

Science - 824-EO - 2023 Question Paper with Solutions

Time Allowed :3 Hours

Maximum Marks :70

Total questions :35

General Instructions

Instruction:

- (i) First 15 minutes are allotted to students to read the question paper.
- (ii) The question paper is divided into two sections—Section (A) and Section (B).
- (iii) Section (A) and (B) are divided into three sub-sections: (a), (b), and (c).
- (iv) Questions in Section (A) are multiple choice type. Selecting the correct choice, fully colour the correct circle in the OMR sheet. Only blue or black ball point pen can be used.
- (v) 1 mark is allotted to each question of Section (A), which contains only multiple choice questions.
- (vi) Section (B) consists of descriptive questions.
- (vii) Marks allotted to each question are given on the right side of the question.
- (viii) It is necessary to answer all the questions of each sub-section of Section (B) altogether. Each sub-section should be started on a new page.
- (ix) All questions are compulsory.

1. A mirror producing a virtual image larger than the object is:

- (A) Plane
- (B) Concave
- (C) Convex
- (D) Any spherical

Correct Answer: (2) Concave

Solution:

Step 1: Understand the behavior of mirrors.

- **Plane mirrors** always produce **virtual, erect, and same-size** images. - **Convex mirrors** always produce **virtual, erect, and diminished** images. - **Concave mirrors** can produce a **virtual, erect, and magnified** image **only when the object is placed between the pole and the focus**. - **Spherical mirrors** include both concave and convex mirrors, but only **concave** mirrors can produce magnified virtual images.

Step 2: Conclude based on mirror behavior.

Only a **concave mirror** has the capability to produce a **virtual image larger than the object** under certain conditions.

Quick Tip

For image formation in mirrors: - Concave mirrors can produce both real and virtual images depending on the object position. - Virtual and magnified images are formed when the object is between the pole and focus of a concave mirror.

2. The human eye forms the image of an object at its:

- (A) iris
- (B) retina
- (C) pupil
- (D) cornea

Correct Answer: (2) retina

Solution:

Step 1: Understand the structure of the human eye.

- The **iris** controls the size of the pupil and regulates the amount of light entering the eye. -

The **pupil** is the opening through which light enters. - The **cornea** helps focus the incoming light. - The **retina** is the light-sensitive layer at the back of the eye where the image is formed.

Step 2: Conclude based on eye function.

The image of an object is always formed on the **retina**, where photoreceptor cells convert it into electrical signals sent to the brain.

Quick Tip

In the human eye: - The retina functions like the film in a camera. - It is the screen where the image is formed and processed.

3. The colour of white light which is deviated maximum on passing through the glass prism is:

- (A) yellow
- (B) violet
- (C) red
- (D) orange

Correct Answer: (2) violet

Solution:

Step 1: Understand dispersion of light through a prism.

When white light passes through a glass prism, it splits into its constituent colors due to different degrees of refraction. This phenomenon is called **dispersion**.

Step 2: Know the order of deviation.

The extent of deviation depends on the wavelength: - **Violet** has the **shortest wavelength** and is deviated the most. - **Red** has the **longest wavelength** and is deviated the least.

Step 3: Conclude based on deviation.

Hence, **violet** light is deviated the most when white light passes through a prism.

Quick Tip

Remember the VIBGYOR order when white light disperses: - Violet deviates the most, - Red deviates the least.

4. The current passing through an electric kettle has been doubled. The heat produced will become:

- (A) half
- (B) double
- (C) four times
- (D) one-fourth

Correct Answer: (3) four times

Solution:

Step 1: Use the formula for heat produced in an electrical circuit.

The heat produced is given by:

$$H = I^2 R t$$

Where: - H is the heat produced, - I is the current, - R is the resistance, - t is the time.

Step 2: Analyze the effect of doubling current.

If the current is doubled:

$$I' = 2I \Rightarrow H' = (2I)^2 R t = 4I^2 R t = 4H$$

Step 3: Conclude.

The heat produced becomes **four times** the original.

Quick Tip

Heat produced in a resistor depends on the square of the current: - Doubling the current increases heat by a factor of $2^2 = 4$.

5. The most suitable material for making the core of an electromagnet is:

- (A) brass
- (B) soft iron
- (C) aluminium
- (D) steel

Correct Answer: (2) soft iron

Solution:

Step 1: Understand the role of the core in an electromagnet.

The core of an electromagnet should: - Enhance the magnetic field, - Magnetize and demagnetize quickly with the current.

Step 2: Compare materials.

- **Soft iron** has high magnetic permeability and low retentivity, making it ideal. - **Steel** retains magnetism and is not easily demagnetized. - **Brass** and **aluminium** are non-magnetic materials.

Step 3: Conclude.

Thus, **soft iron** is the most suitable material for the core of an electromagnet.

Quick Tip

For electromagnets: - Use materials with high magnetic permeability and low retentivity. - Soft iron is preferred because it can quickly gain and lose magnetism.

7. Electric motor is a device which transforms:

- (A) mechanical energy into electrical energy
- (B) heat energy into electrical energy
- (C) electrical energy into heat energy
- (D) electrical energy into mechanical energy

Correct Answer: (4) electrical energy into mechanical energy

Solution:

Step 1: Understand the working principle of an electric motor.

An electric motor works on the principle of converting electrical energy into mechanical energy using the interaction between a magnetic field and current-carrying conductors.

Step 2: Conclude.

The electric motor transforms **electrical energy into mechanical energy**.

Quick Tip

Electric motors are used to power various devices by converting electrical energy into mechanical motion (like in fans, pumps, and electric vehicles).

8. Pure air is:

- (A) a homogeneous mixture

- (B) a mixture of metals
- (C) a mixture of compounds
- (D) None of the above

Correct Answer: (1) a homogeneous mixture

Solution:

Step 1: Understand the composition of pure air.

Pure air is a mixture of gases like nitrogen, oxygen, carbon dioxide, and traces of other gases. These gases are uniformly mixed, and their proportions can vary based on the environment, but the air itself is considered a homogeneous mixture.

Step 2: Conclude.

Since air is a mixture of gases that are evenly distributed, it is a **homogeneous mixture**.

Quick Tip

A homogeneous mixture has a uniform composition throughout, while a heterogeneous mixture has distinct components visible or separable.

9. Alkene is:

- (A) C₃H₆
- (B) C₂H₂
- (C) C₃H₈
- (D) C₄H₁₀

Correct Answer: (1) C₃H₆

Solution:

Step 1: Understand the structure of alkenes.

- Alkenes are hydrocarbons that contain at least one double bond between carbon atoms. -

The general formula for alkenes is C_nH_{2n} .

Step 2: Check the given options.

- C₃H₆ corresponds to an alkene with three carbon atoms and a double bond, so it is an alkene. - C₂H₂ is an alkyne (contains a triple bond). - C₃H₈ is an alkane (no double bond). - C₄H₁₀ is also an alkane.

Step 3: Conclude.

Thus, the correct answer is C_3H_6 , which represents an alkene.

Quick Tip

For hydrocarbons: - Alkenes contain at least one carbon-carbon double bond. - Alkynes have a triple bond, and alkanes have only single bonds.

10. pH value of pure water is:

- (A) 0
- (B) 1
- (C) 7
- (D) 10

Correct Answer: (3) 7

Solution:

Step 1: Understand the pH scale.

The pH scale measures the acidity or basicity of a solution, where: - A pH of 7 indicates a neutral solution. - A pH below 7 indicates an acidic solution. - A pH above 7 indicates a basic (alkaline) solution.

Step 2: Analyze the pH of pure water.

Pure water is neutral, with a pH of exactly 7 at 25°C .

Step 3: Conclude.

Thus, the pH value of pure water is 7.

Quick Tip

Water is neutral at a pH of 7, meaning it is neither acidic nor alkaline.

11. On moving from left to right in the third period of the periodic table:

- (A) Atomic number and atomic size increases
- (B) Atomic number and atomic size decreases
- (C) Atomic number increases and atomic size decreases
- (D) None of the above

Correct Answer: (3) Atomic number increases and atomic size decreases

Solution:

Step 1: Understand periodic trends.

- As you move from left to right across a period in the periodic table: - The **atomic number** increases because protons are being added to the nucleus. - The **atomic size (radius)** decreases because the increasing nuclear charge attracts electrons more strongly, pulling them closer to the nucleus.

Step 2: Conclude.

Thus, on moving from left to right in the third period, the **atomic number increases** and **atomic size decreases**.

Quick Tip

In periods of the periodic table: - Atomic size decreases as the effective nuclear charge increases (due to more protons), pulling electrons closer to the nucleus.

12. Tally the given substances in Column A with their applications in Column B.

Column A Column B

- a. Plaster of Paris i. formation of soap
b. Caustic soda ii. antibacterial
c. Sodium bicarbonate iii. formation of an idol
d. Bleaching powder iv. used for bleaching

The right set of the tally is:

- (A) a - i, b - ii, c - iii, d - iv
(B) a - ii, b - i, c - iv, d - iii
(C) a - iv, b - iii, c - ii, d - i
(D) a - iii, b - i, c - iv, d - ii

Correct Answer: (4) a - iii, b - i, c - iv, d - ii

Solution:

Step 1: Analyze the applications of each substance.

- **Plaster of Paris** is used for making molds and forming idols, so it matches with **iii** (formation of an idol). - **Caustic soda** (NaOH) is used in soap formation, so it matches with **i** (formation of soap). - **Sodium bicarbonate** (baking soda) is used for its bleaching properties, so it matches with **iv** (used for bleaching). - **Bleaching powder** is used as an

antibacterial agent, so it matches with **ii** (antibacterial).

Step 2: Conclude.

The correct set of the tally is: a - iii, b - i, c - iv, d - ii.

Quick Tip

Plaster of Paris is used in construction and making sculptures, while caustic soda is crucial for soap-making. - Sodium bicarbonate has a variety of uses, including as a deodorizer and in cleaning, while bleaching powder is often used for its disinfectant properties.

13. Which one of the following gives red colour with methyl orange?

(A) NaCl (Aq)

(B) Glucose (Aq)

(C) KOH (Aq)

(D) None of the above

Correct Answer: (3) KOH (Aq)

Solution:

Step 1: Understand the behaviour of methyl orange.

Methyl orange is a pH indicator that changes color depending on the acidity or basicity of the solution: - In acidic solutions, methyl orange turns red. - In basic solutions, it turns yellow.

Step 2: Analyze the options.

- **NaCl (Aq)** is a neutral salt and does not affect the color of methyl orange. - **Glucose (Aq)** is a neutral substance and does not affect the pH. - **KOH (Aq)** is a strong base and would turn methyl orange yellow, but since it's not acidic, it won't turn red.

Step 3: Conclude.

None of the above options would turn methyl orange red, as it requires an acidic solution.

Therefore, the correct answer is **None of the above**.

Quick Tip

Remember that methyl orange is used to test acidity. It turns red in acidic conditions and yellow in basic conditions.

14. An eco-friendly renewable source of energy is:

- (A) Wind energy
- (B) Petroleum energy
- (C) Natural gas
- (D) Coal

Correct Answer: (1) Wind energy

Solution:

Step 1: Understand the types of energy sources.

- **Wind energy** is a renewable and eco-friendly source of energy. It does not produce harmful emissions and is naturally replenished. - **Petroleum energy, natural gas, and coal** are all non-renewable fossil fuels that produce carbon emissions, making them environmentally harmful.

Step 2: Conclude.

Wind energy is the only eco-friendly renewable energy source listed in the options.

Quick Tip

Renewable energy sources, like wind, solar, and hydroelectric, are replenished naturally and have a minimal environmental impact compared to fossil fuels.

15. Mendel is famous:

- (A) In the field of heredity
- (B) For discovery of DNA
- (C) For eugenics
- (D) For conservation of biodiversity

Correct Answer: (1) In the field of heredity

Solution:

Step 1: Understand Mendel's contribution.

Gregor Mendel is known as the father of genetics. He conducted experiments with pea plants and formulated the laws of inheritance, which form the foundation of modern genetics.

Step 2: Analyze the options.

- Mendel is primarily famous for his work in **heredity** and the laws of inheritance. - The

discovery of DNA and eugenics are not linked to Mendel, but rather to later scientists like Watson, Crick, and others. - Conservation of biodiversity was not part of Mendel's work.

Step 3: Conclude.

Thus, Mendel is famous for his work **in the field of heredity**.

Quick Tip

Mendel's work on inheritance laid the foundation for the study of genetics. His experiments demonstrated how traits are passed from one generation to the next.

16. Sperms are formed in:

- (A) Vas deferens
- (B) Ovaries
- (C) Testes
- (D) Liver

Correct Answer: (3) Testes

Solution:

Step 1: Understand the male reproductive system.

- Sperms are produced in the **testes**, which are the male gonads. - The **vas deferens** is a tube that carries sperm from the testes to the urethra. - The **ovaries** are the female gonads where eggs are produced. - The **liver** is unrelated to the production of sperm.

Step 2: Conclude.

Sperms are formed in the **testes**.

Quick Tip

Sperm production occurs in the testes through a process called spermatogenesis, which occurs in specialized structures called seminiferous tubules.

17. Alveoli occur in:

- (A) Liver
- (B) Stomach
- (C) Lungs
- (D) Heart

Correct Answer: (3) Lungs

Solution:

Step 1: Understand the structure and function of alveoli.

- **Alveoli** are tiny air sacs located in the lungs where gas exchange occurs. They allow oxygen to enter the blood and carbon dioxide to be removed. - The **liver, stomach,** and **heart** do not contain alveoli.

Step 2: Conclude.

Thus, **alveoli occur in the lungs.**

Quick Tip

The alveoli are the functional units of the lungs, where the exchange of oxygen and carbon dioxide takes place during breathing.

18. For the transport of water, plants have:

- (A) Phloem
- (B) Stomata
- (C) Pith
- (D) Xylem

Correct Answer: (4) Xylem

Solution:

Step 1: Understand the role of plant tissues.

- **Phloem** is responsible for transporting the products of photosynthesis (mainly sugars) throughout the plant. - **Stomata** are pores found on the leaves and stems that allow for gas exchange and transpiration, but they are not responsible for water transport. - **Pith** is a tissue found in the center of plant stems and is mainly involved in storage, not water transport. - **Xylem** is the tissue responsible for transporting water and minerals from the roots to other parts of the plant.

Step 2: Conclude.

Thus, plants use **xylem** for the transport of water.

Quick Tip

Xylem vessels are specialized for water and mineral transport in plants, and phloem vessels are specialized for transporting food.

19. Normal blood pressure of a healthy human is:

- (A) 140/80
- (B) 120/80
- (C) 135/100
- (D) 125/115

Correct Answer: (2) 120/80

Solution:

Step 1: Understand normal blood pressure.

The normal blood pressure for a healthy adult human is typically around **120/80 mmHg**. -

The first number (120) is the systolic pressure, which is the pressure when the heart beats. -

The second number (80) is the diastolic pressure, which is the pressure when the heart rests between beats.

Step 2: Conclude.

The correct normal blood pressure is **120/80**.

Quick Tip

A blood pressure reading above 120/80 may indicate hypertension or other cardiovascular issues, depending on the numbers.

20. Who among the following is famous as the 'Water Man of India'?

- (A) Bindeshwar Pathak
- (B) J.C. Chaudhry
- (C) Rajendra Singh
- (D) Sunderlal Bahuguna

Correct Answer: (3) Rajendra Singh

Solution:

Step 1: Understand the contributions of the individuals.

- **Rajendra Singh** is known as the 'Water Man of India' for his work in water conservation and rainwater harvesting, particularly in Rajasthan. His efforts have revived many water bodies. - **Bindeshwar Pathak** is known for his work in sanitation and the creation of the Sulabh Shauchalaya. - **J.C. Chaudhry** is a well-known educationist, not associated with water conservation. - **Sunderlal Bahuguna** was an environmentalist famous for his involvement in the Chipko movement but not specifically for water conservation.

Step 2: Conclude.

Thus, **Rajendra Singh** is known as the 'Water Man of India'.

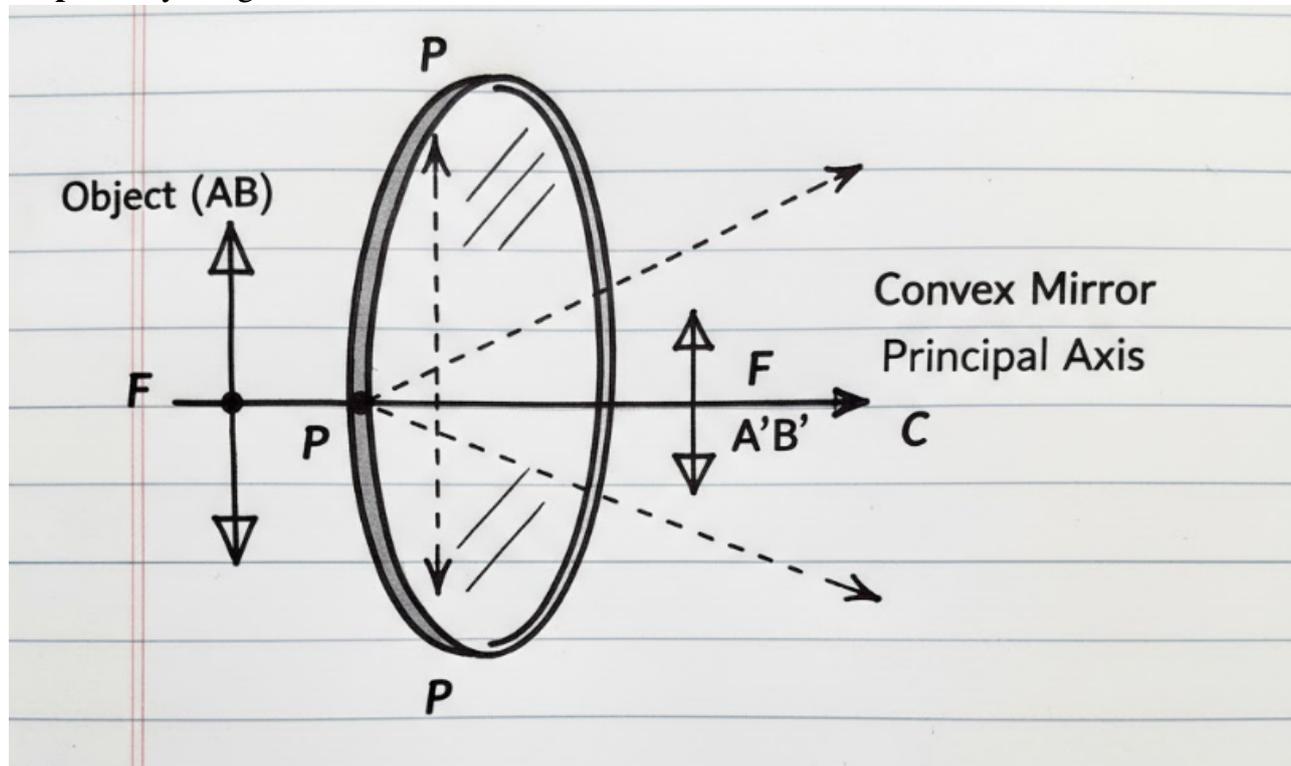
Quick Tip

Rajendra Singh's work on water conservation, including the revival of traditional water systems, has earned him international recognition.

21. Draw a labelled ray diagram to show the formation of the image of an object placed between the pole and infinity by a convex mirror. State the properties of the image formed. Why do we prefer a convex mirror as a rear-view mirror in vehicles?

Solution:

Step 1: Ray Diagram for a convex mirror.



Step 2: Properties of the image formed.

- The image formed by a convex mirror is **virtual, erect, and diminished**. - The image is formed behind the mirror and is smaller than the object, regardless of the position of the object (between the pole and infinity).

Step 3: Why a convex mirror is preferred as a rear-view mirror in vehicles.

- **Wide field of view:** Convex mirrors diverge light rays, making it easier to see a wide area behind the vehicle, providing a larger field of view compared to flat or concave mirrors. -

Virtual, erect, and diminished image: The image formed is always smaller and upright, which makes it easier to view vehicles or objects behind the driver, preventing the image from being distorted. -

Safety: Since the image is smaller, the driver can see a broader area, reducing blind spots and increasing safety.

Quick Tip

Convex mirrors are widely used for safety purposes in vehicles and in places like shopping malls, due to their ability to offer a wide angle of view.

22. Explain with a drawing how hypermetropia is corrected. The near point of a hypermetropic eye is 75 cm. What is the focal length of the lens required to correct this defect? The near point of a normal eye is 25 cm.

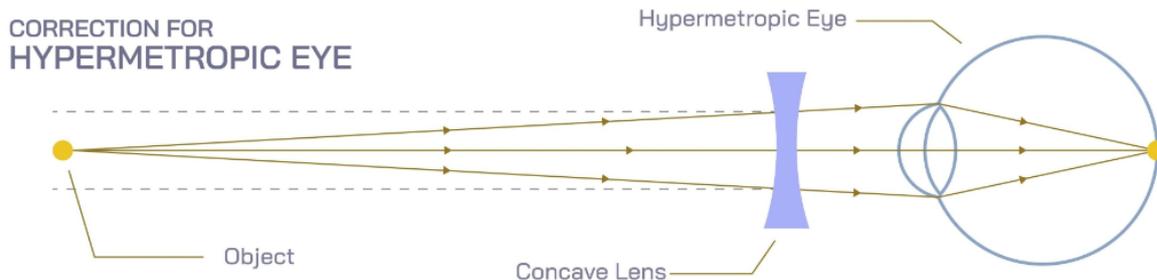
Solution:

Step 1: Understand hypermetropia.

- Hypermetropia, or farsightedness, is a defect in the eye where the near point is farther away than normal. In this case, the near point is 75 cm, whereas for a normal eye, the near point is 25 cm. - The defect occurs when the eye's focal point falls behind the retina, making it difficult to focus on nearby objects.

Step 2: Correction of hypermetropia.

Hypermetropia can be corrected by using a **convex lens**, which converges the light before it enters the eye. The lens brings the image of nearby objects to the normal near point (25 cm).



Step 3: Calculation of focal length.

To calculate the focal length of the lens required to correct the defect, we can use the lens formula:

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

Where: - f is the focal length of the lens, - v is the image distance (which, for correction, is the normal near point of 25 cm), - u is the object distance (which is the near point of the hypermetropic eye, 75 cm).

$$\frac{1}{f} = \frac{1}{25} - \frac{1}{75}$$

Calculating the right-hand side:

$$\frac{1}{f} = \frac{3 - 1}{75} = \frac{2}{75}$$

Thus, the focal length f is:

$$f = \frac{75}{2} = 37.5 \text{ cm}$$

Step 4: Conclusion.

The focal length of the lens required to correct the hypermetropic defect is **37.5 cm**.

Quick Tip

For correcting hypermetropia, a convex lens with a focal length equal to the difference between the near points of the defective and normal eye is used.

23. On what factors does the resistance of a conductor depend? An electric bulb operated at 80 volts takes 10 amperes of current. How much resistance should be connected in series with the bulb to use it at 240 volts so that it takes the same current?

Solution:

Step 1: Factors affecting the resistance of a conductor.

The resistance of a conductor depends on the following factors: 1. **Length of the conductor**

(L): The resistance is directly proportional to the length of the conductor. As the length increases, resistance increases.

$$R \propto L$$

2. **Cross-sectional area (A):** The resistance is inversely proportional to the cross-sectional area of the conductor. As the area increases, the resistance decreases.

$$R \propto \frac{1}{A}$$

3. **Material of the conductor:** The resistance depends on the material's resistivity, denoted by ρ . Each material has a characteristic resistivity that determines its resistance.

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

4. **Temperature of the conductor:** The resistance of most conductors increases with temperature.

Step 2: Calculating the required resistance to use the bulb at 240 volts.

We are given: - The voltage $V_1 = 80 \text{ V}$, - The current $I_1 = 10 \text{ A}$, - The voltage $V_2 = 240 \text{ V}$, - The current $I_2 = I_1 = 10 \text{ A}$ (since we want the same current).

First, calculate the resistance of the bulb at 80 V using Ohm's law:

$$R_1 = \frac{V_1}{I_1} = \frac{80}{10} = 8 \Omega$$

Now, when the bulb is used at 240 V, we want the same current (10 A) to flow through the bulb. The total resistance in the circuit must be such that:

$$R_{\text{total}} = \frac{V_2}{I_2} = \frac{240}{10} = 24 \Omega$$

Since the resistance of the bulb R_1 is already 8Ω , the resistance R_{series} to be connected in series must be:

$$R_{\text{series}} = R_{\text{total}} - R_1 = 24 - 8 = 16 \Omega$$

Step 3: Conclusion.

The resistance that should be connected in series with the bulb to use it at 240 V and maintain the same current of 10 A is **16 Ω** .

Quick Tip

When using electrical devices at higher voltages, resistances in series can help regulate the current to the desired value by limiting the total current according to Ohm's law:

$$I = \frac{V}{R}.$$

24. Define Kilowatt hour. How many Joules are equal to 1 kilowatt-hour? An electric kettle rated 220 volts, 2.2 kilowatts works for 3 hours. Calculate energy consumed and the current.

Solution:

Step 1: Definition of Kilowatt-hour.

A **kilowatt-hour** (kWh) is the amount of energy consumed by a device with a power rating of 1 kilowatt operating for 1 hour. It is a unit of energy commonly used by electric utilities to measure electrical energy consumption.

$$1 \text{ kWh} = 1 \text{ kilowatt} \times 1 \text{ hour}$$

Step 2: Conversion of Kilowatt-hour to Joules.

We know that:

$$1 \text{ kilowatt} = 1000 \text{ watts} \quad \text{and} \quad 1 \text{ hour} = 3600 \text{ seconds}$$

Thus, the energy in Joules for 1 kWh is:

$$1 \text{ kWh} = 1000 \text{ watts} \times 3600 \text{ seconds} = 3,600,000 \text{ Joules}$$

So, $1 \text{ kWh} = 3,600,000 \text{ Joules}$.

Step 3: Calculation of energy consumed by the electric kettle.

The power rating of the electric kettle is 2.2 kilowatts (kW), and it works for 3 hours.

Energy consumed E is given by the formula:

$$E = P \times t$$

Where: - $P = 2.2 \text{ kW}$ (power of the kettle), - $t = 3 \text{ hours}$.

Thus:

$$E = 2.2 \text{ kW} \times 3 \text{ hours} = 6.6 \text{ kWh}$$

Now, convert energy to Joules:

$$E = 6.6 \text{ kWh} \times 3,600,000 \text{ Joules} = 23,760,000 \text{ Joules}$$

Step 4: Calculation of the current.

The electric kettle operates at a voltage of 220 volts, and its power is 2.2 kW.

We can use the formula for electrical power:

$$P = V \times I$$

Where: - $P = 2.2 \text{ kW} = 2200 \text{ W}$ (convert to watts), - $V = 220 \text{ V}$ (voltage), - I is the current.

Rearranging the formula to solve for current:

$$I = \frac{P}{V} = \frac{2200}{220} = 10 \text{ A}$$

Step 5: Conclusion.

- The energy consumed by the electric kettle in 3 hours is **23,760,000 Joules**. - The current drawn by the electric kettle is **10 amperes**.

Quick Tip

To calculate energy consumed, use the formula $E = P \times t$. For power in watts and time in hours, the energy in kWh can be converted to Joules by multiplying by 3,600,000.

OR

State the two ways to increase the force on a current-carrying conductor in a magnetic field. Name one device whose working depends on this effect. State Fleming's left-hand rule with the help of a well-labelled diagram.

Solution:

Step 1: Two ways to increase the force on a current-carrying conductor in a magnetic field.

The force on a current-carrying conductor in a magnetic field depends on three factors: the magnetic field strength, the current, and the length of the conductor in the magnetic field. To increase the force, the following changes can be made:

1. ****Increase the current****: According to the formula $F = BIL \sin \theta$, the force is directly proportional to the current (I). Therefore, increasing the current will increase the force.

2. ****Increase the magnetic field strength****: The force is directly proportional to the magnetic field strength (B). Increasing the strength of the magnetic field will increase the force.

Step 2: Name a device that works on this effect.

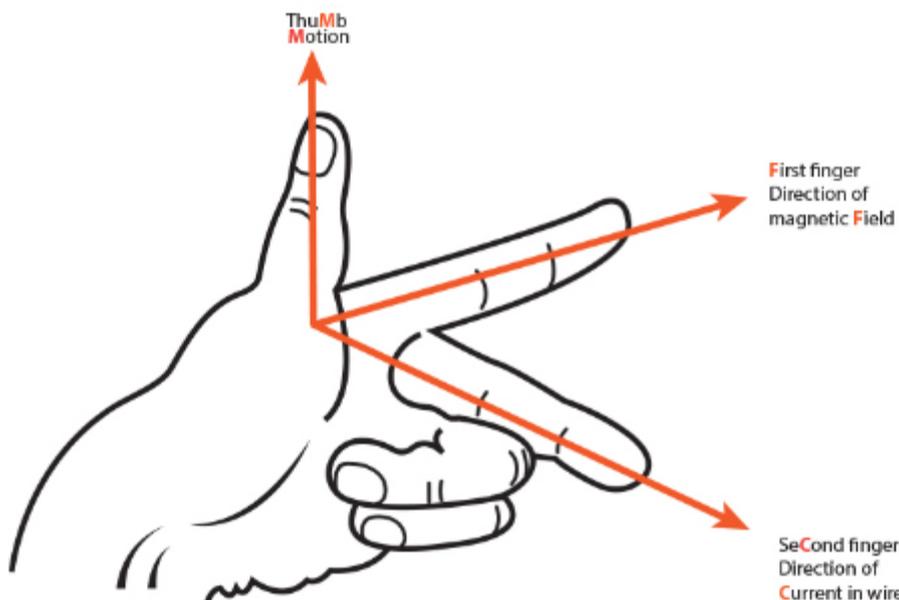
One device whose working depends on this effect is the ****electric motor****. In an electric motor, a current-carrying conductor placed in a magnetic field experiences a force, causing the motor to rotate.

Step 3: Fleming's Left-Hand Rule.

Fleming's Left-Hand Rule is used to determine the direction of the force acting on a current-carrying conductor in a magnetic field. It states:

“If you stretch the thumb, forefinger, and middle finger of your left hand so that they are mutually perpendicular to each other, then: - The **Forefinger** represents the direction of the magnetic field (B). - The **Middle finger** represents the direction of the current (I). - The **Thumb** will point in the direction of the force (F) acting on the conductor.”

Step 4: Diagram for Fleming's Left-Hand Rule.



The diagram above shows the orientation of the left hand when applying Fleming's Left-Hand Rule. The thumb, forefinger, and middle finger are all at right angles to each other. The direction of the force acting on the conductor is determined by the thumb, while the magnetic field and current directions are indicated by the forefinger and middle finger, respectively.

Quick Tip

Fleming's Left-Hand Rule helps determine the direction of motion of a current-carrying conductor in a magnetic field, which is essential in the working of motors.

25. Write IUPAC names of the following compounds:



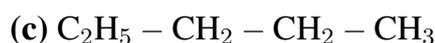
Solution: This compound consists of a vinyl group (ethene) with a chloro and hydroxyl group attached to a three-carbon chain.

IUPAC Name: **3-Chloro-2-propen-1-ol**



Solution: This compound consists of a carboxyl group attached to a two-carbon chain with a propyl group attached.

IUPAC Name: **3-Methylbutanoic acid**



$\text{C}_2\text{H}_5\text{C}_2\text{H}_5$ **Solution:** This compound consists of a butyl group (4 carbon chain) attached to two ethyl groups. IUPAC



Solution: This compound consists of an alkyl chain with iodine and bromine as substituents.

IUPAC Name: **1-Bromo-2-iodoethane**

Quick Tip

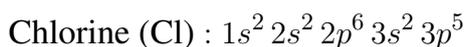
When naming organic compounds, follow the IUPAC rules for naming alkanes, alkenes, alkynes, and functional groups based on their position and nature of bonding. Always check for the longest chain and number it to give the lowest possible locants to the substituents.

26. Write the electronic configuration of chlorine (atomic number 17). Explain its position in the periodic table and write its valency.

Solution:

Step 1: Electronic configuration of chlorine.

The atomic number of chlorine is 17, which means it has 17 electrons. The electronic configuration is written by filling the orbitals in the order of increasing energy:



This configuration indicates: - 2 electrons in the first shell (1s), - 8 electrons in the second shell (2s and 2p), - 7 electrons in the third shell (3s and 3p).

Step 2: Position of chlorine in the periodic table.

- Chlorine is a member of **Group 17** (also known as **Group VIIA**), which is the **halogen group**. - It is in the **third period** of the periodic table. - Chlorine has a total of 7 valence electrons in its outermost shell

($3p^5$), which makes it highly reactive, especially in forming salts with metals.

Step 3: Valency of chlorine.

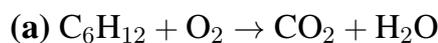
- The valency of chlorine is **1**. This is because chlorine needs one more electron to complete its octet and achieve the stable electronic configuration of argon (a noble gas). - Therefore, chlorine can gain one electron to form a negatively charged ion (Cl), or it can form a covalent bond by sharing one electron with another atom (such as hydrogen in HCl).

Conclusion: The electronic configuration of chlorine is $1s^2 2s^2 2p^6 3s^2 3p^5$, it belongs to Group 17 (halogens) and the third period, and its valency is 1.

Quick Tip

Halogens like chlorine have 7 valence electrons and are highly reactive because they need one more electron to achieve a stable octet. This makes them strong oxidizing agents and reactive in forming ionic or covalent compounds.

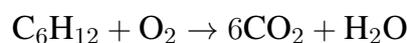
27. Balance the following chemical equations:



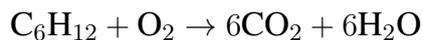
Solution:

The given equation is the combustion of cyclohexane. To balance it:

1. Count the atoms on both sides: - Carbon (C): 6 atoms on the left (in CH). - Hydrogen (H): 12 atoms on the left. - Oxygen (O): 2 atoms on the left in O.
2. Balance carbon atoms first by placing a 6 in front of CO:



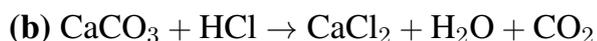
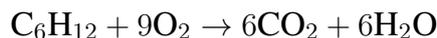
3. Next, balance hydrogen by placing a 6 in front of HO:



4. Finally, balance oxygen. On the right, we have $6 \times 2 = 12$ oxygen atoms in CO and 6 oxygen atoms in HO, for a total of 18 oxygen atoms. Place a 9 in front of O:



The balanced equation is:



Solution:

1. Calcium carbonate reacts with hydrochloric acid to form calcium chloride, water, and carbon dioxide. Let's balance it:

- Balance calcium by placing a 1 in front of CaCl:



- Balance chlorine by placing 2 HCl on the left:



- Balance hydrogen by placing 1 molecule of HO on the right:



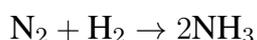
The balanced equation is:



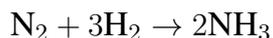
Solution:

This is the synthesis of ammonia (Haber process). To balance it:

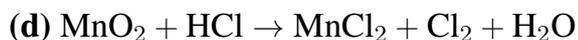
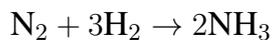
1. On the left, nitrogen (N) has 2 atoms, and hydrogen (H) has 2 atoms. 2. On the right, ammonia (NH) contains 1 nitrogen and 3 hydrogens. To balance hydrogens, place a 3 in front of NH:



3. Now balance nitrogen. Place a 1 in front of N on the left:



The balanced equation is:



Solution:

1. Balance manganese by placing a 1 in front of MnCl:



2. Balance chlorine by placing 4 HCl on the left:



3. Balance hydrogen by placing 2 HO on the right:



4. Finally, balance oxygen by placing 1 MnO on the left:



The balanced equation is:



Quick Tip

To balance chemical equations, start by balancing the atoms of elements that appear only once on each side. Then proceed to balance atoms that appear in multiple compounds. Always check the final equation for consistency.

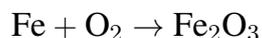
OR

Write short notes on the following:

(a) Oxidation Reaction

Solution:

Oxidation is a chemical reaction in which a substance loses electrons or increases its oxidation state. It is often accompanied by the addition of oxygen or the removal of hydrogen. In oxidation reactions, the substance that loses electrons is said to be oxidized. For example, when iron rusts, it undergoes oxidation:

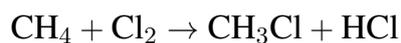


Here, iron (Fe) reacts with oxygen (O) to form iron oxide (rust), and iron is oxidized.

(b) Substitution Reaction

Solution:

A substitution reaction is a type of chemical reaction where an atom or a group of atoms in a molecule is replaced by another atom or group of atoms. This is commonly observed in organic chemistry, particularly in the reactions of halogens with hydrocarbons. For example, in the reaction of methane with chlorine, one hydrogen atom is replaced by a chlorine atom:

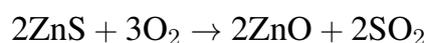


This is a substitution reaction where chlorine (Cl) replaces one hydrogen atom in methane (CH₄) to form chloromethane (CH₃Cl).

(c) Roasting

Solution:

Roasting is a process in metallurgy where ores are heated in the presence of oxygen. It is primarily used to extract metal from its ores by converting them into oxides, which can then be reduced to obtain the metal. For example, roasting of zinc blende (ZnS) produces zinc oxide (ZnO):



Roasting is commonly used for the extraction of metals like zinc, copper, and iron from their sulfide ores.

Quick Tip

In oxidation reactions, the substance that loses electrons is oxidized, and in substitution reactions, atoms or groups are swapped within a molecule.

28. Describe Mendel's Laws.

Solution:

Mendel's laws of inheritance are the foundation of classical genetics. They describe how traits are inherited from one generation to the next. These laws are based on Mendel's experiments with pea plants. There are three main laws:

1. Law of Dominance:

This law states that in a heterozygous organism, the dominant allele will express its trait, while the recessive allele will be masked. In simple terms, when two different alleles are present, the dominant one will determine the organism's appearance.

Example: In pea plants, the allele for round seeds (R) is dominant over the allele for wrinkled seeds (r). Therefore, a plant with the genotype Rr will have round seeds.

R (Round seed) > r (Wrinkled seed)

2. Law of Segregation:

This law states that every organism possesses two alleles for each trait, one inherited from each parent. These alleles segregate (separate) during the formation of gametes (egg and sperm), so each gamete carries only one allele for each trait.

Example: In a cross between two heterozygous pea plants (Rr), the offspring can inherit either the R or r allele from each parent.

Gametes: R or r

Resulting Genotypes: 1 RR : 2 Rr : 1 rr

3. Law of Independent Assortment:

This law states that genes for different traits are inherited independently of one another, provided they are located on different chromosomes. This means the inheritance of one trait does not affect the inheritance of another trait.

Example: In a dihybrid cross between two heterozygous pea plants (RrYy × RrYy), the traits for seed shape (R/r) and seed color (Y/y) assort independently.

Possible Gametes: RY, Ry, rY, ry

F2 Generation Phenotypic Ratio: 9 : 3 : 3 : 1

Conclusion:

Mendel's laws of inheritance laid the foundation for our understanding of genetics. These laws explain how traits are passed from parents to offspring and how genetic variation arises in populations.

Quick Tip

Mendel's laws apply to traits controlled by single genes with clear dominant and recessive alleles. More complex inheritance patterns, such as co-dominance and polygenic inheritance, occur in nature.

29. Give an account of post-fertilization changes in an angiospermic plant.

Solution:

In angiospermic (flowering) plants, post-fertilization refers to the changes that occur after the fertilization of the egg cell. The main processes that occur after fertilization include the development of the seed and fruit, as well as the formation of the embryo. Below are the key steps involved in post-fertilization changes:

1. Formation of the Zygote: - During fertilization, the male gamete (sperm) fuses with the female gamete (egg cell) to form a zygote. This fertilized egg cell will later develop into the embryo within the seed.

2. Development of the Embryo: - The zygote undergoes a series of divisions and differentiations to form the embryo. The embryo consists of the following parts: -

Cotyledons: These are the seed leaves and are the first to appear in the developing embryo. They store nutrients and provide energy for the young seedling during germination. -

Radicle: The embryonic root that will later develop into the mature root system of the plant.

- **Plumule:** The embryonic shoot that will develop into the stem and leaves of the plant.

3. Formation of Endosperm: - In addition to the zygote, the second male gamete fuses with the two polar nuclei present in the central cell of the ovule to form the triploid endosperm. - The endosperm acts as a food reserve for the developing embryo and provides nourishment during seed germination.

4. Seed Coat Formation: - The outer integuments of the ovule develop into the seed coat (testa). The seed coat protects the embryo and provides resistance to desiccation and mechanical damage.

5. Ovary Transforms into Fruit: - After fertilization, the ovary of the flower matures into a fruit. The walls of the ovary thicken and develop into the fruit's pericarp (fruit wall). The fruit contains the seeds, and its role is to protect the seeds and aid in their dispersal. - In some plants, the fruit is fleshy (e.g., apples, berries), while in others, it may be dry (e.g., legumes, nuts).

6. Formation of Seed: - The fertilized ovule develops into a seed, which consists of the embryo, the endosperm, and the seed coat. The seed is the means of reproduction and dispersal in angiospermic plants. - The seed contains stored food reserves (mainly in the endosperm or cotyledons) that are utilized during germination to nourish the developing plant.

7. Ripening of Fruit: - After fertilization, the fruit continues to mature, a process known as ripening. This involves changes in the color, texture, and taste of the fruit, making it attractive for seed dispersal. - In some plants, ripening involves the conversion of starches to sugars, which makes the fruit sweeter and more appealing to animals that will aid in seed dispersal.

8. Dispersal of Seeds: - Once the fruit has ripened, the seeds are ready to be dispersed. Seed dispersal mechanisms include wind, water, animals, or mechanical forces. Successful seed dispersal ensures that the seeds can grow in new locations, away from the parent plant.

Conclusion: Post-fertilization changes in angiospermic plants involve a series of steps that lead to the formation of seeds and fruits. The development of the embryo, endosperm, and seed coat, as well as the maturation of the ovary into a fruit, are crucial steps for the successful reproduction and dispersal of the plant.

Quick Tip

Post-fertilization changes are essential for the formation of seeds, which are the primary means of reproduction in angiospermic plants. The development of the embryo, endosperm, and fruit ensures that the plant can successfully reproduce and spread.

30. In order to save the environment, describe the five types of 'R'.

Solution:

The "five Rs" are a set of principles for sustainable living that can help reduce environmental impact and promote a cleaner, healthier planet. These five principles are:

1. Reduce:

Reducing means cutting down on the amount of waste and consumption. The goal is to consume less and avoid excess. By reducing our use of non-essential goods and opting for products that last longer or have less packaging, we can significantly lower the strain on resources and reduce pollution.

- Example: Using energy-efficient appliances, reducing water usage, and purchasing products with minimal packaging.

2. Reuse:

Reusing involves finding ways to use products and materials multiple times before discarding them. By reusing, we can extend the life of products, reduce waste, and minimize the need for new materials to be produced.

- Example: Using glass jars to store food instead of throwing them away, or repurposing old clothes into rags or other items.

3. Recycle:

Recycling refers to the process of converting waste materials into new products to prevent waste of potentially useful materials. By recycling, we reduce the need for extracting new raw materials, decrease pollution, and conserve energy.

- Example: Recycling paper, plastic, glass, and metal items that can be repurposed into new products.

4. Refuse:

Refusing means saying no to products or practices that harm the environment. By refusing unnecessary single-use plastics, toxic chemicals, or non-recyclable materials, we can prevent pollution and reduce demand for environmentally harmful products.

- Example: Refusing to use plastic bags and opting for reusable bags instead, or saying no to bottled water.

5. Rot (Composting):

Rotting refers to composting organic waste, such as food scraps and yard trimmings, into

nutrient-rich soil. Composting reduces the amount of waste sent to landfills, enriches the soil, and promotes sustainable agriculture.

- Example: Composting vegetable peels, coffee grounds, and lawn clippings to create compost for gardening.

Conclusion:

By practicing the five Rs—**Reduce**, **Reuse**, **Recycle**, **Refuse**, and **Rot**—we can all contribute to reducing our environmental footprint and help create a more sustainable world. These practices reduce waste, conserve resources, and minimize pollution, benefiting both the planet and future generations.

Quick Tip

By focusing on the five Rs, we can make significant strides in reducing our impact on the environment and promoting sustainability. Every small action contributes to a healthier planet!

31. Describe the male reproductive system of humans.

Solution:

The male reproductive system is responsible for producing sperm, the male gametes, and transferring them to the female reproductive system for fertilization. It consists of various internal and external structures. Below are the main components:

1. Testes:

The testes are the primary male reproductive organs that produce sperm and the hormone testosterone. They are located in the scrotum, a sac outside the body that helps maintain a temperature slightly lower than the body's temperature, which is essential for sperm production.

- **Structure:** Each testis contains coiled structures called seminiferous tubules, where sperm are produced through the process of spermatogenesis. - **Function:** The testes also secrete testosterone, which is responsible for the development of male secondary sexual characteristics.

2. Epididymis:

The epididymis is a long, coiled tube attached to the back of each testis. It serves as the site

where sperm mature and are stored.

- **Structure:** It consists of three parts: the head, body, and tail. - **Function:** Sperm mature in the epididymis, gaining the ability to swim and fertilize an egg. The sperm are stored in the tail of the epididymis until ejaculation.

3. Vas Deferens:

The vas deferens is a muscular tube that transports mature sperm from the epididymis to the urethra during ejaculation.

- **Structure:** It passes through the inguinal canal and into the pelvic cavity. -

Function: The vas deferens is responsible for carrying sperm from the epididymis to the urethra, where it mixes with seminal fluid to form semen.

4. Seminal Vesicles:

The seminal vesicles are a pair of glands located behind the bladder. They secrete a thick, alkaline fluid that contains fructose, which provides energy for sperm.

- **Function:** The fluid from the seminal vesicles combines with sperm to form semen, which is ejaculated during intercourse.

5. Prostate Gland:

The prostate gland is located below the bladder and surrounds the urethra. It secretes a milky, alkaline fluid that helps neutralize the acidic environment of the female reproductive tract, providing an optimal pH for sperm survival.

- **Function:** The prostate's secretions form a part of the semen and enhance sperm motility and survival.

6. Bulbourethral Glands (Cowper's Glands):

The bulbourethral glands are small glands located beneath the prostate. They secrete a clear, alkaline fluid that lubricates the urethra and neutralizes any acidic urine that may remain in the urethra.

- **Function:** The secretions from the bulbourethral glands help protect sperm from damage during ejaculation and provide lubrication.

7. Urethra:

The urethra is a tube that carries urine from the bladder and semen from the reproductive system to the outside of the body.

- **Structure:** It passes through the penis and opens at the tip. - **Function:** During

ejaculation, the urethra transports semen, which contains sperm, to the outside. It also transports urine from the bladder but not at the same time as semen.

8. Penis:

The penis is the external organ through which semen is delivered to the female reproductive system. It consists of the shaft, glans, and urethra.

- **Structure:** The penis contains erectile tissue that fills with blood during sexual arousal, causing an erection. - **Function:** The penis delivers sperm into the female reproductive tract during sexual intercourse.

Conclusion:

The male reproductive system is a complex network of organs and glands that work together to produce, mature, and deliver sperm to the female reproductive system for fertilization.

Key components include the testes, epididymis, vas deferens, seminal vesicles, prostate gland, bulbourethral glands, urethra, and penis.

Quick Tip

The male reproductive system relies on both internal and external structures working together to produce sperm and facilitate fertilization. Hormones like testosterone play a key role in the development of male sexual characteristics.

OR

Write an essay on sexual reproduction in flowering plants.

Solution:

Sexual reproduction in flowering plants is a complex but essential process for the production of seeds, which are necessary for the next generation of plants. It involves the fusion of male and female gametes (sperm and egg cells) to form a zygote. This process not only ensures genetic diversity but also the survival of plant species. Below is a detailed account of the process of sexual reproduction in flowering plants.

1. Pollination:

Pollination is the first step in sexual reproduction in flowering plants. It is the transfer of pollen grains from the male part (anther) to the female part (stigma) of a flower. Pollination can occur through various agents: - **Abiotic factors:** Wind and water can carry pollen

from one plant to another. - **Biotic factors**: Insects, birds, and other animals, such as bees and butterflies, help pollinate flowers by transferring pollen as they visit flowers to collect nectar.

Pollination can be **self-pollination** (pollen from the same flower or plant fertilizes the ovule) or **cross-pollination** (pollen from one flower fertilizes the ovule of another flower of the same species).

2. Fertilization:

After successful pollination, the pollen grain germinates on the stigma and forms a pollen tube. This tube grows down the style to reach the ovule inside the ovary. The male gamete (sperm cell) travels through the pollen tube to reach the female gamete (egg cell) inside the ovule. Fertilization occurs when the sperm cell fuses with the egg cell, forming a diploid zygote.

In some plants, the process of fertilization is more complex and involves the fusion of a second sperm cell with the two polar nuclei in the ovule, resulting in the formation of the triploid endosperm. The endosperm will later provide nutrition to the developing embryo.

3. Formation of Seeds:

Once fertilization occurs, the fertilized ovule develops into a seed. The zygote inside the ovule undergoes cell division and differentiation to form the embryo, which consists of the following structures: - **Cotyledons**: The seed leaves that store nutrients for the developing plant. - **Radicle**: The embryonic root that will develop into the plant's root system. - **Plumule**: The embryonic shoot that will develop into the stem and leaves. The ovule's integuments (protective layers) transform into the seed coat, which protects the developing embryo.

At the same time, the surrounding ovary begins to mature into a fruit, and the fruit's pericarp (wall) develops to encase the seeds. The fruit helps in seed dispersal.

4. Seed Dispersal:

Once the fruit is ripe, it facilitates seed dispersal. The dispersal mechanisms include: - **Wind**: Seeds may have wings or fluffy structures that allow them to be carried by the wind (e.g., dandelions). - **Water**: Seeds may float and be carried by water (e.g., coconuts). - **Animals**: Seeds may be carried by animals that eat the fruit and later excrete the seeds elsewhere. - **Mechanical Dispersal**: Some plants have pods that burst

open, scattering seeds (e.g., peas, beans).

Dispersal ensures that the seeds can grow in a new location, away from the parent plant, reducing competition for resources.

5. Germination:

Once the seed reaches a suitable environment, it undergoes germination. During germination, the seed absorbs water and swells, breaking the seed coat. The radicle grows downward to anchor the plant and absorb water, while the plumule grows upward toward the light to form the shoot.

Germination continues as the cotyledons provide energy to the developing plant until the first true leaves emerge and photosynthesis begins.

Conclusion:

Sexual reproduction in flowering plants is essential for genetic diversity and the continuation of plant species. The process involves a series of steps, including pollination, fertilization, seed formation, seed dispersal, and germination. By ensuring that plants can reproduce sexually, they contribute to the biodiversity and resilience of ecosystems.

Quick Tip

Sexual reproduction in plants not only leads to the formation of seeds but also increases genetic variability, which helps plants adapt to changing environments and resist diseases.