate the changes in the ovary and uterus. (PTA - III)

Menstrual cycle:

The cyclic events that take place in a rhythmic fashion during the **reproductive period** of a **woman's life** is called menstrual cycle.

Menstrual cycle consists of 4 phases:

1. Menstrual or Destructive Phase
2. Follicular or Proliferative phase
3. Ovulatory phase
4. Luteal or Secretory phase

Events of Menstrual cycle

Phase	Days	Changes in Ovary	Changes in Uterus	Hormonal changes
Menstrual phase	4 - 5 days	Development of primary follicles	Breakdown of uterine endometrial lining leads to bleeding	Decrease in progesterone and oestrogen
Follicular phase	6th - 13th day	Primary follicles grow to become a fully mature Graafian follicle	Endometrium regenerates through proliferation	FSH and oestrogen increases
Ovulatory phase	14th day	The graafian follicle ruptures and releases the ovum (egg)	Increase in endometrial thickness	LH peak
Luteal phase	15th - 28th day	Emptied graafian follicle develops into corpus luteum	Endometrium is prepared for implantation. If fertilization does not occu corpus luteum degenerates, uterine wall ruptures, bleeding starts and unfertilized egg is expelled	LH and FSH decrease, corpus luteum produces progesterone and its level increases followed by a decline, if menstrual bleeding occurs

VIII. Higher Order Thinking Skills (HOTS).

1. In angiosperms the pollen germinates to produce pollen tube that carries two gametes. What is the purpose of carrying two gametes when single gamete can fertilize the egg?

1. In angiosperms the pollen germinates to produce pollen tube that carries two gametes (or) sperms.
2. One sperm fuses with the egg and forms a diploid zygote.
3. The other sperm fuses with the secondary nucleus (triple fusion) to form the primary endosperm nucleus which is triploid in nature.
4. This endosperm provides food to the developing embryo.
5. If a single gamete is present it can fertilize the egg, but not produce endosperm.

2. Why menstrual cycle does not take place before puberty and during pregnancy?

1. Before puberty the ovaries have thousands of immature eggs and there is no secretion of sexual hormones. So the menstrual cycle does not take place.
2. After fertilization or during pregnancy the corpus luteum continues to secrete progesterone, maintains the thickened state of uterine wall and prevents maturation of another follicle till the end of pregnancy. So the menstrual cycle does not take place.

3. Read the following passage and answer the questions that follow
Rahini and her parents were watching a television programme. An advertisement flashed on the screen which was promoting use of sanitary napkins. Rahini's parents suddenly changed the channel, but she objected to her parents and explained the need and importance of such advertisement.

a. What is first menstruation called? When does it occur?
First menstruation is called as **menarche,** occurs at the age of 11 - 13 years.

b. List out the napkin hygiene measures taken during menstruation?

1. The sanitary pads should be wrapped properly and discarded because they can spread infections.
2. Sanitary pads should not be flushed down the toilet.
3. Napkin incinerators are to be used properly for disposal of used napkins.

c. Do you think that Rahini's objection towards her parents was correct? If so, Why?

Yes, Rahini's objection towards her parents was correct, as it creates a public awareness on the basic needs and biological needs of women.

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

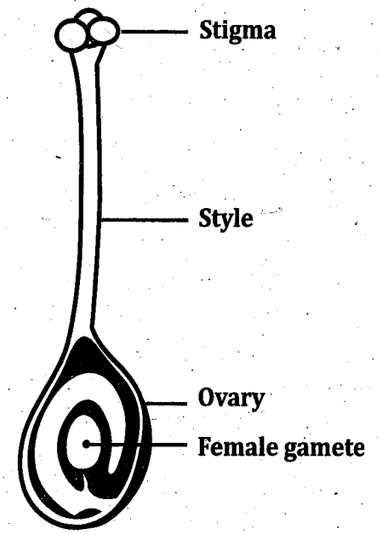
I. Choose the correct answer.

1. The type of cell division occurs in generative cell of mature pollen grain **(PTA - 1)**
a. Mitosis b. Meiosis c. Amitosis d. both b. and c.
Ans: a. Mitosis

2. In humans, a male and a female gamete fuse and form the zygote. The condition of zygote is _____. **(PTA - 4)**
a. haploid b. diploid c. triploid d. tetraploid
Ans: b. diploid

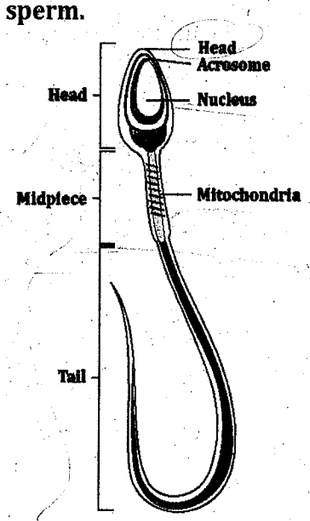
II. Short answers.

1. Draw the structure of gynoecium and label its parts. (APRIL - 2024)



Gynoecium

2. Draw and label the parts of a sperm. (SEP - 2021)



3. How is Corpus luteum formed? Name the hormones secreted by corpus luteum. (PTA - 2)

1. **Corpus luteum** formed in the **ovary** from the **ruptured follicle** during ovulation.
2. The hormone **progesterone** secreted by corpus lutem.

III. Long answers.

1. a. What is pollination? (SEP - 2021)

The transfer of pollen grains from anther to stigma of a flower is called as pollination.

b. State the importance of pollination. (SEP - 2021)

1. It results in fertilization which leads to the formation of fruits and seed.

2. New varieties of plants are formed through new combination of genes in case of cross pollination.

2. Write a note on UTI. (SEP - 2020)

1. Many diseases affect both women and men, but a few diseases occur at a higher frequency in woman.
2. Woman are susceptible to UTI from the bacteria that are present on skin, rectum or vagina.
3. This will enter the urethra, before moving upwards. The types of UTI are,

a. Cystitis or Bladder infection:

1. Bacteria lodged in the urinary bladder thrive and multiply leading to inflammation.
2. It is most common in the age group of 20 to 50.

b. Kidney infection:

1. The bacteria can travel from the urinary bladder and upward to ureter and affect one or both kidneys.
2. It also infects the blood stream and leads to serious life - threatening complications.

c. Asymptomatic Bacteriuria:

The bacteria present in the urinary bladder which may not show any symptoms.

3. Write the importance of fertilization in plants. (PTA - 2)

1. It stimulates the ovary to develop into fruit.
2. It helps in development of new characters from two different individuals.

ADDITIONAL QUESTIONS

I. Match the following:

Column - I	Column - II	Answers
1. Ovulatory phase	a. menarche	**d. LH peak**
2. Follicular phase	b. 15th - 28th day	**c. FSH, oestrogen increase**
3. Menstrual phase	c. FSH, oestrogen increase	**e. 4 - 5 days**
4. Luteal phase	d. LH peak	**b. 15th - 28th day**
5. Puberty	e. 4 - 5 days	**a. menarche**

Column - I	Column - II	Answers
1. Fertilization	a. primary germ layer	**c. zygote**
2. Implantation	b. gestation	**d. blastocyst**
3. Gastrulation	c. Zygote	**a. primary germ layer**
4. Organogenesis	d. blastocyst	**e. organ development**
5. Pregnancy	e. organ development	**b. gestation**

Column - I	Column - II	Answers
1. Parturition	a. ovule	**b. child birth**
2. Mammary gland	b. child birth	**e. colostrum**
3. Chalaza	c. self pollination	**a. ovule**
4. Autogamy	d. grass	**c. self pollination**
5. Anemophily	e. colostrum	**d. grass**

Column - I	Column - II	Answers
1. Entomophily	a. Hydrilla	c. **Honey bee**
2. Hydrophily	b. Vas deferens	a. **Hydrilla**
3. Male	c. Honey bee	b. **Vas deferens**
4. Female	d. Testosterone	e. **uterus**
5. Epithelial cells	e. uterus	f. **granulosa cells**
6. Leydig cells	f. granulosa cells	d. **Testosterone**

Column - I	Column - II	Answers
1. Spermatozoa	a. oogenesis	b. **spermatogenesis**
2. Ova	b. spermatogenesis	a. **oogenesis**
3. Acrosome	c. plasma membrane	e. **hyaluronidase**
4. Zona pellucida	d. follicle cells	c. **plasma membrane**
5. Corona radiata	e. hyaluronidase	d. **follicle cells**

Column - I	Column - II	Answers
1. Leaf	a. strawberry	d. **bryophyllum**
2. Stem	b. asparagus	a. **strawberry**
3. Root	c. agave	b. **asparagus**
4. Bulbils	d. bryophyllum	c. **agave**

II. Choose the correct answer:

1. The inner layer of the pollen grain is called _____.
   a. exine b. funiculus c. intine d. chalaza **Ans: c. intine**
2. _____ is the basal part of the ovule.
   a. funiculus b. micropylar c. chalaza d. polar nuclei **Ans: c. chalaza**
3. Self - pollination is also known as _____.
   a. polygamy b. autogamy c. monogamy d. none of the above
   Ans: b. autogamy
4. Pollination with the help of water is called _____.
   a. anemophily b. entomophily c. hydrophily d. zoophily
   Ans: c. hydrophily
5. _____ is a kind of pollination that takes place in aquatic plants.
   a. anemophily b. hydrophily c. entomophily d. zoophily
   Ans: b. hydrophily
6. The integuments of the ovule develop into the _____.
   a. seed b. fruit c. seed coat d. none of the above
   Ans: c. seed coat
7. The _____ provides food to the developing embryo in plants.
   a. pollen grain b. endosperm c. synergids d. antipodal cells
   Ans: b. endosperm
8. During spore formation _____ develops from the fungal hypha.
   a. spore b. sporangiophore c. sporangium d. none of the above
   Ans: c. sporangium
9. The male part of a flower is composed of _____.
   a. stigma b. stamen c. style d. ovary **Ans: b. stamen**
10. Testes and ovaries in human are the _____ reproductive organs.
    a. primary b. secondary c. Accessory d. none of the above
    Ans: a. primary
11. In man, each testes is covered with a layer of fibrous tissue called _____.
    a. scrotum b. tunica albuginea
    c. sertoli cells d. leydig cells **Ans: b. tunica albuginea**

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

1. In bryophyllum aerial weak stems touch the ground and give off adventitious roots and buds.
   Ans: False
   In **strawberry** aerial weak stems touch the ground and give off adventitious roots and buds.
2. Sexual reproduction occurs by spore formation.
   Ans: False
   Asexual reproduction occurs by spore formation.
3. The pollen grains are produced in the anther within the filament.
   Ans: False
   The pollen grains are produced in the anther within the **pollen sac**.
4. The vegetative cell divides mitotically to form two male gametes.
   Ans: False
   The **generative** cell divides mitotically to form two male gametes.
5. The ovule is attached to the ovary wall by a stalk known as chalaza.
   Ans: False
   The ovule is attached to the ovary wall by a stalk known as **funiculus**.
6. New varieties of plants are formed through new combination of genes in case of self-pollination.
   Ans: False
   New varieties of plants are formed through new combination of genes in case of **cross** pollination.
7. The entomophilous flowers produce enormous amount of pollen grains.
   Ans: False
   The **anemophilous** flowers produce enormous amount of pollen grains.

IV. Assertion and Reason.

1. **Assertion:** Pollination with the help of insects are called entomophily.
   Reason : To attract insects these flowers are brightly coloured, have smell and nectar.
   a. A and R are correct, R explains A. b. A is correct, R is wrong.
   c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
   Ans: a. A and R are correct, R explains A
2. **Assertion:** Pollen tube grows through the tissues of the stigma and style and finally reaches the ovule through the micropyle.
   Reason : Tip of pollen tube bursts and the two sperms enter the embryo sac.
   a. A and R are correct, R explains A. b. A is correct, R is wrong.
   c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
   Ans: d. A and R are correct, R doesn't explain A
3. **Assertion:** The sertoli cells are polyhedral in shape and lie between the seminiferous tubules and secrete testosterone.
   Reason : It initiates the process of spermatogenesis.
   a. A and R are correct, R explains A. b. A is correct, R is wrong.
   c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
   Ans: c. A is wrong, R is correct
4. **Assertion:** The formation of the sperm in male and ovum in female is called gametogenesis.
   Reason : Gametes with haploid cells are produced through gametogenesis.

a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
Ans: d. A and R are correct, R doesn't explain A

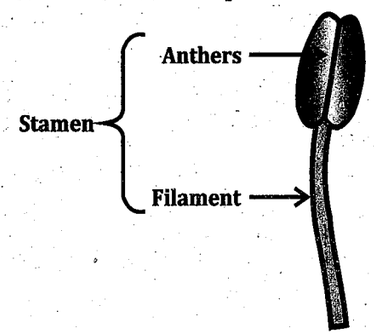
5. **Assertion:** Mensuration is a periodical phenomenon that continues from puberty to menopause.
Reason : This will happen if the released ovum is not fertilized by the sperm.
a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
Ans: a. A and R are correct, R explains A.

V. Analog

1.	Bryophyllum	:	Leaves	
	Strawberry	:	_____	**(stem)**
2.	Sepal	:	calyx	
	Petal	:	_____	**(corolla)**
3.	Pollination by wind	:	anemophily	
	Pollination by insect	:	_____	**(entomophily)**
4.	Ovule	:	seed	
	Ovary	:	_____	**(fruits)**
5.	Decrease in progesterone and oestrogen	:	menstrual phase	
	Increase in FSH and oestrogen	:	_____	**(follicular phase)**
6.	Uterine contraction	:	oxytocin	
	Milk production	:	_____	**(prolactin)**
7.	Surgical procedure in male	:	vasectomy	
	Surgical procedure in female	:	_____	**(tubectomy)**
8.	Corpus luteum persists	:	pregnancy	
	Corpus luteum degenerates	:	_____	**(menstruation)**
9.	Pollination by water	:	hydrophily	
	Pollination by animal	:	_____	**(zoophily)**
10.	Accessory whorls	:	calyx and corolla	
	Essential whorls	:	_____	**(androecium and gynoecium)**

VI. To label the parts in the given diagram.

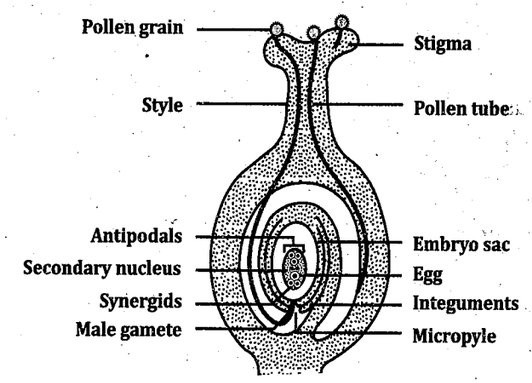
1. Draw the structure of an anther and label its parts.



Anther

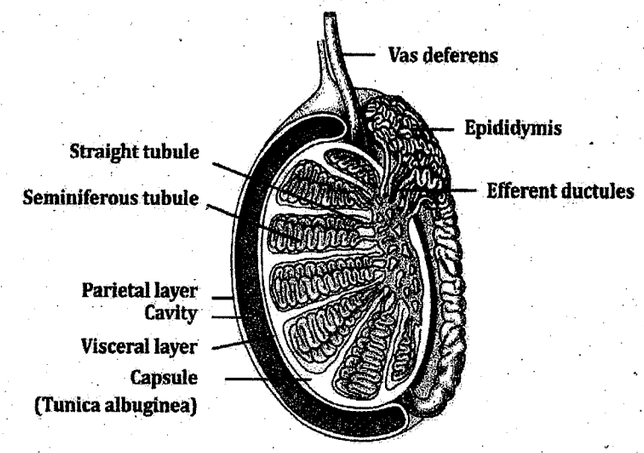
2. Diagrammatically represent the process of fertilization in plants.

Process of Fertilization



3. Draw the L.S structure of human testes and label its parts.

L.S. of human testes



VII. Short Answers:

1. How can spirogyra reproduce?
1. Spirogyra reproduces through fragmentation.
2. Breaking of the filament into many fragments is called fragmentation.
3. Each fragment having atleast one cell may give rise to a new filament of the algae by cell division.

2. Write about asexual reproduction in fungi.
1. The fungi reproduce asexually by spore formation.
2. During spore formation a structure called sporangium develops from the fungal hypha.
3. The nucleus divides several times within the sporangium and each nucleus with small amount of cytoplasm develops into a spore.
4. The spores are liberated and they develop into new hypha after reaching the ground or substratum.

3. What is sexual reproduction?
Sexual reproduction is the process in which two gametes (male and female) are fused to produce offspring of their own kind.

4. Define a flower.

A flower is a modified shoot with limited growth to carryout sexual reproduction.

5. Why are androecium and gynoecium known as essential whorls?

Androecium and gynoecium are known as the essential whorls because they take part directly in reproduction.

6. Differentiate self and cross pollination.

	Self pollination		Cross pollination
1.	Transfer of pollen grains from the anther to stigma of same flower or another flower borne on the same plant.	1.	Transfer of pollen from the anther of a flower to the stigma of a flower on another plant of the same species.
2.	**E.g:** Hibiscus	2.	**E.g:** Apple

7. Write the characters of anemophily flowers.

1. The pollen grains are small, smooth, dry and light in weight.
2. Pollen of such plants are blown off at a distance of more than 1,000km.
3. The stigmas are comparatively large, protruding and sometimes hairy to trap the pollen grains.

   E.g: Grass

8. Write the role of prolactin and oxytocin in lactation.

1. Milk production from alveoli of mammary glands is stimulated by prolactin secreted from anterior pituitary.
2. The ejection of milk is stimulated by posterior pituitary hormone oxytocin.

9. What is implantation?

1. The blastocyst (fertilized egg) reaches the uterus and gets implanted in the uterus.
2. The process of attachment of the blastocyst to the uterine wall (endometrium) is called implantation.
3. The fertilized egg becomes implanted in about 6 - 7 days after fertilization.

VIII. Long Answers:

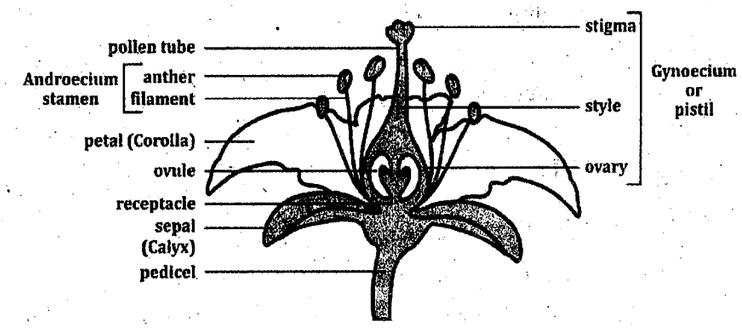
1. Write a essay on the parts of a typical flower.

1. A flower is a modified shoot with limited growth to carry out sexual reproduction.
2. A flower consists of four whorls borne on a thalamus.
3. These whorls are from outside.
   a. Calyx - consisting of sepals
   b. Corolla - consisting of petals
   c. Androecium - consisting of stamens
   d. Gynoecium or pistil - consisting of carpels

Accessory whorls:

The two outermost whorls calyx and corolla are non - essential or accessory whorls as they do not directly take part in the reproduction.

Essential whorls:

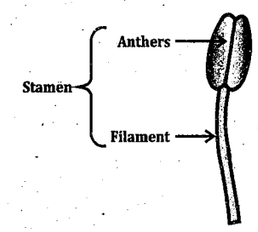


Parts of a flower

The other two whorls androecium and gynoecium are known as the essential whorls, because both take part directly in reproduction.

Androecium:

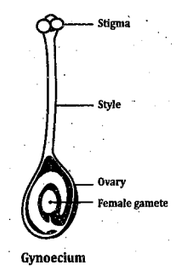
1. Androecium, the male part of a flower is composed of stamens.
2. Each stamen consists of a stalk called the filament and a small bag like structure called anther at the tip.
3. The pollen grains are produced in the anther within the pollen sac.



Anther

Pollen grain:

1. Pollen grains are usually spherical in shape. It has two layered wall namely exine and intine.
2. Mature pollen grains contain two cells, the vegetative and generative cell.
3. Vegetative cell contains a large nucleus.
4. The generative cell divides mitotically to form two male gametes.



Gynoecium:

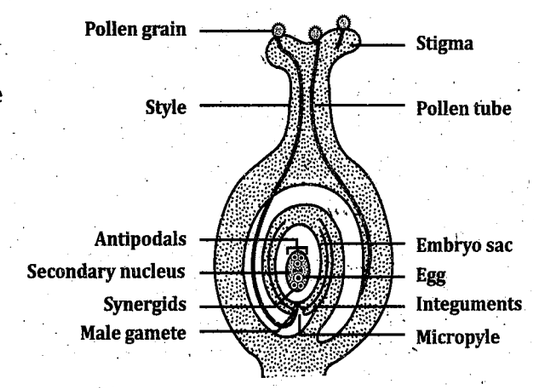
Gynoecium is the female part of the flower and is made up of carpels it has three parts,

1. Ovary
2. Style
3. Stigma

2. Explain the process of fertilization in plants.

1. Pollen grains reach the right stigma and begin to germinate.
2. Pollen grains form a small tube - like structure called pollen tube which emerges through the germ pore. The contents of the pollen grain move into the tube.
3. Pollen tube grows through the tissues of the stigma and style and finally reaches the ovule through the micropyle.
4. Vegetative cell degenerates and the generative cell divides to form two sperms (or male gametes)

Process of Fertilization



5. Tip of pollen tube bursts and the two sperms enter the embryo sac.
6. One sperm fuses with the egg (syngamy) and forms a diploid zygote. The other sperm fuses with the secondary nucleus (triple fusion) to form the primary endosperm nucleus which is triploid in nature.
7. Since two types of fusion syngamy and triple fusion takes place in an embryo sac the process is termed as double fertilization.
8. After triple fusion, primary endosperm nucleus develops into an endosperm.
9. Endosperm provides food to the developing embryo.
10. Later the synergids and antipodal cells degenerate.

3. Explain the structure of an ovum.

1. The mature ovum or egg is spherical in shape. The ovum is almost free of yolk.
2. It contains abundant cytoplasm and the nucleus.
3. The ovum is surrounded by three membranes.
4. The plasma membrane is surrounded by
   i. Inner thin zona pellucida
   ii. Outer thick corona radiata
5. The corona radiata is formed of follicle cells.
6. The membrane forming the surface layer of the ovum is called vitelline membrane.
7. The fluid - filled space between zona pellucida and the surface of the egg is called perivitelline space.

IX. Fill in the blanks.

1. _____ reproduction involves the union of male and female gametes. **(Sexual)**
2. In _____ reproduction new plantlets are formed from the vegetative organs of a plant. **(vegetative)**
3. _____ reproduction has only mitotic division and no gametic fusion. **(Vegetative)**
4. _____ is an example of vegetative reproduction through leaves. **(Bryophyllum)**
5. _____ is an example of vegetative reproduction in stem. **(Strawberry)**
6. The roots of _____ and _____ can be used for vegetative propagation. **(Asparagus, sweet potato)**
7. In some plants, the flower bud modifies into globose bulb called _____. **(Bulbils)**
8. The breaking of filaments in an algae into fragments is called _____. **(fragmentation)**
9. Reproduction in _____ is through fragmentation. **(spirogyra)**
10. Hydra and planaria exhibit the property of _____. **(regeneration)**
11. Production of an offspring by a single parent without the formation and fusion of gametes is called _____ reproduction. **(asexual)**
12. Offsprings produced by _____ reproduction are exact copies of their parent. **(asexual)**
13. _____ is the most common method of asexual reproduction in fungi and bacteria. **(Spore formation)**
14. The _____ in a flower consists of carpels. **(Gynoecium or pistil)**
15. The corolla in a flower consists of _____. **(petals)**
16. The male part of a flower is composed of _____. **(stamens)**
17. The outer layer of the pollen grain is called _____. **(exine)**
18. The pollen grain has prominent apertures called _____. **(germpore)**
19. _____ is the female part of the flower. **(Gynoecium)**
20. The female part of the flower is made up of _____. **(carpels)**
21. The _____ of a flower contains ovules. **(ovary)**
22. _____ is the basal part of the ovule. **(Chalaza)**
23. Three cells at the _____ end in the ovule form the egg apparatus. **(micropylar)**
24. The _____ nuclei are found at the centre of the ovule. **(polar)**
25. The egg apparatus of the ovule consists of one egg cell and two _____. **(synergids)**
26. Asexual reproduction occurs by _____ formation. **(spore)**

27. During spore formation _____ develops from the fungal hypha. **(sporangium)**
28. The stamen in a flower consists of a stalk called the _____. **(filament)**
29. The pollen grains in a flower are produced in the ____ within the pollen sac. **(anther)**
30. The ovule is attached to the ovary wall by a stalk called a _____. **(funiculus)**
31. The embryo sac contains _____ cells. **(seven)**
32. The transfer of pollen grains from anther to stigma of a flower is called as _____. **(pollination)**
33. _____ results in fertilization which leads to the formation of fruits and seed. **(pollination)**
34. Fertilization in man occurs in the _____ of the female genital tract. **(oviduct)**
35. The fusion of the sperm with the ovum results in the formation of _____. **(zygote)**
36. The zygote is a _____ ovum. **(fertilized)**
37. _____ takes place after implantation. **(Gastrulation)**
38. The establishment of germ layers initiates the final phase of _____ development. **(embryonic)**
39. _____ is a temporary association between the embryo and maternal tissues. **(Placenta)**
40. A cord which connects the placenta with the foetus is called _____. **(umbilical cord)**
41. The process of milk production from the mammary glands of the mother is called _____. **(lactation)**
42. The ligation of vas deferens is called _____. **(vasectomy)**
43. The ligation of fallopian tube is called _____. **(tubectomy)**
44. The mode of pollination in hibiscus is _____. **(self - pollination (or) Autogamy)**
45. Self - pollination is also known as _____. **(autogamy)**
46. _____ pollination leads to the production of new varieties. **(cross)**
47. More viable seeds are produced in _____. **(cross pollination)**
48. The pollination with the help of wind is called _____. **(anemophily)**
49. Pollination with the help of insects is called _____. **(entomophily)**
50. The pollination with the help of water is called _____. **(hydrophily)**
51. About 80% of entomophily is carried out by _____. **(honeybees)**
52. Hydrophily takes place in _____ plants. **(aquatic)**
53. _____ pollinate flowers of silk cotton tree. **(Squirrels)**
54. In plants _____ provides food to the developing embryo. **(Endosperm)**
55. Fertilization stimulates the ovary to develop into _____. **(fruit)**
56. The _____ develops into a seed. **(ovule)**
57. In plants the integuments of the ovule develop into the _____. **(seed coat)**
58. In plants the ovary enlarges and develops into a _____. **(fruit)**
59. Each testes is covered with a layer of fibrous tissue called _____. **(tunica albuginea)**
60. The process of spermatogenesis takes place in the _____. **(seminiferous tubules)**
61. _____ are the primary male sex organs in man. **(Testes)**
62. Fallopian tube, uterus and cervix are the _____ sex organs in female. **(accessory)**
63. The _____ cells provide nutrients to the developing sperms. **(sertoli)**
64. The _____ cells of the male reproductive system secrete testosterone. **(leyding)**
65. The formation of the sperm in male and the ovum in female is called _____. **(gametogenesis)**
66. The anterior of a human sperm has a cap like structure called _____. **(acrosome)**
67. The human sperm contains _____ an enzyme that helps the sperm to enter the ovum during fertilization. **(hyaluronidase)**
68. The plasma membrane is surrounded by inner thin _____. **(zona pellucida)**
69. The corona radiata in the ovum is formed of _____. **(follicle cells)**
70. The membrane forming the surface layer of the ovum is called _____ membrane. **(vitelline)**
71. The fluid - filled space between zona pellucida and the surface of the egg is called _____. **(perivitelline space)**
72. The menstrual cycle in human female consists of _____ phases. **(4)**
73. The menstrual phase in human female is also called _____ phase. **(destructive)**
74. The Luteal phase in human female is also called _____ phase. **(secretory)**
75. The onset of puberty in human females is called _____. **(menarche)**
76. During _____ phase of the menstrual cycle there is a decrease in progesterone and oestrogen. **(menstrual)**

18. GENETICS

I. Choose the correct answer.

1. According to Mendel alleles have the following character
   a. pair of genes b. responsible for character
   c. production of gametes d. recessive factors
   Ans: b. responsible for character

2. 9 : 3 : 3 : 1 ratio is due to ※※ **(APR - 2023)**
   a. segregation b. crossing over
   c. independent assortment d. recessiveness
   Ans: c. independent assortment

3. The region of the chromosome where the spindle fibres get attached during cell division
   a. Chromomere b. Centrosome
   c. Centromere d. Chromonema **Ans: c. Centromere**

4. The centromere is found at the centre of the _____ chromosome. **(PTA - V)**
   a. Telocentric b. Metacentric
   c. Sub - metacentric d. Acrocentric **Ans: b. Metacentric**

5. The _____ units form the backbone of the DNA. ※※
   a. 5 carbon sugar b. phosphate
   c. nitrogenous bases d. sugar phosphate **Ans: d. Sugar phosphate**

6. Okasaki fragments are joined together by _____.
   a. Helicase b. DNA polymerase
   c. RNA primer d. DNA ligase **Ans: d. DNA ligase**

7. The number of chromosomes found in human beings are _____. ※※
   a. 22 pairs of autosomes and 1 pair of allosomes
   b. 22 autosomes and 1 allosome
   c. 46 autosomes
   d. 46 pairs autosomes and 1 pair of allosomes
   Ans: a. 22 pairs of autosomes and 1 pair of allosomes

8. The loss of one or more chromosome in a ploidy is called _____.
   a. Tetraploidy b. Aneuploidy c. Euploidy d. Polyploidy
   Ans: b. Aneuploidy

II. Fill in the blanks.

1. The pairs of contrasting character (traits) of Mendel are called _____.
   Ans: alleles

2. Physical expression of a gene is called _____. **Ans: phenotype**

3. The thin thread like structures found in the nucleus of each cell are called _____.
   Ans: chromosomes

4. DNA consists of two _____ chains. ※※ **Ans: polynucleotide**

5. An inheritable change in the amount or the structure of a gene or a chromosome is called _____. **Ans: Mutation**

III. Identify whether the statement are True or False. Correct the false statement.

1. A typical Mendelian dihybrid ratio of F_2 generation is 3 : 1.
   Ans: False
   A typical Mendelian **monohybrid** ratio of F_2 generation is 3 : 1.

2. A recessive factor is altered by the presence of a dominant factor.
   Ans: False
   A recessive factor is **masked** by the presence of a dominant factor.

3. Each gamete has only one allele of a gene.
   Ans: True

4. Hybrid is an offspring from a cross between genetically different parent.
   Ans: True

5. Some of the chromosomes have an elongated knob - like appendages known as telomere. ※※
   Ans: False
   Some of the chromosomes have an elongated knob - like appendages known as **satellite**.

6. New nucleotides are added and new complementary strand of DNA is formed with the help of enzyme DNA polymerase.
   Ans: True

7. Down's syndrome is the genetic condition with 45 chromosomes.
   Ans: False
   Down's syndrome is the genetic condition with **47** chromosomes.

IV. Match the following.

	Column - I			Column - II			Answers
1.	Autosomes	-	a.	Trisomy 21	-	c.	**22 pair of chromosome**
2.	Diploid condition	-	b.	9 : 3 : 3 : 1	-	d.	**2n**
3.	Allosome	-	c.	22 pair of chromosome	-	e.	**23rd pair of chromosome**
4.	Down's syndrome	-	d.	2n	-	a.	**Trisomy 21**
5.	Dihybrid ratio	-	e.	23rd pair of chromosome	-	b.	**9 : 3 : 3 : 1 (PTA - III)**

V. Answer in a sentence.

1. What is a cross in which inheritance of two pairs of contrasting characters are studied?

Dihybrid Cross

2. Name the conditions when both the alleles are identical?

Ans: Homozygous condition

3. A garden pea plant produces axial white flowers. Another of the same species produced terminal violet flowers. Identify the dominant trait? ※※

1. Dominant - Axial violet flower
2. Recessive - Terminal white flower

4. What is the name given to the segments of DNA, which are responsible for the inheritance of a particular character?

Genes

5. Name the bond which binds the nucleotides in a DNA. ※※

Phosphodiester bond

VI. Short answers questions.

1. Why did Mendel select pea plant for his experiments? **(MAY - 2022)**

1. It is naturally **self - pollinating** and so is very easy to raise **pure breeding** individuals.
2. It is easy to **cross - pollinate**.
3. It has deeply defined **contrasting characters**.
4. The flowers are **bisexual**.

2. What do you understand by the term phenotype and genotype? ※※

Phenotype: **(APR - 2023, PTA - IV, SEP - 2022)**

External expression of a particular trait is known as phenotype.

Genotype:

A genotype is the **genetic constitution** of an organism.

3. What are allosomes? ※※※ **(APR - 2023, PTA - II)**

1. Allosomes are chromosomes which are responsible for **determining** the **sex** of an individual.

They are also called as sex chromosomes or **hetero - chromosomes**.

They are of two types **X** and **Y** - chromosomes.

4. What are Okazaki fragments? ※※ **(JULY - 2024, PTA - IV)**

1. During the **replication** of a DNA molecule, the **new strand** is synthesized in **short segments** of DNA which are called okazaki fragments.
2. These fragments are joined together by the enzyme **DNA ligase**.

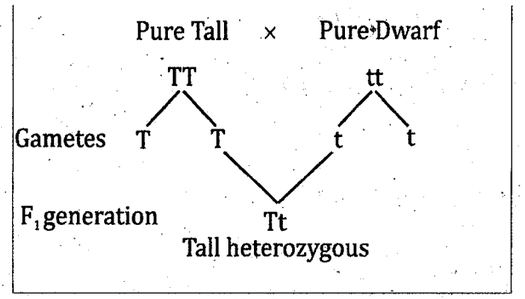
5. Why is euploidy considered to be advantageous to both plants and animals? **(APRIL - 2024, PTA - I)**

1. Euploidy plants are advantageous as they often result in **increased fruit** and **flower size**.
2. They are typically **sterile**.

6. A pure tall plant (TT) is crossed with pure dwarf plant (tt), what would be the F_1 and F_2 generations? Explain. **(PTA - V)**

Ans:

F_1 generation:



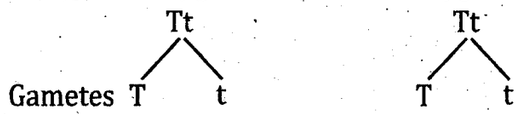
In F_1 generation all plants were tall.

Phenotypic ratio 3:1

F_2 generation:

On self pollinating plants from F_1 generation.

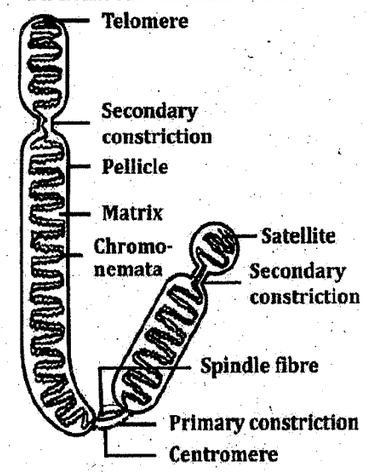
F_1 Heterozygous Tall × Heterozygous Tall



	T	t
T	TT Pure (Homozygous) Tall	Tt Heterozygous Tall
t	Tt Heterozygous Tall	tt Pure (Homozygous) dwarf

1. In F_2 generation homozygous tall – 1, heterozygous tall – 2, homozygous dwarf – 1.
2. Genotypic ratio = 1 : 2 : 1

7. Explain the structure of a chromosome. (PTA - VI, SEP - 21) ※※



1. The chromosomes are **thin, long** and **thread like** structures consisting of two identical strands called sister chromatids held together by the **centromere.**
2. Each chromatid is made up of spirally coiled thin structure called **chromonema.**
3. The chromonema has number of bead like structures along its length called **chromomere.**
4. The chromosomes are made up of **DNA, RNA, chromosomal proteins** (histones and non - histones) and certain **metallic ions.**

Primary constriction:

1. The two arms of a chromosome meet here.
2. In this region the spindle fibres attach to the chromosomes during cell division.

Secondary constriction:

Some chromosomes possess secondary constriction at any point of the chromosome and are known as the nuclear zone or nucleolar organizer.

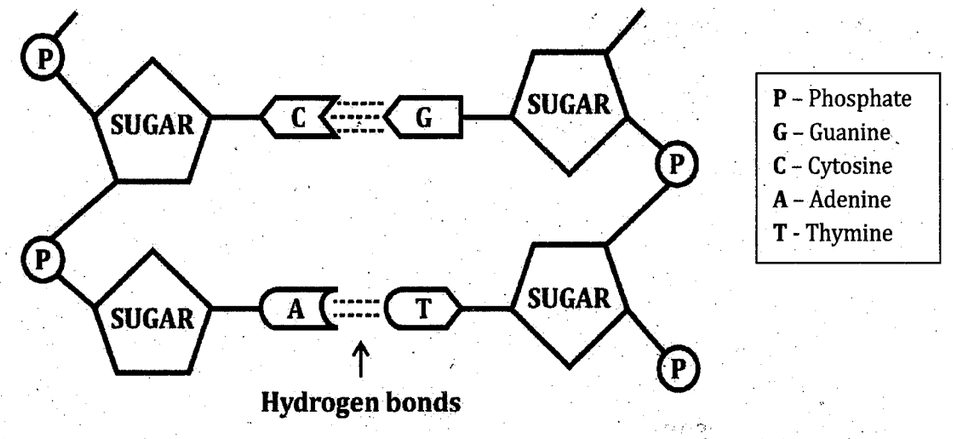
Telomere:

1. It is the end of the chromosome.
2. Each extremity has a polarity and prevents it from joining the adjacent chromosome.
3. It maintains and provides stability.

Satellite:

1. Some of the chromosomes have an elongated knob - like appendage at one end of the chromosome known as satellite.
2. The chromosomes with satellites are called sat - chromosomes.

8. Label the parts of the DNA in the diagram given below. Explain the structure briefly.



1. DNA molecule consists of **two polynucleotide** chain.
2. These chains form a **double helix** structure with two strands which run **anti – parallel** to one another.
3. Nitrogenous bases in the centre are linked to **sugar – phosphate** units.
4. Pairing between the nitrogenous bases is always between **purine** and **pyrimidine** linked by **hydrogen bonds.**
   i. Adenine (A) links Thyamine (T) with two hydrogen bonds **A = T**
   ii. Cytosine (C) links Guanine (G) with three hydrogen bonds **C ≡ G**
5. Hydrogen bonds make the DNA molecule **stable.**
6. The nucleotides in a helix are joined together by **phosphodiester** bonds.

VII. Long answer questions.

1. Explain with an example the inheritance of dihybrid cross. How is it different from monohybrid cross? ※※※

Inheritance of dihybrid cross:

1. Mendel crossed pea plants having **round yellow** seeds with pea plants having **wrinkled green** seeds.
2. Mendel first crossed pure breeding pea plants having round - yellow seeds with pure breeding pea plants having wrinkled green seeds.

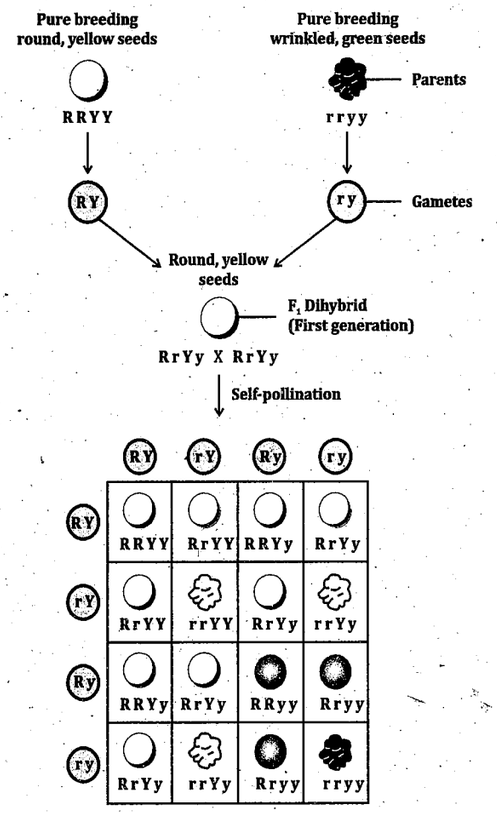
3. In the **first generation (F_1) only round yellow** seeds were produced **no wrinkled - green** seeds were obtained in the F_1 generation.

4. From this it was concluded that **round shape** and **yellow colour** of the seeds were **dominant traits** over the wrinkled shape and green colour of the seeds.

5. When the hybrids of **F_1 generation** pea plants having round - yellow seeds were **cross - bred** by **self-pollination, four types** of seeds having **different combinations** of shape and colour were obtained in second generation of **F_2 generation**.

6. They were round yellow, round - green, wrinkled yellow and wrinkled - green seeds.

7. The ratio of each **phenotype** (or appearance) of seeds in the F_2 generation is **9:3:3:1**. This is known as the **Dihybrid ratio**.



Phenotypic ratio of F_2 generation - 9:3:3:1
Round, Yellow - 9 Wrinkled, Yellow - 3
Round, Green - 3 Wrinkled, Green - 1

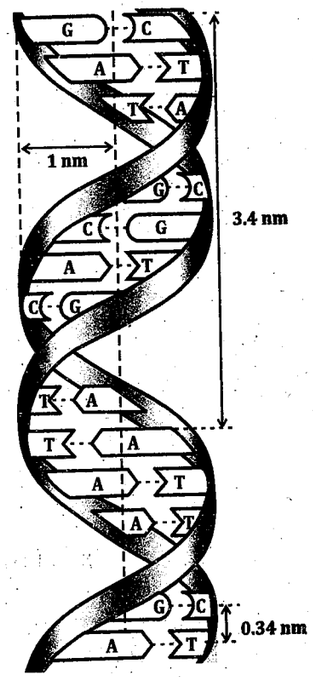
Dihybrid Cross

8. The factors for each character or trait remain **independent** and maintain their **identity** in the **gametes**.

	Monohybrid cross	Dihybrid cross
1.	Crosses involving inheritance of only **one pair** of contrasting characters are called monohybrid crosses.	Dihybrid cross involves the inheritance of **two pairs** of contrasting characteristics at the same time.
2.	It is a cross between two forms of a single trait.	It is a cross between two pairs of contrasting characteristics.
3.	**E.g:** Tall and dwarf plant.	**E.g:** Round - yellow seeds and wrinkled - green seeds.

2. How is the structure of DNA organised? What is the biological significance of DNA? (JUNE - 2023, SEP - 2020)

1. DNA molecule consists of two polynucleotide chains.
2. These chains form a double helix structure.
3. Nitrogenous bases in the centre are linked to sugar - phosphate units which form the backbone of the DNA.
4. Pairing between the nitrogenous bases is very specific and is always between purine and pyrimidine linked by hydrogen bonds.
5. Hydrogen bonds between the nitrogenous bases make the DNA molecule stable.
6. Each turn of the double helix is 34 A° (3.4nm). There are ten base pairs in a complete turn.
7. The nucleotides in a helix are joined together by phosphodiester bonds.



Structure of DNA

Significance of DNA:

1. It is responsible for the transmission of hereditary information from one generation to next generation.
2. It contains information required for the formation of proteins.
3. It controls the development process and life activities of an organism.

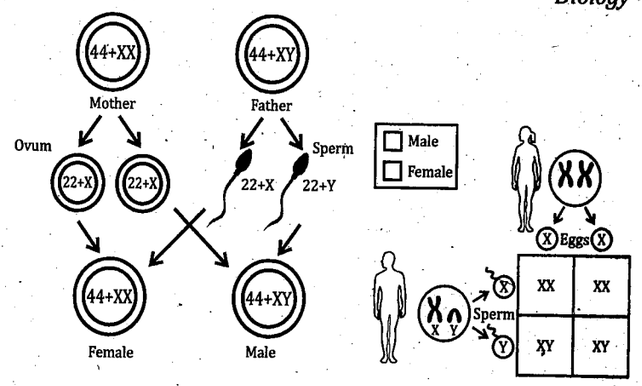
3. The sex of the new born child is a matter of chance and neither of the parents may be considered responsible for it. What would be the possible fusion of gametes to determine the sex of the child?

1. Human beings have 23 pairs of chromosomes out of which 22 pairs are autosomes and one pair (23rd pair) is the sex chromosome.
2. The female gametes or eggs formed are similar in their chromosome type (22 + XX).
3. Human female are homogametic.
4. The male gametes or sperms produced are of two types and are produced in equal proportions.

5. The sperm bearing (22 + X) chromosomes and the sperm bearing (22 + Y) chromosomes.

6. The human males are called heterogametic.

7. It is a chance of probability as to which category of sperm fuses with the egg.



Sex determination in human

8. If the egg (X) is fused by the X - bearing sperm an XX individual (female) is produced.

9. If the egg (X) is fused by the Y - bearing sperm an XY individual (male) is produced.

10. The sperm, produced by the father, determines the sex of the child.

VIII. Higher Order Thinking (HOTS)

1. Flowers of the garden pea are bisexual and self – pollinated. Therefore, it is difficult to perform hybridization experiment by crossing a particular pistil with the specific pollen grains. How Mendel made it possible in his monohybrid and dihybrid crosses?

1. Even though pea plant are bisexual, it has 34 different varieties.
2. Mendel noted that they differ from one another in many ways.
3. Mendel had chosen 7 pairs of contrasting characters for his study.
4. In his Monohybrid cross and dihybrid cross, the factors responsible for each character or trait remain independent and maintain their identity in the gametes.

2. Pure - breed tall pea plants are first crossed with pure - breed dwarf pea plants. The pea plants obtained in F_1 generation are then selfed to produce F_2 generation of pea plants. (GMQ - 2019)

a. What do the plants of F1 generation look like?
Ans: All the plants were **tall.**

b. What is the ratio of tall plants to dwarf plants in F_2 generation?
Ans: 3 : 1

c. Which type of plants were missing in F_1 generation but reappeared in F_2 generation?
Ans: Dwarf plants missing in F_1 generation but they reappeared in the F_2 generation.

3. Kavitha gave birth to a female baby. Her family members say that she can give birth to only female babies because of her family history. Is the statement given by her family members true. Justify your answer.

No, the sperm produced by the father, determines the sex of the child.

1. The male gametes or sperms produced are of two types (22 + x) (22 + y). Human males are called heterogametic.
2. It is a chance of probability as to which category of sperm fuses with the egg.
3. If the egg (x) is fused by the x - bearing sperm an xx individual (female) is produced.
4. If the egg (x) is fused by y - bearing sperm an xy individual (male) is produced.
5. The mother is not responsible in determining the sex of the child.

IX. Value based question.

1. Under which conditions does the law of independent assortment hold good and why?

In case of inheritance of two or more pairs of characters simultaneously, the factors or genes of one pair assort out independently of the other pair.

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Choose the correct answer.

1. Find the correct pair. **(SEP - 2020)**

	Column - A		Column - B
a.	Acrocentric	-	The centromere is found near the centre of the chromosome with two unequal arms.
b.	Submetacentric	-	The centromere is found on the proximal end.
c.	Metacentric	-	The centromere occurs in the centre of the chromosome and form two equal arms.
d.	Telocentric	-	The centromere is found at one end with a short arm and a long arm.

Ans: c. Metacentric - The centromere occurs in the centre of the chromosome and form two equal arms.

2. Find the correct pair: **(MAY - 2022)**

a.	Gregor Johann Mendel	-	Theory of Natural Selection
b.	Waldeyer	-	Chromosomes
c.	Watson and Crick	-	Theory of Evolution
d.	Jean Baptiste Lamarck	-	Law of Heredity

Ans: b. Waldeyer - Chromosomes

3. The formation of nucleolus in the nucleus is by **(PTA - 2)**

a. secondary constriction b. primary constriction
c. telomere d. locus **Ans: a. secondary constriction**

II. Short answers.

1. Differentiate phenotype and genotype. **(PTA - 4)**

	Phenotype		Genotype
1.	**External** expression of a **particular trait.**	1.	The **genetic constitution** of an organism.
2.	Phenotypic ratio is **3 : 1**	2.	Genotypic ratio is **1 : 2 : 1**

III. Long answers.

(PTA - 1)

1. a. In DNA replication, the enzyme that separates the two strands of DNA is _____.
Ans: Helicase

b. Enzyme that removes the twists during the unwinding process of DNA is _____.
Ans: topoisomerase

c. Nucleotides are added with the help of an enzyme called _____.
Ans: DNA polymerase

d. The DNA fragments are joined together by the enzyme _____. **Ans: DNA ligase**

e. The replication stops when the replication fork of the two sides meet at the site called _____.
Ans: terminus

2. If we cross two different parents with the genotype of Tt × tt, what would be the genotypic ratio in its F_1 generation? **(PTA - 3)**

If we cross Tt × tt,
The offspring can occur are **Tt, Tt**
∴ Tall
1 : 1 will be the genotype.

ADDITIONAL QUESTIONS

I. Match the following:

	Column - I		Column - II		Answers
1.	Monohybrid cross	a.	Recessive trait	d.	**Mendel**
2.	Tallness	b.	1 : 2 : 1	c.	**Dominant trait**
3.	Dwarfness	c.	Dominant trait	a.	**Recessive trait**
4.	Phenotypic ratio	d.	Mendel	e.	**3 : 1**
5.	Genotypic ratio	e.	3 : 1	b.	**1 : 2 : 1**

	Column - I		Column - II		Answers
1.	Gene	a.	Spirally coiled	c.	**Inheritance**
2.	Chromonema	b.	Bead like	a.	**Spirally coiled**
3.	Chromomere	c.	Inheritance	b.	**Bead like**
4.	Telomere	d.	knob – like appendage	e.	**Stability**
5.	Satellite	e.	Stability	d.	**knob – like appendage**

	Column - I		Column - II		Answers
1.	Primary constriction	a.	sat - chromosome	b.	**Centromere**
2.	Secondary constriction	b.	Centromere	d.	**nuclear zone**
3.	Satellite	c.	specific position	a.	**sat - chromosome**
4.	Telomere	d.	nuclear zone	e.	**aging clock**
5.	Locus	e.	aging clock	c.	**specific position**

	Column – I		Column - II		Answers
1.	Telocentric	a.	L shaped	d.	**rod shaped**
2.	Submetacentric	b.	sex determination	a.	**L shaped**
3.	Metacentric	c.	somatic characters	e.	**V shaped**
4.	Autosomes	d.	rod shaped	c.	**somatic characters**
5.	Allosomes	e.	V shaped	b.	**sex determination**

	Column - I		Column - II		Answers
1.	Autosome	a.	Chromosome	b.	**22 pairs**
2.	Allosome	b.	22 pairs	e.	**23rd pair**
3.	Idiogram	c.	DNA	d.	**karyotype**
4.	James Watson	d.	karyotype	c.	**DNA**
5.	Waldeyer	e.	23rd pair	a.	**Chromosome**

II. Choose the correct answer:

1. _____ is a graphical representation to calculate the probability of possible genotypes of offsprings in a genetic cross.
a. monohybrid cross b. dihybrid
c. Punnett square d. none of the above **Ans: c. Punnett square**

2. The ratio of seeds in a dihybrid cross in F_2 generation is _____.
a. 9 : 3 : 1 b. 9 : 3 : 3 : 2 c. 9: 3 : 3 : 3 d. 9 : 3 : 3: 1
Ans: d. 9 : 3 : 3: 1

3. The dihybrid cross produces _____ types of F_2 offsprings.
a. two b. three c. one d. four **Ans: d. four**

4. _____ are segments in DNA which are responsible for the inheritance of a particular phenotypic character.
a. Locus b. Chromatin fibres c. Genes d. Alleles
Ans: c. Genes

5. i. The chromosomes are packed with DNA.
ii. Genes are responsible for the inheritance of character,
iii. Genes are present at the focus.
iv. Chromatids are made up of chromonema.
a. i. and iii. are correct b. i. ii. iv. are correct
c. i. iii. are incorrect d. all the above are correct
Ans: b. i. ii. iv. are correct

6. The end of a chromosome is called as _____.
a. centeromere b. satellite c. telomere d. nuclear zone
Ans: c. telomere

7. Knob - like appendages on the chromosome are called _____.
a. satellite b. telomere c. locus d. nuclear organizer
Ans: a. satellite

8. _____ is the number, size and shape of chromosome in the cell nucleus..
a. mutation b. variation c. karyotype d. idiogram
Ans: c. karyotype

9. _____ is the diagrammatic representation of karyotype of a species.
a. idiogram b. mutation
c. sex determination d. punnet square **Ans: a. idiogram**

10. The nucleotides in a helix are joined together by _____ bonds.
a. Hydrogen b. double helix
c. phosphodiester d. hydrogen phosphate **Ans: c. phosphodiester**

11. Each turn of the double helix is _____ A°.
a. 34 b. 3.4 c. 340 d. 0.34 **Ans: a. 34**

12. The enzyme _____ separates the two strands of DNA during replication.
a. DNA ligase b. helicase c. DNA polymerase d. thyroid
Ans: b. helicase

13. If an individual has three haploid set of chromosomes, the condition is called _____.
a. ploidy b. tetraploidy c. triploidy d. diploidy
Ans: c. triploidy

14. Mutation was introduced by _____.
a. Hugo de Vries b. Erwin Chargaff
c. James Watson d. Francis Crick **Ans: a. Hugo de Vries**

15. James Watson and Francis Crick proposed a three dimensional model of _____.
a. cell b. chromosome c. DNA d. none of the above
Ans: c. DNA

16. Nullisomy is represented by _____.
a. (2n −1) b. (2n + 1) c. (2n + 2) d. none of the above
Ans: d. none of the above

17. Sickle cell anaemia is caused by the mutation of _____ gene.
a. Single b. double c. triple d. none of the above
Ans: a. Single

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

1. Plants raised from the seeds of pure breeding parental cross in F_1 generation were dwarf and monohybrids.
Ans: False
Plants raised from the seeds of pure breeding parental cross in F_1 generation were **tall** and monohybrids.

2. The nucleus of each cell contains thin thread like structures called DNA.
Ans: False
The nucleus of each cell contains thin thread like structures called **chromosomes**.

3. Each gene is present at a specific position on a chromosome called its locus.
Ans: True

4. In acrocentric, the centromere occurs in the centre of the chromosome and form two equal arms.
Ans: False
In **metacentric**, the centromere occurs in the centre of the chromosome and form two equal arms.

5. Allosomes contain genes that determine the somatic characters.
Ans: False **Autosomes** contain genes that determine the somatic characters.

6. Carbon bonds between the nitrogenous bases make the DNA molecule stable.
Ans: False
Hydrogen bonds between the nitrogenous bases make the DNA molecule stable.

IV. Assertion and Reason.

1. **Assertion:** Two factors making up a pair of contrasting characters are called alleles.
Reason : The character which expresses itself is called dominant condition.
a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
Ans: d. A and R are correct, R doesn't explain A

2. **Assertion:** DNA is not responsible for the transmission of hereditary information from one generation to next generation.
Reason : It controls the developmental process and life activities of an organism.
a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
Ans: c. A is wrong, R is correct

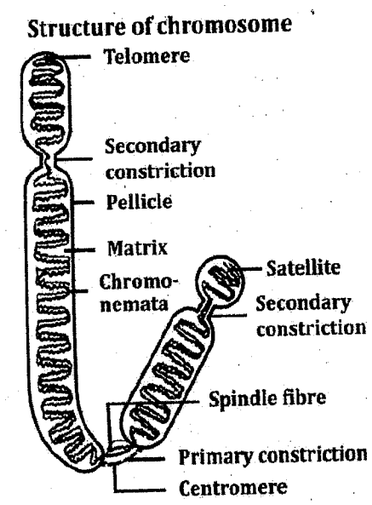
3. **Assertion:** Structural changes in the chromosomes usually occurs due to errors in cell division.
Reason : Tetraploidy plants and animals are typically sterile.
a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
Ans: b. A is correct, R is wrong

4. **Assertion:** Mendel had chosen seven pairs of distinguishing traits.
Reason : The process of acquiring characters or traits from parents is called 'Heredity'.
a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
Ans: d. A and R are correct, R doesn't explain A

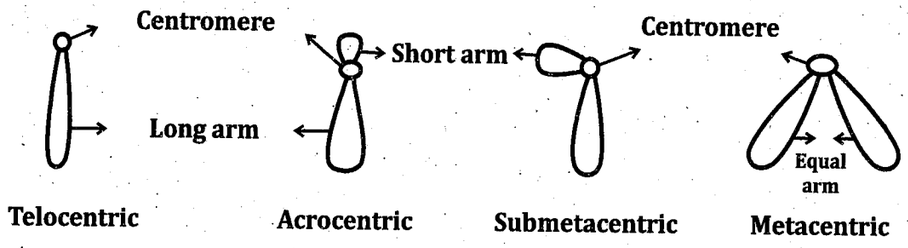
5. **Assertion:** Gene mutation is the changes occurring in nucleotide sequence of a gene.
Reason : It involves substitution, deletion, insertion or inversion of a single or more than one nitrogenous base.
a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
Ans: a. A and R are correct, R explains A

V. To label the parts in the given diagram

1. **Draw the structure of chromosome and label its parts.**



2. Draw the types of chromosomes based on the position of centromere and label its parts.



Types of chromosomes based on position of centromere

VI. Short Answers:

1. Define dominant and recessive condition.

1. When two factors for alternative expression of a trait are brought together by fertilization only one expresses itself, (tallness) masking the expression of the other (dwarfness).
2. The character which expresses itself is called dominant condition.
3. The character which is masked is called recessive condition.

2. What is a Punnett square?

1. Punnett square is a checker board form devised by a British geneticist R.C.Punnett for study of genetic.
2. Punnett square is a graphical representation to calculate the probability of all possible genotypes of offsprings in a genetic cross.

3. State the law of independent assortment.

"In case of inheritance of two or more pairs of characters simultaneously, the factors or genes of one pair assort out independently of the other pair."

4. Write a short note on the nucleolar organizer in a chromosome.

1. Some chromosomes possess secondary constriction at any point of the chromosome.
2. They are known as the nuclear zone or nucleolar organizer.

5. How do Telomeres act as an aging clock in every cell.

1. Telomeres are protective sequences of nucleotides found in chromosomes.
2. As a cell divides every time, they become shorter.
3. Telomeres get too short to do their job, causing our cells to age.

6. Classify chromosome based on the position of centromere.

Based on the position of centromere, the chromosomes are classified as Telocentric, Acrocentric, Sub metacentric and Metacentric.

7. Why is DNA called a polynucleotide?

DNA is a large molecule consisting of millions of nucleotides. Hence it is also called a polynucleotide. Each nucleotide consists of three components.

8. Name the two types of nitrogenous bases in DNA.

There are two types of nitrogenous bases in DNA. They are

a. Purines (Adenine and Guanine)

b. Pyrimidines (Cytosine and Thymine)

9. Define chromosomal mutation.

The sudden change in the structure or number of chromosomes is called chromosomal mutation.

VII. Long Answers:

1. Define chromosomal mutation and list out its results.

Chromosomal mutation:

The sudden change in the structure or number of chromosomes is called chromosomal mutation.

Change in the structure of chromosomes:

1. Structural changes in the chromosomes usually occur due to errors in cell division.
2. Changes in the number and arrangement of genes takes place as a result of deletion, duplication, inversion and translocation in chromosomes.

Changes in the number of chromosomes:

1. They involves addition or deletion in the number of chromosomes present in a cell.
2. This is called ploidy. There are two types of ploidy
   1. Euploidy
   2. Aneuploidy

Euploidy:

1. It is condition in which the individual bears more than the usual number of diploid (2n) chromosomes.
2. If an individual has three haploid sets of chromosomes, the condition is called triploidy(3n).
3. Triploid plants and animals are typically sterile.
4. If it has four haploid sets of chromosomes, the condition is called tetraploidy(4n).
5. Tetraploid plants are advantageous as they often result in increased fruit and flower size.

Aneuploidy:

1. It is the loss or gain of one or more chromosomes in a set.
2. It is of three types. Monosomy (2n -1), Trisomy (2n+1) and Nullisomy (2n – 2).
3. In man, Down's syndrome is one of the commonly known aneuploid condition.

Down's syndrome:

1. This condition was first identified by a doctor named Langdon Down in 1866.
2. It is genetic condition in which there is an extra copy of chromosome 21 (Trisomy 21).
3. It is associated with mental retardation, delayed development, behavioural problems, weak muscle tone, vision and hearing disability are some of the conditions seen in these children.

2. Give a detailed account on DNA replication and the synthesis of a new complementary strand of DNA.

DNA Replication:

1. DNA replication is one of the basic process that occurs within a cell.

2. The two strands of a DNA molecule have complementary base pairs, the nucleotides of each strand provide the information needed to produce its new strand.
3. The two resulting daughter cells contain exactly the same genetic information as the parent cell.
4. DNA replication involves the following steps.

Origin of replication:

1. The specific points on the DNA, where the replication begins, is the site of origin of replication.
2. The two stands open and separate at this point forming the replication fork.

Unwinding of DNA molecule:

1. The enzyme called helicase, bind to the origin of replication site.
2. Helicase separates the two stands of the DNA.
3. The enzyme called topoisomerase separates the double helix above the replication fork and removes the unwinding process.

Formation of RNA primer:

1. An RNA primer is a short segment of RNA nucleotides.
2. The primer is synthesized by the DNA template close to the origin of replication site.

Synthesis of new complementary strand from the parent strand:

1. After the formation of RNA primer nucleotides are added with the help of an enzyme DNA polymerase and a new complementary strand of DNA is formed from each of the parent strand.
2. In one strand, the daughter strand is synthesized as a continuous strand which is called leading strand.
3. In the other strand short segments of DNA are synthesized. This strand called lagging strand.
4. The short segments of DNA are called Okazaki fragments.
5. The fragments are joined together by the enzyme, DNA ligase.
6. The replication stops when the replication fork of the two sides meet at a site called terminus, which is situated opposite to origin of replication site.

VIII. Fill in the blanks.

1. The branch of biology that deals with the genes, genetic variation and heredity of living organisms is called _____. **(genetics)**
2. _____ is transmission of characters, from one generation to the next generation. **(Heredity)**
3. _____ is the differences shown by the individuals of the same species. **(Variation)**
4. _____ is the father of Genetics. **(Gregor Johann Mendel)**
5. The genotypic ratio in Mendel's monohybrid cross is _____. **(1 : 2 : 1)**
6. Tallness in a plant is a _____ character. **(dominant)**
7. Dwarfness in a plant is a _____ character. **(recessive)**
8. The flowers of a pea plant are _____. **(bisexual)**
9. Crosses involving inheritance of only one pair of contrasting characters are called _____ crosses. **(monohybrid)**

Selfing of the F_1 monohybrids in Mendel's experiments resulted in tall and dwarf plants respectively in the ratio of _____. **(3 : 1)**

11. External expression of a particular trait is known as _____. **(phenotype)**
12. Mendel's famous experiment was on _____. **(pea plant)**
13. _____ is a graphical representation to calculate the probability of all possible genotypes of offsprings in a genetic cross. **(Punnet square)**
14. Two factors making up a pair of contrasting characters are called _____. **(alleles)**
15. The character which expresses itself is called _____ condition. **(dominant)**
16. The character which is masked is called _____ condition. **(recessive)**
17. _____ involves the inheritance of two pairs of contrasting characteristics at the same time. **(Dihybrid cross)**
18. A dihybrid cross produced _____ types of F_2 offspring. **(four)**
19. T.H. Morgan was awarded Noble prize for determining the role of _____ in heredity. **(chromosomes)**
20. Chromosomes are packed with _____ that forms the genetic material. **(DNA)**
21. Chromosomes consists of two identical strands called _____. **(sister chromatids)**
22. Chromatids in a chromosome are held together by the _____. **(centromere)**
23. Each chromatid is made up of spirally coiled thin structure called _____. **(chromonema)**
24. The _____ provides stability to the chromosomes. **(telomere)**
25. The elongated knob - like appendages at one end of some chromosomes are called as _____. **(satellite)**
26. The human body is made up of million _____. **(cells)**
27. The term 'chromosomes' was first coined by _____ in 1888. **(Waldeyer)**
28. _____ are the carrier of genetic material which contain the heredity information. **(Chromosomes)**
29. The chromosomes are highly condensed coiled _____ fibres. **(chromatin)**
30. _____ are segments of DNA, which are responsible for the inheritance of a particular phenotypic character. **(Genes)**
31. Each gene is present at a specific position on a chromosome called its _____. **(locus)**
32. During cell division, the _____ is passed from one generation to another. **(genetic information)**
33. The chromonema has number of bead - like structures along its length which are called _____. **(chromomeres)**
34. The chromosomes are made up of DNA, RNA, _____ and metallic ions. **(chromosomal proteins)**
35. _____ provide structural support to the chromosome. **(Proteins)**
36. The two arms of a chromosome meet at a point called _____ or centromere. **(primary constriction)**
37. The _____ is the region where spindle fibres attach to the chromosomes during cell division. **(centromere)**
38. Some chromosomes possess secondary constriction at the _____ zone of the chromosome. **(nuclear)**
39. The end of the chromosome is called _____. **(telomere)**
40. The chromosomes with satellites are called as the _____. **(sat - chromosomes)**
41. _____ act as aging clock in every cell. **(Telomeres)**
42. _____ are protective sequences of nucleotides found in chromosomes. **(Telomeres)**
43. Chromosomes are classified based on the position of the _____. **(centromere)**
44. In _____ chromosomes, the centromere is found on the proximal end. **(Telocentric)**
45. _____ and _____ chromosomes are also called rod - shaped chromosomes. **(Acrocentric, telocentric)**
46. _____ chromosomes are J - shaped or L - shaped. **(submetacentric)**
47. In _____ chromosome the centromere occurs at the centre forming two unequal arms. **(submetacentric)**
48. In _____ chromosome the centromere occurs at the centre forming two equal arms. **(metacentric)**
49. _____ chromosomes are v - shaped. **(Metacentric)**
50. _____ are also called as sex chromosomes. **(Allosomes)**
51. Each human cell contains _____ pairs of chromosomes. **(23)**
52. The _____ pair in the human chromosome is the allosome. **(23rd)**
53. In sexually reproducing organisms the chromosomes are _____. **(diploid)**
54. _____ are rod shaped chromosomes. **(Telocentric)**
55. _____ shaped or L shaped chromosomes. **(Submetacentric)**
56. The eukaryotic chromosomes are classified into _____ and _____. **(autosomes, allosomes)**
57. _____ contain genes that determine the somatic characters. **(Autosomes)**
58. _____ are chromosomes which are responsible for determining the sex of an individual. **(Allosomes)**

59. The number of chromosomes in any living organism is _____. **(constant)**
60. _____ is the number, size and shape of chromosomes in the cell nucleus of an organism. **(Karyotype)**
61. _____ is the diagrammatic representation of karyotype of a species. **(Idiogram)**
62. _____ is the most important constituent of a chromosome. **(DNA)**
63. The most widely accepted model of DNA is the _____ structure. **(double helical)**
64. The sugar molecule of DNA consists of _____ sugar. **(deoxyribose)**
65. Purines and pyrimidines are _____ bases in the DNA. **(nitrogenous)**
66. Nitrogen base + Sugar = _____. **(nucleoside)**
67. Nucleoside + Phosphate = _____. **(nucleotide)**
68. _____ and _____ are the nitrogenous bases found in the DNA. **(Purines, pyrimidines)**
69. Pairing of nitrogenous bases in the DNA is linked by _____ bonds. **(hydrogen)**
70. Adenine links Thymine with _____ hydrogen bonds. **(two)**
71. Watson, Crick and Wilkins were awarded Nobel prize for _____ in 1962. **(medicine)**
72. DNA is a large molecule consisting of millions of _____. **(nucleotides)**
73. DNA is also called a _____. **(polynucleotide)**
74. Each nucleotide consists of _____ components. **(three)**
75. There are two types of _____ bases in DNA. **(nitrogenous)**
76. DNA molecule consists of two _____ chains. **(polynucleotide)**
77. The polynucleotide chains in the DNA form a _____ structure. **(double helix)**
78. Nitrogenous bases in the centre of the DNA linked to _____ units which form the backbone of the DNA. **(sugar - phosphate)**
79. _____ bonds between the nitrogenous bases make the DNA molecule stable. **(Hydrogen)**
80. The nucleotide in a helix are joined together by _____ bonds. **(phosphodiester)**
81. DNA _____ is one of the basic process that occurs within a cell. **(replication)**
82. The two strands of DNA open and separate at a point forming the _____. **(replication fork)**
83. The enzyme called _____ separates the double helix above the replication fork. **(topoisomerase)**
84. An _____ is a short segment of RNA nucleotides. **(RNA primer)**
85. The daughter strand is synthesized as a continuous strand called _____ strand. **(leading)**
86. The short segments of DNA are synthesized in a strand called _____ strand. **(lagging)**
87. The short segments of DNA are called _____ fragments. **(Okazaki)**
88. Sex is determined by the _____ of an individual. **(chromosomes)**
89. Human _____ are called homogametic. **(females)**
90. Human _____ are called heterogametic. **(males)**
91. The sperm, produced by the father, determines the _____ of the child. **(sex)**
92. Fertilization of the egg (22 + X) with a sperm (22 + X) will produce a _____ child. **(female)**
93. Fertilization of the egg (22 + X) with a sperm (22 + Y) will give rise to a _____ child. **(male)**
94. The term mutation was introduced by _____ in 1901. **(Hugo De Vries)**
95. _____ is an inheritable sudden change in the genetic material (DNA) of an organism. **(Mutation)**
96. The sudden change in the structure or number of chromosomes is called _____ mutation. **(chromosomal)**
97. Structural changes in the chromosomes usually occurs due to errors in _____. **(cell division)**
98. The addition or deletion in the number of chromosomes present in a cell is called _____. **(ploidy)**
99. _____ is the condition in which the individual bears more than the usual number of diploid (2n) chromosomes. **(Euploidy)**
100. If an individual has three haploid sets of chromosomes, the condition is called _____. **(triploidy)**
101. Triploid plants and animals are typically _____. **(sterile)**
102. _____ plants are advantageous as they often result in increased fruit and flower size. **(Tetraploid)**
103. _____ is the loss or gain of one or more chromosomes in a set. **(Aneuploidy)**
104. In man, _____ is one of the commonly known aneuploid condition. **(Down's syndrome)**
105. _____ is a genetic condition in which there is an extra copy of chromosome 21. **(Down's syndrome)**
106. Gene mutation is the changes occurring in _____ of a gene. **(nucleotide sequence)**
107. Gene alteration results in abnormal _____ formation in an organism. **(protein)**
108. _____ is caused by the mutation of a single gene. **(Sickle cell anaemia)**

19. ORIGIN AND EVOLUTION OF LIFE

I. Choose the correct answer.

1. Biogenetic law states that _____.
   a. ontogeny and phylogeny go together
   b. ontogeny recapitulates phylogeny
   c. phylogeny recapitulates ontogeny
   d. there is no relationship between phylogeny and ontogeny

   Ans: b. ontogeny recapitulates phylogeny

2. The 'use and disuse theory' was proposed by _____. ※※
   a. Charles Darwin b. Ernst Haeckel
   c. Jean Baptiste Lamarck d. Gregor Mendel

   Ans: c. Jean Baptiste Lamarck

3. Paleontologists deal with
   a. embryological evidences b. fossil evidences
   c. vestigial organ evidences d. all the above **Ans: b. fossil evidences**

4. The best way of direct dating fossils of recent origin is by ※※ **(PTA - I)**
   a. radio - carbon method b. uranium lead method
   c. potassium - argon method d. both (a) and (c)

   Ans: a. radio - carbon method

5. The term Ethnobotany was coined by **(APR - 2023)**
   a. Khorana b. J.W. Harshberger
   c. Ronald Ross d. Hugo de Vries **Ans: b. J.W. Harshberger**

II. Fill in the blanks.

1. The characters developed by the animals during their life time, in response to the environmental changes are called _____. **Ans: acquired characters**
2. The degenerated and non - functional organs found in an organism are called _____. **Ans: vestigial organs**
3. The forelimbs of bat and human are examples of _____ organs. ※※ **Ans: homologous**
4. The theory of natural selection for evolution was proposed by _____. ※※ **(PTA - VI)** **Ans: Charles Darwin**

III. State true or false. Correct the false statements.

1. The use and disuse theory of organs was postulated by Charles Darwin. **(PTA - V)**
   Ans: False ※※

   The use and disuse theory of organs was postulated by **Jean Baptiste Lamarck**

2. The homologous organs look similar and perform similar functions but they have different origin and developmental pattern.
Ans: False

The **analogous** organs look similar and perform similar functions but they have different origin and developmental pattern

3. Birds have evolved from reptiles. ※※
Ans: True

IV. Match the following. (PTA - V)

Column - A		Column - B			Answers		
1.	Atavism	-	a.	caudal vertebrae and vermiform appendix	-	c.	**rudimentary tail and thick hair on the body**
2.	Vestigial organs	-	b.	a forelimb of a cat and a bat's wing	-	a.	**caudal vertebrae and vermiform appendix**
3.	Analogous organs	-	c.	rudimentary tail and thick hair on the body	-	d.	**a wing of a bat and a wing of an insect**
4.	Homologous organs	-	d.	a wing of a bat and a wing of an insect	-	b.	**a forelimb of a cat and a bat's wing**
5.	Wood park	-	e.	radiocarbon dating	-	f.	**Thiruvakkarai**
6.	W.F. Libby	-	f.	Thiruvakkarai	-	e.	**radiocarbon dating**

V. Answer in a word or sentence.

1. **A human hand, a front leg of a cat, a front flipper of a whale and a bat's wing look dissimilar and adapted for different functions. What is the name given to these organs?**

Ans: Homologous organs

2. **Which organism is considered to be the fossil bird?** ※※※ **(PTA - IV)**

Ans: Archaeopteryx

3. **What is the study of fossils called?**

Ans: Palaeontology

VI. Short answers questions.

1. **The degenerated wing of a kiwi is an acquired character. Why is it an acquired character? (PTA - III)**

1. According to Lamarck's use and disuse theory the degenerated wing of a kiwi is an example for organ of disuse.
2. Because when an organ is not used for long time, it gradually degenerates.

2. **Why is Archaeopteryx considered to be a connecting link? (JULY - 24, JUNE - 23)** ※※※

1. Archaeopteryx had wings with feathers, like a bird.
2. It had a long tail, clawed digits and conical teeth, like a reptile.
3. So, Archaeopteryx is considered to be a connecting link between **reptiles** and **birds**.

3. **Define Ethnobotany and write its importance.** ※※ **(JULY - 24, AP - 24, PTA - II, SEP - 20 & 22)**

Ethnobotany is the study of a **region's plants** and their practical uses through the **traditional knowledge** of the local culture of people.

Importance of Ethnobotany:

1. It provides **traditional uses** of plant.
2. It gives information about certain **unknown** and **known** useful plants.

4. **How can you determine the age of the fossils?** ※※ **(SEP - 2020, GMQ - 2019)**

1. The age of fossils is determined by **radioactive elements** present in it.
2. They may be carbon, uranium, lead or potassium.
3. By **radioactive carbon (C^{14}) dating method**, **carbon consumption** of animals and plants **stops** after death and since then, only the **decaying process** of C^{14} occurs continuously.
4. The time passed since death of a plant or animal can be calculated by measuring the **amount** of C^{14} present in their body.

Hence, the age of the fossils are determined.

VII. Long answer questions.

※※

1. Natural selection is a driving force for evolution - How? (GMQ-19,PTA-VI)

I. Survival of the fittest or Natural selection:

1. During the struggle for existence, the organisms which can overcome the challenging situation, **survive** and **adapt** to the surrounding environment.
2. Organisms which are **unable** to **face** the challenges, are **unfit** to survive and disappear.
3. The process of selection of organisms with **favourable variation** is called as natural selection.

II. Origin of species:

According to Darwin, **new species** originates by the gradual accumulation of **favourable variations** for a number of generations.

※※

2. How do you differentiate homologous organs from analogous organs?

	Homologous organs	Analogous organs
1.	The homologous organs are those which have inherited from common ancestors.	Analogous organs are those which have inherited from different ancestors.
2.	They look dissimilar and adapted for different functions.	They look similar and perform similar functions.
3.	They have similar developmental pattern.	They have different developmental pattern.
4.	Their mode of development and basic structure of bone are similar.	Their mode of development and basic structures are different.
5.	**E.g:** Human hand, the front leg of a cat, flipper of a whale and a bat's wing.	**E.g:** The wings of a bat, the wings of a bird and wings of an insect.

3. How does fossilization occur in plants? (PTA - I)

Fossilization:

The process of **formation** of **fossil** in the **rocks** is called fossilization.

Common methods of fossilization:

1. Petrifaction

1. Minerals like silica slowly penetrate in and replace the original organic tissue and forms a rock like fossil.
2. This method of fossilization can preserve hard and soft parts.
3. Most bones and wood fossils are petrified.

2. Mold and Cast

1. A replica of a plant or animal is preserved in sedimentary rocks.
2. When the organism gets buried in sediment it is dissolved by underground water leaving a hollow depression called a mold.
3. It shows the original shape but does not reveal the internal structure.
4. Minerals or sediment fill the hollow depression and forms a cast.

3. Preservation

1. Original remains can be preserved in ice or amber.
2. They protect the organisms from decay.
3. The entire plant or animal is preserved.

4. Compression

1. When an organism dies, the hard parts of their bodies settle at the bottom of the sea bed and are covered by sediment.
2. The process of sedimentation goes on continuously and fossils are formed.

5. Infiltration or replacement

1. The precipitation of minerals takes place which later on infiltrate the cell wall.
2. The process is brought about by several mineral elements such as silica, calcium carbonate and magnesium carbonate.
3. Hard parts are dissolved and replaced by these minerals.

VIII. Higher Order Thinking Skills (HOTS)

1. Arun was playing in the garden. Suddenly he saw a dragon fly sitting on a plant. He observed the wings of it. He thought it looked similar to a wing of a crow. Is he correct? Give reason for your answer. (PTA - II)

Yes, he is correct.

Reason:

1. Because they are analogous organs.
2. The wings of a dragon fly and crow look similar and perform similar functions but they have different origin and developmental pattern.

2. Imprints of fossils tell us about evolution - How?

Fossils:

1. Fossils are evidence of ancient life forms or ancient habitats which have been preserved by natural process.
2. Fossil records show that the evolution has taken a gradual process from simple to complex organisms.
3. The origin of modern birds is supported by the evidences from paleontology.

3. Octopus, cockroach and frog all have eyes. Can we group these animals together to establish a common evolutionary origin. Justify your answer.

1. No, we cannot group these animals together to establish a common evolutionary origin because, **(PTA - IV)**
2. These organs look similar and perform similar functions but they have different origin and developmental pattern.
3. Hence, we can group these animals together in analogous organs.

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Choose the correct answer.

1. Life originates from pre - existing life was showed by **(SEP - 2021)**
   a. Louis Pasteur b. Oparin c. Haldane d. Lamarck
   Ans: a. Louis Pasteur

II. Short answers.

1. What is called evolution? Who proposed the theories of evolution? (SEP - 21, MAY - 22)

1. Formation of new species due to changes in specific characters over several generations as response to natural selection is called evolution.
2. The theories of evolution as proposed by **Lamarck** and **Darwin**.

III. Long answers.

1. a. List the theories postulated to explain the origin of life. (MAY - 2022)

1. Special creation
2. Spontaneous generation
3. Biogenesis
4. Extraterresterial or cosmic origin
5. Chemical evolution of life

b. Who coined the term 'Ethnobotany'? (MAY - 2022)

The term of Ethnobotany was coined by J.W. Harshberger.

2. Explain Lamarck's theories of evolution. (APR - 2023)

1. Internal vital force:

1. Living organisms or their component parts tend to increase in size continuously.
2. This increase in size is due to the inherent ability of the organisms.

2. Environment and new needs:

1. A change in the environment brings about changes in the need of the organisms.
2. In response to the changing environment, the organisms develop certain adaptive characters.
3. The adaptations of the organisms may be in the form of development of new parts of the body.

3. Use and disuse theory:

1. Lamarck's use and disuse theory states that if an organ is used constantly, the organ develops well and gets strengthened.
2. When an organ is not used for a long time, it gradually degenerates.
3. The ancestors of giraffe were provided with short neck and short forelimbs.
4. Due to shortage of grass, they were forced to feed on leaves from trees.
5. The continuous stretching of their neck and forelimbs resulted in the development of long neck and long forelimbs which is an example for constant use of an organ.
6. The degenerated wing of Kiwi is an example for organ of disuse.

4. Theory of inheritance of acquired characters:

1. When there is a change in the environment, the animals respond to the change.
2. They develop adaptive structures.
3. The characters developed by the animals during their life time, in response to the environmental changes are called acquired characters.

According to Lamarck, the acquired characters are transmitted to the offspring by the process of inheritance.

ADDITIONAL QUESTIONS

I. Match the following:

	Column - I		Column - II		Answers
1.	Special creation	- a.	Pre - existing life	- e.	**Supernatural event**
2.	Spontaneous generation	- b.	Oparin	- d.	**Abiogenesis**
3.	Biogenesis	- c.	Panspermia	- a.	**Pre - existing life**

4. Cosmic origin - d. Abiogenesis - c. **Panspermia**
5. Chemical evolution - e. Supernatural event - b. **Oparin**

Column - I **Column - II** **Answers**

1. Homologous - a. wings - bat, birds - d. **forelimb of mammals**
2. Analogous - b. non - functional - a. **wings - bat, birds**
3. Vestigial - c. man - b. **non - functional**
4. Atavism - d. forelimb of mammals - e. **ancestral character**
5. Caudal vertebra - e. ancestral character - c. **man**

Column – I **Column - II** **Answers**

1. Ernst Haeckel - a. Gradual change - e. **Biogenetic law**
2. Leonardo da vinci - b. Fossil bird - d. **Palaeontology**
3. Archaeopteryx - c. Lamarck - b. **Fossil bird**
4. Evolution - d. Palaeontology - a. **Gradual change**
5. Use and Disuse Theory - e. Biogenetic law - c. **Lamarck**

Column – I **Column - II** **Answers**

1. Inheritance - a. H.M.S Beagle - d. **acquired character**
2. Darwin - b. Natural selection - a. **H.M.S Beagle**
3. Origin of species c. Evolution e. **1859**
4. Variation - d. acquired character - c. **Evolution**
5. Survival of fittest - e. 1859 - b. **Natural selection**

Column - I **Column - II** **Answers**

1. Variation - a. mutation theory - c. **raw material**
2. Somatic variation - b. fluctuating - d. **body cells**
3. Germinal variation - c. raw material - e. **germ cells**
4. Continuous variation - d. body cells - b. **fluctuating**
5. Discontinuous variation - e. germ cells - a. **mutation theory**

II. Choose the correct answer:

1. _____ theory explains the origin of the universe.
   a. Lamarck's b. Darwin's c. Big Bang d. Natural selection
   Ans: c. Big Bang
2. According to _____ theory life originated from lifeless matter.
   c. Biogenesis b. Abiogenesis c. Cosmic d. Special creation
   Ans: b. Abiogenesis
3. Biogenesis was speculated by _____.
   a. Louis Pasteur b. Darwin c. Lamarck d. Oparin
   Ans: a. Louis Pasteur
4. The non – functional organs of animals are called _____ organs.
   a. petrified b. accessory c. vestigial d. sensory
   Ans: c. vestigial
5. _____ is the raw material which plays an important role in evolution.
   a. Fossilization b. Preservation c. Compression d. Variation
   Ans: d. Variation
6. _____ deals with the recovery and identification of plant remains of geological past.
   a. Paleobotany b. Ethnobotany c. Paleontology d. Exobiology
   Ans: a. Paleobotany
7. Radioactive carbon dating was discovered by_____.
   a. Lamarck b. Darwin c. Birbal sahani d. None of the above
   Ans: d. None of the above

8. Thiruvakkarai fossil wood park is at _____.
   a. Andhra pradesh b. Maharashtra c. Kerala d. Tamil Nadu
   Ans: d. Tamil Nadu
9. i. The study of a region's plants is ethnobotany.
   ii. The process of formation of fossil in rocks is called paleobotany.
   iii. Radioactive carbon dating was discovered by W.F.Libby.
   iv. Most bones and wood fossils are non - petrified.
   a. i. & iii. are correct b. ii. & iv. are correct
   c. iv. is correct d. i. & ii. are correct
   Ans: a. i. & iii. are correct
10. Mutation and variation are the events involved in _____.
    a. sedimentation b. petrification
    c. evolution d. fossilization **Ans: c. evolution**
11. Discontinuous variation forms the basis for _____.
    a. evolution b. mutation c. variation d. fossilization
    Ans: b. mutation

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

1. Variation arises due to errors occurring in DNA during replication or exposure to UV rays or chemicals.
   Ans: False
   Mutation arises due to errors occurring in DNA during replication or exposure to 'UV rays or chemicals.
2. Most bones and wood fossils are petrified.
   Ans: True
3. When the organism gets buried in sediment it is dissolved by underground water leaving a hollow depression called a cast.
   Ans: False
   When the organism gets buried in sediment it is dissolved by underground water leaving a hollow depression called a **mold**.
4. The organisms which live in extreme environmental conditions on earth are called extremophiles.
   Ans: True
5. Darwin proposed that the acquired characters are passed on to the offsprings in the next generation.
   Ans: False
   Lamarck proposed that the acquired characters are passed on to the offsprings in the next generation.
6. Ethnobotany is the science which looks for the presence of extra – terrestrial life in the universe.
   Ans: False
   Exobiology is the science which looks for the presence of extra - terrestrial life in the universe.

IV. Assertion and Reason.

1. **Assertion:** The first form of life could have come from pre - existing non - living inorganic molecules.
   Reason : It gave rise to formation of diverse organic molecules which are transformed into colloid system to produce life.
   a. A and R are correct, R explains A. b. A is correct, R is wrong.

c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.

Ans: a. A and R are correct, R explains A

2. **Assertion:** The analogous organs are those which have inherited from common ancestors with similar developmental pattern in embryos.

Reason : Their mode of development and basic structure of bone are similar.

a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.

Ans: c. A is wrong, R is correct

3. **Assertion:** Evolution is the gradual change occurring in living organisms over a period of time.

Reason : The reappearance of ancestral characters in some individuals is called atavism.

a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.

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

4. **Assertion:** New species originates by the gradual accumulation of favourable variations for a number of generations.

Reason : Somatic variation occurs in germ cells of an organism.

a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.

Ans: b. A is correct, R is wrong

V. Analog

1.	Homologous organ	:	human hand	
	Analogous organ	:	_____	**(wings of bird)**
2.	Lamarck	:	use and disuse theory	
	Darwin	:	_____	**(natural selection)**
3.	Embryology	:	study of embryo	
	Palaeontology	:	_____	**(study of fossils)**
4.	Somatic variation	:	Inheritable	
	Germinal variation	:	_____	**(heritable)**
5.	Continuous variation	:	gradual accumulation	
	Discontinuous variation	:	_____	**(sudden change)**
6.	Living fossils	:	Ginko biloba	
	Non living fossils	:	_____	**(Archaeopteryx)**
7.	Father of Paleobotany	:	Kasper Maria Von Sternberg	
	Father of Indian Paleobotany	:	_____	**(Birbal Sahani)**

VI. Short Answers:

1. Write about biogenesis.

1. It was speculated by Louis Pasteur (1862) that **life originates from pre - existing life.**
2. He showed that pre - sterilized flasks kept closed airtight, with killed yeast, did not give rise to any life form.
3. While in another flask kept open to air living organisms arose from killed yeast.

2. Define Palaeontology.

Palaeontology:

1. Deals with the **study of fossils.**
2. **Leonardo da Vinci** is called the Father of palaeontology

3. Define paleobotany.

Paleobotany:
It is the branch of paleontology that deals with the **recovery** and **identification** of plant remains of geological past.

4. Define Ethanobotany.

Ethanobotany:
Ethnobotany is the **study of a region's plants** and their practical uses through the **traditional knowledge** of the local culture of people.

5. Define Astrobiology.

Astrobiology:

1. Astrobiology / exobiology is the science which looks for the presence of **extra terrestrial life in the universe.**
2. It deals with the **origin, evolution and distribution of life in the universe** and to investigate the possibility of life in other world.

6. Write the aspects of ethnobotany.

1. Ethnobotany has relevance with problems of nutrition.
2. Health care and life support system.
3. Faith in plants.
4. Cottage industries.
5. Economic upliftment.
6. Conservation of biodiversity and sustainable use of plant resources.

VII. Long Answers:

1. What is variation? And write its type.

1. Variation is the **difference found among individuals** of the same species and the offspring of the same parent.
2. Variation is the **raw material.** Evolution would not be possible without variation.

Types of Variation:

1. Somatic variation:

1. These are the variations which affect the **body (somatic) cells** of the organisms.
2. They are **not heritable.**
3. They occur due to environmental factors.

2. Germinal variation:

1. These variations are produced in **germ cells** of an organism.
2. They are **inherited.**
3. They may be present in ancestors or may occur suddenly.
4. They are classified into two types.
   i. Continuous variation
   ii. Discontinuous variation

Continuous variation:

1. These are **small variations** which occur **among individuals** of a population.

2. They are also called as fluctuating variations.
3. They occur by gradual accumulation in a population.

E.g: Skin colour, height and weight of an individual.

Discontinuous variation:

1. These are **sudden changes** which occur in an organism due to mutations.
2. They do not have any intermediate forms.
3. These large variations are not useful for evolution.

E.g: Short legged Ancon sheep, six or more digits (fingers) in human.

VIII. Fill in the blanks.

1. Origin of life is linked with the origin of _____. **(earth)**
2. The _____ theory explains the origin of universe. **(Big bang)**
3. Earth was supposed to have been formed about _____ years back. **(4.5 billion)**
4. Life appeared _____ years after the formation of earth. **(500 million)**
5. _____ idea embodies that life on Earth is a divine creation. **(Special creation)**
6. According to the big bang, the universe originated _____ years ago. **(15 billion)**
7. The _____ was created when the gaseous clouds started to collapse. **(solar system)**
8. Spontaneous generation is also called as _____. **(Abiogenesis)**
9. Abiogenesis states that life originated from _____ matter. **(lifeless)**
10. Abiogenesis believed that insects originated from _____. **(decaying matter)**
11. Biogenesis states that life originated from _____. **(pre - existing life)**
12. _____ origin states that units of life were transferred to different planets. **(Extraterresterial (or) cosmic)**
13. Some astronomers believe that units of life called _____ were transferred from different planets. **(spores)**
14. Oparin and Haldane believed that life arose by a series of sequential _____. **(chemical reactions)**
15. The evidence of evolution support the concept that all organisms have evolved from _____ ancestors. **(common)**
16. The forelimbs of vertebrates show a _____ structure. **(homologous)**
17. The comparative study of _____ and _____ of animals, reveal that they possess common set of characteristics. **(morphology, anatomy)**
18. The _____ of mammals are homologous structures. **(fore limbs)**
19. _____ organs look similar and perform similar functions but they have different origin. **(Analogous)**
20. Special creation attributes to a _____ event at a particular time in the past. **(supernatural)**
21. Vermiform appendix, nictitating membrane are _____ organs in man. **(vestigial)**
22. _____ law states that ontogeny recapitulates phylogeny. **(Biogenetic)**
23. Biogenetic law is also known as_____ theory. **(recapitulation)**
24. Organisms develop certain adaptive characters in response to their changing _____. **(environment)**
25. The degenerated and non - functional organs of animals are called _____ organs. **(vestigial)**
26. The reappearance of ancestral characters in some individuals is called _____. **(atavism)**
27. Presence of thick hair on the human body is a character of _____. **(atavism)**
28. The embryos from fish to mammals are _____ in their early stages of development. **(similar)**
29. Recapitulation theory was given by _____. **(Ernst Haeckel)**
30. Palaeontology deal with the study of _____. **(fossils)**
31. _____ is called the Father of Palaeontology. **(Leonardo da Vinci)**
32. The origin of modern birds is supported by the evidences from _____. **(palaeontology)**
33. _____ is the oldest known fossil bird. **(Archaeopteryx)**
34. _____ is the gradual change occurring in living organisms over a period of time. **(Evolution)**
35. _____ theory of evolution was published in Philosophic Zoologique. **(Lamarck's)**
36. Lamarck's _____ theory states that if an organ is used constantly, the organ develops well and gets strengthened. **(use and disuse)**

37. When an organ is not used for a long time, it gradually _____. **(degenerates)**
38. The degenerated wing of Kiwi is an example for organ of _____. **(disuse)**
39. The characters developed by the animals during their life time, in response to the environmental changes are called _____ characters. **(acquired)**
40. According to Lamarck, the acquired characters are transmitted to the offspring by the process of _____. **(inheritance)**
41. Darwin worked for a period of _____ years to develop the theory of natural selection. **(20)**
42. Darwin demonstrates the facts of evolution in his book named _____. **(origin of species)**
43. According to Darwin, living beings have the capacity to multiply in a _____ manner. **(geometrical)**
44. According to Darwin, the struggle for existence is of _____ types. **(three)**
45. _____ struggle is the competition among the individuals of same species. **(Intraspecific)**
46. _____ struggle is the competition between the organisms of different species living together. **(Interspecific)**
47. _____ struggle can affect the existence of organisms. **(Environmental)**
48. Small variations are important for _____. **(evolution)**
49. According to Darwin _____ variations are useful to the organism. **(favourable)**
50. _____ variations are harmful or useless to the organism according to Darwin. **(unfavourable)**
51. _____ leads to differences in the phenotype of the offspring from its parents. **(Variation)**
52. _____ variations are not heritable. **(Somatic)**
53. _____ variations are also called as fluctuating variations. **(Continuous)**
54. Discontinuous variations occur due to _____. **(mutation)**
55. Mutation theory was proposed by _____. **(Hugo De vries)**
56. The process of selection of organisms with favourable variation is called as _____. **(natural selection)**
57. New species originates by the gradual accumulation of _____ variations for a number of generations. **(favourable)**
58. Sexual reproduction, which involves meiosis helps in _____ during gametic fusion. **(recombination of genes)**
59. _____ is the raw material which plays an important role in evolution. **(Variation)**
60. _____ would not be possible without variation. **(Evolution)**
61. _____ variation affect the body cells of the organisms. **(Somatic)**
62. _____ variations are produced in germ cells of an organism. **(Germinal)**
63. _____ variation are sudden changes which occur in an organism due to mutations. **(Discontinuous)**
64. Discontinuous variations form the basis for _____ theory. **(Mutation)**
65. _____ and _____ are two events involved in the process of evolution. **(Mutation, Variation)**
66. _____ arises due to errors occurring in DNA during replication. **(Mutation)**
67. _____ leads to variation. **(Mutation)**
68. _____ is the branch of paleontology that deals with recovery and identification of plant remains of geological past. **(Paleobotany)**
69. A _____is any preserved part of a plant that has died long back. **(plant fossil)**
70. Majority of the plant fossils are _____ parts of plants. **(disarticulated)**
71. Fossils throw light on _____ and evolution of plants. **(phylogeny)**
72. Fossil plants can be used in the field of descriptive and comparative _____. **(anatomy)**
73. _____ is a method of fossilization which preserves hard and soft rock parts. **(petrifaction)**
74. Minerals or sediments which fill the mold during fossilization forms a _____. **(cast)**
75. _____ is the Father of Paleobotany. **(Sternberg)**
76. _____ is the Father of Indian Paleobotany. **(Birbal sahani)**
77. The process of formation of fossil in the rocks is called _____. **(fossilization)**
78. Most bones and wood fossils are _____. **(petrified)**
79. A replica of a plant or animal is preserved in _____ rocks. **(sedimentary)**
80. _____ are living organisms that are similar in appearance to their fossilized distant ancestors and usually have no extinct close features. **(Living Fossils)**
81. Ginko biloba is a _____ fossil. **(living)**
82. The age of fossils is determined by _____ elements present in it. **(radioactive)**
83. The time passed since death of a plant are animal can be calculated by measuring the amount of _____ present in their body. **(C^{14})**

20. BREEDING AND BIOTECHNOLOGY

I. Choose the correct answer.

1. Which method of crop improvement can be practised by a farmer if he is inexperienced?
   a. clonal selection b. mass selection
   c. pureline selection d. hybridisation **Ans: b. mass selection**

2. Pusa Komal is a disease resistant variety of _____. ※※ **(SEP - 21)**
   a. sugarcane b. rice c. cow pea d. maize
   Ans: c. cow pea

3. Himgiri developed by hybridisation and selection for disease resistance against rust pathogens is a variety of _____. **(JULY - 24, MAY - 22)**
   a. chilli b. maize c. sugarcane d. wheat
   Ans: d. wheat

4. The miracle rice which saved millions of lives and celebrated its 50th birthday is _____. ※※
   a. IR 8 b. IR 24 c. Atomita 2 d. Ponni
   Ans: a. IR 8

5. Which of the following is used to produce products useful to humans by biotechnology techniques?
   a. enzyme from organism b. live organism
   c. vitamins d. both (a) and (b) **Ans: d. both (a) and (b)**

6. We can cut the DNA with the help of **(APRIL - 2024, 23, SEP - 20, PTA - II)**
   a. scissors b. restriction endonucleases ※※
   c. knife d. RNAase **Ans: b. restriction endonucleases**

7. rDNA is a
   a. vector DNA
   b. circular DNA
   c. recombinant of vector DNA and desired DNA
   d. satellite DNA **Ans: c. recombinant of vector DNA and desired DNA**

8. DNA fingerprinting is based on the principle of identifying _____ sequences of DNA. **(PTA - V)**
   a. single stranded b. mutated
   c. polymorphic d. repetitive **Ans: d. repetitive**

9. Organisms with modified endogenous gene or a foreign gene are also known as
   a. transgenic organisms b. genetically modified
   c. mutated d. both a and b
   Ans: d. both a and b

10. In a hexaploid wheat (2n = 6x = 42) the haploid (n) and the basic (x) number of chromosomes respectively are
    a. n = 7 and x = 21 b. n = 21 and x = 21
    c. n = 7 and x = 7 d. n = 21 and x = 7 **Ans: d. n = 21 and x = 7**

II. Fill in the blanks.

1. Economically important crop plants with superior quality are raised by _____. **Ans: plant breeding**
2. A protein rich wheat variety is _____. ※※ **Ans: Atlas 66**
3. _____ is the chemical used for doubling the chromosomes. ※ **Ans: Colchicine**
4. The scientific process which produces crop plants enriched with desirable nutrients is called _____. ※※ **Ans: biofortification**
5. Rice normally grows well in alluvial soil, but _____ is a rice variety produced by mutation breeding that grows well in saline soil. **Ans: atomita 2** (SEP - 2021)
6. _____ technique made it possible to genetically engineer living organism. **Ans: Recombinant DNA**
7. Restriction endonucleases cut the DNA molecule at specific positions known as _____. **Ans: restriction site**
8. Similar DNA fingerprinting is obtained for _____. **Ans: identical twins**
9. _____ cells are undifferentiated mass of cells. **Ans: stem**
10. In gene cloning the DNA of interest is integrated in a _____. **Ans: vector**

III. State whether true or false. If false, write the correct statement.

1. *Raphano brassica* is a man - made tetraploid produced by colchicine treatment.
   Ans: True

2. The process of producing an organism with more than two sets of chromosome is called mutation. ※※
   Ans: False
   The process of producing an organism with more than two sets of chromosome is called **polyploidy**.

3. A group of plants produced from a single plant through vegetative or asexual reproduction are called a pureline.
   Ans: False
   A group of plants produced from a single plant through vegetative or asexual reproduction are called a **clones**.

4. Iron fortified rice variety determines the protein quality of the cultivated plant.
   Ans: False
   Iron fortified rice variety determines the **iron** quality of the cultivated plant.

5. Golden rice is a hybrid. ※※
Ans: False
Golden rice is a **genetically modified plant**.

6. Bt gene from bacteria can kill insects.
Ans: True

7. *In vitro fertilisation* means the fertilisation done inside the body.
Ans: False
In vitro fertilisation means the fertilisation done **outside** the body.

8. DNA fingerprinting technique was developed by Alec Jeffrey.
Ans: True

9. Molecular scissors refers to DNA ligases.
Ans: False
Molecular scissors refers to **restriction enzymes**.

IV. Match the following.

Column - I			Column - II			Answers		
1.	Sonalika	-	i.	*Phaseolus mungo*	-	iii.	Semi - dwarf wheat
2.	IR 8	-	ii.	Sugarcane	-	v.	Semi - dwarf Rice
3.	Saccharum	-	iii.	Semi - dwarf wheat	-	ii.	Sugarcane
4.	Mung No. 1	-	iv.	Ground nut	-	i.	*Phaseolus mungo*
5.	TMV - 2	-	v.	Semi - dwarf Rice	-	iv.	Ground nut
6.	Insulin	-	vi.	*Bacillus thuringiensis*	-	viii.	first hormone produced using rDNA technique
7.	Bt toxin	-	vii.	Beta carotene	-	vi.	*Bacillus thuringiensis*
8.	Golden rice	-	viii.	first hormone produced using rDNA technique	-	vii.	Beta carotene

V. Understand the assertion statement, justify the reason given and choose the correct choice.

1. **Assertion:** Hybrid is superior than either of its parents.
Reason : Hybrid vigour is lost upon inbreeding.

a. Assertion is correct and reason is wrong.
b. Reason is correct and the assertion is wrong.
c. Both assertion and reason is correct.
d. Both assertion and reason is wrong.

Ans: a. Assertion is correct and reason is wrong.

2. **Assertion :** Colchicine reduces the chromosome number. **(PTA - III)**
Reason : It promotes the movement of sister chromatids to the opposite poles.

a. Assertion is correct and reason is wrong.
b. Reason is correct and the assertion is wrong.
c. Both assertion and reason is correct.
d. Both assertion and reason is wrong.

Ans: d. Both assertion and reason is wrong.

3. **Assertion :** rDNA is superior over hybridisation techniques. **(PTA - IV)**
Reason (R): Desired genes are inserted without introducing the undesirable genes in target organisms.

a. Assertion is correct and reason is wrong.
b. Reason is correct and the assertion is wrong.
c. Both assertion and reason is correct.
d. Both assertion and reason is wrong.

Ans: c. Both assertion and reason is correct.

VI. Answer in a sentence.

1. **Give the name of wheat variety having higher dietary fibre and protein.** ※※
Ans: *Triticale*(6n)

2. **Semi - dwarf varieties were introduced in rice. This was made possible by the presence of dwarfing gene in rice. Name this dwarfing gene.**
Ans: Dee – geo – woo – gen (DGWG) a dwarf variety from China.

3. **Define genetic engineering.** ※※※ **(APR - 2023)**
Genetic engineering is the manipulation and transfer of genes from one organism to another organisms to create a new DNA called as recombinant DNA (rDNA).

4. **Name the types of stem cells.** **(JULY - 24, PTA - II)**
Ans: 1. Embryonic stem cells
2. Adult (or) somatic stem cells

5. **What are transgenic organisms?** ※※ **(PTA - VI)**
Plants or animals expressing a modified endogenous gene or a foreign gene are also known as transgenic organisms.

6. State the importance of biofertiliser.

1. Biofertilisers are easy to produce in abundance and are available at low cost to the marginal farmer.
2. It increases the soil fertility without causing any damage to the soil.

   E.g: Rhizobium, Azospirillum, Azotobacter.

VII. Short answers questions.

1. Discuss the method of breeding for disease resistance. (PTA - VI)

1. The method of breeding for disease resistance is attained through

   i. **Selection** - Selecting the best plants with desired characters.

   ii. **Hybridization** - To combine the characters of two plants that are disease resistant.

   E.g: **Himgiri** wheat is resistance to leaf and stipe rust, hill bunt diseases.

2. Name three improved characteristics of wheat that helped India to achieve high productivity. (PTA - IV)

1. Atlas 66 - Protein rich wheat variety
2. Himgiri - Resistant to diseases like leaf and stipe rust, hill bunt.
3. Sonalika - High yielding, semi - dwarf wheat variety. ※※※

3. Name two maize hybrids rich in amino acid lysine. (APR - 2023, GMQ - 19,MAY - 22)

1. Protina 2. Shakti

4. Distinguish between ※※ (PTA - I)

a. Somatic gene therapy and germ line gene therapy: (SEP - 2021)

	Somatic gene therapy	Germ line gene therapy
1.	It is the replacement of defective gene in **somatic cells**.	It is the replacement of defective gene in **germ cells** (egg and sperm).
2.	It takes place in body cells.	It takes place in the egg and sperm cells.

b. Undifferentiated cells and differentiated cells:

	Undifferentiated cells	Differentiated cells
1.	They are unspecialized cells.	They are specialized cells.
2.	They have variable potency.	They carry out a specific function.
3.	**E.g:** Umbilical cord	**E.g:** Pancreatic cells

5. State the applications of DNA fingerprinting technique.

(JULY - 24, AP - 24, JU-23, SEP-20, PTA-III)

1. DNA fingerprinting technique is widely used in **forensic applications** like crime investigation such as identifying the culprit.
2. It is used for **paternity testing** incase of disputes.
3. It helps in the study of genetic diversity of population, evolution and speciation.

6. How are stem cells useful in regenerative process?

1. Sometimes cells, tissues and organs in the body may be permanently **damaged** or **lost** due to genetic condition or disease or injury.
2. In such situations stem cells are used for the treatment of diseases which is called **stem - cell therapy**.
3. In treating neurodegenerative disorders like Parkinson's disease and Alzheimer's disease neuronal stem cells can be used to replace the damaged or lost neurons.

7. Differentiate between outbreeding and inbreeding. ※※ (APRIL - 2024)

	Outbreeding	Inbreeding
1.	Cross between two **different species** (unrelated) with desirable features of economic value are mated.	Mating of closely related animals within the **same breed** for about **4 - 6** generations.
2.	The hybrids are **stronger** and **vigorous** than their parents.	It helps in the accumulation of **superior genes** and eliminate **undesirable genes**.
3.	**E.g:** Mule	**E.g:** Sheep Hissardale

VIII. Long answers questions.

1. What are the effects of hybrid vigour in animals? (JULY - 24, PTA - I,V)

Hybrid vigour:

The superiority of the hybrid obtained by cross breeding is called as heterosis or hybrid vigour.

Effects of hybrid vigour in animal breeding:

1. Increased production of **milk** by cattle.
2. Increased production of **egg** by poultry.
3. High quality of **meat** is produced.
4. Increased **growth rate** in domesticated animals.

2. Describe mutation breeding with an example. ※※

Mutation:

1. Mutation is defined as the sudden **heritable change** in the nucleotide sequence of DNA in an organism.
2. It is a process by which **genetic variations** are created which in turn brings about changes in the organism.
3. The organism which undergoes mutation is called a **mutant**.
4. The factors which induce mutations are known as mutagens or mutagenic agents.
5. Mutagens are of two types namely physical mutagens and chemical mutagens.

   i. **Physical mutagens:**

   Radiations like X - rays, α, β and γ- rays, UV rays, temperature etc., which induce mutations are called physical mutagens.

   ii. **Chemical mutagens:**

   1. **Chemical substances** that induce mutations are called chemical mutagens.

      E.g: Mustard gas and nitrous acid.

   2. The utilisation of induced mutation in crop improvement is called mutation breeding.

Achievements of mutation breeding:

a. **Sharbati Sonora** wheat produced from Sonora - 64 by using gamma rays.

b. **Atomita 2 rice** with saline tolerance and pest resistance.

c. **Groundnuts** with thick shells.

3. Biofortification may help in removing hidden hunger. How?

1. Biofortification is the scientific process of developing crop plants enriched with **high levels** of **desirable nutrients** like vitamins, proteins and minerals.
2. **Examples:**

a. Protina, Shakti and Rathna are **lysine** rich maize hybrids (developed in India)

b. Atlas 66, a **protein** rich wheat variety.

c. **Iron** rich fortified rice variety.

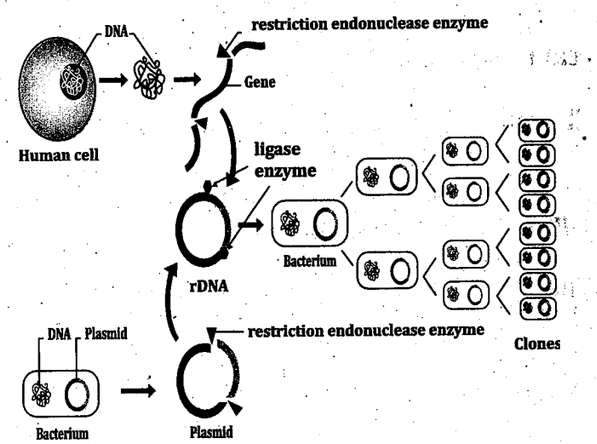
d. **Vitamin A** enriched carrots, pumpkin and spinach.

Thus, Biofortification helps in removing hidden hunger.

4. With a neat labelled diagram explain the techniques involved in gene cloning.

Gene cloning: ※※※

1. The carbon copy of an individual is often called a **clone**. However, more appropriately, a clone means to make a genetically exact copy of an organism.
2. In gene cloning, a gene or a piece of DNA fragment is inserted into a bacterial cell where DNA will be multiplied (copied) as the cell divides.



Genetic engineering technique (Gene cloning)

Techniques involved in gene cloning:

1. Isolation of desired DNA fragment by using **restriction enzymes**.
2. Insertion of the DNA fragment into a suitable **vector** (Plasmid) to make rDNA.
3. Transfer of rDNA into bacterial **host cell** (Transformation).
4. Selection and multiplication of **recombinant host cell** to get a clone.
5. Expression of **cloned gene** in host cell.

5. Discuss the importance of biotechnology in the field of medicine. ⁂⁂

(JUNE - 2023, SEP - 21, MAY - 22)

Using genetic engineering techniques medicinally important valuable proteins or polypeptides that form the potential pharmaceutical products for treatment of various diseases have been developed on a commercial scale.

Pharmaceutical products developed by rDNA technique:

1. Insulin used in the treatment of **diabetes**.
2. Human growth hormone used for treating children with **growth deficiencies**.
3. Blood clotting factors are developed to treat **haemophilia**.
4. Tissue plasminogen activator is used to dissolve **blood clots** and prevent **heart attack**.
5. Development of **vaccines** against various diseases like Hepatitis B and rabies.

IX. Higher Order Thinking Skills (HOTS)

1. A breeder wishes to incorporate desirable characters into the crop plants. Prepare a list of characters he will incorporate.

1. High yield and better quality
2. Disease resistance
3. Insects / pests resistance
4. Nutritional quality
5. Short duration
6. Drought resistance

2. Organic farming is better than Green Revolution. Give reasons.

1. Green revolution is the process of increasing food production through high yielding crop varieties and modern agricultural techniques.
2. Green revolution uses fertilizers and pesticides which are toxic and cause pollution.
3. But organic manures are derived from plant debris, animal faeces and microbes.

4. They make the soil fertile by adding nutrients like nitrogen, phosphorus, potassium to the soil.
5. In organic farming, chemical fertilizers and pesticides are not used.
6. Therefore, there is no toxicity and pollution involved.
7. There is no genetically altered gene (seeds). So it is very cheap.
8. Food chain is protected in agricultural land.
9. Hence, organic farming is safer, healthier for us and better for the environment than green revolution.

3. Polyploids are characterised by gigantism. Justify your answer.

1. An organism having more than two sets of chromosomes is called a polyploid.
2. Such condition is called polyploidy.
3. The size of the fruits depend on the degree of ploidy and the number of genes which are multiplied.
4. This results in gigantism.

4. 'P' is a gene required for the synthesis of vitamin A. It is integrated with genome of 'Q' to produce genetically modified plant 'R'.

1. What is P, Q and R?

P - Beta carotene gene

Q - Rice

R - Golden rice

2. State the importance of 'R' in India.

Importance:

1. It is used to prevent vitamin - A deficiency.
2. It is used for healthy vision, antioxidant, fighting against cell damage.
3. It prevents hidden hunger.

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Fill in the blanks

1. Who is called the "Father of Indian Green Revolution"? **(APRIL - 2024)**

Ans: Dr. M. S Swaminathan

II. Long answers.

1. Explain about Gene Therapy. **(SEP - 2020)**

Gene Therapy:

1. Gene therapy refers to the replacement of defective gene by the direct transfer of functional genes into humans to treat genetic disease or disorder.
2. The genetic makeup of the 'patient; cell is altered using recombinant DNA technology.
3. It was first successfully implemented in 1990.
4. **Somatic gene therapy** is the replacement of defective gene in somatic cells.
5. **Germ line gene therapy** replacement of defective gene in germ cell (egg and sperm).
6. Gene therapy conducted till date has targeted only somatic (non - reproductive) cells.
7. Correction of genetic defects in somatic cells may be beneficial to the patient but the corrected gene may not be carried to the next generation.

2. **Which enzyme cuts DNA at specific sites?** **(APR - 2023)**
Restriction enzymes cuts or break DNA at specific sites and are also called as molecular scissors.

ADDITIONAL QUESTIONS

I. Match the following:

	Column - I		Column - II		Answers
1.	Sonalika	- a.	Indonesia	- e.	**Wheat**
2.	IR -8	- b.	China	- c.	**Miracle rice**
3.	IRRI	- c.	Miracle rice	- d.	**Philippines**
4.	Peta	- d.	Philippines	- a.	**Indonesia**
5.	DGWG	- e.	Wheat	- b.	**China**

	Column - I		Column - II		Answers
1.	Hill Bunt	- a.	Cauliflower	- c.	**Himgiri**
2.	Black rot	- b.	Pusa komal	- a.	**Cauliflower**
3.	Bacterial blight	- c.	Himgiri	- b.	**Pusa komal**
4.	Leaf Hopper	- d.	Pusa Gaurav	- e.	**Pusa sem 2**
5.	Aphids	- e.	Pusa sem 2	- d.	**Pusa Gaurav**

	Column - I		Column - II		Answers
1.	Rathna	- a.	Groundnut	- b.	**Maize**
2.	Atlas 66	- b.	Maize	- d.	**Protein rich**
3.	AK - 10	- c.	Wheat and rye	- a.	**Groundnut**
4.	TV - 29	- d.	Protein rich	- e.	**Tea**
5.	Triticale	- e.	Tea	- c.	**Wheat and rye**

	Column - I		Column - II		Answers
1.	Golden rice	- a.	Salmon	- b.	**Beta carotene**
2.	Insect resistant	- b.	Beta carotene	- e.	**Bt gene**
3.	Transgenic fish	- c.	Cysteine	- a.	**Salmon**
4.	Transgenic sheep	- d.	DNA fingerprinting	- c.	**Cysteine**
5.	Alec Jeffrey	- e.	Bt gene	- d.	**DNA fingerprinting**

II. Choose the correct answer:

1. _____ is the art of developing economically important plants with superior quality.
   a. Animal husbandry b. Plant breeding
   c. Biofortification d. Polyploidy **Ans: b. Plant breeding**
2. Cow pea : Pusa komal

   Wheat : _____
   a. Pusa Gaurav b. Pusa A4 c. Pusa Sem3 d. Himgiri
   Ans: d. Himgiri
3. _____ is the process of developing crop plants with high levels of desired nutrients.
   a. Biofortification b. Selection c. Polyploidy d. Hybridization
   Ans: a. Biofortification
4. Atlas 66, is a protein rich _____ variety.
   a. rice b. wheat c. maize d. barley **Ans: b. wheat**
5. Groundnut varieties like TMV - 2 and AK - 10 are examples of _____ selection.
   a. pureline b. clonal c. germinal d. mass **Ans: d. mass**
6. _____ cells have only one set of chromosomes.
   a. Gametic b. Somatic c. polyploid d. none of the above
   Ans: a. Gametic
7. Chemical agents like colchicine induce _____.
   a. selection b. polyploidy c. plant breeding d. Hybridization
   Ans: b. polyploidy
8. The superiority of the hybrid obtained by cross breeding is called _____.
   a. heterosis b. biofortification
   c. dwarf variety d. none of the above **Ans: a. heterosis**
9. Atomita 2 rice is _____ tolerant.
   a. alcohol b. saline c. mutation d. disease
   Ans: b. saline
10. _____ stem cells are extracted and cultured from early embryos.
   a. Somatic b. Adult c. Stem cell therapy d. Embryonic
   Ans: d. Embryonic
11. Beta carotene gene inserted in rice, improved _____.
   a. Productivity b. disease resistance
   c. growth d. nutritional quality **Ans: d. nutritional quality**
12. The gene responsible for the synthesis of amino acid in transgenic sheep improved _____.
   a. wool quality b. productivity
   c. disease resistance d. both a & b **Ans: d. both a & b**
13. The transfer of rDNA into bacterial host cell is called _____.
   a. selection b. transformation
   c. inbreeding d. heterosis **Ans: b. transformation**

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

1. Selection of desirable clones from the mixed population of vegetatively propagated crop is called pureline selection.
   Ans: False
   Selection of desirable clones from the mixed population of vegetatively propagated crop is called **clonal** selection.
2. An organism having more than two sets of chromosomes is called polyploidy.
   Ans: True
3. The cross between different breeds is called inbreeding.
   Ans: False
   The cross between different breeds is called **outbreeding**.
4. Continued inbreeding increases fertility and productivity.

Ans: False
Continued inbreeding **reduces** fertility and productivity.

5. Restriction enzymes are the enzymes which help in ligating the broken DNA fragments.
Ans: False
DNA ligases are the enzymes which help in ligating the broken DNA fragments.

6. Dolly was the first cloned female sheep.
Ans: True

7. Embryonic stem cell are found in the neonatal and adults.
Ans: False
Somatic stem cell are found in the neonatal and adults.

IV. Assertion and Reason.

1. **Assertion:** Inbreeding is the breeding of unrelated animals.
Reason : Superior males and superior females of the same breed are identified and mated in pairs.
a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
Ans: c. A is wrong, R is correct

2. **Assertion:** Insulin is used in the treatment of diabetes.
Reason : Tissue plasminogen activator is used to dissolve blood clots and prevent heart attack.
a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
Ans: d. A and R are correct, R doesn't explain A

3. **Assertion:** Adult stem cell have the ability to divide and give rise to specific cell types.
Reason : Sources of adult stem cells are amniotic fluid, umbilical cord and bone marrow.
a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
Ans: a. A and R are correct, R explains A

4. **Assertion:** The superiority of the hybrid obtained by cross breeding is called as heterosis.
Reason : Genetic engineering is the manipulation and transfer of genes from one organism to another organism.
a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
Ans: d. A and R are correct, R doesn't explain A

V. Analog

1. Sonalika : wheat
IR 8 : _____ **(miracle rice)**

2. Wheat : himgiri
Cow pea : _____ **(pusa komal)**

3. Lysine rich maize : shakti
Protein rich wheat : _____ **(atlas 66)**

4. One set of chromosome : haploid
Two set of chromosomes : _____ **(diploid)**

5. Physical mutagen : X - ray

Chemical mutagen : _____ **(mustard gas)**

6. Differentiated cells : pancreatic cells
Undifferentiated cells : _____ **(stem cells)**

7. Inserted DNA fragment : transgene
Genetically modified organism : _____ **(transgenic organisms)**

8. Gene therapy : genetic makeup
Gene cloning : _____ **(carbon copy)**

9. Pureline selection : _____ **(self - breeding)**
Clonal selection : vegetative propagation

10. Mutagenic organism : mutant
Mutagenic agents : _____ **(mutagens)**

11. Insulin : diabetes
Blood clotting factors : _____ **(haemophilia)**

VI. Short Answers:

1. What is plant breeding?
Plant breeding is the art of developing economically important plants with superior quality.

2. What is animal husbandry?
1. Animal husbandry involves the breeding of animals. It aims at improving the genotypes of animals to make them more useful to the welfare of mankind.
2. This emphasizes domestication and propagation of animals, under controlled conditions to enhance food production and food quality.

3. What is the aim of crop improvement?
The aim of crop improvement is to develop improved crop varieties possessing higher yield, better quality, resistance to diseases and shorter duration.

4. What is green revolution?
1. Green revolution is the process of increasing food production through high yielding crop varieties and modern agricultural techniques in under developed and developing nations.
2. Dr.Norman E.Borlaug, an American agronomist is known as the "Father of the Green Revolution".

5. What are the contributions of Dr. M.S. Swaminathan to green revolution?
1. Dr. Mankombu Sambasivan Swaminathan is an Indian Scientist known for his leading role in India's Green Revolution.
2. His research on potato, wheat, rice and jute are well known plant breeding experiments.
3. Due to his efforts the wheat production increased from twelve million tonnes in 1960's to seventy million tonnes now.
4. He is aptly called as the "Father of Indian Green Revolution".

6. Write the role of G. Nammalvar in agriculture.
1. Dr. G.Nammalvar (1938 - 2013) was a Tamil agricultural scientist, environmental acitivist and organic farming expert.
2. He founded Nammalvar Ecological Foundation for Farm Research and Global Food Security Trust (NEFFFRGFST - Vanagam) to create public awareness about the benefits of organic farming.

7. Write some disease resistant crop varieties.

	Crop	Variety	Resistance to diseases
1.	Wheat	Himgiri	leaf and stipe rust, hill bunt
2.	Cauliflower	Pusa Shubhra, Pusa Snowball K - 1	Black rot
3.	Cow pea	Pusa Komal	bacterial blight

8. List out some insects / pests resistant varieties.

	Crop	Variety	Resistance to insects / pests
1.	Brassica	Pusa Gaurav	aphids
2.	Flat Bean	Pusa Sem 2, Pusa Sem 3	leaf hopper, aphids and fruit borer
3.	Lady's finger	Pusa Sawani, Pusa A4	Shoot and fruit borer

9. What are called exotic species?

1. It is a process of introducing high yielding varieties of plants from one place to another.
2. Such plants are called as exotic species.

   E.g: *Phaseolus mungo*

10. Differentiate diploid and haploid.

Diploid	Haploid
Sexually reproducing organisms have two complete set of chromosomes in their somatic cells are called diploid(2n).	The gametic cells have only one set of chromosome is called haploid(n).

11. What are clones?

A group of plants produced from a single plant through vegetative or asexual reproduction are called clones.

12. Define hybridization.

1. Hybridization may be defined as the process of crossing two or more types of plants for bringing their desired characters together into one progeny called hybrid.
2. Hybrid is superior in one or more characters to both parents.

13. What is breed?

A breed is a group of animals of common origin within a species that has certain distinguishing characters that are not found in other members of the same species like general appearance and other striking features.

14. Define breeding.

Breeding involves mating parents of different varieties each having some desired trait which are passed onto the off spring.

15. What are the objectives of animal breeding?

Animal breeding aims at improving the genotypes of domesticated animals to increase their yield and improve the desirable qualities to produce milk, egg and meat.

16. What is meant by heterosis?

The superiority of the hybrid obtained by cross breeding is called as heterosis or hybrid vigour.

17. Write the function of restriction enzymes.

Restriction enzymes recognizes a specific base pair sequence (palindromic sequence) in DNA called as restriction site and cleaves the phosphodiester bond with DNA.

VII. Long Answers:

1. What are stem cells? Explain stem cell therapy and it's types.

1. Stem cells are undifferentiated (or) unspecialized mass of cells. The stem cells are the cells of variable potency.
2. Potency refers to the number of possible fates that a cell can acquire.
3. The two important properties of stem cells that differentiate them from other cells are,
   i. It's ability to divide and give rise to more stem cells by self - renewal.
   ii. It's ability to give rise to specialized cells with specific functions by the process of differentiation.

Types of stem cells:

a. Embryonic stem cells:

1. It can be extracted and cultured from the early embryos.
2. These cells are derived from the inner cell mass of blastocyst.
3. These cells can be developed into any cell in the body.

b. Adult stem cells:

1. Adult stem cells (or) somatic stem cell are found in the neonatal (newborn) and adults.
2. They have the ability to divide and give rise to specific cell types.
3. Sources of adult stem cells are amniotic fluid, umbilical cord and bone marrow.

Stem - cell therapy:

1. Sometimes cells, tissues and organs in the body may be permanently damaged or lost due to genetic condition or disease or injury.
2. In such situations stem cells are used for the treatment of diseases which is called stem - cell therapy.
3. In treating neurodegenerative disorders like Parkinson's disease and Alzheimer's disease, neuronal stem cells can be used to replace the damaged or lost neurons.

2. Write the advantages of genetically modified organisms.

1. One of the most tremendous development of genetic engineering is the production of genetically modified plants and animals.
2. Genetic modification refers to the alteration or manipulation of genes in the organisms using rDNA technique in order to produce the desired characteristics.
3. The DNA fragment inserted is called transgene. Plants or animals expressing a modified endogenous gene or a foreign gene are also known as transgenic organisms.
4. The transgenic plants are much stable with improved nutritional quality, resistant to diseases and tolerant to various environment conditions.
5. Similarly, transgenic animals are used to produce proteins of medicinal importance at low cost and improve livestock quality.

VIII. Fill in the blanks.

1. _____ is the art of developing economically important plants with superior quality. **(Plant breeding)**
2. _____ involves the breeding of animals aims at improving the genotypes of animals to make them more useful to the welfare of mankind. **(Animal husbandry)**
3. Modern agricultural practices are activities carried out to improve _____ of plants. **(cultivation)**
4. The aim of _____ is to develop improved crop varieties. **(crop improvement)**
5. _____ is the process of increasing food production through high yielding crop varieties and modern agricultural techniques. **(Green Revolution)**
6. Dr. M. S. Swaminathan introduced _____ wheat varieties in India. **(Mexican)**
7. Norman E. Borlaug is the Father of the _____ Revolution. **(Green)**
8. Dr. M. S. Swaminathan joined with Dr. Borlaug in bringing _____. **(Green Revolution)**
9. Sonalika, Kalyan Sona are _____ varieties of wheat. **(semi - dwarf)**
10. _____ is a high - yielding semi - dwarf rice variety. **(IR - 8)**
11. _____ was a hybrid of high yielding rice variety from Indonesia and China. **(IR -8)**
12. _____ is called the Father of Indian Green Revolution. **(Dr. M.S. Swaminathan)**
13. _____ is a high yielding rice variety from Indonesia. **(Peta)**
14. Dee – geo – woo – gen a dwarf rice variety from _____. **(China)**
15. _____ was a Tamil agricultural scientist. **(Dr . G. Nammalvar)**
16. _____ to created public awareness about the benefits of organic farming. **(Dr. G. Nammalvar)**
17. The introduction of _____ revolution increased rice and wheat production between 1960 and 2000. **(green)**
18. _____ is the scientific process of developing crop plants enriched with high levels of desirable nutrients. **(Biofortification)**
19. Protina, Shakti and Rathna are _____ rich maize hybrids. **(lysine)**
20. High yielding imported plants are called _____. **(exotic species)**
21. Atlas 66, a protein rich _____ variety. **(wheat)**
22. Vitamin A enriched carrots, pumpkin and spinach are products of _____. **(biofortification)**
23. Process of introducing high yielding varieties of plants from one place to another is _____. **(exotic species)**
24. High yielding imported plants are called _____. **(exotic species)**
25. _____ is one of the oldest methods of plant breedings. **(Selection)**
26. In _____ selection seeds of best plants showing desired characters are collected from a mixed population. **(mass)**
27. Groundnut varieties like TMV – 2 and AK – 10 are example of _____ selection. **(mass)**
28. _____ selection is the progeny of a single individual obtained by self breeding. **(Pureline)**
29. Pureline selection is also called as _____. **(individual plant selection)**
30. _____ is similar both genotypically and phenotypically. **(Progeny)**
31. A group of plants produced from a single plant through vegetative or asexual reproduction are called _____. **(clones)**
32. All the plants of a clone are similar both in _____ and _____. **(genotype, phenotype)**
33. Sexually reproducing organisms have _____ sets of chromosomes. **(two)**
34. The _____ cells have only one set of chromosome. **(gametic)**
35. An organism having more than two sets of chromosomes is called _____. **(polyploid)**
36. Polyploidy be induced by _____ such as heat or cold treatment, X – rays. **(physical agents)**
37. Seedless watermelons (3n) and bananas (3n) are a result of _____. **(polyploidy)**
38. Raphano brassica is an allotetraploid by _____ treatment. **(colchicine)**
39. During selection plants are sorted out based on the _____ characters. **(morphological)**
40. The F_1 hybrid in the hybridization experiment is _____. **(sterile)**
41. _____ is the sudden heritable change in the nucleotide sequence of DNA in an organism. **(Mutation)**
42. The organism which undergoes mutation is called a _____. **(Mutant)**
43. The factors which induce mutations are known as mutagens or _____. **(mutagenic agents)**
44. The utilization of induced mutation in crop improvement is called _____. **(mutation breeding)**
45. _____ rice is saline tolerant. **(Atomita 2)**

46. Groundnut with thick shells are produced through _____. **(mutation breeding)**
47. _____ is the common method of creating genetic variation to get improved varieties. **(Hybridization)**
48. Triticale is obtained by crossing _____ and _____. **(wheat, rye)**
49. The main aspects of hybridization is to combine the characters of _____ plants in one plant. **(two)**
50. A _____ is a group of animals of common origin within a species. **(breed)**
51. _____ involves mating parents of different varieties each having some desired trait. **(Breeding)**
52. α, β and γ - rays are called _____ mutagens. **(physical)**
53. _____ gas is an example of a chemical mutagen. **(mustard)**
54. _____ is the first man made cereal in the hybridization experiment. **(Triticale)**
55. _____ breeding aims at improving the genotypes of domesticated animals to increase their yield. **(Animal)**
56. When breeding takes place between animals of the same breed, it is called _____. **(inbreeding)**
57. _____ is a new breed of sheep developed by crossing Bikaneri (Magra) ewes and Australian Marino rams. **(Hissardale)**
58. Continued _____ reduces fertility and productivity. **(inbreeding)**
59. The offsprings by outbreeding formed by outbreeding are called _____. **(hybrids)**
60. The superiority of the hybrid obtained by cross breeding is called as _____. **(heterosis)**
61. _____ is also called as recombinant DNA technology. **(Genetic engineering)**
62. _____ recoginses a specific base pair sequence in DNA called as restriction site. **(Restriction enzymes)**
63. _____ in bacteria that can undergo replication independently along with chromosomal DNA. **(Plasmid)**
64. _____ cuts or break DNA at specific sites. **(Restriction enzymes)**
65. _____ are the enzymes which help in ligating the broken DNA fragments. **(DNA ligases)**
66. The carbon copy of an individual is called a _____. **(clone)**
67. The transfer of rDNA into bacterial host cell is called _____. **(Transformation)**
68. Restriction enzymes are also called as _____. **(molecular scissors)**
69. _____ was the first cloned female sheep, developed by Dr. Ian Wilmut. **(Dolly)**
70. Dolly was created by somatic cell _____ technique. **(nuclear transfer)**
71. Insulin used in the treatment of diabetes is developed by _____ technique. **(rDNA)**
72. _____ activator is used to dissolve blood clots and prevent heart attack. **(Tissue plasminogen)**
73. _____ refers to the replacement of defective gene by the direct transfer of functional genes into humans. **(Gene therapy)**
74. _____ gene therapy is the replacement of defective gene in somatic cells. **(Somatic)**
75. _____ gene therapy replacement of defective gene in germ cell. **(Germ line)**
76. The stem cells are the cells of variable _____. **(potency)**
77. Pancreatic cells which secrete insulin are called as _____. **(differentiated)**
78. Stems cells are _____ cells. **(undifferentiated)**
79. The genetic difference between two individuals can be compared using _____. **(DNA fingerprinting)**
80. DNA fingerprinting was developed by_____. **(Alec Jeffrey)**
81. _____ refers to the number of possible fates that a cell can acquire. **(Potency)**
82. _____stems cells can be extracted and cultured from the early embryos. **(Embryonic)**
83. _____ cells are derived from the inner cell mass of blastocyst. **(Embryonic stem cells)**
84. Stem cells used for the treatment of diseases is called _____. **(stem - cell therapy)**
85. The human genome has _____ base pairs. **(3 billion)**
86. The 1% of DNA sequence present as small stretch of repeated sequences is known as _____. **(satellite DNA)**
87. The ability of stem cells to give rise to specialized cells with specific functions is called _____. **(differentiation)**
88. _____ stem cells can be used to treat Parkinson's disease. **(Neuronal)**
89. DNA fingerprinting technique is widely used in _____ applications. **(forensic)**
90. Plants or animals expressing a modified endogenous gene are known as _____ organisms. **(transgenic)**
91. _____ is the alteration or manipulation of genes using rDNA techniques. **(Genetic modification)**

21. HEALTH AND DISEASES

I. Choose the correct answer.

1. Tobacco consumption is known to stimulate secretion of adrenaline. The component causing this could be ※※
   a. Nicotine b. Tannic acid c. Cucurmin d. Leptin
   Ans: a. Nicotine

2. World 'No Tobacco Day' is observed on_____. **(JUNE - 2023, PTA - I, SEP - 22)**
   a. May 31 b. June 6 c. April 22 d. October 2
   Ans: a. May 31

3. Cancer cells are more easily damaged by radiations than normal cells because they are ※※
   a. Different in structure b. Non - dividing
   c. Mutated Cells d. undergoing rapid division
   Ans: d. undergoing rapid division

4. Which type of cancer affects lymph nodes and spleen? ※※
   a. Carcinoma b. Sarcoma c. Leukemia d. Lymphoma
   Ans: d. Lymphoma

5. Excessive consumption of alcohol leads to ※ **(GMQ - 2019)**
   a. Loss of memory b. Cirrhosis of liver
   c. State of hallucination d. Supression of brain function
   Ans: b. Cirrhosis of liver

6. Coronary heart disease is due to
   a. Streptococci bacteria b. Inflammation of pericardium
   c. Weakening of heart valves d. Insufficient blood supply to heart muscles
   Ans: d. Insufficient blood supply to heart muscles

7. Cancer of the epithelial cells is called **(APRIL - 2024, PTA - VI)**
   a. Leukemia b. Sarcoma c. Carcinoma d. Lipoma
   Ans: c. Carcinoma

8. Metastasis is associated with **(JULY - 2024)**
   a. Malignant tumour b. Benign tumour
   c. Both (a) and (b) d. Crown gall tumour
   Ans: a. Malignant tumour

9. Polyphagia is a condition seen in
   a. Obesity b. Diabetes mellitus
   c. Diabetes insipidus d. AIDS **Ans: b. Diabetes mellitus**

10. Where does alcohol effect immediately after drinking? ※※
    a. Eyes b. Auditory region
    c. Liver d. Central nervous system
    Ans: d. Central nervous system

II. State weather True or False, if false write the correct statement.

1. AIDS is an epidemic disease. ※※
   Ans: False
   AIDS is an **pandemic** disease.
   (Hint: Epidemic – Spread across a particular region
   Pandemic – Spread worldwide)

2. Cancer causing genes are called Oncogenes. ※※
   Ans: True

3. Obesity is characterized by tumour formation.
   Ans: False
   Cancer is characterized by tumour formation.

4. In leukemia both WBCs and RBCs increase in number.
   Ans: False
   In leukemia **only** WBCs increase in number.

5. Study of cause of disease is called etiology.
   Ans: True

6. AIDS is not transmitted by contact with a patient's clothes.
   Ans: True

7. Type2 diabetes mellitus results due to insulin deficiency. ※※
   Ans: False
   Type1 diabetes mellitus results due to insulin deficiency.

8. Carcinogens are cancer causing agents.
   Ans: True

9. Nicotine is a narcotic drug.
   Ans: False
   Nicotine is an **addictive** drug.

10. Cirrhosis is associated with brain disorder.
    Ans: False
    Cirrhosis is associated with **liver** disorder.

III. Expand the following abbreviations. ※※※

1. IDDM - Insulin Dependent Diabetes Mellitus
2. HIV - Human Immunodeficiency Virus
3. BMI - Body Mass Index
4. AIDS - Acquired Immuno Deficiency Syndrome
5. CHD - Coronary Heart Disease
6. NIDDM - Non - Insulin Dependent Diabetes Mellitus

IV. Match the following. (APR - 2023)

	Column - I			Column - II			Answers
1.	Sarcoma	-	a.	stomach cancer	-	e.	**connective tissue cancer**
2.	Carcinoma	-	b.	excessive thirst	-	a.	**stomach cancer**
3.	Polydipsia	-	c.	excessive hunger	-	b.	**excessive thirst**
4.	Polyphagia	-	d.	lack of blood flow to heart muscle	-	c.	**excessive hunger**
5.	Myocardial Infarction	-	e.	connective tissue cancer	-	d.	**lack of blood flow to heart muscle**

V. Fill in the blanks. ※※

1. Cirrhosis is caused in liver due to excessive use of _____. **Ans: alcohol**
2. A highly poisonous chemicals derived from tobacco is _____. **Ans: nicotine**
3. Blood cancer is called _____. ※※ **(PTA - IV)** **Ans: leukaemia**
4. Less response of a drug to a specific dose with repeated use is called _____. ※※ **Ans: drug tolerance**
5. Insulin resistance is a condition in _____ diabetes mellitus. **Ans: Type 2**

VI. Analogy type questions. Identify the first words and their relationship and suggest a suitable word for the fourth blank.

1. Communicable : AIDS
   Non communicable : _____ **(Cancer)**
2. Chemotherapy : Chemicals
   Radiation therapy : _____ **(radiation)**
3. Hypertension : Hypercholesterolomia
   Glycosuria : _____ **(Hyperglycemia)**

VII. Answer in a sentence.

1. What are psychotropic drugs? (PTA - II)

Psychotropic drugs act on the brain and alter the behaviour, consciousness, power of thinking and perception.

2. Mention the diseases caused by tobacco smoke. ※※

1. Lungs and oral cancer
2. Bronchitis
3. Pulmonary tuberculosis
4. Emphysema
5. Hypoxia
6. Heart diseases
7. Gastric and Duodenal ulcers

3. What are the contributing factors for Obesity? (PTA - V, SEP - 21 & 22)

Obesity is due to, ※※

1. Genetic factors
2. Physical inactivity
3. Overeating
4. Endocrine factors

4. What is adult onset diabetes?

Type - 2 Non - Insulin Dependent Diabetes Mellitus is also called adult onset diabetes.

5. What is metastasis? ※※ (APRIL - 2024)

1. The cancerous cells migrate to distant parts of the body and affect new tissues.
2. This process is called metastasis.

6. How does insulin deficiency occur? ※※

Insulin deficiency occurs due to the destruction of β- cells in the pancreas.

VIII. Short answer questions.

1. What are the various routes by which transmission of human immunodeficiency virus takes place? ※※ (JUNE - 2023, PTA - I)

1. **Sexual contact** with infected person.
2. Use of **contaminated needles** or syringes especially in case of intravenous drug abusers.
3. By transfusion of **contaminated** / infected **blood** or blood products.
4. From infected **mother to** her **child** through placenta.

2. How is a cancer cell different from a normal cell? ※※ (PTA - IV, SEP - 2021)

	Cancer cell	Normal cell
1.	Cancer is an **abnormal** and **uncontrolled division** of cells	It is a **normal** and **controlled** division of cells.
2.	They invade and destroy surrounding tissue forming a tumor or **neoplasm**	They **do not invade** and **destroy** the surrounding tissue.
3.	It is a **heterogenous** group of cells that do not respond to normal cell division.	They **respond** to normal cell division.

3. Differentiate between Type - 1 and Type - 2 Diabetes mellitus.

(APRIL - 2024, PTA - IV)

	Factors	Type - 1 Insulin dependent diabetes mellitus (IDDM)	Type - 2 Non - Insulin dependent diabetes mellitus (NIDDM)
1.	Prevalence	10 - 20%	80 - 90%
2.	Age of onset	Juvenile onset (< 20 years)	Maturity onset (> 30 years)
3.	Body weight	Normal or underweight	Obese
4.	Defect	Insulin deficiency due to destruction of β cells	Target cells do respond to insulin
5.	Treatment	Insulin administration is necessary	Can be controlled by diet, exercise and medicine

4. Why is a dietary restriction recommended for an obese individual?

1. Low calorie, normal protein, vitamins and mineral, restricted carbohydrate and fat, high fiber diet can prevent overweight.
2. Calorie restriction for weight reduction is safe and most effective.

(SEP - 2020, GMQ - 2019)

5. What precautions can be taken for preventing heart diseases?

1. Reduction in the intake of calories, low saturated fat, cholesterol rich food, low carbohydrates and common salt.
2. Increase in the intake of fibre rich diet, fruits, vegetables, protein, minerals and vitamins.
3. Regular exercise, walking and yoga.
4. Avoid Alcohol consumption and smoking.

IX. Long answer questions.

1. Suggest measures to overcome the problems of an alcoholic.

Education and counselling: **(SEP - 21, MAY - 22)**

Education and proper counselling will help the alcoholics to overcome their problems and stress, to accept failures in their life.

Physical activity:

Individuals undergoing rehabilitation should be channelized into healthy activities like reading, music, sports, yoga and meditation.

Seeking help from parents and peer groups:

1. When a problematic situation occurs, the affected individuals should seek help and guidance from parents and peers.
2. It would help them to share their feeling of anxiety, wrong doing and get rid of the habit.

Medical assistance:

1. Individual should seek help from psychologists and psychiatrists to get relieved from this condition and to lead a relaxed and peaceful life.
2. Alcohol de - addiction and rehabilitation programmes are helpful to the individual so that they could get rid of the problem completely and can lead a normal and healthy life.

2. Changes in lifestyle is a risk factor for occurrence of cardiovascular diseases. Can it be modified? If yes, suggest measures for prevention.

Yes, changes in lifestyle can modify the occurrence of cardiovascular diseases.

Measures for prevention of cardiovascular disease:

Diet management:

1. Reduction in the intake of calories, low saturated fat and cholesterol rich food, low carbohydrates and common salt are some of the dietary modifications.
2. Diet rich in polyunsaturated fatty acids (PUFA) is essential.
3. Increase in the intake of fibre diet, fruits and vegetables, protein, minerals and vitamin are required.

Physical activity:

Regular exercise, walking and yoga are essential for body weight maintenance.

Addictive substance avoidance:

Alcohol consumption and smoking are to be avoided.

X. Higher Order Thinking Skills (HOTS).

1. What is the role of fat in the cause of atherosclerosis? **(PTA - III)**

1. Atherosclerosis is caused by deposition of fat (cholesterol) in the blood vessels.

2. It usually develops slowly over many years beginning from childhood, they may form a fatty streak to a fibrous complicated plaque.
3. It leads to the narrowing of blood vessels.

2. Eating junk food and consuming soft drinks results in health problems like obesity, still children prefer. What are the suggestions you would give to avoid children eating junk food/ consumption of soft drinks?

1. Planning your meals.
2. Eating small portions frequently.
3. Improving the selection of food for each meal.
4. Calculating the calorific value of each meal.
5. Opting traditional and homemade snacks with high nutritional value.
6. Avoid junk food in grocery stores.
7. Substituting soft drinks with fresh fruit juices.
8. Increasing the intake of sprouts, pulses and cereals as snacks.
9. Eating multicolour dishes.

3. Regular physical exercise is advisable for normal functioning of human body. What are the advantages of practising exercise in daily life? (PTA - VI)

1. Regular physical exercise increases muscle size, strength and endurance.
2. It is also essential to prevent obesity.
3. Due to regular exercise, blood supply to muscle increases.
4. It results in the increased supply of oxygen.
5. Further exercises make body metabolism more efficient, improve digestion and enhance neuro muscular co - ordination.

4. A leading weekly magazine has recently published a survey analysis which says that number of AIDS patient in the country is increasing day by day. The report says that the awareness among the people about AIDS is still very poor. You are discussing the magazine report in your class and a team of your class decides to help people to fight against the dreadful disease.

a. What problem you face when trying to educate the people in your village near by your school?

1. Conducting awareness program about AIDS by school children, will not be easily accepted by some adults.
2. Village women feel shy and embarrassed to hear information about proper sexual contact.

3. School children feel difficult in advocating safe sex and advantages of using condoms.

b. How do you overcome the problem?

School children should be accompanied by their guide teachers or health officers, nurses, to advocate the village people about safe sex for avoiding HIV infections and AIDS.

XI. Value based questions.

1. Once a person starts taking drugs or alcohol it is difficult to get rid of the habit. Why?

1. Once a person starts taking alcohol or drugs, he becomes addicted to these substances physically and mentally.
2. Whenever he tries to get rid of this habit, he shows unpleasant 'withdrawal symptoms' and these include vomiting, diarrhea, shivering, twitching, perspiration, abdominal and muscular cramps etc.,
3. So, it becomes difficult for a person to get rid of this habit.

2. Men addicted to tobacco lead to oxygen deficiency in their body. What could be the possible reason?

1. Inflammation of lung alveoli, decreases the surface area for gaseous exchange and cause **emphysema**.
2. **Carbon monoxide** of tobacco smoke binds the haemoglobin of RBC, and decrease its oxygen carrying capacity causing **hypoxia** in body tissue.
3. This is the reason for oxygen deficiency in tobacco addicted men.

3. Name any three foods that are to be avoided and included in the diet of a diabetic patient. Why should it be followed?

Avoided:

1. Refined sugars (sucrose and glucose)
2. Saturated fats
3. Junk foods

Foods to be included:

1. Low carbohydrate and fibre rich diet.
2. Whole grains, millets
3. Green leafy vegetables, wheat and unpolished rice.

Reason: The above mentioned foods to be included should be followed to maintain a healthy blood glucose level in a diabetic patient. **(PTA - V)**

4. How can informational efforts change people's HIV knowledge and behaviour?

Informational efforts in people have resulted in the following changes,

1. Screening of blood from blood banks for HIV before transfusion.
2. Ensuring the use of disposable needles and syringes in hospitals and clinics.
3. Advocating safe sex and advantages of using condoms.

XII. Assertion and reason.

1. **Assertion:** All drugs act on the brain.

   Reason : Drugs disturb the functioning of the body and mind.

   a. If both Assertion and Reason are true and Reason is the correct explanation of Assertion
   b. If both Assertion and Reason are true that Reason is not the correct explanation of Assertion
   c. Assertion is true but Reason is false
   d. Both Assertion and Reason are false

   Ans: a. If both Assertion and Reason are true and Reason is the correct explanation of Assertion

2. **Assertion:** Excretion of excess glucose in urine is observed in a person with diabetes mellitus.

   Reason : Pancreas is unable to produce sufficient quantity of insulin.

   a. If both Assertion and Reason are true and Reason is the correct explanation of Assertion
   b. If both Assertion and Reason are true that Reason is not the correct explanation of Assertion
   c. Assertion is true but Reason is false
   d. Both Assertion and Reason are false

   Ans: a. If both Assertion and Reason are true and Reason is the correct explanation of Assertion

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Choose the correct answer.

1. Select the odd one from the following about Diabetes mellitus. **(PTA - 3)**
   a. Prevalence 10% - 20% b. Juvenile onset
   c. Underweight d. Obese **Ans: d. Obese**

II. Long answers.

1. **Mention any two approaches for protection of an Abused child. (SEP - 2020)**

Measures adopted for monitoring and assessment of abused child who have undergone signs and symptoms of distress are,

I. Child helpline:
The Child Helpline provides a social worker who can assist the child by providing food, shelter and protection.

II. Counselling the child:
Psychologists and social workers should provide guidance, counselling and continuous support to victimized child.

2. **Explain smoking hazards and the harmful effects of tobacco. (APR - 2023)**

When smoke is inhaled, the chemicals get absorbed by the tissues and cause the following harmful effects.

1. **Benzopyrene** and **polycyclic hydrocarbons** present in tobacco smoke is carcinogenic causing lung cancer.
2. Causes inflammation of throat and bronchi leading to conditions like **bronchitis** and **pulmonary tuberculosis.**
3. Inflammation of lung alveoli, decrease surface area for gas exchange and cause **emphysema**.
4. **Carbon monoxide** of tobacco smoke binds to haemoglobin of RBC and decreases its oxygen carrying capacity causing **hypoxia** in body tissues.
5. **Increased blood pressure** caused by smoking leads to increased risk of heart disease.
6. Causes **increased gastric secretion** which leads to gastric and duodenal ulcers.
7. Tobacco chewing causes **oral cancer** (mouth cancer).

ADDITIONAL QUESTIONS

I. Match the following:

	Column - I		Column - II		Answers
1.	Benzopyrene	- a.	hypoxia	- e.	**lung cancer**
2.	Carbon monoxide	- b.	endocrine disorder	- a.	**hypoxia**
3.	Diabetes	- c.	insulin deficient	- b.	**endocrine disorder**
4.	Type 1 diabetes	- d.	no response to insulin	- c.	**insulin deficient**
5.	Type 2 diabetes	- e.	lung cancer	- d.	**no response to insulin**

	Column - I		Column - II		Answers
1.	Tobacco	- a.	Drug dependence	- b.	**Nicotine**
2.	Psychotropic drugs	- b.	Nicotine	- d.	**mood altering**
3.	POCSO	- c.	Inviolability of child right	- e.	**sexual assault**
4.	CPCR	- d.	mood altering	- c.	**Inviolability of child right**
5.	WHO	- e.	sexual assault	- a.	**Drug dependence**

II. Choose the correct answer:

1. Increased urine output is called _____.
   a. Glycosuria b. Polyphagia c. Polyuria d. Polydipsia
   Ans: c. Polyuria

2. _____ is the most common pancreatic endocrine disorder.
   a. Cancer b. Obesity c. Diabetes mellitus d. AIDS
   Ans: c. Diabetes mellitus

3. Benign tumors are _____ tumors.
   a. malignant b. non - malignant
   c. none of the above d. both a & b **Ans: b. non - malignant**

4. The tumor formed from cancer cells is called _____.

a. carcinogen b. oncology c. neoplasm d. oncogenic
Ans: c. neoplasm

5. Carbon monoxide of tobacco smoke causes _____.
a. cancer b. lung cancer c. hypoxia d. emphysema
Ans: c. hypoxia

6. Psychotropic drugs are called _____ drugs.
a. narcotic b. mood altering
c. addictive d. none of the above **Ans: b. mood altering**

7. The ministry of Women and Child Development championed the introduction of the _____ Act in 2012.
a. NCPCR b. CPCR c. POCSO d. WHO **Ans: c. POCSO**

8. Diabetes mellitus is a _____ disorder.
a. genetic b. sexually transmitted
c. chronic - metabolic d. none of the above **Ans: c. chronic - metabolic**

9. The prevalence of Type 1 diabetes is _____.
a. 1 - 2% b. 10 - 25 % c. 80 - 90 % d. 10 - 20% **Ans: d. 10 - 20%**

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

1. Mental dependence is a feel that drugs help them to reduce stress.
Ans: False
Psychological dependence is a feel that drugs help them to reduce stress.

2. Inflammation of lung alveoli, decrease surface area for gas exchange and cause hypoxia.
Ans: False
Inflammation of lung alveoli, decrease surface area for gas exchange and cause **emphysema**.

3. Increased blood glucose level causes hyperglycemia. **Ans: True**

4. Over weight and obesity are conditions where the body weight is lesser than the mean standard weight for age and height of an individual.
Ans: False
Over weight and obesity are conditions where the body weight is **greater** than the mean standard weight for age and height of an individual.

5. Deficient blood supply to heart muscle is myocardial infarction.
Ans: False
Deficient blood supply to heart muscle is **ischemia**.

IV. Analog

1. Type - 1 IDDM : children
Type - 2 NIDDM : _____ **(adults)**

2. Increased urine output : polyuria
Excess thirst : _____ **(polydipsia)**

3. Increased blood glucose level : hyperglycemia
High blood cholesterol : _____ **(hypercholesterolemia)**

4. High density lipoprotein in : good cholesterol
Low density lipoprotein in : _____ **(bad cholesterol)**

5. World cancer day : 4th February

National cancer awareness day : _____ **(7th November)**

6. Carcinoma : skin cancer
Connective tissue cancer : _____ **(sarcoma)**

7. Physical irritant : lung cancer
Chemical agent : _____ **(Nicotine)**

8. National AIDS control organization : NACO
Non - Government organization : _____ **(NGO's)**

9. Immunotherapy : immune system
Psychotherapy : _____ **(rest and relaxation)**

V. Assertion and Reason.

1. **Assertion:** Carbon monoxide of tobacco smoke binds to haemoglobin of RBC and decreases its oxygen carrying capacity causing hypoxia in body tissue.
Reason : Increased blood pressure caused by smoking leads to increased risk of heart disease.
a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explains A.
Ans: d. A and R are correct, R doesn't explain A

2. **Assertion:** Increased blood glucose level polyuria.
Reason : Excessive glucose excreted in urine glycosuria.
a. A and R are correct, R explains A. b. A is correct, R is wrong.
c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
Ans: c. A is wrong, R is correct

VI. Short Answers:

1. **Define drug abuse.**
A person who is habituated to a drug due to its prolonged use is called drug addict.

2. **Write any two behavioural changes of drug users.**
1. Change in food and sleeping habits.
2. Fluctuation in body weight and appetite.

3. **Define obesity.**
1. Obesity is the state in which there is an accumulation of excess body fat with an abnormal increase in body weight.
2. Obesity is a complex multifactorial chronic disease developing from influence of social, behavioural, psychological, metabolic and cellular factors.

4. **Differentiate carcinomas and sarcomas.**

	Carcinomas	Sarcomas
1.	Arise from epithelial and glandular tissue.	Arise from connective and muscular tissue.
2.	They include cancers of skin, lung, stomach and brain.	They include the cancer of bones, cartilage, tendons, adipose tissue and muscles.
3.	About 85% of the tumours are carcinomas.	These form 1% of all tumours.

5. Mention the preventive measures for cancer.

1. Cancer control programme should focus on primary prevention and early detection.
2. To prevent lung cancer tobacco smoking is to be avoided and protective measures to be taken against exposure to toxic pollutants of industries.
3. Excessive exposure to radiation is to be avoided to prevent skin cancer.

6. How can AIDS be diagnosed.

The presence of HIV virus can be confirmed by Western Blot analysis or Enzyme Linked Immunosorbent Assay (ELISA).

VII. Long Answers:

1. List out the preventive measures for child sexual abuse.

1. Do not talk to any suspected person or strangers and to maintain a distance.
2. Not to be alone with unknown person.
3. Be careful while travelling alone in public or private transport.
4. Not to receive money, toys, gifts or chocolates from known or unknown person to them without the knowledge of their parents.
5. Not to allow known or unknown person to touch them.

2. Explain briefly about the treatment of cancer.

Surgery: Tumours are removed by surgery to prevent further spread of cancer cells.

Radiation therapy: Tumour cells are irradiated by lethal doses of radiation while protecting the surrounding normal cells.

Chemotherapy: It involves administration of anticancerous drugs which prevent cell division and are used to kill cancer cells.

Immunotherapy: Biological response modifiers like interferons are used to activate the immune system and help in destroying the tumors.

VIII. Fill in the blanks.

1. _____ refers to cruel, violent, harmful or injurious treatment of another human being. **(Abuse)**
2. _____ is a form of power and dominance of one person over another. **(Sexual harassment)**
3. _____ refers to inappropriate or forced sexual contact. **(Sexual Abuse)**
4. _____ abuse is more common at work places. **(Sexual)**
5. _____ are considered soft targets for sexual abuse. **(Children)**
6. The _____ provides a social worker who can assist the child by providing food, shelter and protection. **(child helpline)**
7. A child victim of sexual offences should receive medical care and treatment from health care professionals to overcome mental stress and _____. **(depression)**
8. The National Commission for Protection of Child Rights (NCPCR) was set up in _____. **(March 2007)**
9. Protection of all children of all age group upto _____ years of age is of equal importance. **(18)**
10. The physical and mental dependency on alcohol, smoking and drugs is called _____. **(addiction)**
11. The addictive potential of substances pulls an individual into a _____ cycle. **(vicious)**
12. A person who is habituated to a drug due to its prolonged use is called _____. **(drug addict)**
13. A drug that modifies the physical, biological, psychological or social behaviour of a person is called _____ drug. **(addictive)**
14. International Day against Drug Abuse and Illicit Trafficking is on _____. **(June 26)**
15. Narcotic Drugs and Psychotropic Substances Act was introduced in _____. **(1985)**
16. _____ drugs interact with the central nervous system and affect an individual. **(Addictive)**
17. Drugs which act on the brain and alter behaviour are called _____ drugs. **(psychotropic)**
18. Psychotropic drugs are referred as _____ drugs. **(mood altering)**

19. Addiction to tobacco is due to _____ an alkaloid present in it. **(nicotine)**
20. _____ and _____ present in tobacco smoke is carcinogenic causing lung cancer. **(Benzopyene, polycyclic hydrocarbons)**
21. Tobacco causes inflammation of throat and bronchi leading to conditions like _____ and _____. **(bronchitis, pulmonary tuberculosis)**
22. _____ of tobacco smoke binds to haemoglobin of RBC and decreases its oxygen carrying capacity. **(Carbon monoxide)**
23. Tobacco chewing causes _____ cancer. **(oral)**
24. Anti -Tobacco Act was passed on _____ 2004. **(May 1st)**
25. The dependence of alcohol is called _____. **(alcoholism)**
26. _____ Abuse causes lack of co - ordination of body organs. **(Alcohol)**
27. Liver damage resulting in fatty liver which leads to ___ and formation of fibrous tissues. **(cirrhosis)**
28. Diabetes mellitus is a _____ disorder. **(chronic metabolic)**
29. Type- 1 diabetes is caused by the destruction of _____ in the pancreas. **(β cells)**
30. Type - 2 diabetes is also called as _____. **(adult onset diabetes)**
31. _____ sugars should be avoided by a diabetic. **(Refined)**
32. _____ plays an important role in facilitating a good control of diabetes. **(Exercise)**
33. _____ is the state in which there is an accumulation of excess body fat with an abnormal increase in body weight. **(Obesity)**
34. An adult weighing more than _____ % of the standard weight is overweight. **(10)**
35. An adult weighing more than _____ % of the standard weight is obese. **(20)**
36. _____ for weight reduction is safe and most effective. **(Calorie restriction)**
37. A low calorie diet accompanied by moderate exercise will be effective in causing _____. **(weight loss)**
38. _____ disease (CVD) is associated with diseases of the heart and blood vessels. **(Cardiovascular)**
39. _____ disease is caused by deposition of cholesterol in the blood vessels. **(Coronary heart)**
40. The narrowing of blood vessels in to heart leads to _____. **(atherosclerosis)**
41. Desirable level for blood cholesterol should be less than _____ mg/dl for Indians. **(200)**
42. The risk of coronary heart disease increases as blood cholesterol levels increases from _____ mg/dl. **(200 to 300)**
43. _____ or _____ cholesterol lowers risk of heart disease. **(HDL, good)**
44. _____ or _____ cholesterol increases risk of heart disease. **(LDL, bad)**
45. _____ is the deficient blood supply to the heart muscles. **(Ischemia)**
46. _____ is the death of the heart muscle tissue. **(Myocardial infarction)**
47. _____ is the most common type of cancer which affect children below 15 years of age. **(Leukaemia)**
48. The study of cancer is called _____. **(Oncology)**
49. Cancer is an abnormal and uncontrolled division of cells that invade and destroy surrounding tissue forming a tumour or _____. **(neoplasm)**
50. Carcinomas arise from epithelial and _____ tissues. **(glandular)**
51. About 85% of the tumours are _____. **(carcinomas)**
52. _____ occurs in the connective and muscular tissues. **(sarcomas)**
53. ___ tumours grow very rapidly invading and damaging the surrounding normal tissues. **(Malignant)**
54. _____ are characterized by an increase in the formation of white blood cells in the bone marrow and lymph nodes. **(Leukemia)**
55. Leukaemia are called _____ cancers. **(blood)**
56. Cancer causing agents are called _____. **(carcinogens)**
57. Betel and tobacco chewing causes _____ cancer. **(oral)**
58. Excessive exposure to sunlight may cause _____ cancer. **(skin)**
59. Cancer causing viruses are called _____ viruses. **(oncogenic)**
60. Tumour cells are irradiated by lethal doses of _____. **(radiation)**
61. _____ involves administration of anticancerous drugs which prevent cell division. **(Chemotherapy)**
62. The migration of cancer cells to distant parts of the body is called _____. **(metastasis)**
63. To prevent _____ cancer tobacco smoking must be avoided. **(lung)**
64. AIDS is a severe viral disease and caused by _____. **(Human Immunodeficiency Virus)**

22. ENVIRONMENTAL MANAGEMENT

I. Fill in the blanks.

1. Deforestation leads to _____ in rainfall. **Ans: decrease**
2. Removal of soil particles from the land is called _____. **Ans: soil erosion**
3. Chipko movement is initiated against _____. ※ **Ans: deforestation**
4. _____ is a biosphere reserve in Tamilnadu. **Ans: Nilgiris**
5. Tidal energy is _____ type of energy. **Ans: renewable**
6. Coal, petroleum and natural gas are called _____ fuels. **Ans: fossil**
7. _____ is the most commonly used fuel for the production of electricity. ※※ **Ans: Coal**

II. State whether True or False. Correct the statements which are false.

1. Biogas is a fossil fuel. ※※
   Ans: False
   Petroleum is a fossil fuel.
2. Planting trees increases the groundwater level.
   Ans: True
3. Habitat destruction cause loss of wild life.
   Ans: True
4. Nuclear energy is a renewable energy. ※※
   Ans: False
   Nuclear energy is a **non renewable** energy
5. Overgrazing prevents soil erosion.
   Ans: False
   Overgrazing **results** in soil erosion.
6. Poaching of wild animals is a legal act.
   Ans: False
   Poaching of wild animals is an **illegal** act
7. National park is a protected park.
   Ans: True
8. Wild life protection act was established in 1972.
   Ans: True

III. Match the following.

	Column - I			Column - II			Answers
1.	Soil erosion	-	a.	energy saving	-	c.	**removal of vegetation**
2.	Bio gas	-	b.	acid rain	-	e.	**CO_2**
3.	Natural gas	-	c.	removal of vegetation	-	f.	**non - renewable energy**

4.	Green house gas	-	d.	renewable energy	-	b.	**acid rain**
5.	CFL bulbs	-	e.	CO_2	-	a.	**energy saving**
6.	Wind	-	f.	non - renewable energy	-	d.	**renewable energy**
7.	Solid waste	-	g.	lead and heavy metals	-	g.	**lead and heavy metals**

IV. Choose the correct answer.

1. Which of the following is / are a fossil fuel? **(JUNE - 2023, PTA - V, SEP - 2022)**
   i. Tar ii. Coal iii. Petroleum
   a. i. only b. i. and ii. c. ii. and iii. d. i. ii. and iii.
   Ans: c. ii. and iii
2. What are the steps will you adopt for better waste management?
   a. reduce the amount of waste formed b. reuse the waste
   c. recycle the waste d. all of the above
   Ans: d. all of the above
3. The gas released from vehicles exhaust are ※※
   i. Carbon monoxide ii. Sulphur dioxide
   iii. Oxides of nitrogen
   a. i. and ii. b. i. and iii. c. ii. And iii. d. i. ii. and iii.
   Ans: d. i. ii. and iii
4. Soil erosion can be prevented by
   a. deforestation b. afforestation
   c. over growing d. removal of vegetation **Ans: b. afforestation**
5. A renewable source of energy is **(JULY - 2024)**
   a. petroleum b. coal c. nuclear fuel d. trees **Ans: d. trees**
6. Soil erosion is more where there is
   a. no rainfall b. low rainfall
   c. rainfall is high d. none of these **Ans: c. rainfall is high**
7. An inexhaustible resources is
   a. wind power b. soil fertility
   c. wild life d. all of the above **Ans: a. wind power**
8. Common energy source in village is
   a. electricity b. coal
   c. biogas d. wood and animal dung **Ans: d. wood and animal dung**
9. Green house effect refers to ※※
   a. cooling of earth b. trapping of UV rays
   c. cultivation of plants d. warming of earth
   Ans: d. warming of earth

10. A cheap, conventional, commercial and inexhaustible source of energy is **(PTA - II)**
    a. hydropower b. solar energy
    c. wind energy d. thermal energy **Ans: a. hydropower**
    (Note: Wind energy is not cheap as the cost of establishment is very high. Hydro power is the cheapest and widely used source of energy.)

11. Global warming will cause
    a. raise in level of oceans b. melting of glaciers
    c. sinking of islands d. all of these **Ans: d. all of these**

12. Which of the following statement is wrong with respect to wind energy
    a. wind energy is a renewable energy
    b. the blades of wind mill are operated with the help of electric motor
    c. production of wind energy is pollution free
    d. usage of wind energy can reduce the consumption of fossil fuels
    Ans: b. the blades of wind mill are operated with the help of electric motor

V. Answer in a sentence.

1. What will happen if trees are cut down?

Cutting down of trees (deforestation) gives rise to ecological problems like floods, drought, soil erosion, loss of wild life, extinction of species, imbalance of biogeochemical cycles, alteration of climatic conditions and desertification.

2. What would happen if the habitat of wild animals is disturbed? ※※

1. Exploitation and shrinking of forest covered areas has resulted in animals becoming extinct, threatened and are on the verge of extinction.
2. Further, animals **approach human settlements** in search of food and water and also **attack human life**.

3. What are the agents of soil erosion? (JULY - 2024, PTA - II) ※※※

1. High velocity of wind 3
2. Air currents 4
3. Flowing water 2
4. Landslide 5
5. Human activities (deforestation, farming and mining) 6
6. Overgrazing by cattle. 1

4. Why fossil fuels are to be conserved? (PTA - IV, SEP - 2022)

1. The coal and petroleum reserves can get exhausted if we continue using them at a rapid rate.
2. The formation of these fossil fuels is a **very slow process** and takes a very long period of time for **renewal**.

Solar energy is available in nature and it can be renewed continuously. Thus, solar energy is a renewable energy.

5. Solar energy is a renewable energy. How? ※※

1. Because the sun gives out vast amount of light and heat.
2. These energy resources are available in unlimited amount in nature and they can be renewed over a short period of time.

6. How are e - wastes generated? (PTA - VI, SEP - 2021)

1. E - wastes are generally called as electronic wastes.
2. They are generated through spoiled, out dated, non - repairable electrical and electronic devices.

VI. Short answer questions.

1. What is the importance of rainwater harvesting? (JU - 23, PTA - IV, MAY - 22)

Rain water harvesting helps to, ※※※

1. Overcome the rapid depletion of **ground water levels**.
2. To meet the increase **demand** of water.
3. **Reduces flood** and **soil erosion**.
4. Water stored in ground is not contaminated by human and animal wastes and hence can be used for **drinking purpose**.

2. What are the advantages of using biogas? (PTA - I)

1. It burns without smoke and therefore causes **less pollution**.
2. An excellent way to get rid of organic wastes like **bio - waste** and **sewage material**.
3. Left over slurry is good manure rich in **nitrogen** and **phosphorus**.
4. It is safe and **convenient** to use.
5. It can **reduce** the amount of **greenhouse gases** emitted.

3. What are the environmental effects caused by sewage?

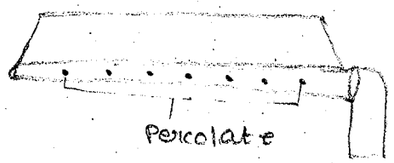
1. Untreated sewage or wastewater generated from domestic and industrial process is the **leading polluter** of water sources in India.
2. Sewage water results in **agricultural contamination** and **environmental degradation**.

What are the consequences of deforestation? **(APRIL - 2024)**

Deforestation gives rise to ecological problems like,

1. Floods
2. Drought
3. Soil erosion
4. Loss of wild life
5. Extinction of species
6. Imbalance of biogeochemical cycles
7. Alteration of climatic conditions
8. Desertification.

Percolate – to move gradually through a surface that has very small holes or spaces in it.



VII. Long answer questions. ※※※ (APR - 2023, SEP-21)

1. How does rainwater harvesting structures recharge ground water?

The main purpose of rainwater harvesting is to make the rainwater percolate under the ground so as to recharge 'ground water level'.

Methods of rainwater harvesting:

I. Roof top rainwater harvesting:

1. Roof tops are excellent rain catchers.
2. The rain water that falls on the roof of the houses, apartments, commercial buildings etc., is collected and stored in the surface tank and can be used for domestic purpose.

II. Recharge pit:

1. In this method, the rainwater is first collected from the roof tops or open spaces and is directed into the percolation pits through pipes for filtration.
2. After filtration the rainwater enters the recharge pits or ground wells.

Some of the methods used in rural areas are:

i. Digging of tanks or lakes (Eris):

1. It is one of the traditional water harvesting system in Tamilnadu.
2. Eris are constructed in such a way that if the water in one eri overflows, it automatically gets diverted to the eri of the next village, as these eris are interconnected.

ii. Ooranis:

1. These are small ponds to collect rainwater.
2. The water is used for various domestic purpose (drinking, washing and bathing).
3. These ponds cater the nearby villages.

2. How will you prevent soil erosion? **(PTA - III)**

1. Retain vegetation cover, so that soil is not exposed.
2. Cattle grazing should be controlled.
3. Crop rotation and soil management improve soil organic matter.
4. Runoff water should be stored in the catchment.
5. Reforestation, terracing and contour ploughing.
6. Wind speed can be controlled by planting trees in form of a shelter belt.

3. What are the sources of solid wastes? How are solid wastes managed?

Sources of solid wastes:

1. Municipal wastes
2. Hospital wastes
3. Industrial wastes
4. E - wastes

Solid waste management:

Solid - waste management involves the **collection**, **treatment** and **proper disposing** of solid material that is discarded from the household and industrial activities.

Methods of solid wastes disposal:

i. Segregation:
It is the separation of different type of waste materials like **biodegradable** and **non biodegradable wastes.**

ii. Sanitary landfill:

1. Solid wastes are dumped into **low lying areas.**
2. The layers are **compacted** by trucks to allow settlement.
3. The waste materials get stabilized in about **2 - 12months.**
4. The organic matter undergoes **decomposition.**

iii. **Incineration:**

It is the **burning** of **non - biodegradable** solid wastes (medical wastes) in properly constructed furnace at high temperature.

iv. **Composting:**

Biodegradable matter of solid wastes is digested by microbial action or earthworms and converted into **humus**.

Recycling of wastes:

1. Papers from old books are recycled to produce papers in paper mills.
2. Agricultural wastes can be used to make paper and hard board.
3. Cowdung and organic wastes are used in gobar gas plant.

4R Approach:

4R – Reduce, Reuse, Recovery and Recycle followed for effective waste management.

4. Enumerate the importance of forest. (GMQ - 2019) ※※※

1. Forests are an **important component** of our environment.
2. Forest is dominated by
   i. microorganisms
   ii. flowering plants
   iii. shrubs
   iv. climbers
   v. dense trees
   vi. provide a vast habitat for wild animals.
3. Forests also contribute to the **economic development** of our country.
4. Forests are vital for **human life.**
5. It is a source for a wide range of **renewable natural resource.**
6. They provide wood, food, fodder, fibre and medicine.
7. Forest are major factor of **environment concern** like,
   i. carbon sink
   ii. regulate climatic conditions
   iii. increase rainfall

   iv. reduce global warming
   v. prevent natural hazards like flood and landslides
   vi. protect wildlife
   vii. act as catchments for water conservation.
8. They also play a vital role in maintaining the **ecological balance.**

5. What are the consequences of soil erosion? ※※

1. The top layers of soil contain humus and mineral salts, which are vital for the growth of plants.
2. Removal of upper layer of soil by wind and water is called soil erosion.
3. Soil erosion causes a significant loss of humus, nutrients and decrease the fertility of soil.
4. The direct and primary effect of soil erosion is soil loss and nutrient leaching resulting in reduction of land productivity.
5. Annual floods causes damages to crops, property and lives.
6. Deforested rain forest soil becomes dry and nutrient - deficient as there is no longer vegetation to hold water and nutrients in place.
7. Heavy rains further erode soil and saturate waterways with excess nutrients, disrupting the food chains of tropical ecosystems.
8. Eroded sediments can even change the course of rivers, which suffer from huge deposits of silt from deforestation.
9. Desertification is another possible consequence of erosion.

6. Why is the management of forest and wildlife resource considered as a challenging task? ※

Management of forest and wildlife resource considered as a challenging task due to the following reasons:

1. Lack of public awareness.
2. Wildlife poaching.
3. Global warming and climate change.
4. Water scarcity and changes in rainfall pattern.

5. Killing of animals and trees by people for economic benefit.
6. Illegal cutting down of trees for many purposes.
7. Increase in human population.

VIII. Assertion and Reasoning.

1. **Assertion:** Rainwater harvesting is to collect and store rainwater.

   Reason : Rainwater can be directed to recharge the underground water source.

   a. Both assertion and reason are true and reason is correct explanation of assertion
   b. Both assertion and reason are true but reason is not the correct explanation of assertion
   c. Assertion is true but reason is false
   d. Both assertion and reason are false.

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

IX. Higher Order Thinking Skills (HOTS)

1. **Although coal and petroleum are produced by degradation of biomass, yet we need to conserve them. Why? (PTA - II)**
   1. Coal and petroleum are called fossil fuels as they are formed from the degradation of biomass buried deep under the earth millions of years ago.
   2. The coal and petroleum reserves can get exhausted if we continue using them at a rapid rate.
   3. But the formation of these fossil fuels as a very slow process and takes very long period of time for renewal. So we need to conserve them.
2. **What are the objectives for replacing non - conventional energy resources from conventional energy resources?**
   1. Because non - conventional energy resources are available in unlimited amount in nature.
   2. They can be renewed over a short period of time,
   3. They are cheap.
   4. They can be harvested continuously.
3. **Why is the Government imposing ban on the use polythene bags and plastics? Suggest alternatives. How is this ban likely to improve the environment?**
   1. Government of India is imposing a ban in the use of polythene bags because they cannot be degraded naturally by the action of micro organism.

   2. They remain in the soil for a long time and continue to poison the soil by toxic byproducts that keep leaching from them.
   3. Also, they do not allow water to seep in as their water proof.
   4. Polythene bags when accidentally eaten by animals can harm them and even lead to their death.

   Alternatives:
   1. Cloth bags, paper bags and jute bags.
   2. Because they are biodegradable and environment friendly.
   3. They can be recycled easily.

   Ban will improve the environment in the following ways:
   1. Help to prevent land, water pollution.
   2. It will lead to less productions of polythenes, which help in reduction of harmful gases from factories.

X. Value based questions.

1. **Why is it not possible to use solar cells to meet our energy needs? State three reason to support to your answer.**
   1. High cost of installation.
   2. Limited availability of special grade silicon to make solar cells.
   3. Availability of sunlight throughout the year is not possible in many places.
   4. Unavailability of efficient system to store electrical energy generated by solar panels.
2. **How would you dispose the following wastes?**

   a. **Domestic wastes like vegetable peels.**

   Vegetable peels are disposed in composting pits and used for making **compost** or converted into humus.

   b. **Industrial wastes like metallic cans.**
   Can the disposal protect the environment? How?
   1. Industrial wastes like metallic cans can be recycled to make new items.
   2. Yes, the disposal protects the environment as there are no industrial wastes left over after recycling.
3. **List any three activities based on 4R approach to conserve natural resources.**

   I. **Reduce** - Take your own bag to the grocery store.
   II. **Reuse** - Collect rainwater in a rain barrel to use to water the garden.
   III. **Recycle** - All metal cans should be recycled.

IV. Recovery - Conversion of waste materials into resources such as electricity, heat, compost and fuel through thermal and biological means.

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Choose the correct answer.

1. The soft finely stratified sedimentary rock refers to **(GMQP - 2019)**
   a. shale b. petroleum c. methane d. coal **Ans: a. shale**

2. Match the following. **(SEP - 2020)**

Column - A			Column - B	
a.	Polyvinyl chloride	-	i.	Affects brain development in children
b.	Cadmium	-	ii.	Affects the growth of reproductive system
c.	Lead	-	iii.	Asthmatic bronchitis
d.	Chromium	-	iv.	Neural damage

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

3. Match the following: **(MAY - 2022)**

Column - A			Column - B	
a.	Solar Energy	-	i.	Flowing water
b.	Petroleum	-	ii.	Mobile phone
c.	Hydropower	-	iii.	Inexhaustible energy
d.	Electronic device	-	iv.	Exhaustible energy resource

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

4. The energy obtained from the movement of water due to ocean tides is _____. **(PTA - 6)**
   a. Tidal energy b. Wind energy
   c. Solar energy d. water energy **Ans: a. Tidal energy**

II. Long answers.

1. **What is 4R approach?** **(PTA - 1)**
   The four methods of effective waste management are - Reduce, Reuse, Recovery and Recycle known as 4R approach.

2. **List out the advantages of tidal energy.** **(PTA - 5)**
   1. Tidal energy does not produce any pollution.
   2. It does not use any fuel and does not produce any waste.
   3. Tides are predictable, so tidal energy can be produced at any time.
   4. Water is denser than air and therefore can generate electricity at lower speeds than wind turbines.

ADDITIONAL QUESTIONS

I. Match the following:

Column - I	Column - II	Answers
1. Outdated electronics	a. 4R approach	d. e - waste
2. Biogas	b. Non - biodegradable waste	c. cow dung
3. Waste management	c. cow dung	a. 4R approach
4. Paddy husk	d. e - waste	e. Livestock fodder
5. Incineration	e. Livestock fodder	b. Non - biodegradable waste

Column - I	Column - II	Answers
1. Sludge removal	a. disinfection	c. degradation
2. Chlorination	b. turbine	a. disinfection
3. Tidal stream	c. degradation	b. turbine
4. Oorani	d. eris	e. small ponds
5. Digging of tanks	e. small ponds	d. eris

Column - I	Column - II	Answers
1. Lead	a. Neural damage	b. Peripheral nervous system
2. Chromium	b. Peripheral nervous system	d. Asthmatic bronchitis
3. Cadmium	c. Chronic damage	a. Neural damage
4. PVC	d. Asthmatic bronchitis	e. Dioxin
5. Mercury	e. Dioxin	c. Chronic damage

II. Choose the correct answer:

1. _____ is concerned with the proper management of natural resources.
   a. Preservation b. Conservation
   c. Observation d. none of the above **Ans: b. Conservation**

2. _____ is the burning of non – biodegradable solid wastes at high temperature.
   a. Incinerator b. Composting
   c. Sanitary landfill d. Segregation **Ans: a. Incinerator**

3. _____ is a place reserved exclusively for animals.
   a. Forest b. National park c. Sanctuary d. none of the above
   Ans: c. Sanctuary

4. The unwanted, outdated and non - working electronic products are called _____.
   a. biodegradable wastes b. Non - biodegradable
   c. Solid waste d. None of the above **Ans: d. None of the above**

5. The process of screening of water to remove soil and solid particles is called _____.
   a. aeration b. Pre - screening c. sedimentation d. sludge removal
   Ans: b. Pre - screening

6. _____ % of e - wastes produced are recycled.
   a. 5 b. 50 c. .5 d. 55 **Ans: a. 5%**

7. _____ damages the central and peripheral nervous system.
   a. Chromium b. Mercury c. Cadmium d. Lead **Ans: d. Lead**

8. Biomedical components form _____ % of e - wastes.
   a. 7 b. 6 c. 12 d. 66 **Ans: a. 7**

9. _____ are small ponds to collect rainwater
   a. Eris b. Dams c. Ooranis d. None of the above **Ans: c. Ooranis**
10. Hydropower plants converts _____ energy of flowing water in electricity.
   a. mechanical b. kinetic c. wind d. light **Ans: b. kinetic**
11. The world largest wind turbine is situated in _____.
   a. California b. Hawaii c. India d. Africa **Ans: b. Hawaii**

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

1. Removal of upper layer of soil by wind and water is called soil erosion.
   Ans: True
2. The conventional energy resources account for 50% of the world's production of commercial energy
   Ans: False
   The conventional energy resources account for **90%** of the world's production of commercial energy.
3. Solar energy is free, eco - friendly, renewable source of energy.
   Ans: False
   Wind energy is free, eco - friendly, renewable source of energy.
4. Hydropower plant converts the potential energy of flowing water into electricity.
   Ans: False
   Hydropower plant converts the **kinetic** energy of flowing water into electricity.
5. Sanctuary is a reserved area for the conservation of entire wildlife including plants and animals.
   Ans: False
   National park is a reserved area for the conservation of entire wildlife including plants and animals.
6. Biogas is produced by the aerobic decomposition of cow dung.
   Ans: False
   Biogas is produced by the **anaerobic** decomposition of cow dung.

IV. Assertion and Reason.

1. **Assertion :** Energy efficient bulbs like CFL must be used to save electric energy.
   Reason : CFL bulbs are costlier than ordinary bulbs, hence using ordinary bulbs can save our money.
   a. Both assertion and reason are true and reason is correct explanation of assertion
   b. Both assertion and reason are true but reason is not the correct explanation of assertion
   c. Assertion is true but reason is false
   d. Both assertion and reason are false.
   Ans: c. Assertion is true but reason is false
2. **Assertion:** Solar cells is used in calculators, electronic toys and watches.
   Reason : Solar energy does not cause pollution.
   a. A and R are correct, R explains A. b. A is correct, R is wrong.
   c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
   Ans: d. A and R are correct, R doesn't explain A
3. **Assertion:** Lead damages central and peripheral nervous system and affect brain development in children.

   Reason : Mercury causes asthmatic bronchitis.
   a. A and R are correct, R explains A. b. A is correct, R is wrong.
   c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
   Ans: b. A is correct, R is wrong
4. **Assertion:** Segregation is the separation of different type of waste materials like biodegradable and non biodegradable wastes.
   Reason : Incineration is the burning of non - biodegradable solid wastes (medical wastes) in properly constructed furnace at high temperature.
   a. A and R are correct, R explains A. b. A is correct, R is wrong.
   c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
   Ans: d. A and R are correct, R doesn't explain A
5. **Assertion:** Solar water heater does not require electricity, they heat up water directly from sunlight.
   Reason : Solar cell is a device that absorbs sunlight and converts it into electric energy.
   a. A and R are correct, R explains A. b. A is correct, R is wrong.
   c. A is wrong, R is correct. d. A and R are correct, R doesn't explain A.
   Ans: a. A and R are correct, R explains A.

V. Analog

1. Destructing of trees : deforestation
   Planting of trees : _____ **(afforestation)**
2. Renewable energy source : solar energy
   Non - renewable energy source : _____ **(petroleum)**
3. Soil erosion : removal of soil
   Soil conservation : _____ **(prevention of soil erosion)**
4. Non renewable : exhaustible
   Renewable : _____ **(in exhaustible)**
5. Bio gas : animal wastes
   Shale gas : _____ **(sedimentary rock)**
6. Solar panel : many solar cells
   Solar plant : _____ **(many solar panels)**
7. Compact fluorescent lamp : CFL
   Light emitting diode : _____ **(LED)**
8. Burning of non - biodegradable waste : Incineration
   Conversion of biodegradable waste : _____ **(composting)**
9. Solid waste : hospital waste
   E waste : _____ **(computer)**
10. Degradation in the presence of air : Aeration
   Setting down process : _____ **(sedimentation)**
11. Ocean tides : _____ **(tidal energy)**
   Flowing water : water energy
12. Recharge pits : ground wells
   Ooranies : _____ **(small ponds)**

VI. Short Answers:

1. **What is environmental management?**
   Environmental management deals with the different aspects of environment, it's structure, function, its quality and its maintenance including conservation of its living and non - living components.

2. What is meant by conservation?

Proper utilization and management of nature and it's resources is termed as conservation.

3. What is meant by chipko movement?

1. The chipko movement was a non - violent agitation in 1973 that was aimed at protection and conservation of trees.
2. 'Chipko' means from the word 'embrace' as the villagers hugged the trees and encircled them to prevent them from being cut.
3. It is originated in the Chamoli district of Uttar Pradesh.

4. Name any three organizations involved in conservation of wildlife.

1. Indian Board for Wildlife (IBWL)
2. World Wildlife Fund (WWF) for nature
3. World Conservation Union (WCN)

5. What is the role of Radhika Ramasamy in wildlife photography?

1. Radhika Ramasamy, a native Venkatachalapuram village, Theni District in Tamilnadu was the first Indian woman to strike an international reputation as wildlife photographer.
2. Her passion is towards bird photography. A photo book on wildlife titled "The best of wildlife moments" was published in November 2014.

6. What are fossil fuels?

1. Fossil fuels are found inside the earth's crust and are energy rich substances formed by natural process, such as anaerobic over millions of years.
2. As the accumulating sediment layers produce heat and pressure, the remains of the organisms are gradually transformed into hydrocarbons.

   E.g: Petroleum, coal

7. What are the uses of fossil fuels?

1. Coal is used for generation of electricity at thermal power plants.
2. Petrol and diesel are used to run automobiles, trucks, trains, ships and airplanes etc.,
3. Kerosene and LPG (Liquefied Petroleum Gas) is used as domestic fuel for cooking food.

8. How does the Taj Mahal gets polluted?

1. The Mathura oil refinery owned by Indian oil corporation present around Taj Mahal produce sulphur and nitrogen oxides.
2. The white marble became yellow due to air pollution.
3. The government of India has set up emission standards around the monument to protect from the damage.

9. What is meant by shale? How fuel is extracted from this?

1. Shale refers to the soft finely stratified sedimentary rock that is formed from the compaction of small old rocks containing mud and minerals - such as quartz and calcite, trapped beneath earth's surface.
2. These rocks contain fossil fuels like oil and gas in their pores.

3. The fuel is extracted by a technique called hydraulic fracturing (drilling or well boring of sedimentary rocks layers to reach productive reservoir layers).

10. What is hydropower?

1. Harnessing the energy from the flowing water can be used to produce electricity.
2. The technique to harness the water energy is called hydropower.

11. What is meant by hydro electricity?

Hydropower plants converts the kinetic energy of flowing water into electricity. This is called hydro electricity.

12. What are the purposes of rainwater harvesting?

1. Rainwater harvesting is a technique of collecting and storing rainwater for future use.
2. It is a traditional method of storing rain water in underground tanks, ponds, lakes, check dams and used in future.
3. The main purpose of rainwater harvesting is to make the rainwater percolate under the ground so as to recharge groundwater level.

13. Give some examples for sources of E – wastes.

Computers, laptops, mobile phones, printers, monitors, televisions, DVD players, calculators, toys, sport equipments, refrigerators, washing machines, mixer grinder, water heater, printing cartridges, etc.,

14. Differentiate renewable resources from non - renewable resources.

	Renewable resources	Non - renewable resources
1.	Resources can be renewed simultaneously along with their exploitation.	It cannot be recycled and can get exhausted by unlimited and continuous use.
2.	They can maintain themselves by natural recycling or can be replenished by proper management.	They cannot be replaced easily and may come to an end after a certain period of time.
3.	**E.g:** forest, crops, wildlife, etc.,	**E.g:** coal, petroleum, etc.,

VII. Long Answers:

1. Write some steps to conserve coal and petroleum resources.

It is necessary to conserve or save coal and petroleum resources for the future use, which can be done by reducing their consumption.

1. If electricity is saved, it will return reduce the use of coal.
2. Using bicycle for covering short distances instead of using cars, scooters or motorcycles.
3. Using pressure cooker can reduce the consumption of kerosene and LPG while cooking food. Solar cooker and solar heaters can be used wherever possible.
4. Motor vehicles should be designed with fuel efficient engines to increase efficiency and also reduce air pollution.

2. How tidal energy is formed? Write it's advantages.

1. Tidal energy is the energy obtained from the movement of water due to ocean tides.
2. Tides are the rise and fall of sea levels caused by the combined effects of the gravitational forces exerted on the oceans of the earth.
3. A tidal stream is a fast flowing body of water created by tides. Turbines are placed in tidal streams.
4. When the tides hit the turbine, the turbine rotates and converts the tidal energy into electric energy.

Advantages of tidal energy: **(PTA - V)**

1. Tidal energy does not produce any pollution.
2. It does not use any fuel and does not produce any waste.
3. Tides are predictable, so tidal energy can be produced at any time.
4. Water is denser than air and therefore can generate electricity at lower speeds than wind turbines.

3. How will you conserve electrical energy at home and school?

The following measures can be taken even at home and school to save electricity.

1. Use energy efficient appliances to save electricity like Compact Fluorescent Lamps (CFL), Light Emitting Diode (LED) bulbs and other electric equipments.
2. Switch off the lights and fans, television and other electrical appliances when not in use.
3. Switch of the mobile phone charges when not in use.
4. Maximize the use of solar radiation. Solar water heating system can be used instead of electric geysers.
5. Minimize the use of air conditioners.

4. Describe the steps involved in wastewater treatment methods?

The conventional waste water treatment methods involve the following steps.

a. Pre screening
b. Aeration
c. Sedimentation process
d. Sludge removal
e. Disinfection
f. Water recycling

a. Pre - Screening

Waste water generated from domestic and industrial activities is screened to remove soil and solid particulates.

b. Aeration:

Screened waste water is then pumped to an aeration tank. Here the microbial contaminants are removed by the biological degradation that occurs in the presence of air.

c. Sedimentation process:

1. In this process, the solid particles in suspension from are allowed to settle.
2. The particles that settle out from the suspension is known as sludge.

d. Sludge removal:

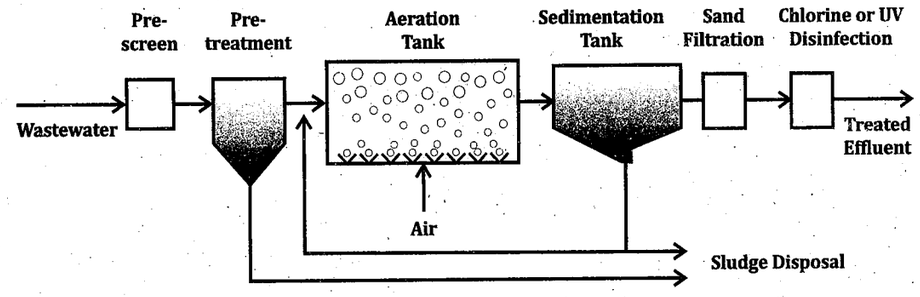
The sludge generated by the degradation process is transferred periodically from the tank for safe disposal.

e. Disinfection:

Chlorination and ultraviolet radiation of treated water is required to remove any micro organism contamination.

f. Water recycling:

The water will then be supplied for domestic or industrial purposes.



Conventional Wastewater Treatment

VIII. Fill in the blanks.

1. _____ resources cannot be recycled. **(Non - renewable)**
2. Continuous increase in population caused an increased demand for _____. **(resources)**
3. Conservation of _____ makes important contributions to the social and economic development of the country. **(natural resources)**
4. _____ are conserved for their biological, economic and recreational values. **(Natural resources)**
5. The use of natural resources in excess and unplanned way leads to _____ in the environment. **(imbalance)**
6. _____ resources can get exhausted by unlimited use. **(Non - renewable)**
7. Proper utilization and management of nature and its resources is termed as _____. **(conservation)**
8. Mineral ores are _____ resources. **(non - renewable)**
9. _____ are a source of wide range of renewable natural resource. **(Forests)**
10. _____ acts as catchments for water conservation. **(Forests)**
11. _____ is the destruction of large area of forests. **(Deforestation)**
12. India is losing about _____ hectares of forest cover every year. **(1.5 million)**
13. The ___ movement was a non - violent agitation aimed at protection and conservation of trees. **(Chipko)**
14. India has an area of _____ hectare classified as reserved forests. **(752.3 lakh)**
15. The forest conservation act was adopted in _____. **(1980)**
16. Exploitation of wildlife resources has decreased global wildlife population by _____. **(52%)**
17. The wildlife protection act was established in _____. **(1972)**
18. _____ park was the first to be established in 1936 in Uttarakhand. **(Jim Corbett national)**
19. There are _____ biosphere reserves in India. **(15)**
20. The _____ is a biosphere reserve in Tamilnadu **(Nilgiris)**
21. _____ was the first Indian woman to strike an international reputation as a wildlife photographer. **(Rathika Ramasamy)**
22. _____ conservation project was launched in 1976. **(Crocodile)**
23. _____ conservation project was launched in 1999. **(Sea Turtle)**
24. Indian Rhino vision 2020 is to conserve at least _____ greater one - horned rhinos in Assam, India by 2020. **(3000)**
25. The top layers of soil contain _____ and mineral salts. **(humus)**
26. Removal of upper layer of soil by wind and water is called _____. **(soil erosion)**
27. _____ resources can be classified as non - renewable and renewable. **(Energy)**
28. Conventional energy resources account for _____ the world's production of commercial energy. **(90%)**
29. _____ are found inside the earth's crust. **(Fossil fuel)**
30. The remains of the organisms are gradually transformed into _____. **(hydrocarbons)**
31. Non - renewable energy are also called _____ energy resources. **(exhaustible)**
32. Renewable energy are also called as _____ energy resources. **(inexhaustible)**

33. Coal and petroleum are _____ resources. **(natural)**
34. _____ is used for generation of electricity at thermal power plants. **(Coal)**
35. _____ is also known as crude oil. **(Petroleum)**
36. Kerosene and LPG obtained form _____. **(Petroleum)**
37. The white marble in Taj Mahal became yellow due to _____. **(air pollution)**
38. Solar energy is the energy obtained from the _____. **(sun)**
39. The various devices used for harnessing sun's energy are called _____ devices. **(solar energy)**
40. Coal and petroleum are called _____ fuels. **(fossil)**
41. _____ is made up of silicon that converts sunlight directly into electricity. **(Solar cells)**
42. Arrangement of many solar cells side by side connected to each other is called _____. **(solar panel)**
43. Biogas is also commonly called as _____. **(Gobar gas)**
44. _____ are photovoltaic devices. **(Solar cells)**
45. _____ is the fuel in solar cells. **(sunlight)**
46. The starting material used in producing biogas is _____. **(cowdung)**
47. The percentage of methane in Biogas is approximately _____. **(75%)**
48. _____ refers to the soft finely stratified sedimentary rock that is formed beneath the Earth's surface. **(Shale)**
49. Shale gas is extracted by a technique called _____. **(hydraulic fracturing)**
50. The world's largest and tallest wind turbine is situated in _____. **(Hawaii)**
51. One wind turbine in Hawaii can produce electricity for _____ homes. **(300)**
52. _____ is a machine that converts the energy of wind into rotational energy. **(Windmill)**
53. When the blowing air strikes the blades of the windmill, it exerts _____. **(force)**
54. The technique to harness the water energy is called _____. **(hydropower)**
55. Nearly _____ of the Earth's surface is covered by water. **(71%)**
56. The kinetic energy possessed by wind is converted to _____ power by wind turbines. **(mechanical)**
57. Hydropower plants converts the _____of flowing water into electricity. **(kinetic energy)**
58. A _____ is a fast flowing body of water created by tides. **(tidal stream)**
59. _____ energy does not use any fuel. **(Tidal)**
60. _____ is a technique of collecting and storing rainwater for future use. **(Rainwater harvesting)**
61. _____ are excellent rain catchers. **(Roof tops)**
62. _____ are small ponds to collect rainwater. **(Ooranis)**
63. _____ Dam is also known as Grand Anicut. **(Kallanai)**
64. The conversion of kinetic energy of flowing water into electricity is called _____. **(hydroelectricity)**
65. The main purpose of rainwater harvesting is to recharge _____ level. **(groundwater)**
66. In a recharge pit, the water collected is directed into the _____ through pipes for filtration. **(percolation pit)**
67. _____ Dam is the fourth oldest dam in the world. **(Kallanai)**
68. Spoiled, outdated non - repairable electrical and electronic devices are called _____. **(e - wastes)**
69. _____ causes asthmatic bronchitis. **(Chromium)**
70. _____ accumulates in kidney and liver of causes neural damage. **(Cadmium)**
71. In aeration _____ wastewater is pumped to an aeration tank. **(screened)**
72. _____ is the burning of non - biodegradable solid wastes in properly constructed furnace at high temperature. **(Incineration)**
73. Biodegradable matter of solid wastes is digested by microbial action or earthworms and converted into humus by _____. **(composting)**
74. _____ is a process concerned with the use, preservation and proper management of natural resources from destructive activities. **(Conservation)**
75. Conservation of _____ contributes to the social and economic development of the country. **(natural resources)**
76. _____ is a reserved area for the conservation of entire wildlife including plants and animals. **(National park)**
77. _____ is a place reserved exclusively for the use of animals. **(Sanctuary)**
78. _____ cells is a device that absorbs sunlight and converts it into electric energy. **(Solar)**
79. _____ water heater does not require electricity. **(Solar)**
80. Biogas is produced by the _____ decomposition of cow dung. **(anaerobic)**
81. The collection and storing rain water for future purpose is known as _____. **(rainwater harvesting)**

23. VISUAL COMMUNICATION

I. Choose the best answer.

1. Which software is used to create animation? ※※ **(PTA - III)**
   a. Paint b. PDF c. MS Word d. Scratch
   Ans: d. Scratch
2. All files are stored in the _____. **(GMQ - 2019)**
   a. Folder b. box c. Pai d. scanner **Ans: a. Folder**
3. Which is used to build scripts? **(PTA - I)**
   a. Script area b. Block palette c. stage d. sprite
   Ans: a. Script area
4. Which is used to edit programs? ※※ **(PTA - II)**
   a. Inkscape b. script editor c. stage d. sprite
   Ans: b. script editor
5. Where you will create category of blocks?
   a. Block palette b. Block menu
   c. Script area d. sprite **Ans: b. Block menu**

II. Match the following.

Column - I			Column - II			Answers		
1.	Script Area	-	a.	Type notes	-	e.	Build scripts
2.	Folder	-	b.	Animation software	-	d.	Store files
3.	Scratch	-	c.	Edit programs	-	b.	Animation software
4.	Costume editor	-	d.	Store files	-	c.	Edit programs
5.	Notepad	-	e.	Build scripts	-	a.	Type notes

III. Answer the following.

1. What is Scratch? ※※ **(JULY - 2024)**

1. 'Scratch' is a software used to **create animations**, **cartoons** and **games** easily.
2. It is a **visual programming language**.
3. It was developed in the Massachusetts Institute of Technology (MIT) Media Lab to make **programming easier** and more fun to learn.

2. Write a short note on editor and its main parts. **(JUNE - 2023)**

The scratch editor has three main parts. They are Stage, Sprite and Script editor.

1. **Stage:**
   1. Stage is the **background** appearing when we open the **scratch window**.
   2. The background will most often be white.

2. **Sprite:**
   1. The characters on the background of a scratch window are known as **sprite**.
   2. Usually a cat appears as a sprite when the scratch window is opened.
3. **Script:** Where you **edit** your **programs** or your sprite's pictures.

What is Stage? **(APRIL - 2024, SEP - 2020)**

1. Stage is the **background** appearing when we open the **scratch window**.
2. The background will most often be white.
3. We can change the background colour as we like.

What is Sprite? **(APR - 2023)**

1. The **characters** on the **background** of a Scratch window are known as Sprite.
2. Usually a cat appears as a sprite when the Scratch window is opened.
3. The software provides facilities to make alternations in sprite.

ANSWERS FOR GOVT. QUESTION PAPERS & P.T.A. QUESTION PAPERS

I. Choose the correct answer.

1. In computer _____ is used to collect the notes. **(PTA - 4)**
   a. Notepad b. Paint c. Scanner d. Scratch **Ans: a. Notepad**
2. More people are using _____ and _____ operating systems in their computers. **(PTA - 5)**
   a. Mac, Amiga b. Solaris, iOS c. Windows, LINUX d. Android, Minix 3
   Ans: c. Windows, LINUX
3. The application in a computer created any output is generally referred as _____. **(PTA - 6)**
   a. command b. folder c. file d. paint **Ans: c. file**

ADDITIONAL QUESTIONS

I. Analog

1. Stage list : top left
   Sprite list : _____ **(bottom left)**
2. Choose the category of blocks : block menu
   Choose the block to use : _____ **(block palette)**
3. Individual book : file
   Whole set of books : _____ **(folder)**
4. Type notes : notepad application
   Draw pictures : _____ **(paint application)**

II. Short Answers:

1. **Why do we prefer a computer?**
   The reason we prefer computer is it's speed and the ability to store data.

2. **How can we save data and information in a computer?**
   We can save them in folders which accommodate multiple files or a single file.
3. **What is referred as a file?**
   1. The output we get from any application is commonly referred as file.
   2. The individual book in a shelf can be considered as a file.
4. **What is the use of guide board?**
   1. We use 'Guide board' to go to the unknown places like that when we 'on' the computer click the 'START' button at the left corner of the computer, it shows the list of all programs in the computer.
   2. Now select the required program and create the required files.
5. **What is visual communication device?**
   The device which helps in explaining the concepts easily through pictures is known as visual communication device.

III. Long Answers:

1. **How can we create files?**
   1. If the computer is operating on the windows OS, we can collect our notes in 'Notepad' application and draw pictures in paint application.
   2. As per its name we can type notes in 'Notepad' and save the created files in a folder.
   3. Likewise in the 'paint' app we can draw and edit pictures. With these pictures we can create image gallery, animations and graphics easily.
   4. Pictures and audio - visuals gives us more understanding than teaching and writing on the blackboard.
   5. Instead of saying a story' once upon a time there was a king, we can understand the concept easily by seeing the video and also it registers easily in the minds of the students.
   6. The devices which helps in explaining the concepts easily through pictures is known as 'visual communication device'.
   7. For example, photos, audio - visuals, drawings, animations all these can be created easily with the help of computer.
   8. Cinema is a good example for 'visual communication device'.

IV. Fill in the blanks.

1. The application for the specific purposes determines the nature of the _____. **(file)**
2. A _____ is a storage space that contains multiple files. **(folder)**
3. The _____ application helps us to create an image gallery, animations and graphics easily. **(paint)**
4. The device which helps in explaining the concepts easily through pictures is known as _____. **(Visual Communication Device)**
5. _____ is a good example for Visual Communication Device. **(Cinema)**
6. _____ is a software used to create animations, cartoons and games easily. **(Scratch)**
7. _____ is the background appearing when we open the scratch window. **(Stage)**
8. The characters on the background of a Scratch window are known as _____. **(Sprite)**
9. _____ you choose the category of blocks (programming statements) to use. **(Block menu)**
10. _____ is used to choose the block to use. **(Block palette)**