Grade 10 Science Uttar Pradesh 2022

Note:

(i)First 15 minutes time has been allotted for the candidates to read the question paper.

(ii) This question paper is divided into three parts, A, B and C.

(iii) First question of each part is a multiple choice type question in which four alternative answers are given in each. Select the correct answer and write down in your answer-book.

(iv) Attempt all the questions of each part together at one place. Each part should be attempted on a new page.

(v) All questions are compulsory.

(vi) Marks allotted for each question are mentioned against them.

(vii) Illustrate your answers with neat and labelled diagrams and chemical equations, wherever necessary.

Part A

Q1. **(a)** Refractive index of the medium with respect to air, is maximum for:

(i) Water

(ii) Diamond

(iii) Glass

(iv) Turpentine oil

Solution:

(ii) Diamond

The refractive index is the measure of how much a ray of light bends when it enters a medium.

Among the given options, Diamond has the maximum refractive index (approximately 2.42), which means it bends light the most compared to the others.

(b) To remove myopia or short-sightedness, one should use the spectacles with:

(i) Concave lens

(ii) Concave mirror

(iii) Convex lens

(iv) Convex mirror

Solution:

(i) Concave lens

Myopia, or short-sightedness, occurs when the image of a distant object is formed in front of the retina. This condition can be corrected using a concave lens, which diverges light rays before they reach the eye, so the image is formed directly on the retina.

(c) Magnetic lines of force:

(i) are always parallel

(ii) meet at a point

(iii) do not intersect each other

(iv) intersect each other

Solution:

(iii) do not intersect each other

Magnetic lines of force do not intersect because if they did, it would mean there are two directions of the magnetic field at one point, which is not possible.

(d) If ϕ = Magnetic flux, B = Internaty of magnetic field and A = Area of cross-section, the correct relation among, these is :

(i) $\mathrm{B} = \phi/\mathrm{A}$

(ii) $\phi = B/A$

(iii) $\mathrm{A} = \mathrm{B}.\phi$

(iv) $\mathrm{B} = \phi.\mathrm{A}$

Solution:

(i) $\mathrm{B} = \phi/\mathrm{A}$

The magnetic flux ϕ is the product of the magnetic field strength B and the area A perpendicular to it:

$\phi = B \cdot A$

Rearranging:

$B=\phi/A$

Q2. **(a)** The image of an object placed on the principal axis at 30 cm from the pole of a concave mirror is formed on the object itself. What is the focal length of the mirror?

Solution:

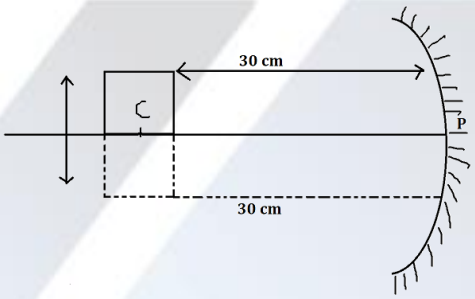
For a concave mirror, if the image is formed on the object itself, the object is at the center of curvature. The radius of curvature R is equal to twice the focal length f.

$f=R/2$

Here, the object distance

$u=R=30$ cm

$f=30/2=15$cm.



(b) Find out the radius of curvature of a concave mirror of focal length 40 cm.

Solution:

The radius of curvature R is related to the focal length f as:

$R=2f$

Given

$f=40$

$R=2\times40=80$cm

(c) Why is convex mirror used in auto vehicles?

Solution:

Convex mirrors are used in automobiles as rearview mirrors because:

They provide a wider field of view, enabling the driver to see a larger area behind the vehicle.

They always form virtual, erect, and diminished images, which help in assessing distances and surroundings.

Q3. **(a)** A concave lens of 15 cm focal length forms the image of an object at a distance of 10 cm from the lens. At what distance is the object situated from the lens? Draw ray diagram also.

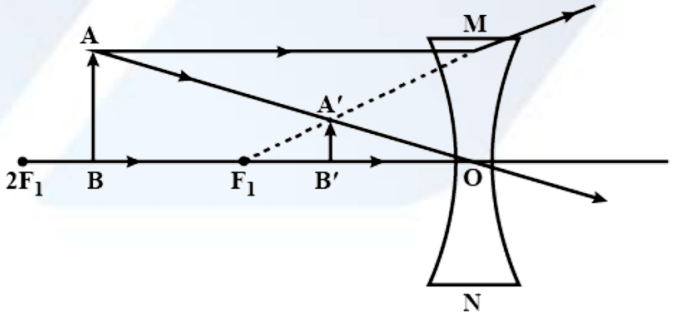
Solution:

Given: $f = -15$

$$v = -10$$

From mirror formula, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$$\frac{1}{-10} - \frac{1}{u} = \frac{1}{-15}$$
$$\frac{1}{u} = \frac{1}{15} - \frac{1}{10}$$
$$u = -30 \text{ cm}$$



OR

A man using spectacles, can observe clearly an object placed at 25 cm distance. The focal length of the lens used in the spectacles is 50 cm. At what distance can the man read a book without using the spectacles?

Solution:

To determine the distance at which the man can read a book using the spectacles, we need to use the lens formula:

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

where f is the focal length, v is the image distance, and u is the object distance. Given that the focal length f is 50 cm and the object distance u is 25 cm, we can solve for v.

Step by Step Solution:

Step 1

Write down the lens formula:

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

Step 2

Substitute the given values into the formula:

$\frac{1}{50}=\frac{1}{v}-\frac{1}{25}$

Step 3

Rearrange the equation to solve for v:

$\frac{1}{v}=\frac{1}{50}+\frac{1}{25}$

Step 4

Calculate the value of v:

$\frac{1}{v} = \frac{1}{50} + \frac{2}{50} = \frac{3}{50}$, so

$v = \frac{50}{3} = 16.67$

Without using the spectacles, the man can read a book clearly at a distance of 16.67 cm.

(b) An electron of mass 9×10^{-31} kg and charge 1.6×10^{-19} coulomb is moving with velocity 3×10^6 m/sec parallel to X -axis and enters into a magnetic field of 0.3 Weber/m^2 parallel to Z-axis. Determine the force acting on the electron, acceleration and the direction of force.

Solution:

As Given Data:

Mass of the electron, $m = 9 \times 10^{-31}$ kg

Charge of the electron, $q = -1.6 \times 10^{-19}$C (negative for electrons)

Velocity of the electron, $v = 3 \times 10^6$ m/s (along the X-axis)

Magnetic field strength, $B = 0.3$ T (along the Z-axis)

Force Acting on the Electron

The magnetic force on a charged particle is given by the formula:

$$F = q \cdot v \cdot B \cdot \sin\ \theta$$

Where:

$\boldsymbol{\theta}$ is the angle between the velocity vector and the magnetic field vector.

Here, $\boldsymbol{\theta} = \mathbf{90}^\circ$ because the velocity (X-axis) is perpendicular to the magnetic field (Z-axis).

Since $\sin\ 90^\circ = 1$:

$$F = q \cdot v \cdot B$$

Substitute the given values:

$$F = (-1.6 \times 10^{-19}) \cdot (3 \times 10^6) \cdot (0.3)$$

$$F = -1.44 \times 10^{-13}\ \text{N}$$

The negative sign indicates that the force direction is opposite to the conventional direction for positive charges.

Magnitude of the force:

$$F = 1.44 \times 10^{-13} \text{ N}$$

Acceleration of the Electron

Acceleration a is related to the force by Newton's second law:

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

Substitute the values:

$$a = \frac{1.44 \times 10^{-13}}{9 \times 10^{-31}}$$
$$a = 1.6 \times 10^{17} \text{ m/s}^2$$

Acceleration:

$$a = 1.6 \times 10^{17} \text{ m/s}^2$$

Direction of the Force

The direction of the magnetic force is determined by the Fleming's Left-Hand Rule or the Right-Hand Rule for Negative Charges:

The velocity vector (v) is along the X-axis.

The magnetic field (B) is along the **Z**-axis.

For a negatively charged particle, the force will act in the negative Y -axis direction.

Force acting on the electron: 1.44×10^{-13} N

Acceleration of the electron: 1.6×10^{17} m/s^2

Direction of force: Negative 𝕐-axis

OR

The resistances 2Ω, 3Ω and 5Ω are joined in series. If a potential difference of 30 volt is applied at the ends of the combination, calculate the potential difference between the ends of each resistance.

Solution:

To find the potential difference across each resistor in a series circuit, we first need to calculate the total resistance and the current flowing through the circuit. Then, we can use Ohm's Law to find the voltage across each resistor.

Step by Step Solution:

Step 1

Calculate the total resistance (R_total) in series:

R_total $= R1 + R2 + R3 = 2\Omega + 3\Omega + 5\Omega = 10\Omega$.

Step 2

Use Ohm's Law ($V = I^{*}R$) to find the current (I) in the circuit.

The total voltage (_total) is 30V,

so I = V_total / R_total

$= 30\ \text{V}/10\Omega = 3\ \text{A}$.

Step 3

Calculate the potential difference (VI) across the 2Ω resistor:

$\text{V1} = 1 * R1 = 3\ \text{A} * 2\Omega = 6\ \text{V}$.

Step 4

Calculate the potential difference (V2) across the 3Ω resistor:

$\text{V2} = 1^{*}\text{R2} = 3\ \text{A} * 3\Omega = 9\ \text{V}$.

Step 5

Calculate the potential difference (V3) across the 5Ω resistor:

$\text{V3} = 1 * \text{R3} = 3\ \text{A} * 5\Omega = 15\ \text{V}$.

Final Answer:

The potential differences are: 6 V across the 2Ω resistor, 9 V across the 3Ω resistor, and 15 V across the 5Ω resistor.

Q4. What do you understand by magnetic effect of electric current? On which factors does the intensity of magnetic field due to a straight long current carrying conductor depend? Write down the law for the direction of magnetic field.

Solution:

The magnetic effect of electric current refers to the phenomenon where a magnetic field is produced around a conductor when an electric current flows through it. This was discovered by Hans Christian Ørsted in 1820. The magnetic field produced can be observed by placing a magnetic compass near the current-

carrying conductor, where the needle deflects, indicating the presence of the magnetic field.

Factors Affecting the Intensity of Magnetic Field Around a Straight Current-Carrying Conductor:

1. Strength of Current (I):

The intensity of the magnetic field is directly proportional to the current flowing through the conductor. Greater the current, stronger the magnetic field.

$$B \propto I$$

2. Distance from the Conductor (r):

The magnetic field intensity decreases as the distance from the conductor increases. It is inversely proportional to the distance from the conductor.

$$B \propto 1/r$$

3. Medium Around the Conductor:

The nature of the medium (e.g., air, water, or a magnetic material) surrounding the conductor affects the magnetic field. A material with high magnetic permeability enhances the magnetic field.

The mathematical expression for the magnetic field intensity around a long straight current-carrying conductor is:

$$B=\mu_0 I/2\pi r$$

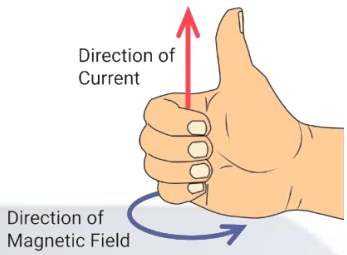
Where:

- B is the magnetic field intensity
- μ_0 is the permeability of free space
- I is the current through the conductor
- r is the distance from the conductor

Law for the Direction of Magnetic Field:

The direction of the magnetic field around a current-carrying conductor can be determined using the Right-Hand Thumb Rule.

Right-Hand Thumb Rule:



- Imagine holding the current-carrying conductor in your right hand with your thumb pointing in the direction of the current.
- The direction in which your curled fingers wrap around the conductor gives the direction of the magnetic field.

OR

What is the principle of electric motor? Describe its construction using labelled diagram. Explain its working. Write the uses of electric motor.

Solution:

Principle of an Electric Motor:

An electric motor works on the principle of the magnetic effect of electric current and force on a current-carrying conductor in a magnetic field. When a current-carrying conductor is placed in a magnetic field, it experiences a force due to the interaction between the current and the magnetic field. This force causes the conductor to move.

This phenomenon is explained by Fleming's Left-Hand Rule, which determines the direction of motion (force) of the conductor.

Fleming's Left-Hand Rule:

According to this rule:

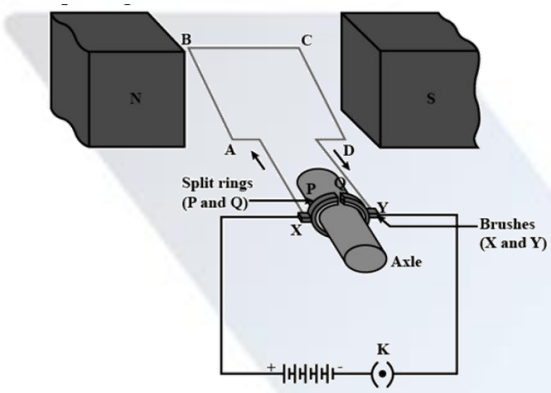
1. Stretch the thumb, forefinger, and middle finger of your left hand such that they are mutually perpendicular.

2. If:

- The forefinger points in the direction of the magnetic field (B),

- The middle finger points in the direction of the current (I),

- Then the thumb points in the direction of the force or motion (F) acting on the conductor.



Components of an Electric Motor:

1. Armature Coil: A rectangular coil of wire that carries current. It is free to rotate about an axis.

2. Magnetic Field: A strong magnetic field is created by a magnet (electromagnet or permanent magnet) in which the armature coil is placed.

3. Commutator: A device that reverses the direction of current in the coil after every half rotation to maintain continuous rotation of the motor.

4. Brushes: Carbon or metal pieces that maintain contact with the commutator and allow current to flow to the armature.

5. Battery or Power Source: Supplies current to the motor.

Working of an Electric Motor:

1. When current flows through the armature coil placed in a magnetic field, a force acts on each side of the coil according to Fleming's Left-Hand Rule.

2. These forces create a torque (rotational force) that causes the coil to rotate.

3. The commutator reverses the current direction after every half rotation, ensuring that the coil continues to rotate in the same direction.

4. This continuous rotation of the coil is used to perform mechanical work.

Applications of Electric Motors:

1. Electric fans, mixers, and pumps

2. Electric cars and trains

3. Industrial machines and tools

4. Appliances like refrigerators and washing machines

Part B

Q5. (a) The pH value of pure water is:

(i) 0

(ii) 1

(iii) 7

(iv) 14

Solution:

(iii) 7

The pH value of pure water is 7, as it is neutral in nature.

(b) The metal which removes hydrogen from acid is:

(i) Zn

(ii) Cu

(iii) Ag

(iv) Hg

Solution:

(i)Zn

Metals like zinc (Zn) react with acids to produce hydrogen gas by displacing hydrogen from acids.

(c) The chemical formula of propane is :1

(i) CH_4

(ii) C_3H_8

(iii) C_4H_{10}

(iv) C_2H_6

Solution:

(ii) C_3H_8

Propane is an alkane with the molecular formula C_3H_8.

Q6. (a) Write the IUPAC name of the following compounds :

(i) $CH_3CH_2CH_2CH_3$

(ii) CH_3COOH

Solution:

(i) $CH_3CH_2CH_2CH_3$:

IUPAC name: Butane

This compound has 4 carbon atoms in a straight chain. It is called butane.

(ii) CH_3COOH:

IUPAC name: Ethanoic Acid

This is a carboxylic acid with 2 carbon atoms. It is called ethanoic acid (commonly known as acetic acid).

(b) Write the Mendeleev's periodic law and explain it.

Solution:

The physical and chemical properties of elements are periodic functions of their atomic masses.

Explanation:

- Mendeleev arranged elements in increasing order of their atomic masses in the periodic table.
- Elements with similar properties were placed in the same group.

- He left gaps for undiscovered elements and predicted their properties, which were later found to be accurate.

(c) Complete the following chemical reactions:

(i) $CH_3COOH + C_2H_5OH \xrightarrow[H_2SO_4]{conc.} +$

(ii) $C_2H_5Br + KOH$ (aqueous)

Solution:

(i) $CH_3COOH + C_2H_5OH \rightarrow$ (Conc. H_2SO_4, heat)

$CH_3\ COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$

Ethanoic acid reacts with ethanol in the presence of concentrated sulfuric acid to form an ester and water.

(ii) C_2H_5Br + KOH (aqueous):

$C_2\ H_5\ Br + KOH \rightarrow C_2\ H_5\ OH + KBr$

Ethyl bromide reacts with aqueous potassium hydroxide to form ethanol and potassium bromide.

Q7. **(a)** Write the name and chemical formulae of washing soda and baking soda.

Solution:

Washing Soda:

Name: Sodium carbonate decahydrate

Formula: $Na_2CO_3 \cdot 10H_2O$

Baking Soda:

Name: Sodium bicarbonate

Formula: $NaHCO_3$

(b) Explain the double displacement reaction with examples?

Solution:

Double Displacement Reaction:

A reaction in which two compounds exchange their ions to form two new compounds is called a double displacement reaction.

Example:

Reaction of sodium chloride and silver nitrate:

$NaCl + AgNO_3 \rightarrow NaNO + AgCl \downarrow$

(A white precipitate of silver chloride is formed.)

2. Reaction of barium chloride and sodium sulfate:

$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 \downarrow + 2NaCl$

(A white precipitate of barium sulfate is formed.)

Q8. **(a)** What is corrosion? Explain it with example.

Solution:

Corrosion is the process in which metals are gradually destroyed or weakened by chemical reactions with substances in their environment, such as air, moisture, or acids. This process leads to the formation of undesirable compounds on the surface of the metal, which reduces its strength, appearance, and functionality.

How Corrosion Occurs:

- Metals, when exposed to air and moisture, react with oxygen and water.
- This reaction leads to the formation of oxides or other compounds on the surface of the metal.
- Over time, this weakens the metal and causes it to deteriorate.

Example: Rusting of Iron

- Iron reacts with oxygen in the presence of water or moisture to form hydrated iron(III) oxide, commonly known as rust.

$$4Fe + 3O_2 + 6H_2O \rightarrow 4Fe(OH)_3$$

This hydrated iron oxide slowly dehydrates to form rust:

$$Fe(OH)_3 \rightarrow Fe_2O_3 \cdot xH_2O$$

Rust appears as a reddish-brown flaky layer on the surface of iron.

Effects of Corrosion:

- Weakens structures (e.g., bridges, buildings, pipelines).
- Reduces the efficiency of machinery and tools.
- Leads to significant economic losses.

Prevention of Corrosion:

- Painting or Coating: Applying paint, grease, or oil to protect the metal surface.
- Galvanization: Coating iron with zinc to prevent rusting.
- Alloying: Mixing metals like chromium or nickel with iron to form stainless steel.
- Cathodic Protection: Using sacrificial anodes to protect the metal.

(b) Write a short note on Saponification.

Solution:

Saponification: Saponification is the process of producing soap by reacting fats or oils with an alkali (like sodium hydroxide or potassium hydroxide). The reaction results in the formation of soap (sodium or potassium salt of fatty acids) and glycerol as a byproduct.

$$C_3H_5(C_{17}H_{35}COO)_3 + 3NaOH \rightarrow 3C_{17}H_{35}COONa + C_3H_5(OH)_3$$

Here:

$C_{17}H_{35}COONa$: Sodium stearate (soap)

$C_3H_5(OH)_3$: Glycerol

Steps in Saponification:

- Fats/oils are heated with a strong base like NaOH or KOH.
- The triglycerides are broken down into glycerol and fatty acid salts (soap).
- The soap can then be separated, dried, and molded.

Uses of Saponification:

- Manufacturing soaps for cleaning purposes.
- Producing glycerol for use in cosmetics, pharmaceuticals, and food products.

(c) Define Period and Groups in the periodic table.

Solution:

The periodic table is a systematic arrangement of elements based on their increasing atomic numbers, and it is divided into periods (horizontal rows) and groups (vertical columns).

1. Periods:

A period is a horizontal row in the periodic table. There are 7 periods in the periodic table.

Elements in the same period have the same number of electron shells, but their chemical properties change progressively across the period due to an increasing number of valence electrons.

Example:

Period 1:

H, He (1 shell)

Period 2:

Li, Be, B, C, N, O, F, Ne (2 shells)

Characteristics of Periods:

- The atomic size decreases from left to right due to an increase in nuclear charge.
- Metallic character decreases, while non-metallic character increases across a period.
- Elements in a period show gradual changes in physical and chemical properties.

2. Groups:

A group is a vertical column in the periodic table.

There are 18 groups in the periodic table.

Elements in the same group have the same number of valence electrons, which gives them similar chemical properties.

Example:

Group 1:

Li, Na, K, Rb, Cs, Fr (all have 1 valence electron).

Group 17:

F, Cl, Br, I, At (all have 7 valence electrons).

Characteristics of Groups:

- Atomic size increases down a group due to the addition of more electron shells.
- Elements in a group have similar chemical properties because their valence electron configuration is the same.
- Metallic character increases down the group, while non-metallic character decreases

Property	**Periods**	**Groups**

Arrangement	Horizontal rows	Vertical columns
Number	**7** periods	18 groups
Valence Electrons	Changes progressively across a period	Remains the same within a group
Chemical Properties	Vary significantly across a period	Similar within a group
Atomic Size	Decreases left to right	Increases from top to bottom

OR

Write short notes on the following :

(a) Redox reaction

Solution:

Redox Reaction: Redox reactions are chemical reactions in which oxidation and reduction occur simultaneously. The term "redox" is derived from two processes:

- Oxidation: The loss of electrons or gain of oxygen.
- Reduction: The gain of electrons or loss of oxygen.

Key Concepts:

- Oxidation and reduction always occur together because the electrons lost by one substance are gained by another.
- Oxidizing agent: The substance that causes oxidation and is itself reduced.
- Reducing agent: The substance that causes reduction and is itself oxidized.

Examples:

Reaction between Zinc and Copper Sulfate:

$$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$$

Zinc is oxidized to Zn^{2+}, and copper is reduced to Cu.

Reaction in Respiration: Glucose is oxidized, and oxygen is reduced to form carbon dioxide and water.

(b) Homologous series

Solution:

Homologous Series: A homologous series is a group of organic compounds that have similar chemical properties, the same functional group, and a regular difference of $-CH_2$ in their molecular formula.

General Characteristics:

Functional Group: Members of a homologous series have the same functional group (e.g., alcohol, alkane, alkene).

Similar Chemical Properties: They undergo similar types of chemical reactions.

Gradation in Physical Properties: Their physical properties, such as boiling point and melting point, show a gradual increase with the molecular mass.

General Formula: All compounds in a homologous series follow a general molecular formula.

Example: Alkanes: C_nH_{2n+2}

Successive Members Differ by CH_2 Group: For example, in the alkane series:

CH_4, C_2H_6, C_3H_8 ,...

(c) Characteristics of Mendeleev's periodic table

Solution:

Mendeleev's Periodic Table: Mendeleev arranged the 63 known elements in a periodic table based on their atomic masses and chemical properties in 1869. His periodic table was the foundation for the modern periodic table.

Key Characteristics:

- Periodic Law: Mendeleev stated that the properties of elements are periodic functions of their atomic masses.
- Arrangement of Elements: Elements were arranged in rows (periods) and columns (groups) based on increasing atomic mass.
- Predictive Power: Mendeleev left gaps in his periodic table for undiscovered elements. He predicted the properties of these elements, which were later discovered (e.g., Gallium, Germanium, and Scandium).
- Grouping of Similar Elements: Elements with similar properties were placed in the same group. For example, alkali metals like lithium, sodium, and potassium were placed in Group 1.
- Correction of Atomic Masses: Mendeleev corrected the atomic masses of some elements (e.g., Beryllium and Indium) based on their properties and positions in the table.
- Exceptions: Some elements were placed out of order based on atomic mass to preserve their chemical properties (e.g., Cobalt before Nickel).

Limitations:

- The position of isotopes could not be explained since they have different atomic masses but similar properties.
- Elements like hydrogen and the noble gases could not be placed accurately.
- The periodic table did not account for the atomic number, which was introduced later.

Part C

Q9. **(a)** The processes by which complex organic molecules are broken down into simpler molecules are :

(i) anabolic reactions

(ii) catabolic reactions

(iii) Both (i) and (ii)

(iv) normal reactions

Solution:

(ii) Catabolic reactions

Catabolic reactions involve the breakdown of large, complex organic molecules (like carbohydrates, proteins, and lipids) into simpler molecules, releasing energy in the process. These reactions are a part of metabolism and provide energy for the body to perform various functions.

(b) Which of the following vitamin deficiency causes Pellagra disease?

(i) Vitamin B_1

(ii) Vitamin B_2

(iii) Vitamin B_5

(iv) Vitamin B_{12}

Solution:

(ii) Vitamin B_2 (Riboflavin)

Pellagra is caused by the deficiency of Vitamin B_2 (Riboflavin), which plays a critical role in energy metabolism and maintaining healthy skin and nerves. Common symptoms of pellagra include dermatitis, diarrhea, and dementia (the "3 D's").

(c) Haemoglobin plays a significant role in : 1

(i) respiration

(ii) excretion

(iii) digestion

(iv) nutrition

Solution:

(i) Respiration

Haemoglobin is a protein found in red blood cells that binds to oxygen in the lungs and transports it to tissues throughout the body. It also carries carbon dioxide from tissues back to the lungs for exhalation.

(d) Translocation of food by Phloem occurs in the form of :

(i) protein

(ii) fats

(iii) sucrose

(iv) fatty acids

Solution:

(iii)Sucrose

In plants, the phloem is responsible for transporting food produced by photosynthesis from leaves to other parts of the plant. This food is primarily transported in the form of sucrose, a soluble sugar. The process of translocation requires energy and is facilitated by the pressure flow mechanism.

Q10. (a) Which enzyme is found in saliva and which substance does that enzyme digest?

Solution:

The enzyme found in saliva is amylase, specifically salivary amylase (also known as ptyalin).

Function:

Salivary amylase begins the digestion of carbohydrates by breaking down starch (a polysaccharide) into simpler sugars like maltose (a disaccharide).

Chemical Reaction:

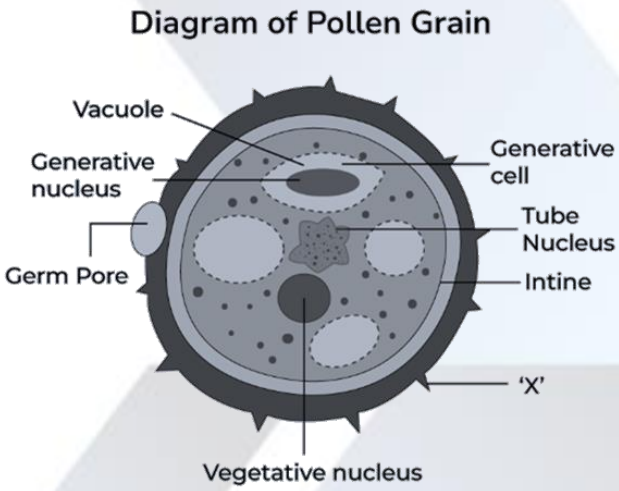
$$\text{Starch} \xrightarrow{salivary\ amylase} \text{Maltose}$$

Explanation:

When food is chewed, saliva containing salivary amylase mixes with it, initiating the digestion process in the mouth. This is the first step in the breakdown of carbohydrates before the food moves to the stomach for further digestion.

(b) Draw a labelled diagram of pollen grain.

Solution:



(c) What is regeneration? Give any two examples of it.

Solution:

Regeneration is the biological process by which an organism restores, repairs, or regrows lost or damaged tissues, organs, or body parts. This ability varies among different organisms and depends on their complexity and the type of cells they possess. Regeneration involves cell division (mitosis), differentiation (formation of specialized cells), and tissue remodeling to form the missing structures.

In simpler organisms, regeneration can recreate entire organisms, while in more complex organisms, it is often limited to specific parts like skin, bones, or tails.

Examples of Regeneration

Planaria (Flatworms):

Regenerative Ability: Planaria exhibit an extraordinary ability to regenerate their entire body. If a planarian is cut into several pieces, each piece can grow into a complete organism.

How It Happens: Planaria possess specialized stem cells called neoblasts, which help in the regeneration of lost parts. These cells divide and differentiate to reform the missing parts of the body.

Significance: It demonstrates a very high level of regenerative capability, especially in simpler organisms.

Example Experiment: If a planarian is cut horizontally or vertically, each segment will regenerate into a new planarian within a few days.

Lizards (Tail Regeneration):

Regenerative Ability: Lizards can regenerate their tails if they are detached, usually as a defense mechanism when escaping predators.

How It Happens: The cells at the base of the tail divide and differentiate to form a new tail. The process involves blastema formation (a group of undifferentiated cells), which regrows the missing tail.

Limitation: The regenerated tail may not be identical to the original one, as it lacks bones and instead has cartilage.

Purpose: This ability aids in survival, allowing the lizard to escape predators by sacrificing its tail.

Other Examples of Regeneration in Nature

Starfish: Starfish can regenerate their arms if lost. In some cases, an entire starfish can regenerate from a single arm and part of its central disc.

Hydra: Hydra, a simple freshwater organism, can regenerate its entire body from a small fragment due to the presence of interstitial stem cells.

Humans: Humans have limited regenerative abilities. For example, the liver can regenerate its damaged tissues, and skin cells regenerate during wound healing.

Importance of Regeneration

Survival Mechanism: In animals like lizards and starfish, regeneration is used as a defense mechanism to escape predators or repair damage.

Healing and Repair: In humans and higher organisms, regeneration helps in wound healing and recovery from injuries.

Scientific Research: Studying regeneration has provided insights into cell division, stem cells, and the potential for regenerative medicine in treating diseases or injuries.

Q11. **(a)** What do you know about monohybrid and dihybrid crosses?

Solution:

Monohybrid and Dihybrid Crosses

Monohybrid and dihybrid crosses are genetic experiments designed to study how traits are inherited in offspring, based on the laws of inheritance proposed by Gregor Mendel.

Monohybrid Cross

A monohybrid cross is a genetic cross involving a single trait or character controlled by a pair of contrasting alleles. It helps to determine the inheritance pattern of one specific trait.

- Involves one pair of contrasting traits (e.g., tall vs. short plants).
- The parents are homozygous (pure) for the trait, one dominant and one recessive.
- The resulting offspring are studied across generations to observe how the trait is passed on.

Example: Height in Pea Plants

Parent Generation (P):

- Tall plant (TT) × Short plant (tt).

F_1 Generation (First Filial):

- All plants are tall (Tt). The dominant allele (T) masks the recessive allele (t).

F_2 Generation (Second Filial):

- When F_1 plants are self-crossed (Tt × Tt), the phenotypic ratio is 3:1 (Tall:Short).

Genotypic ratio: 1:2:1 (TT, Tt, Tt, tt).

Dihybrid Cross

A dihybrid cross is a genetic cross involving two traits or characters controlled by two different pairs of alleles. It helps to study the inheritance patterns when two traits are considered simultaneously.

- Involves two pairs of contrasting traits (e.g., seed shape: round vs. wrinkled, and seed color: yellow vs. green).
- The parents are homozygous for both traits, one dominant and one recessive.
- The offspring are observed to determine the independent inheritance of these traits.

Example: Seed Shape and Color in Pea Plants

Parent Generation (P):

- Round Yellow seeds (RRYY) × Wrinkled Green seeds (rryy).

F_1 Generation:

- All plants have Round Yellow seeds (RrYy).

F_2 Generation:

- When F_1 plants are self-crossed (RrYy × RrYy), the phenotypic ratio is 9:3:3:1:

9 Round Yellow.

3 Round Green.

3 Wrinkled Yellow.

1 Wrinkled Green.

Aspect	**Monohybrid Cross**	**Dihybrid Cross**
Number of Traits	One trait (e.g., height)	Two traits (e.g., shape and color)
Number of Alleles	One pair of alleles	Two pairs of alleles
Phenotypic Ratio	3: 1	9: 3: 3: 1
Inheritance Law studied	Law of Segregation	Law of Independent Assortment

OR

What are sex-linked diseases ? Name any two sex-linked diseases.

Solution:

Sex-linked diseases are genetic disorders that arise due to mutations in genes located on the sex chromosomes (X and Y chromosomes). Since males and females have different combinations of sex chromosomes (XY for males and XX for females), the inheritance pattern of these diseases often differs between genders.

X-Linked Diseases:

- Most sex-linked diseases are caused by mutations in genes located on the X chromosome.
- Males (XY) are more commonly affected because they have only one X chromosome. A single defective gene on their X chromosome causes the disease.
- Females (XX) are often carriers, as they have a second normal X chromosome to compensate for the defective one.

Y-Linked Diseases:

- These are very rare because the Y chromosome contains relatively few genes.
- Only males are affected, as females lack a Y chromosome.

Examples of Sex-Linked Diseases:

1. Hemophilia (X-Linked):

- A disorder in which blood does not clot properly due to the absence of clotting factors.
- Commonly affects males, while females are usually carriers.
- Symptoms include prolonged bleeding, internal bleeding, and easy bruising.

2. Color Blindness (X-Linked):

- A condition in which a person cannot distinguish between certain colors, usually red and green.
- More common in males due to the single X chromosome.
- Females are generally carriers and rarely show symptoms.

(b) What is double circulation? Explain it.

Solution:

Double circulation is a type of blood circulation system in which blood passes through the heart twice in one complete cycle of the body. This ensures the separation of oxygen-rich blood and oxygen-poor blood, enabling efficient oxygen delivery to the body tissues.

Humans and other mammals exhibit double circulation, which is a characteristic feature of organisms with a four-chambered heart.

Types of Circulations in Double Circulation:

Pulmonary Circulation

- Blood flows from the heart to the lungs and back to the heart.
- Purpose: To oxygenate the blood by exchanging carbon dioxide for oxygen in the lungs.
- Pathway:

  Oxygen-poor blood from the right ventricle → Pulmonary artery → Lungs → Oxygen-rich blood returns to the left atrium via the pulmonary veins.

Systemic Circulation

- Blood flows from the heart to the rest of the body and back to the heart.
- Purpose: To deliver oxygen and nutrients to tissues and collect carbon dioxide and other wastes.
- Pathway:

  Oxygen-rich blood from the left ventricle → Aorta → Body tissues → Oxygen-poor blood returns to the right atrium via veins (e.g., vena cava).

Features of Double Circulation:

- Separation of Oxygenated and Deoxygenated Blood:

  Oxygenated blood is pumped to the body, while deoxygenated blood is directed to the lungs for oxygenation.

- Efficient Supply of Oxygen:

  The separation ensures that tissues receive blood rich in oxygen, which is essential for energy production and maintaining body functions.

- Four-Chambered Heart:

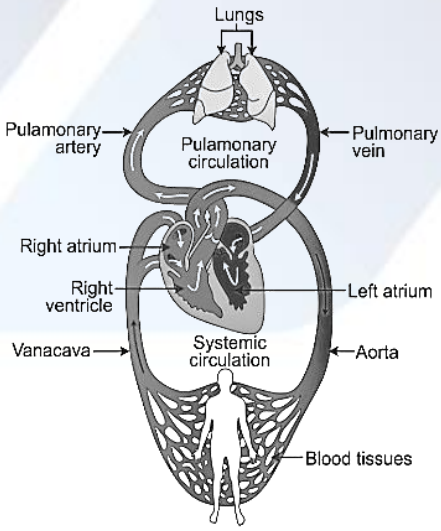
  The heart is divided into four chambers: two atria (right and left) and two ventricles (right and left).

  The right side handles deoxygenated blood, while the left side manages oxygenated blood.

Importance of Double Circulation:

- Efficient Gas Exchange: Maximizes the oxygen uptake in the lungs.
- Higher Energy Demand: Supports the high metabolic rate in warm-blooded animals.
- Prevents Mixing: Ensures oxygen-poor and oxygen-rich blood do not mix, providing sufficient oxygen to tissues.

Diagram of Double Circulation:



Pulmonary Circuit: Right Atrium → Right Ventricle → Lungs → Left Atrium.

Systemic Circuit: Left Atrium → Left Ventricle → Body → Right Atrium.

OR

What do you know about family planning? Describe any two methods of family planning.

Solution:

Family planning refers to the practices and methods adopted by individuals or couples to control the number and spacing of children. It aims to ensure proper health, economic stability, and overall well-being of the family. It plays a crucial role in population control and in improving maternal and child health.

Objectives of Family Planning:

- To prevent unintended pregnancies.
- To ensure proper spacing between children.
- To control population growth for societal and environmental sustainability.
- To promote reproductive health and reduce maternal and infant mortality.

Methods of Family Planning

Family planning methods are broadly categorized into temporary methods and permanent methods. Below are two commonly used methods of family planning:

1. Barrier Methods (Temporary Method)

Barrier methods prevent the sperm from meeting the egg, thus avoiding fertilization.

Examples:

Condoms: A sheath made of latex or polyurethane worn by males (or females) during intercourse. It prevents sperm from entering the female reproductive system.

Advantages:

Provides protection from sexually transmitted diseases (STDs) like HIV/AIDS.

Easily available and affordable.

Diaphragms or Cervical Caps: Devices inserted into the female reproductive tract to block sperm entry.

2. Oral Contraceptive Pills (Temporary Method)

Pills contain hormones (estrogen and progesterone) that prevent ovulation, making it impossible for an egg to be fertilized.

Advantages:

Highly effective when taken as prescribed.

Helps in regulating menstrual cycles.

Disadvantages:

May cause side effects like nausea or weight gain in some users.

Other Methods of Family Planning:

Intrauterine Devices (IUDs): A T-shaped device inserted into the uterus to prevent implantation of the fertilized egg.

Surgical Methods (Permanent):

Vasectomy: Surgical sterilization for males by cutting or blocking the vas deferens.

Tubectomy: Surgical sterilization for females by tying or cutting the fallopian tubes.

Importance of Family Planning

Health Benefits: Reduces health risks for mothers and children by preventing frequent pregnancies.

Economic Stability: Helps families plan their finances effectively by spacing or limiting children.

Population Control: Controls overpopulation, which impacts resources, healthcare, and education.

Q12. Differentiate between androecium and gynoecium. Explain functions of both and differentiate between pollination and and fertilization.

Solution:

Feature	Androecium	Gynoecium
Definition	Male reproductive part of a flower.	Female reproductive part of a flower.
Components	Consists of stamens (anther and filament).	Consists of carpels (stigma, style, ovary).
Function	Produces pollen grains (male gametes).	Produces ovules and houses the female gametes.
Location	Located inside the petals, around the gynoecium.	Located centrally in the flower.

Functions of Androecium and Gynoecium

Androecium (Male Reproductive Part):

Produces pollen grains in the anther, which contain male gametes.

Facilitates the transfer of pollen grains during pollination.

Gynoecium (Female Reproductive Part):

Produces ovules in the ovary, which contain female gametes (egg cells).

Provides a site for fertilization when the pollen grain reaches the ovule.

Pollination is the transfer of pollen, whereas fertilization is the fusion of gametes to initiate seed formation. Both are essential steps in sexual reproduction in flowering plants.

Self-pollination: Transfer of pollen grains from the anther to the stigma of the same flower or another flower of the same plant.

Cross-pollination: Transfer of pollen grains from the anther of one flower to the stigma of another flower of a different plant of the same species.

Explanation of Fertilization:

After pollination, the pollen grain germinates on the stigma and forms a pollen tube that travels down the style to the ovule in the ovary.

The male gamete in the pollen tube fuses with the female gamete (egg cell) in the ovule to form a zygote, which develops into a seed.

Feature	Pollination	Fertilization
Definition	Transfer of pollen grains from the anther to the stigma of a flower.	Fusion of male and female gametes to form a zygote.
Process	Occurs externally between flower parts.	Occurs internally within the ovary.
Types	Self-pollination and cross-pollination.	No such types; it is a singular process.
Outcome	Leads to pollen germination.	Leads to the formation of a zygote.
Agents	Involves agents like wind, water, insects, or animals.	Does not involve external agents.

OR

Explain Mendel's law of segregation by monohybrid cross and also explain the genotype and phenotype of generation obtained by it.

Solution:

Law of segregation states that during gamete formation, the alleles for each gene segregate from each other so that each gamete carries only one allele for each gene. the given example as the image shows that the F2 generation has 2 purple flowers and 1 white flower due segregation of alleles in the genes.