

UP Board Class 10 Science - 824(CJ) - 2025 Question Paper with Solutions

Time Allowed :3 Hours	Maximum Marks :70	Total Questions :11
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General Instructions

Read the following instructions very carefully and strictly follow them:

1. First 15 minutes are allotted for the candidates to read the question paper.
2. The question paper is divided into two Parts – Part 'A' and Part 'B'.
3. Part 'A' and Part 'B' are divided into three Sub-sections I, II, and III.
4. In Part 'A' of the question paper, there are Multiple Choice Type Questions. Select the correct alternative and then by a blue or black ballpoint pen, fill completely in the circle in OMR Answer-Sheet. Do not erase, cut, or use whitener on the OMR Answer-Sheet after answering.
5. 1 mark is allotted for each question in the Multiple Choice Type Questions of Part 'A'.
6. Part 'B' has descriptive questions.
7. The allotted marks are given in each question.
8. All the questions of Sub-Sections of Part 'B' are to be attempted all at a time. Start each Sub-Section from a new page.
9. All the questions are compulsory.

Part - A

1. The image of an object formed by a concave mirror is found virtual, erect and greater than the object. Where should be the position of the object?

- (A) Between the principal focus and centre of curvature
- (B) On the centre of curvature
- (C) Beyond the centre of curvature
- (D) Between the pole and principal focus of mirror

Correct Answer: (D) Between the pole and principal focus of mirror

Solution:

Step 1: Understanding the Concept:

This question is about the image formation properties of a concave mirror. A concave mirror

can form both real and virtual images depending on the position of the object.

Step 2: Detailed Explanation:

The characteristics of the image formed by a concave mirror change with the object's position:

- When the object is beyond the centre of curvature (C), the image is real, inverted, and diminished, formed between C and F.
- When the object is at the centre of curvature (C), the image is real, inverted, and of the same size, formed at C.
- When the object is between the centre of curvature (C) and the principal focus (F), the image is real, inverted, and magnified, formed beyond C.
- When the object is at the principal focus (F), the image is real, inverted, and highly magnified, formed at infinity.
- When the object is between the pole (P) and the principal focus (F), the image is **virtual, erect, and magnified**, formed behind the mirror.

The question specifies that the image is virtual, erect, and greater than the object (magnified). This corresponds to the case where the object is placed between the pole and the principal focus.

Step 3: Final Answer:

Therefore, the correct position of the object is between the pole and the principal focus of the mirror.

Quick Tip

This specific property of a concave mirror (forming a virtual, erect, and magnified image) is the principle behind its use as a shaving mirror or a makeup mirror. It allows a person to see a larger image of their face.

2. The focal lengths of a spherical mirror and a thin spherical lens are -15 cm . The mirror and lens are possibly

- (A) Both concave
- (B) Both convex
- (C) Concave mirror and convex lens
- (D) Convex mirror and concave lens

Correct Answer: (A) Both concave

Solution:

Step 1: Understanding the Concept:

This question tests the knowledge of the Cartesian sign convention used in optics for spherical mirrors and lenses. The sign of the focal length determines the type of mirror or lens.

Step 2: Detailed Explanation:

According to the standard sign convention:

For Spherical Mirrors:

- A **concave mirror** has a negative focal length ($f < 0$) because its focus is in front of the mirror, in the direction opposite to the incident light for an object at infinity.
- A **convex mirror** has a positive focal length ($f > 0$) because its focus is behind the mirror.

For Spherical Lenses:

- A **concave lens** (diverging lens) has a negative focal length ($f < 0$).
- A **convex lens** (converging lens) has a positive focal length ($f > 0$).

Given that the focal length for both the mirror and the lens is -15 cm (a negative value), both must be of the concave type.

Step 3: Final Answer:

The mirror is a concave mirror, and the lens is a concave lens. Therefore, both are concave.

Quick Tip

A simple rule to remember is that for both mirrors and lenses, a **negative focal length** corresponds to a **concave** (converging for mirror, diverging for lens) optical element, while a **positive focal length** corresponds to a **convex** (diverging for mirror, converging for lens) one.

3. Which of the following lenses would you like at the time of reading small letters, found in dictionary?

- (A) A convex lens of focal length 50 cm
- (B) A concave lens of focal length 50 cm
- (C) A convex lens of focal length 10 cm
- (D) A concave lens of focal length 10 cm

Correct Answer: (C) A convex lens of focal length 10 cm

Solution:

Step 1: Understanding the Concept:

To read small letters, one needs a magnifying glass. A magnifying glass produces a virtual, erect, and magnified image of a nearby object. This is a characteristic property of a convex lens when the object is placed within its focal length.

Step 2: Detailed Explanation:

1. **Choice of Lens Type:** A concave lens always produces a virtual, erect, and diminished image, regardless of the object's position. Since we need magnification, a concave lens is unsuitable. This eliminates options (B) and (D). A convex lens is required for magnification.

2. **Choice of Focal Length:** The magnifying power (M) of a convex lens used as a simple microscope or magnifier is inversely related to its focal length (f). For an image formed at the near point, $M = 1 + D/f$, where D is the least distance of distinct vision. A smaller focal length (f) results in a larger magnifying power (M).

3. **Comparison:** We have two convex lenses with focal lengths of 50 cm and 10 cm. To get better magnification for reading small letters, we should choose the lens with the shorter focal length.

Therefore, a convex lens of focal length 10 cm is the better choice compared to one with a focal length of 50 cm.

Step 3: Final Answer:

The most suitable lens is a convex lens with a shorter focal length, which is the 10 cm option.

Quick Tip

The power of a lens is given by $P = 1/f$. A lens with a shorter focal length has a higher power and provides greater magnification. For reading glasses or magnifying glasses, higher power is generally better.

4. The part of human eye forming the image of an object is

- (A) Cornea
- (B) Iris
- (C) Pupil
- (D) Retina

Correct Answer: (D) Retina

Solution:

Step 1: Understanding the Concept:

This question asks to identify the part of the human eye that functions as the screen where the image is formed, similar to the film in a camera.

Step 2: Detailed Explanation:

Let's review the functions of the parts listed:

- **Cornea:** The transparent outer layer at the front of the eye. It does the primary refraction (bending) of light entering the eye.
- **Iris:** The colored part of the eye. It controls the size of the pupil, thus regulating the amount of light that enters the eye.
- **Pupil:** The opening in the center of the iris that allows light to pass through to the lens.
- **Retina:** A light-sensitive layer of tissue at the back of the eye. It contains photoreceptor cells (rods and cones) that detect light. The eye's lens focuses light to form a real, inverted image on the retina.

The image is projected and formed on the retina, which then converts the light signals into neural signals for the brain to interpret.

Step 3: Final Answer:

The part of the human eye that forms the image of an object is the retina.

Quick Tip

An easy analogy is to compare the eye to a camera. The cornea and lens act as the camera's lens system, the iris as the aperture, and the retina as the light-sensitive sensor (or film) where the image is captured.

5. Two conducting wires having same material, length and diameter in an electric circuit are arranged in series first and then in parallel. The ratio of heat generated in series and parallel arrangements will be

- (A) 1:2
- (B) 2:1
- (C) 1:4
- (D) 4:1

Correct Answer: (C) 1:4

Solution:

Step 1: Understanding the Concept:

This problem involves Joule's law of heating and the calculation of equivalent resistance for series and parallel circuits. The heat generated depends on the resistance, current, voltage, and time.

Step 2: Key Formula or Approach:

Let the resistance of each wire be R . Since material, length, and diameter are the same, their resistances are equal.

The heat generated (H) in a circuit is given by $H = \frac{V^2}{R_{eq}}t$, where V is the voltage of the source, R_{eq} is the equivalent resistance, and t is the time. We use this formula because the voltage source V is the same for both arrangements.

Step 3: Detailed Explanation:

1. Series Arrangement: The two wires are connected in series. The equivalent resistance (R_s) is:

$$R_s = R + R = 2R$$

The heat generated in the series combination (H_s) is:

$$H_s = \frac{V^2}{R_s}t = \frac{V^2}{2R}t$$

2. Parallel Arrangement: The two wires are connected in parallel. The equivalent resistance (R_p) is:

$$\frac{1}{R_p} = \frac{1}{R} + \frac{1}{R} = \frac{2}{R} \implies R_p = \frac{R}{2}$$

The heat generated in the parallel combination (H_p) is:

$$H_p = \frac{V^2}{R_p}t = \frac{V^2}{(R/2)}t = \frac{2V^2}{R}t$$

3. Ratio of Heat Generated: We need to find the ratio $H_s : H_p$.

$$\frac{H_s}{H_p} = \frac{\frac{V^2t}{2R}}{\frac{2V^2t}{R}} = \frac{V^2t}{2R} \times \frac{R}{2V^2t}$$

The terms V^2 , t , and R cancel out:

$$\frac{H_s}{H_p} = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$$

So, the ratio is 1 : 4.

Step 4: Final Answer:

The ratio of heat generated in series to parallel arrangements is 1:4.

Quick Tip

When the voltage source is constant, heat generated is inversely proportional to resistance ($H \propto 1/R$). The ratio of resistances is $R_s/R_p = (2R)/(R/2) = 4$. Therefore, the ratio of heat generated will be the inverse, $H_s/H_p = 1/4$.

6. The arrangement to produce electric current is called -

- (A) Generator
- (B) Galvanometer
- (C) Ammeter
- (D) Motor

Correct Answer: (A) Generator

Solution:

Step 1: Understanding the Concept:

This question asks to identify the device whose primary function is to generate or produce an electric current. This requires knowledge of the purpose of basic electrical devices.

Step 2: Detailed Explanation:

Let's define the function of each device:

- **Generator:** An electric generator is a device that converts mechanical energy into electrical energy, typically by rotating a coil in a magnetic field. This process induces an electric current, so it produces electricity.
- **Galvanometer:** A galvanometer is a sensitive instrument used to detect the presence and direction of a small electric current in a circuit. It does not produce current.
- **Ammeter:** An ammeter is an instrument used to measure the magnitude of the electric current flowing through a circuit. It must be connected in series and does not produce current.
- **Motor:** An electric motor is a device that converts electrical energy into mechanical energy (motion). It consumes electric current to produce rotation, it does not produce current.

Based on these definitions, the device used to produce electric current is the generator.

Step 3: Final Answer:

The arrangement to produce electric current is called a Generator.

Quick Tip

Remember the key energy conversions:

- **Generator:** Mechanical Energy $\rightarrow$ Electrical Energy (produces current)
- **Motor:** Electrical Energy $\rightarrow$ Mechanical Energy (uses current)

They are essentially opposite devices in terms of energy flow.

7. Which of the following describes the correct magnetic field near a long current carrying wire?

- (A) The lines of magnetic field are perpendicular to the wire.
- (B) The lines of magnetic field are parallel to the wire.
- (C) The magnetic lines of field are radial.
- (D) The lines of magnetic field are concentric with centre on the wire.

Correct Answer: (D) The lines of magnetic field are concentric with centre on the wire.

Solution:

Step 1: Understanding the Concept:

This question is about the magnetic field pattern produced by a straight, long wire carrying an electric current. The shape and direction of the magnetic field lines are described by the Right-Hand Thumb Rule.

Step 2: Detailed Explanation:

When an electric current flows through a straight conductor, it creates a magnetic field around it.

- The magnetic field lines are in the form of concentric circles.
- The plane of these circles is perpendicular to the wire.
- The center of all these circles lies on the wire.

Let's analyze the options:

- (A) Perpendicular to the wire: Incorrect. The field lines are circular, not straight lines perpendicular to the wire.
- (B) Parallel to the wire: Incorrect. This pattern is characteristic of the magnetic field inside a long solenoid.
- (C) Radial: Incorrect. The field lines are not directed radially outwards or inwards.
- (D) Concentric with centre on the wire: Correct. This accurately describes the circular magnetic field lines that loop around the wire.

Step 3: Final Answer:

Therefore, the correct description of the magnetic field is that the lines are concentric circles with the wire at their center.

Quick Tip

Use the Right-Hand Thumb Rule to visualize this. If you point your thumb in the direction of the current in a straight wire, your fingers will curl in the direction of the magnetic field lines, forming concentric circles.

8. A solution turns red litmus into blue. The possible pH value of the solution is

- (A) 1
- (B) 6
- (C) 3
- (D) 8

Correct Answer: (D) 8

Solution:

Step 1: Understanding the Concept:

This question relates the color change of a litmus indicator to the pH scale, which measures the acidity or basicity of a solution.

Step 2: Detailed Explanation:

- **Litmus Indicator:** Litmus is an indicator used to test whether a solution is acidic or basic.
 - In an **acidic solution**, blue litmus paper turns red.
 - In a **basic (or alkaline) solution**, red litmus paper turns blue.
- **The pH Scale:**
 - $\text{pH} < 7$ indicates an acidic solution.
 - $\text{pH} = 7$ indicates a neutral solution.
 - $\text{pH} > 7$ indicates a basic solution.

The problem states that the solution turns red litmus into blue. This means the solution is basic. Therefore, its pH value must be greater than 7.

Looking at the options:

- (A) 1, (B) 6, and (C) 3 are all less than 7, indicating acidic solutions.
- (D) 8 is greater than 7, indicating a basic solution.

Step 3: Final Answer:

The only possible pH value for a basic solution among the choices is 8.

Quick Tip

A simple mnemonic to remember the color change for bases is: **Base** turns red litmus **Blue**.

9. Zinc powder reacts with dilute sulphuric acid to release which of the following gas?

- (A) O₂
- (B) Cl₂
- (C) CO₂
- (D) H₂

Correct Answer: (D) H₂

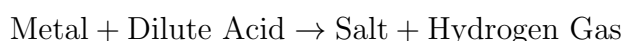
Solution:

Step 1: Understanding the Concept:

This question is about the chemical reaction between a metal and a dilute acid. The outcome of such a reaction is determined by the position of the metal in the reactivity series relative to hydrogen.

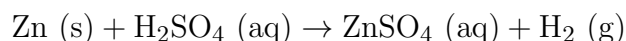
Step 2: Detailed Explanation:

The general rule for the reaction between a metal and a dilute acid is:



This reaction occurs if the metal is more reactive than hydrogen (i.e., it is placed above hydrogen in the reactivity series). Zinc (Zn) is more reactive than hydrogen.

The specific chemical reaction between zinc powder and dilute sulphuric acid (H₂SO₄) is:



In this reaction, zinc displaces hydrogen from sulphuric acid to form the salt zinc sulphate (ZnSO₄) and releases hydrogen gas (H₂).

Step 3: Final Answer:

The gas released is hydrogen (H₂).

Quick Tip

Remember the reactivity series. Metals like K, Na, Ca, Mg, Al, Zn, Fe, Pb are above hydrogen and will displace it from dilute acids. Metals like Cu, Hg, Ag, Au, Pt are below hydrogen and will not.

10. The general formula for alkyne is

- (A) C_nH_{2n}
- (B) C_nH_{2n+2}
- (C) C_nH_{2n-2}

(D) C_nH_{2n+4}

Correct Answer: (C) C_nH_{2n-2}

Solution:

Step 1: Understanding the Concept:

This question tests the knowledge of the general formulas for the homologous series of hydrocarbons: alkanes, alkenes, and alkynes. These formulas relate the number of carbon atoms (n) to the number of hydrogen atoms.

Step 2: Detailed Explanation:

- **Alkanes** are saturated hydrocarbons with only carbon-carbon single bonds. Their general formula is C_nH_{2n+2} .
- **Alkenes** are unsaturated hydrocarbons with at least one carbon-carbon double bond. Their general formula is C_nH_{2n} .
- **Alkynes** are unsaturated hydrocarbons with at least one carbon-carbon triple bond. Their general formula is C_nH_{2n-2} .

The question asks for the general formula for alkynes. Based on the definitions above, the correct formula is C_nH_{2n-2} .

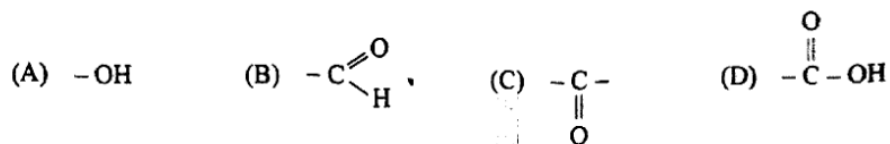
Step 3: Final Answer:

The general formula for alkyne is C_nH_{2n-2} .

Quick Tip

You can remember the formulas as a sequence. Start with Alkenes (C_nH_{2n}). Alkanes have two more hydrogens (C_nH_{2n+2}), and Alkynes have two fewer hydrogens (C_nH_{2n-2}).

11. The functional group of aldehyde is



Correct Answer: (B)

Solution:

Step 1: Understanding the Concept:

Functional groups are specific groups of atoms within molecules that are responsible for the

characteristic chemical reactions of those molecules. This question asks to identify the structure of the aldehyde functional group.

Step 2: Detailed Explanation:

Let's identify each functional group shown in the options:

- (A) **-OH**: This is the hydroxyl group, which is the functional group for **alcohols**.
- (B) **-CHO**: This structure shows a carbon atom double-bonded to an oxygen atom and single-bonded to a hydrogen atom. This is the **aldehyde** functional group.
- (C) **>C=O** : This is the carbonyl group. When this group is bonded to two other carbon atoms, it is the functional group for **ketones**.
- (D) **-COOH**: This structure shows a carbon atom double-bonded to one oxygen atom and single-bonded to another oxygen atom which is bonded to a hydrogen. This is the carboxyl group, the functional group for **carboxylic acids**.

The question specifically asks for the aldehyde functional group.

Step 3: Final Answer:

The structure in option (B) represents the aldehyde functional group.

Quick Tip

The key feature of an aldehyde (-CHO) is that the carbonyl group (C=O) is always at the end of a carbon chain, meaning it's bonded to at least one hydrogen atom. In contrast, a ketone's carbonyl group is always within the chain.

12. Which of the following metal displaces hydrogen from acids?

- (A) Mg/Zn
- (B) Pt
- (C) Cu
- (D) Hg

Correct Answer: (A) Mg/Zn

Solution:

Step 1: Understanding the Concept:

The ability of a metal to displace hydrogen from a dilute acid depends on its position in the metal reactivity series. Metals that are more reactive than hydrogen can displace it.

Step 2: Detailed Explanation:

The reactivity series arranges metals in order of their decreasing chemical reactivity. A simplified version is: $K \prec Na \prec Ca \prec Mg \prec Al \prec Zn \prec Fe \prec Pb \prec [H] \prec Cu \prec Hg \prec Ag \prec Au \prec Pt$

- Metals **above** Hydrogen (H) in the series are reactive enough to displace hydrogen from dilute acids (like HCl and H_2SO_4).
- Metals **below** Hydrogen (H) are less reactive and cannot displace it from dilute acids.

Let's analyze the options:

- **(A) Mg/Zn:** Magnesium and Zinc are both well above hydrogen in the series. They are reactive and will displace hydrogen.
- **(B) Pt:** Platinum is far below hydrogen. It is a very unreactive (noble) metal.
- **(C) Cu:** Copper is below hydrogen.
- **(D) Hg:** Mercury is below hydrogen.

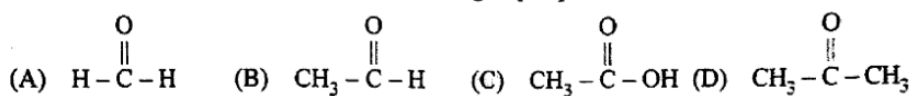
Therefore, only magnesium and zinc from the given options will displace hydrogen from acids.

Step 3: Final Answer:

The correct option is (A) Mg/Zn.

Quick Tip

A common mnemonic to remember the reactivity series is: "**P**lease **S**top **C**alling **M**um **A**fter **C**ute **Z**ebra, **I**nstead **T**ry **L**earning **H**ow **C**opper **S**aves **G**old." (Potassium, Sodium, Calcium, Magnesium, Aluminium, Carbon, Zinc, Iron, Tin, Lead, Hydrogen, Copper, Silver, Gold).

13. In which of the following compound Ketonic group is present?

Correct Answer: (D)

Solution:

Step 1: Understanding the Concept:

A ketonic group (or ketone functional group) consists of a carbonyl group (a carbon atom double-bonded to an oxygen atom, $C=O$) where the carbon atom is bonded to two other carbon atoms. It is found in the middle of a carbon chain, not at the end.

Step 2: Detailed Explanation:

Let's analyze the structure of each compound:

- **(A) H-CHO (Methanal):** This is an aldehyde. The carbonyl carbon is bonded to two hydrogen atoms.
- **(B) CH₃-CHO (Ethanal):** This is an aldehyde. The carbonyl carbon is bonded to one carbon atom and one hydrogen atom.
- **(C) CH₃-COOH (Ethanoic Acid):** This is a carboxylic acid. It contains a carboxyl group, not a ketonic group.
- **(D) CH₃-CO-CH₃ (Propanone):** Here, the central carbon atom is double-bonded to an oxygen atom and is also single-bonded to two other carbon atoms (from the two methyl groups). This fits the definition of a ketone.

Step 3: Final Answer:

The compound containing a ketonic group is CH₃-CO-CH₃, also known as propanone or acetone.

Quick Tip

The simplest possible ketone is propanone, as it requires a central carbonyl group to be surrounded by at least one carbon atom on each side, making a total of three carbon atoms. Aldehydes can have just one carbon atom (methanal).

14. Which of the following is related to excretory system in humans?

- (A) Stomach
- (B) Spleen
- (C) Heart
- (D) Kidney

Correct Answer: (D) Kidney

Solution:

Step 1: Understanding the Concept:

The excretory system is a biological system that removes excess, unnecessary materials from the body fluids of an organism, so as to help maintain internal chemical homeostasis and prevent damage to the body. The question asks to identify the main organ of this system from the given options.

Step 2: Detailed Explanation:

Let's analyze the function of each organ listed:

- **Stomach:** A major organ of the digestive system, responsible for breaking down food.
- **Spleen:** An organ of the lymphatic system, involved in filtering blood and in the immune response.

- **Heart:** The central organ of the circulatory system, responsible for pumping blood throughout the body.
- **Kidney:** The primary organ of the excretory system. The kidneys are a pair of organs that filter waste products from the blood and produce urine.

Based on these functions, the kidney is the organ related to the excretory system.

Step 3: Final Answer:

The kidney is the correct answer as it is the main organ of the human excretory system.

Quick Tip

Associate major organs with their primary systems: Heart → Circulatory, Lungs → Respiratory, Stomach → Digestive, Brain → Nervous, and Kidneys → Excretory.

15. During the process of respiration, the break-down of glucose into pyruvates takes place in -

- (A) Mitochondrial matrix
- (B) Cytoplasm
- (C) Nucleoplasm
- (D) Lysosome

Correct Answer: (B) Cytoplasm

Solution:

Step 1: Understanding the Concept:

Cellular respiration is a multi-step process. The question is asking for the specific location of the first stage of this process. The breakdown of a 6-carbon glucose molecule into two 3-carbon pyruvate molecules is known as glycolysis.

Step 2: Detailed Explanation:

The process of cellular respiration can be divided into three main stages:

1. **Glycolysis:** This is the initial breakdown of glucose into pyruvate. This universal first step occurs in the **cytoplasm** of all living cells, both prokaryotic and eukaryotic.
2. **Krebs Cycle (or Citric Acid Cycle):** If oxygen is present, the pyruvate molecules enter the **mitochondrial matrix**, where they are further broken down.
3. **Electron Transport Chain:** This final stage also occurs in the mitochondria (specifically, the inner mitochondrial membrane) and produces the majority of ATP.

Therefore, the conversion of glucose into pyruvate happens in the cytoplasm.

Step 3: Final Answer:

The breakdown of glucose into pyruvates takes place in the cytoplasm.

Quick Tip

Remember the locations for cellular respiration: Glycolysis happens "out" in the cytoplasm, while the Krebs cycle and electron transport chain happen "in" the mitochondria.

16. The ability of organism to give rise to new organisms from their body parts, is known as -

- (A) Fission
- (B) Budding
- (C) Regeneration
- (D) Fragmentation

Correct Answer: (C) Regeneration

Solution:

Step 1: Understanding the Concept:

This question asks to identify the mode of asexual reproduction where a new individual can develop from a fragment of the parent's body.

Step 2: Detailed Explanation:

Let's define the given terms:

- **Fission:** A mode of asexual reproduction in which a unicellular organism divides into two or more daughter cells. Example: Amoeba.
- **Budding:** A new organism develops from an outgrowth or bud on the parent's body. Example: Hydra.
- **Regeneration:** This is the ability of an organism to regrow lost or damaged body parts. In some organisms, like Planaria or starfish, a small fragment of the body can grow into a complete new organism. This ability to form a new organism from a body part is a form of asexual reproduction.
- **Fragmentation:** In this process, the body of a multicellular organism breaks into two or more fragments, and each fragment develops into a new individual. Example: Spirogyra.

While fragmentation is a process of breaking, regeneration is the underlying ability to regrow the parts to form a new whole. The question asks for the "ability," which makes regeneration the most appropriate answer. For many simple animals, regeneration is their mechanism of

reproduction via fragmentation.

Step 3: Final Answer:

The ability of an organism to give rise to new organisms from their body parts is known as regeneration.

Quick Tip

Associate keywords with organisms: Fission → Amoeba, Budding → Hydra, Fragmentation → Spirogyra, Regeneration → Planaria. Regeneration implies the "power to regrow," which can lead to a new organism.

17. Which of the following is converted into seed?

- (A) Ovule
- (B) Stigma
- (C) Style
- (D) Pollen Grain

Correct Answer: (A) Ovule

Solution:

Step 1: Understanding the Concept:

This question is about the changes that occur in a flower after fertilization. Fertilization triggers the development of certain parts of the flower into the fruit and seed.

Step 2: Detailed Explanation:

In flowering plants, the process of reproduction involves pollination followed by fertilization.

- **Pollen Grain:** Contains the male gametes. It lands on the stigma.
- **Stigma:** The receptive part of the pistil that receives the pollen.
- **Style:** The stalk connecting the stigma to the ovary.
- **Ovule:** Located inside the ovary, it contains the female gamete (egg cell).

After a male gamete from the pollen grain fertilizes the egg cell inside the **ovule**, the ovule develops and matures into a **seed**. The ovary, which contains the ovule(s), develops into the fruit.

Step 3: Final Answer:

After fertilization, the ovule is converted into the seed.

Quick Tip

A simple way to remember the post-fertilization changes is: the **Ovary** becomes the fruit, and the **Ovule** becomes the seed.

18. A section of DNA that provides information for the synthesis of a protein, is called -

- (A) Trait
- (B) Gene
- (C) Genotype
- (D) Allele

Correct Answer: (B) Gene

Solution:

Step 1: Understanding the Concept:

This question asks for the correct biological term for a segment of DNA that carries the instructions for building a specific protein.

Step 2: Detailed Explanation:

Let's define the terms:

- **Trait:** A specific characteristic of an organism, such as height or eye color. It is the physical expression of genes.
- **Gene:** The fundamental unit of heredity. It is a specific sequence of nucleotides in DNA that codes for a functional product, which is often a protein. This matches the question's description.
- **Genotype:** The genetic constitution of an individual organism, representing the combination of alleles it possesses.
- **Allele:** One of the different forms of a particular gene. For example, the gene for flower color can have an allele for purple flowers and an allele for white flowers.

The section of DNA that holds the code for making a protein is called a gene.

Step 3: Final Answer:

A section of DNA that provides information for the synthesis of a protein is called a gene.

Quick Tip

Think of DNA as a cookbook. A **gene** is a single recipe for a specific dish (protein). An **allele** is a variation of that recipe (e.g., spicy vs. mild). The **genotype** is the collection of all your recipe versions. A **trait** is the final dish you serve (the observable characteristic).

19. Which of the following is an example of artificial ecosystem?

- (A) Grassland
- (B) Forest
- (C) Desert
- (D) Agriculture land formed by humans

Correct Answer: (D) Agriculture land formed by humans

Solution:

Step 1: Understanding the Concept:

Ecosystems can be classified as natural or artificial (man-made). A natural ecosystem develops and sustains itself without human intervention, while an artificial ecosystem is created and maintained by humans.

Step 2: Detailed Explanation:

Let's classify the options:

- **Grassland:** A natural ecosystem dominated by grasses.
- **Forest:** A large area of land covered with trees and undergrowth, which is a natural ecosystem.
- **Desert:** A barren area of landscape where little precipitation occurs, a natural ecosystem.
- **Agriculture land formed by humans:** This refers to crop fields or farms. These are ecosystems created by humans for the purpose of food production. Humans clear the land, choose the plants (monoculture), provide water (irrigation), and add nutrients (fertilizers), making it a classic example of an artificial ecosystem.

Step 3: Final Answer:

Agriculture land formed by humans is an example of an artificial ecosystem.

Quick Tip

If an ecosystem requires human input to be created or sustained (like a garden, an aquarium, or a crop field), it is considered artificial. Natural ecosystems like forests and oceans are self-sustaining.

20. Which of the following is not a plant hormone?

- (A) Auxin
- (B) Cytokinin

- (C) Thyroxin
(D) Gibberellin

Correct Answer: (C) Thyroxin

Solution:

Step 1: Understanding the Concept:

This question requires differentiating between plant hormones (phytohormones) and animal hormones. Plant hormones are chemical messengers that regulate various aspects of plant growth and development.

Step 2: Detailed Explanation:

The major classes of plant hormones are:

- **Auxins:** Promote stem elongation, root formation, and fruit development.
- **Cytokinins:** Promote cell division and growth.
- **Gibberellins:** Promote stem elongation, germination, and flowering.
- **Abscisic Acid:** Inhibits growth, promotes dormancy, and helps plants respond to stress.
- **Ethylene:** Promotes fruit ripening and senescence.

Let's look at the options:

- (A) Auxin, (B) Cytokinin, and (D) Gibberellin are all major types of plant hormones.
- **(C) Thyroxin:** This is a hormone produced by the thyroid gland in vertebrate animals. It plays a crucial role in regulating metabolism. It is not found in plants.

Step 3: Final Answer:

Thyroxin is an animal hormone, not a plant hormone.

Quick Tip

Remember the five main groups of plant hormones: Auxins, Cytokinins, Gibberellins, Abscisic Acid, and Ethylene. Any hormone name outside of this list, especially one familiar from human biology like insulin or thyroxin, is likely the correct answer in a "which is not" question.

Part - B

1(i).

(i) An object placed at a distance 25 cm from a concave mirror forms a real image

of size double that of the object. Find the focal length of the mirror.

Solution:

Step 1: Understanding the Concept:

This problem requires the use of the mirror formula and the magnification formula for a concave mirror. We must use the Cartesian sign convention.

Step 2: Key Formula or Approach:

- **Sign Convention:** For a concave mirror, the object distance (u) is negative. A real image is inverted, so its magnification (m) is negative, and the image distance (v) is also negative.
- **Magnification Formula:** $m = \frac{\text{height of image}}{\text{height of object}} = -\frac{v}{u}$
- **Mirror Formula:** $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

Step 3: Detailed Explanation:

Given Data:

- Object distance, $u = -25$ cm.
- The image is real and its size is double the object's size. This means the magnification, $m = -2$.

First, we find the image distance (v) using the magnification formula:

$$\begin{aligned}m &= -\frac{v}{u} \\-2 &= -\frac{v}{-25} \\-2 &= \frac{v}{25} \implies v = -50 \text{ cm}\end{aligned}$$

The negative sign confirms that the image is real and formed in front of the mirror. Now, we use the mirror formula to find the focal length (f):

$$\begin{aligned}\frac{1}{f} &= \frac{1}{v} + \frac{1}{u} \\ \frac{1}{f} &= \frac{1}{-50} + \frac{1}{-25} \\ \frac{1}{f} &= \frac{-1 - 2}{50} = \frac{-3}{50} \\ f &= -\frac{50}{3} \approx -16.67 \text{ cm}\end{aligned}$$

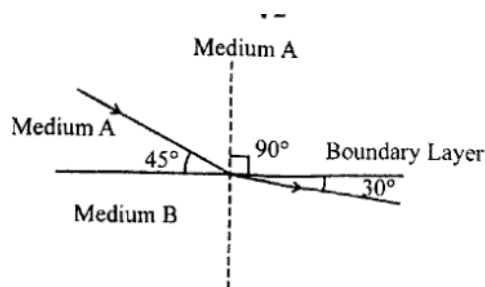
Step 4: Final Answer:

The focal length of the concave mirror is -16.67 cm.

Quick Tip

Always apply the sign convention at the very beginning when listing your given data. For concave mirrors, a real image is always inverted ($m < 0$), and a virtual image is always erect ($m > 0$).

1(ii)) Find the angle of refraction and the refractive index of medium B relative to medium A in the following figure. Which of the medium is denser and why? Given that $\sin 60^\circ = \frac{\sqrt{3}}{2}$, $\sin 45^\circ = \frac{1}{\sqrt{2}}$.



Solution:

Step 1: Understanding the Concept:

This problem involves the refraction of light and requires the application of Snell's Law. We must first correctly identify the angles of incidence and refraction from the given diagram. These angles are always measured with respect to the normal.

Step 2: Key Formula or Approach:

- **Snell's Law:** $n_A \sin i = n_B \sin r$
- **Relative Refractive Index** of medium B with respect to A is $n_{BA} = \frac{n_B}{n_A} = \frac{\sin i}{\sin r}$

Step 3: Detailed Explanation:

1. Finding the Angles:

- The angle of incidence (i) is the angle between the incident ray and the normal. The diagram shows the angle with the boundary is 45° . So, $i = 90^\circ - 45^\circ = 45^\circ$.
- The angle of refraction (r) is the angle between the refracted ray and the normal. The diagram shows the angle with the boundary is 30° . So, $r = 90^\circ - 30^\circ = 60^\circ$.

The angle of refraction is 60° .

2. Finding the Relative Refractive Index (n_{BA}):

$$n_{BA} = \frac{\sin i}{\sin r} = \frac{\sin 45^\circ}{\sin 60^\circ}$$

Substitute the given values:

$$n_{BA} = \frac{1/\sqrt{2}}{\sqrt{3}/2} = \frac{1}{\sqrt{2}} \times \frac{2}{\sqrt{3}} = \frac{2}{\sqrt{6}} = \frac{\sqrt{2}}{\sqrt{3}} \approx 0.816$$

The refractive index of medium B relative to medium A is $\frac{2}{\sqrt{6}}$ or $\frac{\sqrt{2}}{\sqrt{3}}$.

3. Determining the Denser Medium: The light ray bends **away from the normal** as it enters medium B (since $r = 60^\circ > i = 45^\circ$). Light bends away from the normal when it travels from a denser medium to a rarer medium.

Therefore, **Medium A is denser than Medium B.**

Reasoning: Because the angle of refraction is greater than the angle of incidence, the speed of light in medium B is greater than in medium A, which means medium B is optically rarer and medium A is optically denser.

Quick Tip

A simple rule for refraction:

- Light bends **Towards** the normal when going into a **Denser** medium ($r < i$).
- Light bends **Away** from the normal when going into a **Rarer** medium ($r > i$).

2. (i) A man suffering near sightedness can read clearly a book placed at distance 20 cm. Which type of lens and having how much focal length should be used in his opticals to read a book placed at 25 cm?

Solution:

Step 1: Understanding the Concept:

The problem describes a person with near-sightedness (myopia) who wants to see an object at 25 cm clearly, but their eye is accommodated to see it clearly at 20 cm. The corrective lens should take the object from its actual position (25 cm) and form a virtual image at the position where the person can see it clearly (20 cm).

Step 2: Key Formula or Approach:

We will use the lens formula and apply the sign convention.

- **Object distance (u):** The actual position of the book, $u = -25$ cm.
- **Image distance (v):** The position where the virtual image should be formed, $v = -20$ cm.
- **Lens Formula:** $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

Step 3: Detailed Explanation:

Substitute the values of u and v into the lens formula:

$$\frac{1}{f} = \frac{1}{-20} - \frac{1}{-25}$$

$$\frac{1}{f} = -\frac{1}{20} + \frac{1}{25}$$

Find a common denominator, which is 100:

$$\frac{1}{f} = \frac{-5 + 4}{100}$$

$$\frac{1}{f} = -\frac{1}{100}$$

$$f = -100 \text{ cm}$$

Since the focal length is negative, the lens is a **concave lens**.

Step 4: Final Answer:

A **concave lens** with a focal length of **100 cm** should be used.

Quick Tip

Near-sightedness (myopia) is corrected using a concave lens (negative focal length), while far-sightedness (hypermetropia) is corrected using a convex lens (positive focal length).

(ii) Calculate the focal length of a lens of power +20 Diopter.

Solution:

Step 1: Understanding the Concept:

The power of a lens is the reciprocal of its focal length in meters. The unit of power is the Diopter (D).

Step 2: Key Formula or Approach:

The relationship between power (P) and focal length (f) is:

$$P = \frac{1}{f(\text{in meters})} \quad \text{or} \quad f(\text{in cm}) = \frac{100}{P(\text{in Diopters})}$$

Step 3: Detailed Explanation:

Given Data: Power, $P = +20 \text{ D}$.

We can use the second formula to directly calculate the focal length in centimeters:

$$f(\text{in cm}) = \frac{100}{20}$$

$$f = 5 \text{ cm}$$

Since the power is positive, the focal length is also positive, which indicates that it is a convex lens.

Step 4: Final Answer:

The focal length of the lens is 5 cm.

Quick Tip

Remember to check the units. The standard formula $P = 1/f$ requires f to be in meters. If you are given f in cm or want to find it in cm, using $P = 100/f$ (or $f = 100/P$) is a quick and direct method.

3. (i) What will be the resistance of a wire when twisted half?

Solution:

Step 1: Understanding the Concept:

The resistance of a wire depends on its length, cross-sectional area, and the resistivity of the material. "Twisted half" is interpreted as folding the wire in half and twisting the two halves together. This changes both the length and the area of the conductor.

Step 2: Key Formula or Approach:

The formula for resistance (R) is:

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

where ρ is the resistivity, L is the length, and A is the cross-sectional area.

Step 3: Detailed Explanation:

Let the original wire have length L , area A , and resistance R .

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

When the wire is folded in half and twisted, the new parameters are:

- New length, $L' = \frac{L}{2}$
- New cross-sectional area, $A' = 2A$ (since we now have two strands of the wire conducting in parallel)

The new resistance, R' , can be calculated as:

$$R' = \rho \frac{L'}{A'} = \rho \frac{(L/2)}{(2A)}$$

$$R' = \rho \frac{L}{4A} = \frac{1}{4} \left(\rho \frac{L}{A} \right)$$

Since $R = \rho \frac{L}{A}$, we have:

$$R' = \frac{R}{4}$$

Step 4: Final Answer:

The resistance of the wire will become one-fourth of its original resistance.

Quick Tip

When a wire is stretched, its length increases and area decreases. When it's folded, its length decreases and effective area increases. Always consider how both dimensions change to find the new resistance.

(ii) There are two resistances of 3 ohm and 5 ohm. Both resistances are joined in parallel with a cell. Which of the resistances will be hotter?

Solution:

Step 1: Understanding the Concept:

The "hotness" of a resistor is determined by the rate at which it dissipates heat, which is its power (P). We need to compare the power dissipated by each resistor.

Step 2: Key Formula or Approach:

The formulas for electrical power are $P = VI$, $P = I^2R$, and $P = \frac{V^2}{R}$.

Since the resistances are connected in **parallel**, the voltage (V) across both resistors is the same. Therefore, the most convenient formula to use for comparison is:

$$P = \frac{V^2}{R}$$

Step 3: Detailed Explanation:

Let $R_1 = 3\Omega$ and $R_2 = 5\Omega$. The voltage V across both resistors is constant. From the formula $P = \frac{V^2}{R}$, we can see that power is inversely proportional to resistance ($P \propto \frac{1}{R}$) when voltage is constant.

This means the resistor with the **lower resistance** will dissipate **more power** and become hotter.

Comparing the two resistances:

$$3\Omega < 5\Omega$$

Therefore, the 3 ohm resistor will dissipate more power than the 5 ohm resistor.

Step 4: Final Answer:

The 3 ohm resistance will be hotter.

Quick Tip

Remember this key difference:

- In a **series** circuit, current (I) is the same. Use $P = I^2R$. More resistance means more heat.
- In a **parallel** circuit, voltage (V) is the same. Use $P = V^2/R$. More resistance means less heat.

4. (i) Three resistances 20, 24 and 30 ohm are joined in (a) series and (b) parallel. Calculate the equivalent resistance in each case.

Solution:

Step 1: Understanding the Concept:

This problem requires the application of the formulas for calculating equivalent resistance for resistors connected in series and in parallel.

Step 2: Key Formula or Approach:

- **For Series Combination:** The equivalent resistance (R_s) is the sum of the individual resistances.

$$R_s = R_1 + R_2 + R_3$$

- **For Parallel Combination:** The reciprocal of the equivalent resistance (R_p) is the sum of the reciprocals of the individual resistances.

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

Step 3: Detailed Explanation:

Given resistances are $R_1 = 20\ \Omega$, $R_2 = 24\ \Omega$, and $R_3 = 30\ \Omega$.

(a) Series Combination:

$$R_s = 20 + 24 + 30 = 74\ \Omega$$

(b) Parallel Combination:

$$\frac{1}{R_p} = \frac{1}{20} + \frac{1}{24} + \frac{1}{30}$$

To add these fractions, we find the least common multiple (LCM) of 20, 24, and 30, which is 120.

$$\frac{1}{R_p} = \frac{6}{120} + \frac{5}{120} + \frac{4}{120}$$

$$\frac{1}{R_p} = \frac{6+5+4}{120} = \frac{15}{120}$$

$$\frac{1}{R_p} = \frac{1}{8}$$

$$R_p = 8\ \Omega$$

Step 4: Final Answer:

- (a) The equivalent resistance in series is **74 Ω** .
(b) The equivalent resistance in parallel is **8 Ω** .

Quick Tip

Remember that the equivalent resistance in a series combination is always greater than the largest individual resistance. In a parallel combination, it is always smaller than the smallest individual resistance.

(ii) A current of 5 ampere is flowing in a circuit for 8 sec. How many electrons pass through the circuit in this time interval? If the resistance of the circuit is 20 ohm, calculate the heat produced in this time interval.

Solution:

Step 1: Understanding the Concept:

This problem has two parts. The first part involves the quantization of charge to find the number of electrons. The second part involves Joule's law of heating to calculate the heat produced.

Step 2: Key Formula or Approach:

- **Total Charge:** $Q = I \times t$
- **Quantization of Charge:** $Q = n \times e$, where n is the number of electrons and e is the charge of one electron (1.6×10^{-19} C).
- **Joule's Law of Heating:** $H = I^2 R t$

Step 3: Detailed Explanation:

Given Data:

- Current, $I = 5$ A
- Time, $t = 8$ s
- Resistance, $R = 20 \Omega$

Part 1: Number of Electrons (n)

First, calculate the total charge (Q) that flows through the circuit.

$$Q = I \times t = 5 \text{ A} \times 8 \text{ s} = 40 \text{ C}$$

Now, use the quantization of charge formula to find the number of electrons (n).

$$n = \frac{Q}{e} = \frac{40 \text{ C}}{1.6 \times 10^{-19} \text{ C}}$$
$$n = 25 \times 10^{19} = 2.5 \times 10^{20} \text{ electrons}$$

Part 2: Heat Produced (H)

Use Joule's law of heating:

$$H = I^2 R t$$
$$H = (5 \text{ A})^2 \times (20 \Omega) \times (8 \text{ s})$$

$$H = 25 \times 20 \times 8$$

$$H = 500 \times 8 = 4000 \text{ J}$$

Step 4: Final Answer:

The number of electrons that pass through the circuit is 2.5×10^{20} .

The heat produced in this time interval is **4000 Joules**.

Quick Tip

Ensure your units are in the standard SI system before calculation (Current in Amperes, Time in seconds, Resistance in Ohms). The final unit for heat will be Joules.

OR

(i) Why do the two magnetic lines of force do not intersect each other?

Solution:

The tangent drawn at any point on a magnetic field line gives the direction of the magnetic field at that point. If two magnetic field lines were to intersect, it would imply that at the point of intersection, there are two different directions for the magnetic field. This is physically impossible, as a compass needle placed at that point cannot point in two directions simultaneously. Therefore, magnetic field lines never intersect.

(ii) Write down the properties of magnetic lines of force.

Solution:

The properties of magnetic lines of force are:

1. They are continuous closed loops. They emerge from the North pole and enter the South pole outside the magnet, and travel from the South pole to the North pole inside the magnet.
2. The tangent to the field line at any point gives the direction of the magnetic field at that point.
3. They never intersect each other.
4. The density of the field lines (how close they are to each other) represents the strength of the magnetic field. The field is stronger where the lines are closer together, such as near the poles.
5. They tend to contract longitudinally (like a stretched spring), which explains the attraction between opposite poles.
6. They exert a lateral (sideways) pressure, which explains the repulsion between like poles.

(iii) When will the force acting on a current carrying conductor be maximum in a magnetic field?

Solution:

The force (F) acting on a current-carrying conductor placed in a magnetic field is given by the formula:

$$F = BIL \sin \theta$$

where B is the magnetic field strength, I is the current, L is the length of the conductor in the field, and θ is the angle between the direction of the current and the direction of the magnetic field.

The value of $\sin \theta$ is maximum when $\theta = 90^\circ$, where $\sin 90^\circ = 1$.

Therefore, the force acting on a current-carrying conductor is maximum when the conductor is placed **perpendicular** to the direction of the magnetic field.

Quick Tip

Remember the conditions for force on a conductor:

- **Maximum force:** when current and magnetic field are perpendicular ($\theta = 90^\circ$).
- **Zero force:** when current and magnetic field are parallel or anti-parallel ($\theta = 0^\circ$ or $\theta = 180^\circ$).

5. Write the structural formula of the following compounds :

(i) Ethanoic acid (ii) 1-Chloropropane (iii) Butanone-2 (iv) Neo-pentane

Solution:

Step 1: Understanding the Concept:

To write the structural formula of an organic compound from its name, we need to decode the IUPAC or common name. This involves identifying the number of carbon atoms in the parent chain (from the root word like 'eth-', 'prop-', 'but-'), the type of carbon-carbon bonds (from '-ane', '-ene', '-yne'), and the functional groups or substituents present.

Step 2: Detailed Explanation:

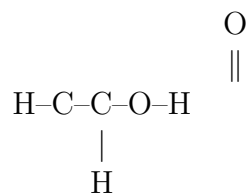
(i) Ethanoic acid:

- **Eth-** indicates a parent chain of 2 carbon atoms.
- **-an-** indicates that the carbon atoms are connected by a single bond.

- **-oic acid** indicates the presence of a carboxylic acid functional group (-COOH).

The structure is CH₃-COOH.

Structural Formula:

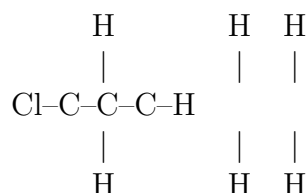


(ii) **1-Chloropropane:**

- **Prop-** indicates a parent chain of 3 carbon atoms.
- **-ane** indicates single bonds between carbon atoms.
- **1-Chloro-** indicates a chlorine atom (Cl) attached to the first carbon atom of the chain.

The structure is CH₂Cl-CH₂-CH₃.

Structural Formula:

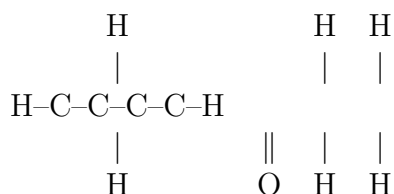


(iii) **Butanone-2 (or Butan-2-one):**

- **But-** indicates a parent chain of 4 carbon atoms.
- **-an-** indicates single bonds between carbon atoms.
- **-one-2** indicates a ketone functional group (a carbonyl group, C=O) on the second carbon atom.

The structure is CH₃-CO-CH₂-CH₃.

Structural Formula:

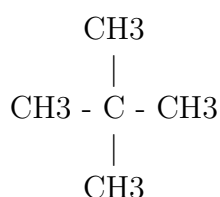


(iv) **Neo-pentane:**

- **Neo-** is a common prefix indicating a central carbon atom bonded to four other groups.
- **Pent-** indicates a total of 5 carbon atoms.
- The structure consists of a central carbon atom bonded to four methyl ($-\text{CH}_3$) groups. Its IUPAC name is 2,2-dimethylpropane.

The structure is $\text{C}(\text{CH}_3)_4$.

Structural Formula:



Quick Tip

Break down the IUPAC name to build the structure: 1. **Root word:** Find the longest carbon chain. 2. **Suffix:** Identify the primary functional group (e.g., -ol, -al, -oic acid, -one) or bond type (-ane, -ene, -yne). 3. **Prefix:** Add any substituents (like chloro-, methyl-) at the numbered positions.

6. (i) What do you mean by alloys? Write the name, composition and uses of two main alloys of copper.

Solution:

Step 1: Understanding the Concept:

An alloy is a substance made by melting two or more elements together, at least one of them a metal. They are designed to have properties that are more desirable than those of their components. This question asks for the definition of an alloy and details of two specific alloys of copper.

Step 2: Detailed Explanation:

Definition of an Alloy:

An alloy is a homogeneous mixture of two or more metals, or a metal and a non-metal. Alloying is done to enhance the properties of the constituent metals, such as increasing hardness, strength, or resistance to corrosion.

Two Main Alloys of Copper:

1. Brass

- **Composition:** It is an alloy of Copper (Cu) and Zinc (Zn). The proportion can vary, but typically it is around 60-80% Cu and 20-40% Zn.
- **Properties:** It is more malleable than bronze or zinc and has a low melting point. It has a bright gold-like appearance.
- **Uses:** Due to its acoustic properties and appearance, it is used in musical instruments (like trumpets, horns), decorative items, plumbing fittings, and ammunition casings.

2. Bronze

- **Composition:** It is an alloy of Copper (Cu) and Tin (Sn). Typically it is around 88% Cu and 12% Sn.
- **Properties:** It is hard, brittle, and has excellent resistance to corrosion, especially from seawater.
- **Uses:** Due to its durability and corrosion resistance, it is used for making statues, medals, bells, marine hardware (propellers, ship fittings), and bearings.

Quick Tip

A simple way to remember the compositions: **B**rass contains **Z**inc, and **B**ronze contains **T**in.

(ii) How copper metal can be obtained from copper sulphide (Cu_2S) and also write chemical equations.

Solution:

Step 1: Understanding the Concept:

The extraction of copper from its sulphide ore (copper glance, Cu_2S) is a metallurgical process. Since copper is a moderately reactive metal, its sulphide ore is first partially roasted to form an oxide, which then reacts with the remaining sulphide ore in a process called auto-reduction to produce copper metal.

Step 2: Detailed Explanation:

The process involves two main steps:

1. Roasting:

The copper sulphide ore is heated in a controlled supply of air. During roasting, a part of the

copper(I) sulphide is converted into copper(I) oxide. Sulphur dioxide gas is evolved.

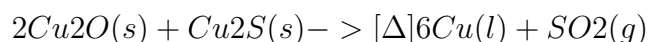
Chemical Equation:



2. Smelting (Auto-reduction):

After partial roasting, the supply of air is stopped, and the temperature of the furnace is raised. In the absence of air, the copper(I) oxide formed in the roasting step reacts with the remaining copper(I) sulphide. The copper(I) oxide reduces the copper(I) sulphide to produce molten copper metal. This is called auto-reduction because no external reducing agent is needed.

Chemical Equation:



The copper obtained in this process is called "blister copper" because as it solidifies, the dissolved SO_2 escapes, forming blisters on the surface.

Quick Tip

Auto-reduction is a common extraction method for less reactive metals like copper, mercury, and lead from their sulphide ores. The key is the partial roasting to form an oxide, which then acts as the oxidizing agent for the remaining sulphide.

7. Write short notes on the following :

- (i) Neutralisation reaction
- (ii) Plaster of Paris
- (iii) pH-Value

Solution:

(i) Neutralisation reaction

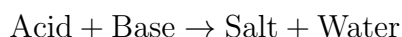
Step 1: Understanding the Concept:

A neutralisation reaction is a chemical reaction in which an acid and a base react quantitatively with each other.

In this reaction, the acidic properties of the acid and the basic properties of the base are cancelled or "neutralised".

Step 2: Key Formula or Approach:

The general word equation for a neutralisation reaction is:



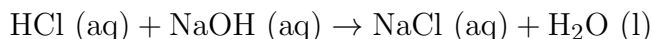
Step 3: Detailed Explanation:

When an acid (e.g., Hydrochloric acid, HCl) reacts with a base (e.g., Sodium hydroxide, $NaOH$), they form a salt (Sodium chloride, $NaCl$) and water (H_2O).

The H^+ ions from the acid combine with the OH^- ions from the base to form water molecules.

The remaining ions (the cation from the base and the anion from the acid) combine to form the salt.

Example Reaction:



These reactions are generally exothermic, meaning they release heat.

(ii) Plaster of Paris

Step 1: Understanding the Concept:

Plaster of Paris is a white powdery chemical compound which is a hemihydrate of calcium sulfate.

Step 2: Key Formula or Approach:

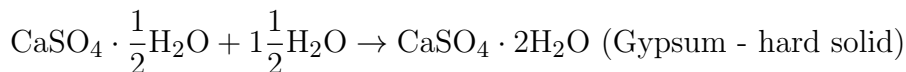
The chemical formula for Plaster of Paris is $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$.

Step 3: Detailed Explanation:

Preparation: It is prepared by heating gypsum (calcium sulfate dihydrate, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) to a temperature of about 100°C (373 K) in a kiln.



Properties: When mixed with water, it rehydrates back into gypsum, setting into a hard solid mass.



Uses: It is used in hospitals for setting fractured bones, for making casts for statues and toys, and as a decorative material for ceilings.

(iii) pH-Value

Step 1: Understanding the Concept:

The pH value is a measure of the acidity or alkalinity of a solution. The pH scale is logarithmic and inversely indicates the concentration of hydrogen ions in the solution.

Step 2: Key Formula or Approach:

The pH is defined as the negative logarithm (base 10) of the molar concentration of hydrogen ions ($[\text{H}^+]$).

$$\text{pH} = -\log_{10}[\text{H}^+]$$

Step 3: Detailed Explanation:

The pH scale typically ranges from 0 to 14.

- A pH value of 7 is considered neutral (e.g., pure water).

- A pH value less than 7 indicates an acidic solution (higher concentration of H⁺ ions).
- A pH value greater than 7 indicates a basic or alkaline solution (lower concentration of H⁺ ions).

For example, lemon juice has a pH of about 2 (acidic), while soap solution has a pH of about 10 (alkaline).

The pH scale is crucial in chemistry, biology, and environmental science for determining the properties of substances.

Quick Tip

For neutralisation reactions, always remember the products are salt and water. For Plaster of Paris, the key is the reversible reaction with gypsum and its water of crystallisation. For pH, remember that it's an inverse logarithmic scale: lower pH means higher acidity.

7. (OR) Write the chemical equations for the reaction of water with the following:

- Aluminium
- Calcium
- Iron

Solution:

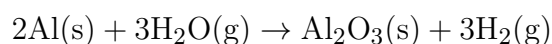
Step 1: Understanding the Concept:

The reactivity of metals with water varies depending on their position in the reactivity series. Some react with cold water, some with hot water or steam, and some do not react at all. The products are typically a metal hydroxide or a metal oxide, and hydrogen gas.

Step 2: Writing Balanced Chemical Equations:

(i) Aluminium with water:

Aluminium does not react with cold or hot water. However, it reacts with steam to form aluminium oxide and hydrogen gas. A protective layer of aluminium oxide (Al₂O₃) usually prevents it from reacting, but if this layer is removed, the reaction proceeds.



Here, (s) denotes solid and (g) denotes gas (steam).

(ii) Calcium with water:

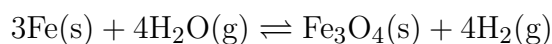
Calcium is reactive enough to react with cold water. The reaction is less violent than that of sodium or potassium. It forms calcium hydroxide and hydrogen gas. The heat produced is not sufficient for the hydrogen to catch fire.



Here, (l) denotes liquid and (aq) denotes aqueous solution. Calcium starts floating because bubbles of hydrogen gas stick to its surface.

(iii) Iron with water:

Iron does not react with cold or hot water. It reacts with steam to form iron(II,III) oxide (also known as magnetite) and hydrogen gas. The reaction is reversible.



FeO is a mixed oxide of FeO and Fe₂O₃.

Quick Tip

Remember the reactivity series to predict the reaction conditions. Metals high in the series (like Ca) react with cold water. Metals in the middle (like Al, Fe) react with steam. Metals low in the series (like Cu, Ag, Au) do not react with water or steam. Always balance the chemical equations.

8. What is vegetative propagation ? Write advantages of vegetative propagation in brief.

Solution:

Step 1: Understanding the Concept:

Vegetative propagation is a type of asexual reproduction in plants where new individuals arise from any vegetative part of the parent plant, such as roots, stems, or leaves, rather than from seeds or spores. The new plant is genetically identical to the parent.

Step 2: Detailed Explanation:

Definition: Vegetative propagation is the process of generating new plants from vegetative propagules (parts of the parent plant). Common methods include:

- **Cutting:** A piece of stem or leaf is cut and planted (e.g., Rose, Sugarcane).
- **Layering:** A stem attached to the parent plant is layered into the soil to form roots (e.g., Jasmine).
- **Grafting:** A stem cutting (scion) from a desired plant is joined to the root system (stock) of another plant (e.g., Mango, Apple).
- **Natural Methods:** Plants propagate naturally through structures like runners (strawberry), tubers (potato), and bulbs (onion).

Step 3: Advantages of Vegetative Propagation:

1. **Genetic Uniformity:** Plants produced are genetically identical to the parent plant. This helps in preserving desirable parental characteristics (e.g., fruit quality, flower color).
2. **Faster Growth:** Plants grown through vegetative propagation mature and bear fruits/flowers much earlier than those grown from seeds.
3. **Propagation of Seedless Plants:** It is the only method to reproduce plants that produce non-viable seeds or no seeds at all (e.g., Banana, seedless Grapes).
4. **Higher Success Rate:** For many species, vegetative propagation has a higher chance of success and is an easier and more certain method of propagation than growing from seeds.

Quick Tip

When asked for advantages, think about speed, genetic consistency, and the ability to reproduce plants that can't be grown from seed. Mentioning specific examples for each method (like potato for tubers) makes the answer stronger.

9. Write short notes on the following:

- (i) Synapse
- (ii) Auxin

Solution:

(i) Synapse

Step 1: Understanding the Concept:

A synapse is a specialized junction where a nerve impulse is transmitted from one neuron to another, or from a neuron to a target effector cell such as a muscle or gland cell.

Step 2: Detailed Explanation:

A synapse consists of three main parts:

1. **Presynaptic terminal:** The axon terminal of the transmitting neuron. It contains synaptic vesicles filled with chemical messengers called neurotransmitters.
2. **Synaptic cleft:** A microscopic gap between the presynaptic terminal and the postsynaptic cell membrane.

3. **Postsynaptic membrane:** The membrane of the receiving neuron or effector cell, which has receptors for the neurotransmitters.

Function: When an electrical nerve impulse (action potential) reaches the presynaptic terminal, it triggers the release of neurotransmitters into the synaptic cleft. These neurotransmitters diffuse across the cleft and bind to specific receptors on the postsynaptic membrane, causing a change in the receiving cell, which can either excite or inhibit it, thus propagating the signal.

(ii) Auxin

Step 1: Understanding the Concept:

Auxins are a class of plant hormones (or phytohormones) that play a crucial role in the regulation of plant growth and development. The most well-known auxin is Indole-3-acetic acid (IAA).

Step 2: Detailed Explanation:

Production: Auxins are primarily produced in the apical meristems of shoots (tips of the stems), young leaves, and developing seeds.

Functions:

- **Cell Elongation:** Auxins promote the elongation of cells in stems and coleoptiles, which is a primary mechanism for plant growth.
- **Phototropism:** They are responsible for the bending of plant shoots towards light. Light causes auxin to migrate to the shaded side of the stem, promoting cell elongation there and causing the stem to bend towards the light source.
- **Gravitropism:** They mediate the response of plants to gravity, causing roots to grow downwards and shoots to grow upwards.
- **Apical Dominance:** Auxin produced in the apical bud inhibits the growth of lateral (axillary) buds, leading to the plant growing taller rather than bushier.
- **Root Initiation:** Auxins are used commercially to stimulate root formation in stem cuttings.

Quick Tip

For synapse, remember it's a "chemical bridge" that converts an electrical signal to a chemical one and back again. For auxin, associate it primarily with "growth" and "bending" (phototropism and gravitropism).

10. Define ecosystem. Describe different components of pond ecosystem in brief.

Solution:

Step 1: Defining Ecosystem:

An ecosystem is defined as a biological community of interacting organisms (biotic components) and their physical environment (abiotic components) functioning as a single unit. It involves the flow of energy and the cycling of nutrients between these components.

Step 2: Components of a Pond Ecosystem:

A pond is a classic example of a self-sustaining aquatic ecosystem. Its components are broadly divided into abiotic and biotic factors.

A. Abiotic Components: These are the non-living components of the ecosystem.

- **Water:** The primary medium of the ecosystem. Its depth, temperature, and clarity are important factors.
- **Sunlight:** The ultimate source of energy for the ecosystem, essential for photosynthesis. The amount of light penetration depends on water clarity.
- **Dissolved Gases:** Oxygen (for respiration) and Carbon Dioxide (for photosynthesis) dissolved in water.
- **Inorganic and Organic Substances:** Nutrients like nitrates, phosphates, and calcium dissolved in water or present in the bottom sediment (mud).

B. Biotic Components: These are the living organisms of the ecosystem.

- **Producers (Autotrophs):** They produce their own food, mainly through photosynthesis. Examples include:
 - Phytoplankton (microscopic floating algae).
 - Filamentous algae.
 - Submerged plants (e.g., Hydrilla) and floating plants (e.g., Lotus, Water lily).
- **Consumers (Heterotrophs):** They obtain energy by feeding on other organisms.
 - **Primary Consumers (Herbivores):** Feed on producers. E.g., Zooplankton (microscopic animals), tadpoles, some snails, and small fish.
 - **Secondary Consumers (Carnivores):** Feed on primary consumers. E.g., Frogs, larger fish, water beetles.
 - **Tertiary Consumers (Top Carnivores):** Feed on secondary consumers. E.g., Kingfishers, large fish, water snakes.

- **Decomposers (Saprotrophs):** They break down dead organic matter (dead plants and animals) and waste products, releasing nutrients back into the ecosystem. E.g., Bacteria and Fungi, present in the water and bottom mud.

Quick Tip

When describing an ecosystem, always structure your answer into abiotic (non-living) and biotic (living) components. For biotic components, further classify them into producers, consumers (with different levels), and decomposers to show the flow of energy.

11. Differentiate between Autotrophic nutrition and Heterotrophic nutrition with examples.

Solution:

Step 1: Understanding the Concepts:

Nutrition is the process by which organisms obtain and utilize food for energy, growth, and maintenance. Based on the source of food, nutrition is broadly classified into two types: autotrophic and heterotrophic.

Autotrophic Nutrition: The mode of nutrition in which an organism synthesizes its own organic food from simple inorganic substances (like CO and HO). The term comes from "auto" (self) and "troph" (nourishment).

Heterotrophic Nutrition: The mode of nutrition in which an organism cannot synthesize its own food and depends on other organisms (plants or animals) for its nutritional requirements. The term comes from "hetero" (other) and "troph" (nourishment).

Step 2: Detailed Differentiation:

Basis of Difference	Autotrophic Nutrition	Heterotrophic Nutrition
Source of Food	Organisms produce their own food from inorganic raw materials.	Organisms obtain pre-prepared organic food from other organisms.
Energy Source	Energy is obtained from sunlight (photosynthesis) or chemical reactions (chemosynthesis).	Energy is obtained by breaking down complex organic food molecules.
Presence of Chlorophyll	Photosynthetic autotrophs possess chlorophyll to trap solar energy.	Chlorophyll is absent.
Role in Ecosystem	They are producers in the food chain.	They are consumers (primary, secondary, tertiary) or decomposers in the food chain.
Process	Food is synthesized within the body.	Food is ingested and then digested within the body.
Examples	All green plants, algae, cyanobacteria, and some chemosynthetic bacteria.	All animals, fungi (yeast, mushroom), and most bacteria.

Quick Tip

Using a table is the best way to answer differentiation questions. Always include a basis for comparison to make your points clear and structured. Remember the core difference: autotrophs are 'producers' and heterotrophs are 'consumers'.

11. (OR) Describe functions of various parts of human alimentary canal with diagram.

Solution:

Step 1: Understanding the Concept:

The human alimentary canal (or digestive tract) is a long, continuous tube extending from the mouth to the anus. Its primary function is the digestion of food, absorption of nutrients, and elimination of solid waste.

(Note: A well-labelled diagram showing the mouth, pharynx, oesophagus, stomach, small intestine, large intestine, rectum, and anus, along with associated glands like salivary glands, liver, and pancreas, should be drawn.)

Step 2: Functions of Various Parts:

1. Mouth (Buccal Cavity):

- **Ingestion:** Taking in of food.

- **Mechanical Digestion:** Teeth cut, tear, and grind the food (mastication).
- **Chemical Digestion:** Saliva, secreted by salivary glands, contains the enzyme salivary amylase (ptyalin), which begins the digestion of starch into simpler sugars. Saliva also lubricates the food to form a bolus for easy swallowing.

2. Pharynx and Oesophagus:

- The pharynx is a common passage for food and air. The epiglottis prevents food from entering the windpipe.
- The **oesophagus** is a muscular tube that transports the bolus from the pharynx to the stomach through wave-like muscular contractions called **peristalsis**. No digestion occurs here.

3. Stomach:

- It is a J-shaped muscular organ that stores food for several hours.
- **Mechanical Digestion:** The muscular walls of the stomach churn and mix the food with gastric juices.
- **Chemical Digestion:** Gastric glands secrete gastric juice containing:
 - **Hydrochloric Acid (HCl):** Creates an acidic medium (pH 1.5-3.5) that kills harmful bacteria and activates pepsin.
 - **Pepsin:** An enzyme that begins the digestion of proteins into smaller peptides.
 - **Mucus:** Protects the inner lining of the stomach from the corrosive action of HCl.
- The semi-digested food here is called chyme.

4. Small Intestine:

- It is the longest part of the alimentary canal and the main site for the complete digestion and absorption of food. It is divided into the duodenum, jejunum, and ileum.
- It receives secretions from the liver (**bile juice**) and the pancreas (**pancreatic juice**).
- **Bile Juice:** Emulsifies fats (breaks down large fat globules into smaller ones), making it easier for enzymes to act on them.
- **Pancreatic Juice:** Contains enzymes like trypsin (for digesting proteins), pancreatic amylase (for carbohydrates), and lipase (for fats).
- **Intestinal Juice:** Secreted by the walls of the small intestine, it contains enzymes that complete the digestion of carbohydrates into glucose, proteins into amino acids, and fats into fatty acids and glycerol.
- **Absorption:** The inner wall has millions of finger-like projections called **villi**, which vastly increase the surface area for the absorption of digested nutrients into the bloodstream.

5. Large Intestine:

- It is wider and shorter than the small intestine.
- Its main function is to absorb water and electrolytes from the undigested food material.
- It also forms and stores feces.

6. Rectum and Anus:

- The rectum stores the feces temporarily.

- The **anus** is the opening through which the feces are eliminated from the body (egestion or defecation).

Quick Tip

To remember the sequence of organs, use a mnemonic like "Mouse Oesophagus Stomach, Small Large Rectum Anus". For functions, associate specific enzymes with each organ (Amylase - Mouth, Pepsin - Stomach, Trypsin/Lipase - Small Intestine) and their roles. Always mention the role of villi in absorption for the small intestine.
