CBSE EXAMINATION PAPER-2025

SCIENCE

(Solved)

Time allowed : 3 hours | Maximum Marks : 90

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **45 questions.** All questions are **compulsory.**

ii. This question paper is divided into **5 sections.**

iii. **Section A** – questions number **1 to 3** are case based questions

iv. **Section B** – questions number **4 to 23** are multiple choice questions

v. **Section C** – questions number **24 to 31** are very short answer

vi. **Section D** – questions number **32 to 39** are short answer

vii. **Section E** – questions number **40 to 45** are long answer

viii. There is no overall choice given in the question paper. However, an internal choice has been provided in few questions.

ix. Use of calculator is NOT allowed.

Section A

Question 1.

'A' and 'B' are two salts used for washing purposes. Salt 'A' is used for bathing also. Four test tubes I, II, III and IV as mentioned below are taken.

I. Rain water + solution of salt 'A'

II. Rain water + solution of salt 'B'

III. Tubewell water + solution of salt 'A'

IV. Tubewell water + solution of salt ‘B’

The test tubes are shaken one by one almost identically for the same time and the lengths of foam formed in each test tube is noted.

(1) Differentiate between salt A and salt B.

[1 Marks]

Answer: Salt A is soap which is basic and gets less foam with hard water, while salt B is detergent which is acidic or neutral and foams well even in hard water. Soap (salt A) is soluble in water and affects litmus paper making it basic. Detergent (salt B) is made from synthetic acids/bases and is used for washing clothes and works in hard and soft water. This is observed from the foam formation in tubes I to IV as per the case.

Key Points: Salt A is soap - Salt A is basic - Salt B is detergent - Salt B is acidic or neutral - Soap forms less foam with hard water - Detergent forms foam in hard water - Soap affects litmus to basic - Detergent derived from synthetic acid/base

(2) In which one of the four test tubes is the foam formed the minimum?

[1 Marks]

Answer: Answer: The foam formed is minimum in test tube IV (Tubewell water + solution of salt B) because tubewell water is hard due to dissolved sulphates/chlorides of calcium and magnesium, which react with soap (salt A) to form scum and reduce foam. Salt B is detergent and is less affected, but still foam is less in hard water. Hence, test tube IV has minimum foam.
Explanation: Hard water reacts with soap to form curdy scum and decreases foam formation. Detergents work better in hard water but still foam is less compared to soft water like rain water. Therefore, minimum foam is in IV as it contains hard water and salt B solution.

Key Points: Foam is minimum in test tube IV - Hard water contains calcium and magnesium salts - Soap forms scum in hard water reducing foam

(3) What are esters? What happens when an ester reacts with an alkali (say sodium hydroxide)? Give a chemical equation for the reaction.

[2 Marks]

Answer:

Esters are chemical compounds formed from the reaction between an alcohol and a carboxylic acid. When an ester reacts with an alkali like sodium hydroxide, it undergoes a reaction called saponification, where the ester breaks down to form an alcohol and a salt of the acid. For example, ethyl ethanoate reacts with sodium hydroxide to give ethanol and sodium ethanoate as shown: $CH_3COOCH_2CH_3 + NaOH \rightarrow CH_3COONa + CH_3CH_2OH$
This reaction is important for making soap, relating to the washing salts discussed in the case.

Key Points: Esters are formed from alcohol and carboxylic acid - Reaction with alkali is saponification - Ester + NaOH forms alcohol + salt of acid

(4)

What is the cause of hardness of water ? Sometimes it is observed that while bathing foam is formed with difficulty and an insoluble substance is formed. Name this substance and write the cause of its formation.

[2 Marks]

Answer: Cause of hardness of water: Hardness of water is caused due to the presence of calcium (Ca^{2+}) and magnesium (Mg^{2+}) salts such as sulphates and chlorides in water.
Insoluble substance formed during bathing: When soap reacts with hard water, it forms a white curdy solid called soap scum.
Reason of formation: This soap scum is formed because calcium and magnesium ions react with soap and produce an insoluble compound which makes foam formation difficult and leaves a residue while bathing, as seen in test tubes with tubewell water in the case passage.

Key Points: Hardness caused by Ca and Mg salts - Soap scum formed by reaction of soap with hard water - Soap scum is insoluble and reduces foam formation

Question 2.

A person while climbing up a rocky hill comes into a panic state and fear. His body starts reacting in a ‘flight-or-flight’ condition to adjust to the dangerous and stressful situation.

Based on the above facts, answer the questions that follow.

(1) Name the hormone secreted in the blood of the person in this situation.

[2 Marks]

Answer: In this situation, the hormone secreted in the blood is adrenaline. Adrenaline, produced by the adrenal glands, plays a crucial role in the body's response to stress and triggers the 'fight-or-flight' mechanism. This hormone helps the body adjust to danger by increasing heart rate, dilating air passages, and mobilizing energy reserves to prepare the individual for a quick response.

> **Key Points: adrenaline - produced by adrenal glands - prepares body for fight-or-flight response - increases heart rate - enhances oxygen supply**

(2) State any two responses in the body of the person as a result of the secretion of this hormone.

[1 Marks]

Answer: In response to the secretion of adrenaline during a panic state, the person's body exhibits several physiological changes. Firstly, the heart rate increases, allowing for quicker blood circulation to muscles and vital organs, preparing the body for either fight or flight. Secondly, the breathing rate accelerates, enabling more oxygen to be taken in, which is essential for peak physical performance in high-stress situations.

> **Key Points: Heart rate increases-Breathing rate accelerates**

(3) How does the action of the chemical signal in terms of hormones differ from the electrical impulses via nerve cells?

[1 Marks]

Answer: The action of chemical signals in terms of hormones, such as adrenaline, differs significantly from electrical impulses sent via nerve cells. Hormones are transmitted through the bloodstream and can affect multiple target cells throughout the body, resulting in widespread and prolonged changes in physiological activity. For example, adrenaline prepares the body for a 'fight-or-flight' response by increasing heart rate, dilating air passages, and redirecting blood flow to essential organs. In contrast, electrical impulses are quick and localized, transmitting signals directly along nerve cells for immediate responses, such as reflex actions. While hormonal responses take longer to initiate, they are essential for coordinating complex and sustained bodily changes in response to stress, allowing organisms to adapt effectively to challenging situations.

Key Points: Hormonal signals via adrenaline affect multiple target cells; Electrical impulses are quick and localized; Hormonal responses are slower but result in widespread changes; 'Fight-or-flight' responses require coordinated actions involving hormones.

(4)

Name the source gland of the hormone secreted in this condition.

[2 Marks]

Answer: The source gland of the hormone secreted in this condition is the adrenal gland. The adrenal glands produce adrenaline (also known as epinephrine), which plays a crucial role in the body's fight-or-flight response. When faced with a stressful situation, like climbing a rocky hill, the adrenal glands release adrenaline into the bloodstream, preparing the body to respond to the perceived threat. This hormone increases heart rate, enhances oxygen supply to the muscles, and helps the body to react promptly.

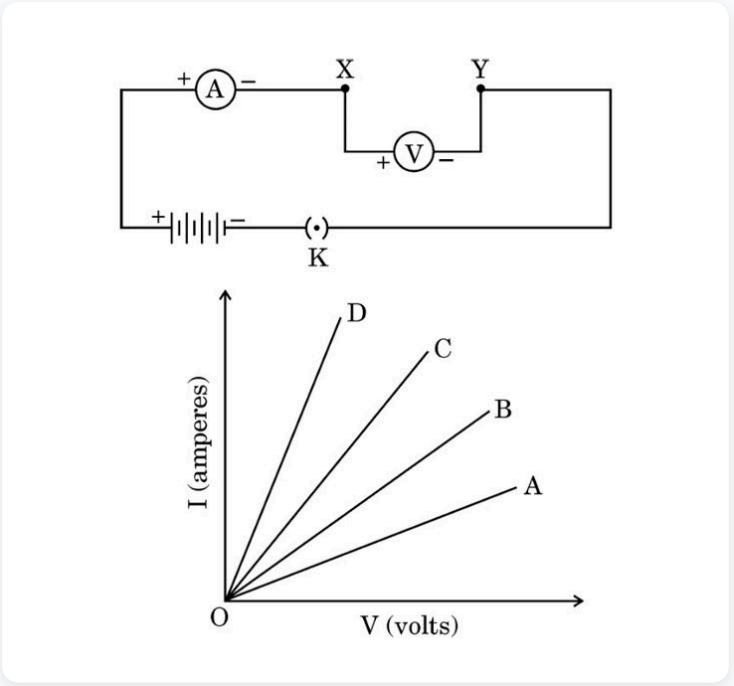
Key Points: adrenal glands-adrenaline-fight-or-flight response

Question 3.

As shown in the diagram, an electric circuit consisting of an ammeter, a voltmeter, 4 cells of 1·5 V each, a plug key with a gap XY was set up. Voltmeter and ammeter readings were recorded in the observation table for four arrangements as given below :

Arrangement No. 1 – only resistor R_1 in gap XY
Arrangement No. 2 – only resistor R_2 in gap XY
Arrangement No. 3 – Resistors R_1 and R_2 in series in gap XY
Arrangement No. 4 – Resistors R_1 and R_2 in parallel in gap XY

Based on the observations, four V – I graphs A, B, C and D as shown in figure were drawn. Study these graphs.



(1) Which one of the graphs represents the series combination of R_1 and R_2 ?

[1 Marks]

Answer: Graph representing the series combination of R_1 and R_2 is the one where the voltage increases with current showing a higher resistance than individual resistors. As per the case, arrangement 3 has R_1 and R_2 in series, so the graph with the steepest slope corresponds to this combination because series resistors have total resistance equal to the sum of individual resistances, resulting in lower current for the same voltage.

Key Points: series combination - higher resistance - steepest slope on V-I graph

(2) A battery of 6 V is connected with a series combination of five resistors of 0·1Ω , 0·2 Ω, 0·3Ω , 0·4 Ω and 0·5Ω. How much current would flow through the 0·3Ω resistor ? Justify your answer.

[2 Marks]

Answer: In a series circuit, the current remains the same through all resistors, so the current through the 0.3Ω resistor is equal to the total current. Total resistance R = 0.1 + 0.2 + 0.3 + 0.4 + 0.5 = 1.5Ω. Using Ohm's Law, I = V / R = 6 V / 1.5Ω = 4 A. Therefore, 4 A current flows through the 0.3Ω resistor. This matches the case where current is same in series resistors as explained in the case passage.

Key Points: In series current is same - Total resistance is sum of individual resistances - Calculate current using Ohm's Law I = V/R

(3) Which one of these graphs represents the parallel combination of R_1 and R_2?

[1 Marks]

Answer: Graph D represents the parallel combination of R_1 and R_2 because in parallel circuits voltage across resistors is the same and the total current is the sum of currents through each resistor, as explained in the case paragraph. Graph D will show higher current for the same voltage compared to series or single resistors.

Key Points: Parallel combination voltage is same across resistors - Total current is sum of branch currents - Graph with higher current for same voltage represents parallel combination

(4) Show an arrangement of three resistors, each of resistance 10Ω , so that the combination has a resistance of 15Ω . Give justification for your answer.

[2 Marks]

Answer: Arrangement: Connect two resistors in parallel and the third resistor in series with this parallel combination to get a total resistance of 15 Ohms.
Justification: Two 10 Ohm resistors in parallel give 5 Ohms (since 1/R = 1/10 + 1/10 = 2/10, so R = 5 Ohms). Then, adding third 10 Ohm resistor in series gives total resistance R = 5 + 10 = 15 Ohms. This matches the required value. This setup is based on the series and parallel resistance rules explained in the case passage.

Key Points: Two resistors in parallel give 5 Ohms - Third resistor in series adds 10 Ohms - Total resistance becomes 15 Ohms

Section B

Question 4.

Consider the following chemical equation:

$p\ Al + q\ H_2O \longrightarrow r\ Al_2O_3 + s\ H_2$

To balance this chemical equation, the values of ‘p’, ‘q’, ‘r’ and ‘s’ must be respectively:

[1 Marks]

(A) 3, 1, 2, 2

(B) 2, 3, 3, 1

(C) 3, 2, 2, 1

(D) 2, 3, 1, 3

Explanation:

To balance the equation:

$p\ Al + q\ H_2O \rightarrow r\ Al_2O_3 + s\ H_2$

- **Al_2O_3** has **2 aluminium atoms**, so we need **2 Al** on the left → p = 2
- **Al_2O_3** has **3 oxygen atoms**, so we need **3 H_2O** to provide them → q = 3

- **3 H_2O** gives **6 hydrogen atoms**, which form **3 H_2 molecules** → s = 3
- One molecule of **Al_2O_3** is enough → r = 1

Final balanced equation:

$2\ Al + 3\ H_2O \rightarrow Al_2O_3 + 3\ H_2$

Question 5.

Which of the given option represents a family of salts?

[1 Marks]

(A) $MgSO_4$, $CuSO_4$, $MgCl_2$

(B) $NaNO_3$, $CaCO_3$, Na_2CO_3

(C) K_2SO_4, Na_2SO_4, $CaSO_4$

(D) NaCl, Na_2SO_4, $CaSO_4$

Explanation:

A **family of salts** has the **same anion** but different cations.

- In **Option** :
  - **K_2SO_4**, **Na_2SO_4**, **$CaSO_4$**
  - All have the **same anion SO_4^{2-}** (sulfate)
  - Different cations (K^+, Na^+, Ca^{2+})
    So, they belong to the **same salt family**.

Final Answer: K_2SO_4, Na_2SO_4, $CaSO_4$

Question 6.

The most common method of extraction of metals from their oxide ores is :

[1 Marks]

(A) Reduction with carbon

(B) Reduction with aluminium

(C) Electrolytic reduction

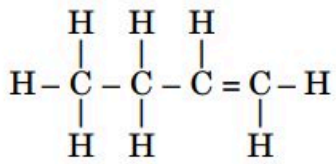
(D) Reduction with hydrogen

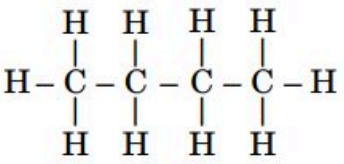
Explanation: The correct answer is 'Reduction with carbon' because the context describes how metal oxides can be reduced to obtain the respective metals, and using carbon as a reducing agent is a common approach for many metal oxides, such as zinc oxide, which can be reduced to metallic zinc using carbon. This reduction is easier and more feasible compared to other methods described.

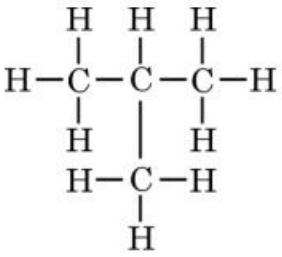
Question 7.

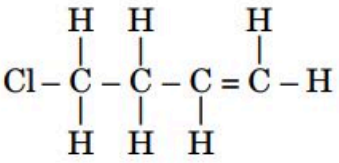
Given below are the structures of some hydrocarbons. Select the two structures which are related to each other from the given options :

[1 Marks]

(i) 

(ii) 

(iii) 

(iv) 

(A) (ii) and (iii)

(B) (ii) and (iv)

(C) (i) and (iv)

(D) (i) and (iii)

Explanation:

Step-by-step analysis:

(ii):

- Structure: Straight-chain hydrocarbon
- Molecular formula: C_4H_{10}
- This is **butane**

(iii):

- Structure: Branched hydrocarbon

- Molecular formula: C_4H_{10}
- This is **isobutane**

(ii) and (iii) are **isomers** of each other — **same molecular formula, different structures**.

Question 8.

Choose the incorrect statement about the common reaction used in hydrogenation of vegetable oils.

[1 Marks]

(A) It is an addition reaction.

(B) It takes place in the presence of nickel or palladium catalyst.

(C) The product contains only single bonds between carbon atoms.

(D) It is an addition reaction which occurs in the presence of an acid catalyst.

Explanation: The incorrect statement is: 'It is an addition reaction which occurs in the presence of an acid catalyst.' This is incorrect because the hydrogenation of vegetable oils occurs in the presence of nickel or palladium as catalysts, not acid catalysts. The process involves adding hydrogen to unsaturated hydrocarbons to convert them into saturated hydrocarbons.

Question 9.

Match Column-I with Column-II and select the correct option from the choices provided.

[1 Marks]

	Column-I		*Column-II*
a.	Site of fertilisation of egg with the sperm	(i)	Vagina
b.	Site of implantation of embryo	(ii)	Uterus
c.	Site of entry of sperm into the female reproductive tract	(iii)	Oviduct
d.	Site through which the waste materials generated by the developing embryo are removed	(iv)	Placenta
		(v)	Cervix

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

(B) a-(iii), b-(i), c-(v), d-(iv)

(C) a-(ii), b-(i), c-(v), d-(iv)

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

Explanation:

The correct option is a-(iii), b-(ii), c-(i), d-(iv) because it accurately matches the items listed in Column-I with their corresponding descriptions in Column-II based on the context of bonding in carbon and the distinctions between mixtures, solutions, suspensions, and colloidal solutions.

Question 10.

The part of the brain which maintains the posture and balance of the body is :

[1 Marks]

(A) Cerebellum

(B) Cerebrum

(C) Pons

(D) Medulla

Explanation: The correct answer is 'Cerebellum' because it is specifically mentioned in the context that the cerebellum is responsible for precision of voluntary actions and maintaining the posture and balance of the body.

Question 11.

The plant hormone present in greater concentration in the areas of rapidly dividing cells is :

[1 Marks]

(A) Gibberellins

(B) Abscisic acid

(C) Cytokinins

(D) Auxin

Explanation: The correct option is Cytokinins because, as stated in the context, cytokinins promote cell division and are found in greater concentration in areas where cells are dividing rapidly, such as in fruits and seeds.

Question 12.

Select a pair of bisexual flowers from the following :

[1 Marks]

(A) Papaya and mustard

(B) Hibiscus and mustard

(C) Hibiscus and watermelon

(D) Hibiscus and papaya

Explanation: The correct pair of bisexual flowers is Hibiscus and mustard. Both of these flowers contain both stamens (the male reproductive structures that produce pollen) and pistils (the female reproductive structures), making them bisexual. In contrast, papaya and watermelon are unisexual flowers, containing either stamens or pistils but not both.

Question 13.

The gastric glands present in the wall of the stomach release :

[1 Marks]

(A) Mucus and Trypsin

(B) Pepsin and Salivary amylase

(C) Pepsin and Trypsin

(D) Mucus and Pepsin

Explanation: The correct answer is 'Mucus and Pepsin'. The gastric glands in the stomach release hydrochloric acid, pepsin (a protein digesting enzyme), and mucus. Mucus serves to protect the stomach lining from the harsh effects of the acid, and pepsin is essential for digesting proteins. The provided context explicitly mentions these components being released by the gastric glands.

Question 14.

Absolute refractive index of water and glass is $\frac{4}{3}$ and $\frac{3}{2}$ respectively. If the speed of light in glass is 2×10^8 m/s, the speed of light in water is:

[1 Marks]

(A) $\frac{9}{4}$ m/s

(B) $\frac{16}{9}$ m/s

(C) $\frac{7}{3}$ m/s

(D) $\frac{9}{8}$ m/s

Explanation:

$n=vc \Rightarrow v=nc$

So,

vw=c/nw=3×10power8/4/3=3×10power8×3/4=9/4×10power8

Question 15.

When a beam of white light passes through a region of very fine dust particles, the colour of light that scatters the most in that region is :

[1 Marks]

(A) red

(B) orange

(C) blue

(D) yellow

Explanation: The correct answer is blue. This is because very fine particles scatter light of shorter wavelengths more effectively, and blue light has a shorter wavelength compared to red, orange, or yellow light. The context states that very fine particles mainly scatter blue light, which directly supports this conclusion.

Question 16.

A wire of length ‘l’ is gradually stretched so that its length increases to 3l. If its original resistance is R, then its new resistance will be :

[1 Marks]

(A) 9R

(B) 27R

(C) 6R

(D) 3R

Explanation: The resistance of a wire is directly proportional to its length and inversely proportional to its cross-sectional area. When the length of the wire is increased to 3l, its resistance will increase according to the formula R' = R * (new length/original length)^2. Since the length increases by a factor of 3, the new resistance R' = R * (3)^2 = 9R.

Question 17.

Which one of the following statements is not true about a bar magnet ?

[1 Marks]

(A) It produces magnetic field lines.

(B) It has attractive power for iron filings.

(C) The direction of magnetic field lines inside a bar magnet is from its north pole to its south pole.

(D) It sets itself in north-south direction when suspended freely.

Explanation: The correct answer is 'The direction of magnetic field lines inside a bar magnet is from its north pole to its south pole.' This statement is not true because, according to the context, magnetic field lines actually emerge from the north pole and merge at the south pole, indicating that the field lines inside the magnet are directed from the south pole to the north pole.

Question 18.

The strength of magnetic field produced inside a long straight current carrying solenoid does not depend upon :

[1 Marks]

(A) number of turns in the solenoid

(B) radius of the coil of the solenoid

(C) material of the core filled inside the solenoid

(D) direction of current flowing through the solenoid

Explanation:

The **strength of the magnetic field (B)** inside a **long straight current-carrying solenoid** is given by the formula:

$B=\mu_0\mu_r \cdot nIL$

Where:

- B = magnetic field
- μ_0 = permeability of free space
- μ_r = relative permeability (depends on the **core material**)
- n = number of turns
- I = current
- L = length of solenoid

- So, magnetic field depends on:
    - Number of turns
    - Direction of current — affects direction, not magnitude, but still part of the field
    - Material of the core — via permeability μr\mu_rμr
    - **Not on radius** of the coil — **radius has no effect on field strength** inside a long solenoid

Question 19.

Other than the abiotic components, which of the given biotic components are not required to make an aquarium with small herbivorous fishes a self-sustaining system ?

(i) Aquatic plants and aquatic animals

(ii) Terrestrial plants and terrestrial animals

(iii) Decomposers as bacteria and fungi

(iv) Consumers as clown fishes and sea urchins

[1 Marks]

(A) (ii) and (iv)

(B) (ii) and (iii)

(C) (i) and (iv)

(D) (i) and (iii)

Explanation: The correct options are (ii) and (iv). Terrestrial plants and animals are not suitable for an aquarium with aquatic herbivorous fishes because they cannot survive in water. Additionally, while consumers like clown fishes and sea urchins are important in general ecosystems, they are not needed to sustain a system specifically featuring small herbivorous fish, which rely on aquatic plants and primary producers.

Question 20.

Assertion (A) : Hydrogen gas is not evolved when a metal reacts with nitric acid.

Reason (R) : Nitric acid is a strong reducing agent and reduces the hydrogen produced in the reaction to water.

[1 Marks]

(A) Assertion (A) is false, but Reason (R) is true.

(B) Assertion (A) is true, but Reason (R) is false.

(C) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(D) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

Explanation:

The correct option is 'Assertion (A) is true, but Reason (R) is false.' Assertion (A) is true because hydrogen gas is indeed not evolved when metals react with nitric acid due to its strong oxidizing properties. However, Reason (R) is false as nitric acid acts as an oxidizing agent, not a reducing agent, and it oxidizes the hydrogen gas produced to water.

Question 21.

Assertion (A) : In our actions of writing or talking, our nervous system communicates with the muscles.

Reason (R) : Cranial nerves and spinal nerves form the peripheral nervous system.

[1 Marks]

(A) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(B) Assertion (A) is false, but Reason (R) is true.

(C) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(D) Assertion (A) is true, but Reason (R) is false.

Explanation: Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A). While it is true that the nervous system communicates with muscles during actions like writing or talking, the fact that cranial and spinal nerves form the peripheral nervous system does not specifically explain how this communication happens.

Question 22.

Assertion (A) : Magnetic field lines around a bar magnet never intersect each other.

Reason (R) : Magnetic field produced by a bar magnet is a quantity that has both magnitude and direction.

[1 Marks]

(A) Assertion (A) is true, but Reason (R) is false.

(B) Assertion (A) is false, but Reason (R) is true.

(C) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(D) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

Explanation:

Assertion (A):

Magnetic field lines around a bar magnet never intersect each other.
True

- If magnetic field lines were to **intersect**, it would mean **two directions of the magnetic field** at a single point — which is **physically impossible**.

Reason (R):

Magnetic field produced by a bar magnet is a quantity that has both magnitude and direction.
True

- A **magnetic field** is a **vector quantity** — it has both **magnitude and direction**.

Connection:

- Because magnetic field has **a unique direction at every point**, the field lines **cannot cross** — otherwise, it would suggest **multiple directions at one point**.
- So, the **Reason correctly explains** the Assertion.

Question 23.

Assertion (A) : Use of jute bags for shopping reduces pollution.

Reason (R) : Jute is biodegradable and its bag may be reused as and when needed.

[1 Marks]

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Assertion (A) is true, but Reason (R) is false.

(C) Assertion (A) is false, but Reason (R) is true.

(D) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

Explanation: Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A) because using jute bags indeed reduces pollution as jute is biodegradable, which means it decomposes naturally and can also be reused, thereby minimizing waste in the environment.

Section C

Question 24. List the possible sources of energy required in decomposition reactions. Illustrate any one with a suitable example.

[2 Marks]

Answer: Decomposition reactions require energy sources like heat, light, or electricity to break down reactants. For example, during the electrolysis of water, an electrical current decomposes water into hydrogen and oxygen gases. This reaction is endothermic as it absorbs energy to occur, showcasing the necessity of energy input in decomposition processes.

Key Points: heat-light-electricity-endothermic reaction-example of electrolysis of water

Question 25. What is observed when hydrated ferrous sulphate crystals are heated in a dry boiling tube? Give balanced chemical equation(s) of the reaction(s) that occur(s).

[2 Marks]

Answer:

When hydrated ferrous sulphate crystals ($FeSO_4.7H_2O$) are heated in a dry boiling tube, they lose water and turn from green to reddish-brown. This process results in a decomposition reaction, producing ferric oxide ($Fe2O_3$), sulphur dioxide (SO_2), and sulphur trioxide (SO_3). The balanced chemical equation for the reaction is: $2FeSO_4(s) + Heat \rightarrow Fe_2O_3(s) + SO_2(g) + SO_3(g)$.

Key Points:

Loss of water upon heating-Change of colour from green to reddish-brown-Decomposition reaction producing ferric oxide, SO_2 , SO_3-Balanced equation:$2FeSO_4(s) + Heat \rightarrow Fe_2O_3(s) + SO_2(g) + SO_3(g)$.

Question 26.

(a) Write the formula of the ions which (i) acids, and (ii) bases generate in water solutions.

(b) Dry HCl gas does not change the colour of dry litmus paper. Why ?

[2 Marks]

Answer: Acids produce hydrogen ions (H^+) in aqueous solutions, while bases generate hydroxide ions (OH^-). Dry HCl gas does not change the color of dry litmus paper because there are no water molecules available to convert HCl into its ionized form ($H^+ + Cl^-$). Litmus paper only reacts with ions in a solution, so without water, the acidic character of HCl is not demonstrated.

Key Points: H^+ ions from acids- OH^- ions from bases- Dry HCl gas lacks ionization

Question 27. State the main function of veins in human circulatory system. Why do they not need thick walls?

[2 Marks]

Answer: The main function of veins in the human circulatory system is to collect carbon dioxide-rich blood from various organs and transport it back to the heart. Unlike arteries, veins do not require thick walls because the blood is under lower pressure. Instead, veins have valves that prevent the backflow of blood, ensuring that it flows in one direction towards the heart, facilitating efficient circulation.

Key Points: Function of veins: collect carbon dioxide-rich blood; Transport blood back to the heart; Thin walls due to low pressure; Valves prevent backflow; Ensure one-directional flow.

Question 28.

(a) Explain how the proteins control the ‘characteristics’ in an organism with the help of an example of ‘tallness’ trait in pea plant.

(b) Name the section of DNA that controls the ‘characteristics’ in an organism.

[2 Marks]

Answer: Proteins control characteristics in organisms by influencing specific traits, like tallness in pea plants. The tallness trait is influenced by a gene that encodes an enzyme responsible for hormone production, promoting growth. A dominant allele ‘T’ produces sufficient hormone for tallness, while the recessive allele ‘t’ results in less hormone, leading to shortness. Thus, the presence of the ‘T’ allele determines tallness. The DNA section that controls this is called a gene.

Key Points: Proteins influence traits-Example of tallness in pea plants-Hormone production is key-Dominant allele 'T' leads to tallness-Recessive allele 't' leads to shortness-DNA section controlling traits is a gene

Question 29. A student has difficulty in reading his textbooks but can read the blackboard clearly while sitting in the last row. Name the defect of vision the student is suffering from. List two reasons due to which this defect arises. Write the nature of the lenses required to correct this defect.

[2 Marks]

Answer: The student is suffering from hypermetropia, also known as farsightedness. This defect arises due to the eyeball being too short or the cornea having insufficient curvature, causing difficulty in focusing on nearby objects. It can also occur from aging, where the lens loses its flexibility. To correct hypermetropia, convex lenses are required, which help to converge light rays before they enter the eye, enabling the student to see nearby objects clearly.

> **Key Points: Hypermetropia-farsightedness-eye too short or insufficient curvature-aging affects lens flexibility-convex lenses required for correction**

Question 30. Draw a ray diagram to show the path of a ray of light falling obliquely on one of the refracting faces of a triangular glass prism and mark the angle of deviation on it.

[2 Marks]

Answer: To illustrate the refraction of light through a triangular prism, draw a triangle representing the prism's outline. Mark the incident ray, PE, inclined to face AB. Draw the refracted ray, EF, entering the prism at angle of incidence, ∠i. At point E, the ray bends towards the normal. Upon exiting face AC, sketch the emergent ray, FS, forming angle of emergence, ∠e. The angle of deviation, ∠D, is marked between PE and FS.

> **Key Points: Draw prism outline-Label incident ray PE, refracted ray EF, and emergent ray FS-Mark angles of incidence ∠i and emergence ∠e-Illustrate angle of deviation ∠D**

Question 31. An electric kettle is rated 230 V; 1000 W. Calculate the resistance of its heating element when in operation.

[2 Marks]

Answer: To calculate the resistance of the heating element of the electric kettle, we use the formula P = V * I. First, find the current I using I = P/V, so I = 1000 W / 230 V = 4.35 A. Next, calculate the resistance R using R = V/I, which gives R = 230 V / 4.35 A = 52.87 Ω. Therefore, the resistance of the heating element is approximately 52.87 ohms.

> **Key Points: Use P = V * I formula - Calculate current I = P/V - Calculate resistance R = V/I**

Section D

Question 32.

(a) What is a reactivity series of elements ? How is it developed ? Arrange the following elements as they are arranged in the reactivity series : Aluminum, Calcium, Copper, Lead

(b) Write balanced chemical equation to show the reaction of iron (III) oxide (Fe_2O_3)with aluminium.

[3 Marks]

Answer: The reactivity series is a ranking of metals based on their reactivity, placed in order from most reactive to least reactive. It is developed through displacement experiments that observe how metals interact with solutions of other metals. In the given series, Calcium is the most reactive, followed by Aluminum, then Lead, and finally Copper, which is the least reactive. This order is significant in predicting reactions in chemistry. The balanced chemical equation for the reaction of iron (III) oxide with aluminum is $2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$. This reaction, known as thermite reaction, is highly exothermic and demonstrates aluminum's strong reducing ability.

Key Points: Reactivity series definition - Arrangement in order of decreasing reactivity - Developed through displacement experiments - Elements arranged: Calcium, Aluminum, Lead, Copper - Balanced equation: $2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$

Question 33. Common salt is an important raw material for various chemicals of daily use. State in brief the method of preparation of (i) Sodium hydroxide, and (ii) Sodium hydrogen carbonate from common salt. Write balanced chemical equations of the reactions that occur.

[3 Marks]

Answer: (i) Preparation of Sodium hydroxide:
Sodium hydroxide is prepared by the electrolysis of an aqueous solution of common salt (sodium chloride). When electricity is passed through brine, chlorine gas is released at the anode, hydrogen gas at the cathode, and sodium hydroxide remains in solution. This process is called the chlor-alkali process.
The reactions are:
$2NaCl + 2H_2O$ --electricity--> $Cl_2 + H_2 + 2NaOH$

(ii) Preparation of Sodium hydrogen carbonate:
Sodium hydrogen carbonate (baking soda) is prepared by the Solvay process using common salt. First, sodium chloride solution is reacted with ammonia and carbon dioxide to form sodium hydrogen carbonate.
The reactions are:
$NaCl + NH_3 + CO_2 + H_2O$ --> $NaHCO_3 + NH_4Cl$
The sodium hydrogen carbonate precipitates out and is collected by filtration.

Key Points:

Sodium hydroxide by electrolysis of brine - Chlor-alkali process - Reaction equation for NaOH preparation - Sodium hydrogen carbonate by Solvay process - Reaction with ammonia and carbon dioxide - Reaction equation for $NaHCO_3$ production

Question 34.

On the basis of the characteristics of the processes given in the brackets in each case, differentiate between the following:

(a) Products of breakdown of pyruvate in aerobic and anaerobic respiration in human beings (product(s) of the processes)

(b) Respiration and photosynthesis in plants (gas released)

(c) Respiration in terrestrial animals and fishes (organs involved)

[3 Marks]

Answer: (a) In aerobic respiration in human beings, pyruvate is broken down into carbon dioxide and water with the release of a large amount of energy. In anaerobic respiration, pyruvate is converted into lactic acid, and energy released is much less.
(b) In respiration, plants release carbon dioxide gas as a byproduct. In photosynthesis, plants release oxygen gas while making food.
(c) Terrestrial animals respire using lungs which allow exchange of gases with the air. Fishes respire using gills which extract oxygen dissolved in water.

Key Points: Products of aerobic respiration: carbon dioxide and water - Product of anaerobic respiration: lactic acid - Respiration releases carbon dioxide - Photosynthesis releases oxygen - Terrestrial animals use lungs for respiration - Fishes use gills for respiration

Question 35.

A pure pea plant having round (R), yellow (Y) seeds is crossed with another pure pea plant having wrinkled (r), green (y) seeds. Subsequently F_1 progeny is self-pollinated to obtain F_2 progeny.

(a) What do the seeds of F_1 generation look like?

(b) Give the possible combinations of traits in seeds of F_2 generation. Also give their ratio.

(c) State the reason of obtaining seeds of new combination of traits in F_2 generation.

[3 Marks]

Answer: (a) All seeds of the F_1 generation have round and yellow seeds because round (R) is dominant over wrinkled (r) and yellow (Y) is dominant over green (y). Hence, the genotype of F_1 seeds

is RrYy and the phenotype is round and yellow.
(b) The F_2 generation shows four types of seed traits combinations: round yellow (RY), round green (Ry), wrinkled yellow (rY), and wrinkled green (ry). Their phenotypic ratio is 9 : 3 : 3 : 1, respectively.
(c) The new combinations of traits in F_2 generation occur due to independent assortment of alleles during gamete formation. Alleles for seed shape and seed color segregate independently and recombine randomly during fertilization, producing new trait combinations.

Key Points: F1 seeds are round and yellow - F2 seeds have 4 trait combinations with 9:3:3:1 ratio - Independent assortment causes new trait combinations in F2

Question 36. What is a rainbow? Draw a labelled diagram to show its formation.

[3 Marks]

Answer: A rainbow is a natural spectrum that appears in the sky after rainfall when sunlight shines on water droplets in the atmosphere. It presents a beautiful arc of colors: red, orange, yellow, green, blue, indigo, and violet, which result from the dispersion of sunlight. The process begins with sunlight entering a water droplet, where it bends (refracts) and spreads into its component colors. The light reflects off the inner surface of the droplet and refracts again as it exits, creating the visual spectrum we see. This phenomenon is typically observed when the Sun is low and positioned opposite the direction of the rainbow. A labelled diagram can illustrate how sunlight interacts with water droplets to form the arc of colors.

Key Points: Rainbow as a spectrum-Formation due to sunlight and water droplets-Direction of sunlight matters-Seven colors: red, orange, yellow, green, blue, indigo, violet-Diagram illustrating light refraction and reflection

Question 37.

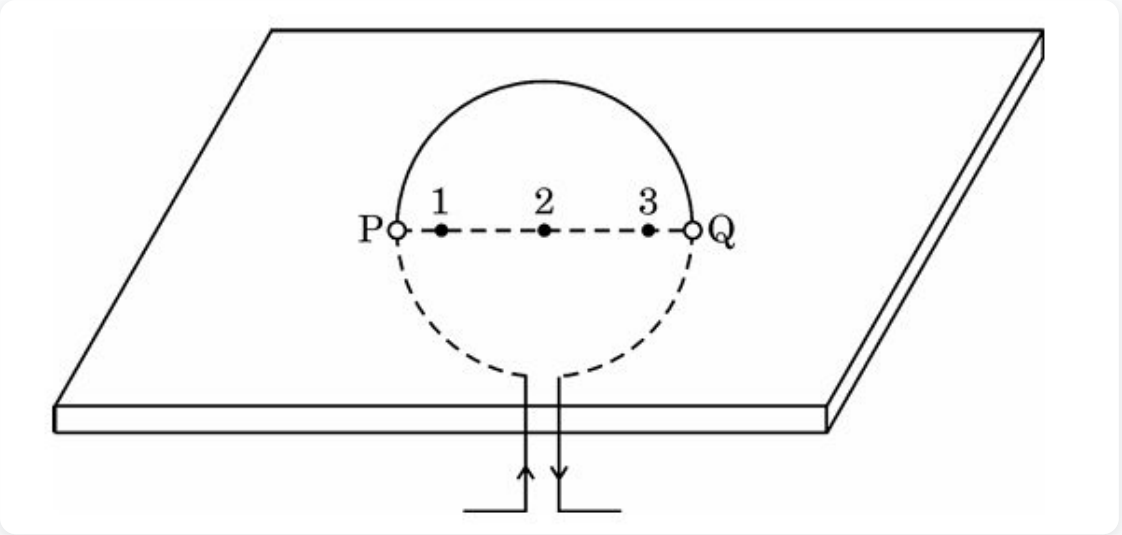
Consider a rectangular cardboard having two holes P and Q through which a current carrying circular loop has been inserted as shown in the diagram.

(a) Make this diagram on your answer sheet and draw three magnetic field lines, one each passing through the points 1 (near P), 2 (at the centre of the loop) and 3 (near Q).

(b) List two factors on which the intensity of the magnetic field produced at the centre of the loop depends.

(c) Name the rule you will apply to determine the direction of magnetic field produced due to a current carrying straight conductor.

[3 Marks]



Answer: (a) The diagram of a circular current carrying loop passing through holes P and Q on a rectangular cardboard is drawn. Three magnetic field lines are drawn with arrows showing direction: one passing near point 1 (close to hole P), another passing through point 2 (centre of the loop), and the third passing near point 3 (close to hole Q). The lines are circular around the wire and inside the loop, they are nearly straight and go from one side of the loop to the other.
(b) The two factors on which the intensity of the magnetic field at the centre of the loop depends are:
1. The magnitude of the current flowing through the loop.
2. The radius of the circular loop.
(c) The rule used to determine the direction of the magnetic field produced by a current carrying straight conductor is the **Right-Hand Thumb Rule**. According to this rule, if the thumb of the right hand points in the direction of the current, then the curled fingers show the direction of the magnetic field around the conductor.

Key Points: Diagram with magnetic field lines at points 1, 2, 3 - Magnetic field intensity depends on current and radius of loop - Use Right-Hand Thumb Rule to find magnetic field direction

Question 38.

(a) ‘‘In a food chain energy flow is unidirectional.’’ Give two reasons for the given statement.

(b) If 10,000 J energy is available at the producer level, how much energy will be available to the secondary consumers ? Give reason to justify your answer.

[3 Marks]

Answer:

In a food chain, energy flow is unidirectional due to two main reasons: Firstly, autotrophs or producers convert solar energy into chemical energy through photosynthesis. This energy is not returned to the original source but continues to flow to the next trophic levels. Secondly, as energy transitions from one trophic level to another, approximately 90% is lost at each step due to metabolic processes, heat production, and waste, which limits energy availability for subsequent consumers. For part (b), if

10,000 J of energy is available at the producer level, only about 1,000 J will be available to secondary consumers. This is derived from the 10% rule, where only 10% of the energy from one trophic level is passed to the next level, illustrating the inefficiency in energy transfer through the food chain.

Key Points:

Unidirectional energy flow; producers convert solar energy; energy loss at each trophic level; 90% energy loss; 10% rule in energy transfer; example of energy available to secondary consumers.

Question 39.

Design an experimental set-up to demonstrate that ‘‘Alcohol and glucose contain hydrogen but are not categorised as acids’’. Also give the reason to justify this fact.

[3 Marks]

Answer: To demonstrate that alcohol and glucose contain hydrogen but are not classified as acids, we can set up a simple experiment. First, prepare two solutions: one with glucose and the other with alcohol, alongside a solution of hydrochloric acid. Use two nails attached to a cork, placing the cork in a 100 mL beaker filled with each solution. Connect the nails to a bulb. The bulb will glow in the acid solution, indicating the presence of ions that conduct electricity. In contrast, the glucose and alcohol solutions will not cause the bulb to glow, proving they do not dissociate into ions in solution and do not show acidic properties. Thus, even though they contain hydrogen, they do not produce hydrogen ions (H+), which are responsible for acidity.

Key Points: Set up solutions of alcohol and glucose alongside hydrochloric acid; use nails and cork in a beaker; observe bulb behavior; acids glow; alcohol and glucose do not; conclusion: presence of H+ ions defines acidity.

Section E

Question 40.

(i) Consider the following metals : K, Ca, Al, Cu, Ag, Fe Select from the above metals, a metal which

I. does not react with oxygen even at high temperature.

II. reacts with oxygen at ordinary temperature and forms a protective oxide layer which prevents the metal from further oxidation.

III. catches fire when kept in the open.

IV. does not burn in oxygen but the hot metal is coated with a black coloured oxide layer.

(ii) What are amphoteric oxides ? With the help of balanced chemical equations show that aluminium oxide is an amphoteric oxide.

(iii) What are alkalis ? Give one example.

[5 Marks]

Answer: (i) **Selection of metals based on their reaction with oxygen:**
I. Metal which does not react with oxygen even at high temperature is **Ag (Silver)**. Silver is less reactive and resistant to oxidation.
II. Metal which reacts with oxygen at ordinary temperature and forms a protective oxide layer is **Al (Aluminium)**. Aluminium oxide layer protects the metal from further oxidation.
III. Metal which catches fire when kept in the open is **K (Potassium)**. It is highly reactive and reacts vigorously with oxygen.
IV. Metal which does not burn in oxygen but the hot metal is coated with a black coloured oxide layer is **Cu (Copper)**. Copper forms black copper(II) oxide on heating.

(ii) **Amphoteric oxides:**
Amphoteric oxides are metal oxides that react with both acids and bases to form salt and water, showing both acidic and basic properties.
Aluminium oxide (Al_2O_3) is amphoteric because it reacts with acids and bases as shown below:
Reaction with acid (HCl): $Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 3H_2O$
Reaction with base (NaOH): $Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O$
These reactions prove aluminium oxide behaves both as acid and base.

(iii) **Alkalis:**
Alkalis are bases that dissolve in water to give hydroxide ions (OH^-) making the solution basic. An example of an alkali is sodium hydroxide (NaOH).

Key Points: Silver does not react with oxygen even at high temperature - Aluminium forms protective oxide layer at room temperature - Potassium catches fire in air - Copper forms black oxide layer on heating - Amphoteric oxides react with acids and bases - Aluminium oxide is amphoteric - Alkalis are water soluble bases - Example: Sodium hydroxide (NaOH)

Question 41.

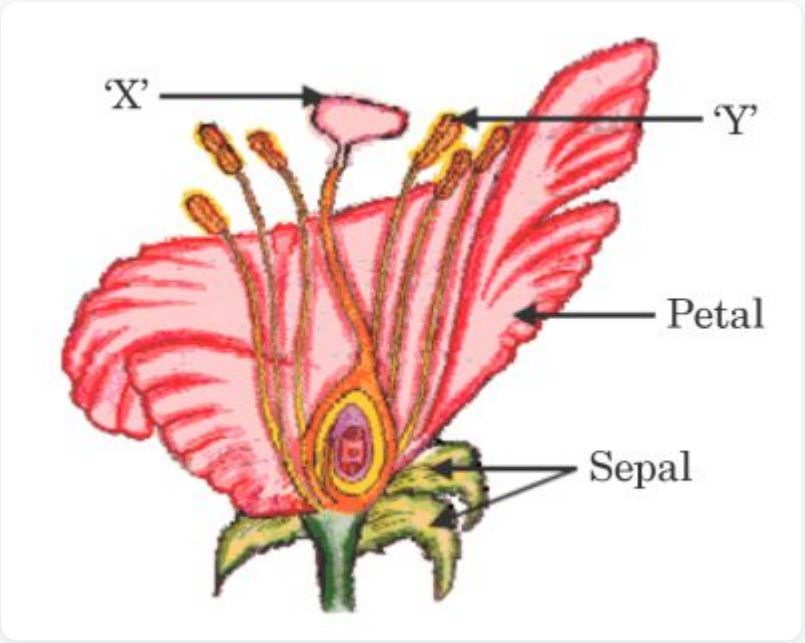
(i) Identify the parts ‘X’ and ‘Y’ in the figure given below :

(ii) Name the yellowish coloured structures produced by the part labelled as ‘Y’.

(iii) Write the name of the process by which these are transferred to the part labelled as ‘X’.

(iv) Explain the process of seed formation in a flowering plant.

[5 Marks]



Answer: (a) The part labelled as 'X' is the **pistil** or **carpel**, which is the female reproductive part of the flower. The part labelled as 'Y' is the **anther**, which is the male reproductive part of the flower.
(b) The yellowish coloured structures produced by the anther (part 'Y') are called **pollen grains**.
(c) The process by which pollen grains are transferred from the anther (Y) to the stigma of the pistil (X) is called **pollination**.
(d) **Process of seed formation in a flowering plant:** After pollination, a pollen grain lands on the stigma of the pistil (X). It germinates and forms a pollen tube that grows down through the style to reach the ovary. The male gametes travel through the pollen tube to the ovule inside the ovary. One male gamete fuses with the egg cell in the ovule thereby fertilization takes place and a zygote is formed. The zygote develops into an embryo. The ovule develops into a seed containing the embryo, and the ovary develops into a fruit surrounding the seed. This process of fertilization leading to seed formation ensures the formation of new plants.

Key Points: Part X is pistil - Part Y is anther - Yellowish structures are pollen grains - Transfer process is pollination - Seed formation involves pollination, fertilization, and development of ovule into seed

Question 42.

(i) ‘‘In refraction of light through a rectangular glass slab, the emergent ray is always parallel to the direction of the incident ray.’’ Why ? Explain with the help of a ray diagram. What happens when a ray of light falls normally on one of the faces of a rectangular glass prism ? Draw diagram.

(ii) An object is placed at a distance of 30 cm from the optical centre of a concave lens of focal length 20 cm. Use Lens formula to determine the position of the image formed in this case.

[5 Marks]

Answer: (i) When light passes through a rectangular glass slab, it undergoes refraction at two parallel surfaces. At the first surface, the ray bends towards the normal as it enters the denser medium, and at the second surface, it bends away from the normal as it comes out to the rarer medium. Due to the parallel nature of the two surfaces, the emergent ray is parallel to the incident ray but is laterally shifted. This means the light ray does not deviate in direction but shifts sideways.

If a ray of light falls normally (at 90 deg) on one face of a rectangular glass prism, it passes straight without any refraction because the angle of incidence is zero and light does not bend when passing through a boundary at normal incidence.

Ray diagram for refraction through glass slab:
Incident ray -> Refracted ray bending towards normal inside glass slab -> Emergent ray parallel to incident ray but shifted laterally.

Ray diagram for ray falling normally on prism:
Incident ray -> passes straight through without bending.

(ii) Given: Object distance u = -30 cm (since object distance is taken opposite to the direction of incident light), focal length f = -20 cm (concave lens has negative focal length).
Using lens formula: $1/f = 1/v - 1/u$
$\Rightarrow 1/v = 1/f + 1/u = 1/(-20) + 1/(-30) = -1/20 - 1/30 = -(3/60 + 2/60) = -5/60 = -1/12$
Therefore, v = -12 cm.

This means the image is formed at 12 cm on the same side as the object (virtual image). The image is erect, diminished, and virtual as is typical of a concave lens.

Hence, the position of the image is 12 cm in front of the lens on the same side as the object.

Key Points: Emergent ray parallel to incident due to parallel surfaces - Emergent ray shifted laterally - Ray at normal incidence passes straight without bending - Use of lens formula 1/f = 1/v - 1/u - Negative focal length for concave lens - Image position calculated as 12 cm on same side (virtual image)

Question 43.

(i) With the help of balanced chemical equations state the process of extracting

(I) mercury from its ore called cinnabar, and

(II) copper from its sulphide ore.

(ii) Silver and copper articles slowly lose their shiny surfaces when exposed to air. Name the compounds formed on

(I) silver articles, and

(II) copper articles in the form of coating.

[5 Marks]

Answer: (i) Extraction Processes:

(I) Mercury from cinnabar ore:

Cinnabar is mercury sulphide (HgS). When heated in the presence of oxygen, it undergoes roasting to form mercuric oxide (HgO) and sulfur dioxide (SO_2) gas.

$2HgS(s) + 3O_2(g)$ --heat--> $2HgO(s) + 2SO_2(g)$

Then, mercuric oxide is further heated to obtain mercury metal and oxygen gas:

$2HgO(s)$ --heat--> $2Hg(l) + O_2(g)$

(II) Copper from its sulphide ore:

Copper is commonly found as copper(I) sulphide (Cu_2S). When heated in the presence of oxygen, it forms copper(I) oxide (Cu_2O) and sulfur dioxide gas:

$2Cu_2S(s) + 3O_2(g)$ --heat--> $2Cu_2O(s) + 2SO_2(g)$

Further heating of copper(I) oxide with copper(I) sulphide produces copper metal and sulfur dioxide:

$Cu_2O(s) + Cu_2S(s)$ --heat--> $6Cu(s) + SO_2(g)$

(ii) Compounds formed when silver and copper articles lose their shine:

(I) Silver articles react with sulfur-containing gases in air to form a coating of silver sulphide (Ag_2S).

(II) Copper articles react with moist carbon dioxide and oxygen of air to form a green coating mainly composed of basic copper carbonate ($CuCO_3 * Cu(OH)_2$), also called patina.

These reactions cause the articles to lose their shiny appearance.

Key Points:

Mercury is extracted by roasting cinnabar to form HgO then heating to get mercury-HgS to HgO and SO_2 then HgO to Hg and O_2 - Copper is extracted by roasting its sulphide ore Cu_2S to Cu_2O and SO_2, further heating with Cu_2S gives copper metal and SO_2 - Silver forms silver sulphide coating (Ag_2S) on exposure to air - Copper forms green basic copper carbonate coating on exposure to moist air

Question 44.

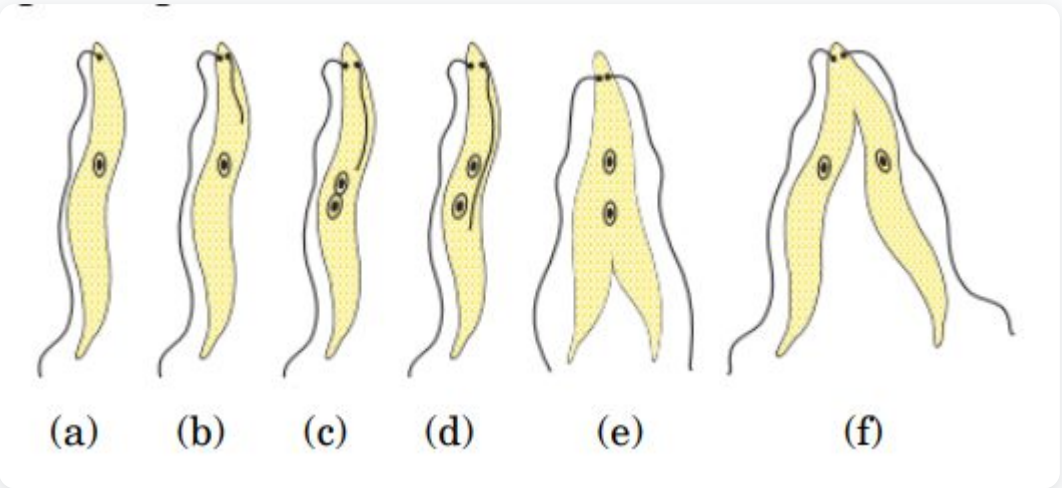
(i) Name the type of asexual mode of reproduction shown in the given figure.

(ii) Identify the unicellular organism in the diagram.

(iii) List any two advantages of asexual reproduction over sexual reproduction.

(iv) Name and explain any one mode of asexual reproduction observed in Hydra.

[5 Marks]



Answer: (a) The type of asexual reproduction shown in the figure is **budding**.
(b) The unicellular organism in the diagram is **amoeba**.
(c) Two advantages of asexual reproduction over sexual reproduction are:

1. It does not require a mate, so reproduction can occur rapidly and easily.
2. Offspring are genetically identical to the parent, ensuring stability of traits.

(d) One mode of asexual reproduction in Hydra is **budding**. In budding, a new small outgrowth called a bud develops on the body of the parent Hydra. The bud grows by cell division and develops tentacles and a mouth. Once fully formed, the bud detaches from the parent and lives independently as a new Hydra. This process allows Hydra to reproduce quickly without the need for fertilization.

Key Points: Asexual reproduction - Budding - Amoeba is unicellular - Advantages: no mate needed, genetically identical offspring - Hydra reproduces by budding

Question 45.

(i) A student wishes to study the image formation by a concave mirror using candle flame as object. State the type of the image formed by the mirror and mention the change in the image formed, if any, that he observes when the candle flame is gradually moved away from the pole of the mirror. Draw a ray diagram to show the image formation when the object distance is nearly equal to the radius of curvature of the mirror.

(ii) A convex mirror used for rear-view on an automobile has a focal length of 3·0 m. If a bus is located at 6·0 m from this mirror, use mirror formula to find the position of the image of the bus as seen in the mirror.

[5 Marks]

Answer: (i) When a candle flame is placed in front of a concave mirror, the type of image formed depends on the position of the candle relative to the mirror's focal point (F) and center of curvature (C). When the candle flame is at the radius of curvature (at C), the image formed is real, inverted and of the same size as the object.

As the candle flame is gradually moved away from the pole of the mirror from a position closer than the focal point, the image changes from being virtual, erect and enlarged (when object is closer than F), to real, inverted and magnified (between F and C), then to real, inverted and same size (at C), and then to real, inverted and diminished (beyond C).

Ray diagram: For the object at C, draw two rays from the top of the candle flame: one parallel to the principal axis which after reflection passes through the focal point, and another passing through C which reflects back on itself. The point where rays meet after reflection is the image location.

(ii) Given focal length, f = +3.0 m (for convex mirror focal length is positive), object distance, u = -6.0 m (object distances are taken negative in mirror formula conventions). Using mirror formula:

$1/f = 1/v + 1/u$

$\Rightarrow 1/v = 1/f - 1/u = 1/3.0 - 1/(-6.0) = 1/3 + 1/6 = (2 + 1)/6 = 3/6 = 1/2$

$\Rightarrow v = 2$ m

The positive value of v indicates that the image is virtual and formed behind the mirror, at 2 m from the mirror.

So, the image of the bus is formed at 2 m behind the convex mirror.

> **Key Points: Image type depends on object position - Image changes from virtual to real as object moves away from pole - Image position can be found using mirror formula for convex mirror**