CBSE 10th Class Science

Duration :3 HR	Maximum Marks :80	Total Questions :39

General Instructions

Read the following instructions very carefully and strictly follow them :

(i) This question paper comprises **39** questions. All questions are compulsory.

(ii) This question paper is divided into five sections – **A, B, C, D and E**.

(iii) **Section A** – Question Nos. **1 to 20** are multiple choice type questions. Each question carries **1 mark**.

(iv) **Section B** – Question Nos. **21 to 26** are very short answer type questions. Each question carries **2 marks**. Answer to these questions should be in the range of **30 to 50 words**.

(v) **Section C** – Question Nos. **27 to 33** are short answer type questions. Each question carries **3 marks**. Answer to these questions should be in the range of **50 to 80 words**.

(vi) **Section D** – Question Nos. **34 to 36** are long answer type questions. Each question carries **5 marks**. Answer to these questions should be in the range of **80 to 120 words**.

(vii) **Section E** – Question Nos. **37 to 39** are of **3 source-based/case-study units of assessment** carrying **4 marks each with sub-parts**.

(viii) There is no overall choice. However, an internal choice has been provided in some sections. Only one of the alternatives has to be attempted in such questions.

Section : A

Select and write the most appropriate option out of the four options given for each of the questions 1 to 20. There is no negative marking for wrong answer. Each question carries 1 mark.

1.

Which one of the following gets biomagnified at different levels in a food chain ? **1**

(a) Carbon monoxide

(b) CFC's

(c) DDT

(d) Manure

Correct Answer: (c) DDT

Solution: Biomagnification refers to the increasing concentration of a substance, such as a toxic chemical, in the tissues of organisms at successively higher levels in a food chain. DDT (Dichlorodiphenyltrichloroethane) is a persistent organic pollutant that is known to biomagnify. Carbon monoxide is a toxic gas but doesn't typically biomagnify in this manner. CFCs (Chlorofluorocarbons) are known for ozone depletion. Manure is organic matter and acts as a fertilizer, it does not biomagnify.

$$\boxed{\text{DDT}}$$

Quick Tip

Quick Tip:

- Biomagnification occurs with substances that are persistent (do not break down easily), fat-soluble (accumulate in fatty tissues), and biologically active.
- Common examples of biomagnifying substances include heavy metals (like mercury) and certain pesticides (like DDT).

2.

In the food chains given below. Select the most efficient food chain in terms of energy : **1**

(a) Grass → Grasshopper → Frog → Snake

(b) Plants → Deer → Lion

(c) Plants → Man

(d) Phytoplankton → Zooplankton → Small Fish → Big Fish

Correct Answer: (c) Plants → Man

Solution: Energy is lost at each trophic level in a food chain, typically around 90Comparing the given options: (a) Grass → Grasshopper → Frog → Snake (4 trophic levels) (b) Plants → Deer → Lion (3 trophic levels) (c) Plants → Man (2 trophic levels) (d) Phytoplankton → Zooplankton → Small Fish → Big Fish (4 trophic levels) The food chain "Plants → Man" has the fewest trophic levels (2 levels), meaning the least amount of energy is lost between the producer (Plants) and the final consumer (Man).

$$\boxed{\text{Plants} \rightarrow \text{Man}}$$

Quick Tip

Quick Tip:

- Energy transfer between trophic levels is inefficient (around 10% rule).
- Shorter food chains result in a greater proportion of energy from the producers being transferred to the top consumers.
- The most efficient food chain is generally the one with the fewest trophic levels.

3. An element 'M' has 25% of the electrons filled in the third shell as in the second shell. The element 'M' is : **1**

(a) Sodium

(b) Magnesium

(c) Aluminium

(d) Calcium

Correct Answer: (b) Magnesium

Solution: The second shell (L-shell) can hold a maximum of 8 electrons. Assuming the second shell is completely filled for an element progressing to the third shell, it has 8 electrons. Number of electrons in the third shell = 25% of electrons in the second shell Number of electrons in the third shell = $0.25 \times 8 = 2$ electrons. The electronic configuration of element 'M' is: First shell (K-shell): 2 electrons Second shell (L-shell): 8 electrons Third shell (M-shell): 2 electrons So, the electronic configuration is 2, 8, 2. The atomic number of element 'M' = Total number of electrons = $2 + 8 + 2 = 12$. The element with atomic number 12 is Magnesium (Mg). Electronic configurations of the given options: (a) Sodium (Na, Z=11): 2, 8, 1 (b) Magnesium (Mg, Z=12): 2, 8, 2 (c) Aluminium (Al, Z=13): 2, 8, 3 (d) Calcium (Ca, Z=20): 2, 8, 8, 2 Element 'M' is Magnesium.

$$\boxed{\text{Magnesium}}$$

Quick Tip

Quick Tip:

- The maximum number of electrons in the first shell (K) is 2, second shell (L) is 8, and third shell (M) is 18 (but it starts filling the fourth shell after 8 electrons in the third shell for elements like K, Ca).
- Calculate the number of electrons in the third shell based on the second shell's count (usually assumed to be full if the third shell is being filled).
- Determine the atomic number and identify the element.

4. An optical device 'X' is placed obliquely in the path of a narrow parallel beam of light. If the emergent beam gets displaced laterally, the device 'X' is : 1

(a) plane mirror

(b) convex lens

(c) glass slab

(d) glass prism

Correct Answer: (c) glass slab

Solution: When a narrow parallel beam of light passes obliquely through a glass slab, it undergoes refraction at two parallel surfaces. The emergent ray is parallel to the incident ray but is displaced laterally.

- A plane mirror reflects light, changing its direction according to the laws of reflection. It does not cause lateral displacement in the context of a transmitted beam.
- A convex lens converges a parallel beam of light to a focal point (or diverges if it's a concave lens).
- A glass prism disperses white light into its constituent colors and deviates the path of light, but the primary characteristic described (lateral displacement of a parallel emergent beam) is specific to a glass slab.

Therefore, the optical device 'X' is a glass slab.

$$\boxed{\text{glass slab}}$$

Quick Tip

Quick Tip:

- Lateral displacement is the perpendicular distance between the incident ray and the emergent ray when light passes through a refracting medium with parallel faces (like a glass slab).
- A prism causes deviation and dispersion, not just lateral displacement of a parallel emergent beam.

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5. A piece of wire of resistance 'R' is cut lengthwise into three identical parts. These parts are then connected in parallel. If the equivalent resistance of this combination is R', then the value of R/R' is : **1**

(a) 1/9

(b) 1/3

(c) 3

(d) 9

Correct Answer: (d) 9

Solution: Let the original wire have length L and cross-sectional area A. Its resistance is $R = \rho\frac{L}{A}$, where ρ is the resistivity of the material. When the wire is cut "lengthwise into three identical parts", it means the length of each part becomes L/3, while the cross-sectional area A and resistivity ρ remain the same for each part. Resistance of each of the three identical parts, say R_1, will be:
$R_1 = \rho\frac{(L/3)}{A} = \frac{1}{3}\left(\rho\frac{L}{A}\right) = \frac{R}{3}$. So, each of the three parts has a resistance of $R/3$. These three parts are then connected in parallel. The equivalent resistance R' of a parallel combination of three resistors R_1, R_1, R_1 is given by: $\frac{1}{R'} = \frac{1}{R_1} + \frac{1}{R_1} + \frac{1}{R_1} = \frac{3}{R_1}$.
Substituting $R_1 = R/3$: $\frac{1}{R'} = \frac{3}{(R/3)} = \frac{3\times3}{R} = \frac{9}{R}$. So, $R' = \frac{R}{9}$. We need to find the value of R/R'. $\frac{R}{R'} = \frac{R}{(R/9)} = R \times \frac{9}{R} = 9$.

$\boxed{9}$

Quick Tip

Quick Tip:

- Resistance is directly proportional to length ($R \propto L$) and inversely proportional to cross-sectional area ($R \propto 1/A$).
- If a wire is cut into 'n' identical parts lengthwise, the resistance of each part becomes R/n.
- For 'n' identical resistors each of resistance r_{part} connected in parallel, the equivalent resistance is $R_{eq} = r_{part}/n$.

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6. In which one of the following situations a chemical reaction does not occur? **1**

(a) Milk is left open at room temperature during summer

(b) Grapes get fermented

(c) An iron nail is left exposed to humid atmosphere

(d) Melting of glaciers

Correct Answer: (d) Melting of glaciers

Solution: A chemical reaction involves the formation of new substances with different chemical properties.

- (a) Milk left open at room temperature during summer: Bacteria convert lactose (milk sugar) into lactic acid, causing the milk to sour. This is a chemical change (fermentation).
- (b) Grapes get fermented: Yeast converts sugars in grapes into ethanol and carbon dioxide. This is a chemical change.
- (c) An iron nail is left exposed to humid atmosphere: Iron reacts with oxygen and moisture to form iron oxide (rust). This is a chemical change (corrosion).

- (d) Melting of glaciers: Ice (solid water) changes its state to liquid water. The chemical composition (H_2O) remains the same. This is a physical change.

Therefore, a chemical reaction does not occur during the melting of glaciers.

Melting of glaciers

Quick Tip

Quick Tip:

- Chemical changes involve the formation of new chemical substances and are often irreversible or difficult to reverse.
- Physical changes involve a change in state or form but not in chemical composition (e.g., melting, boiling, freezing, dissolving).

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7. In order to prepare dry hydrogen chloride gas in humid atmosphere the gas produced is passed through a guard tube (drying tube) which contains : 1

(a) Calcium chloride

(b) Calcium oxide

(c) Calcium hydroxide

(d) Calcium carbonate

Correct Answer: (a) Calcium chloride

Solution: To prepare dry hydrogen chloride (HCl) gas, a drying agent is needed that absorbs moisture but does not react with HCl. Hydrogen chloride is an acidic gas.

- (a) Calcium chloride (anhydrous $CaCl_2$): It is a common and effective drying agent that does not react with HCl gas.
- (b) Calcium oxide (CaO): It is a basic oxide. It would react with acidic HCl gas: $CaO + 2HCl \rightarrow CaCl_2 + H_2O$. So, it cannot be used.

- (c) Calcium hydroxide ($Ca(OH)_2$): It is a base. It would react with acidic HCl gas: $Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$. So, it cannot be used.
- (d) Calcium carbonate ($CaCO_3$): It is a salt of a weak acid and a strong base, effectively basic. It would react with HCl gas: $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$. So, it cannot be used.

The most suitable drying agent from the options is anhydrous calcium chloride.

Calcium chloride

Quick Tip

Quick Tip:

- Drying agents should be chemically inert towards the gas they are drying.
- Acidic gases (like HCl, SO_2, CO_2) cannot be dried using basic drying agents (like CaO, NaOH).
- Basic gases (like NH_3) cannot be dried using acidic drying agents (like concentrated H_2SO_4).
- Common neutral drying agents include anhydrous calcium chloride, fused calcium chloride, silica gel, and phosphorus pentoxide (P_2O_5). Concentrated sulfuric acid is an acidic drying agent.

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8. Select from the following a hydrocarbon having one C–C bond and one C=C bond : **1**

(a) Benzene

(b) Cyclohexane

(c) Butyne

(d) Propyne

Correct Answer: None of the options are correct.

Solution: We need to find a hydrocarbon with exactly:

- One C–C single bond
- One C=C double bond

Analyzing each option:
(a) Benzene ($\mathbf{C_6H_6}$) - Cyclic structure with alternating single and double bonds - Has 3 C–C and 3 C=C bonds - *Does not match* (too many bonds)
(b) Cyclohexane ($\mathbf{C_6H_{12}}$) - Saturated cyclic hydrocarbon - Has 6 C–C single bonds, no double bonds - *Does not match* (no C=C bond)
(c) Butyne ($\mathbf{C_4H_6}$) - Alkyne structure ($CH{\equiv}C{-}CH_2{-}CH_3$ or $CH_3{-}C{\equiv}C{-}CH_3$) - Contains C≡C triple bond, not C=C - *Does not match*
(d) Propyne ($\mathbf{C_3H_4}$) - Structure: $CH_3{-}C{\equiv}CH$ - Has one C–C single bond and one C≡C triple bond - *Does not match* (has triple bond instead of double)
The correct molecule would be **Propene ($\mathbf{C_3H_6}$)**:

$$CH_2{=}CH{-}CH_3$$

which contains:

- 1 C=C bond (between first two carbons)
- 1 C–C bond (between last two carbons)

However, propene is not among the given options. Therefore, **none of the provided choices** satisfy the condition.

Quick Tip

Quick Tip:

- Alkanes: Only C–C single bonds
- Alkenes: At least one C=C bond
- Alkynes: At least one C≡C bond
- Propene is the simplest alkene meeting these criteria

9. The essential element taken up from the soil by the plants to synthesize proteins is : **1**

(a) Phosphorus

(b) Nitrogen

(c) Iron

(d) Magnesium

Correct Answer: (b) Nitrogen

Solution: Proteins are complex macromolecules composed of amino acids. Amino acids contain carbon, hydrogen, oxygen, and nitrogen. Nitrogen is a key component of the amino group ($–NH_2$) in amino acids. Plants absorb nitrogen from the soil, usually in the form of nitrate (NO_3^-) or ammonium (NH_4^+) ions, to synthesize amino acids and subsequently proteins.

- Phosphorus is essential for nucleic acids (DNA, RNA) and ATP, as well as cell membranes.
- Iron is a micronutrient involved in chlorophyll synthesis and enzyme function.
- Magnesium is a component of chlorophyll and an activator for many enzymes.

While all these are essential, nitrogen is the defining element for protein synthesis from the options.

Nitrogen

Quick Tip

Quick Tip:

- Proteins are made of amino acids, and all amino acids contain nitrogen.
- Plants require nitrogen in relatively large amounts (macronutrient) for growth and development, primarily for protein and nucleic acid synthesis.

10. The minimum number of identical bulbs of rating 4V; 6W, that can work safely with desired brightness, when connected in series with a 240 V mains supply is : **1**

(a) 20

(b) 40

(c) 60

(d) 80

Correct Answer: (c) 60

Solution: Each bulb is rated 4V, 6W. When connected in series, the voltage across the combination is the sum of the voltages across individual bulbs. To work safely with desired brightness, each bulb should operate at its rated voltage of 4V. Let 'n' be the minimum number of identical bulbs connected in series. The total voltage across the 'n' bulbs in series will be $n \times 4V$. This total voltage must be equal to the mains supply voltage, which is 240 V. So, $n \times 4 = 240$. $n = \frac{240}{4}$. $n = 60$. Therefore, a minimum of 60 bulbs must be connected in series. When these 60 bulbs are in series, the current through each bulb can be calculated: Current $I = \frac{P}{V} = \frac{6W}{4V} = 1.5A$. The resistance of each bulb $R_{bulb} = \frac{V}{I} = \frac{4V}{1.5A} = \frac{4}{3/2} = \frac{8}{3}\Omega$. Or $R_{bulb} = \frac{V^2}{P} = \frac{(4V)^2}{6W} = \frac{16}{6} = \frac{8}{3}\Omega$. Total resistance of 60 bulbs in series $= 60 \times \frac{8}{3} = 20 \times 8 = 160\Omega$. Current from mains $= \frac{240V}{160\Omega} = \frac{24}{16} = \frac{3}{2} = 1.5A$. This matches the rated current for each bulb, so they will operate with desired brightness.

$\boxed{60}$

Quick Tip

Quick Tip:

- In a series circuit, the voltage divides across the components.
- To operate multiple identical devices at their rated voltage from a higher supply voltage, connect them in series such that the sum of their rated voltages equals the supply voltage.
- Number of devices = (Total Supply Voltage) / (Rated Voltage of one device).

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11. An electric bulb is rated 220 V; 11W. The resistance of its filament when it glows with a power supply of 220 V is : **1**

(a) 4400 Ω

(b) 440 Ω

(c) 400 Ω

(d) 20 Ω

Correct Answer: (a) 4400 Ω

Solution: Given: Rated Voltage (V) = 220 V Rated Power (P) = 11 W The bulb is operating at its rated voltage (power supply of 220 V). We can use the formula relating power, voltage, and resistance: $P = \frac{V^2}{R}$. We need to find the resistance (R). $R = \frac{V^2}{P}$. Substitute the given values: $R = \frac{(220V)^2}{11W}$ $R = \frac{220 \times 220}{11}$ $R = \frac{48400}{11}$. To simplify $\frac{48400}{11}$: $\frac{44000}{11} = 4000$ and $\frac{4400}{11} = 400$. So,
$48400 \div 11 = (44000 + 4400) \div 11 = 4000 + 400 = 4400$. Alternatively, $220/11 = 20$. So, $R = 20 \times 220 = 4400$. The resistance of its filament is 4400 Ω.

$$\boxed{4400\Omega}$$

Quick Tip

Quick Tip:

- The power rating of an electrical device is usually specified for a particular operating voltage.
- Use the power formula $P = V^2/R$ to find resistance when power and voltage are known.
- Other useful power formulas are $P = VI$ and $P = I^2R$.

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12. Select TRUE statements about lymph from the following : **1**

A. Lymph vessels carry lymph through the body and finally open into larger arteries.

B. Lymph contains some amount of plasma, proteins and blood cells.

C. Lymph contains some amount of plasma, proteins and red blood cells.

D. Lymph vessels carry lymph through the body and finally open into larger veins.

The true statements are :

(a) A and B

(b) B and D

(c) A and C

(d) C and D

Correct Answer: (b) B and D

Solution: Let's analyze each statement:

A. Lymph vessels carry lymph through the body and finally open into larger arteries. This is FALSE. Lymph is returned to the bloodstream via large veins (e.g., subclavian veins), not arteries.

B. Lymph contains some amount of plasma, proteins and blood cells. This is TRUE. Lymph is derived from interstitial fluid, which is similar to plasma but with fewer

large proteins. It contains white blood cells (lymphocytes), but generally lacks red blood cells and platelets in significant numbers. So, "blood cells" here refers mainly to white blood cells.

C. Lymph contains some amount of plasma, proteins and red blood cells. This is FALSE. Lymph typically does not contain red blood cells. Their presence would indicate damage to blood vessels.

D. Lymph vessels carry lymph through the body and finally open into larger veins. This is TRUE. The lymphatic system collects excess interstitial fluid and returns it to the circulatory system by emptying into large veins near the heart.

The true statements are B and D.

$$\boxed{\text{B and D}}$$

Quick Tip

Quick Tip:

- Lymph is interstitial fluid that has entered lymphatic vessels.
- It is similar in composition to blood plasma but has fewer proteins and normally lacks red blood cells. It is rich in lymphocytes (a type of white blood cell).
- The lymphatic system is a one-way system that returns fluid from the tissues to the venous (blood) circulation.

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13. Plants like rose and banana have lost the capacity to produce : **1**

(a) flowers

(b) buds

(c) seeds

(d) fruits

Correct Answer: (c) seeds

Solution: Many cultivated varieties of plants like roses and bananas have been selected or bred for characteristics that favor vegetative propagation. While they still produce flowers and often fruits, their capacity to produce viable seeds is often reduced or lost.

- (a) Flowers: Roses and bananas produce flowers.
- (b) Buds: Buds are essential for growth and are present.
- (c) Seeds: Many cultivated roses are hybrids and produce few or no viable seeds. Commercial bananas are parthenocarpic, meaning they develop fruit without fertilization, and are thus seedless or have only rudimentary, non-viable seeds.
- (d) Fruits: Roses produce hips (fruits), and bananas are well-known for their fruits.

The most significant lost capacity, especially in commercially propagated varieties, is the production of viable seeds, leading to reliance on vegetative propagation.

$$\boxed{\text{seeds}}$$

Quick Tip

Quick Tip:

- Vegetative propagation is common in plants like roses (cuttings) and bananas (suckers).
- Parthenocarpy is the development of fruit without prior fertilization, often resulting in seedless fruits.
- Many horticultural varieties are selected for traits that might reduce seed viability to ensure consistency through vegetative propagation.

14. When a pure-tall pea plant is crossed with a pure-dwarf pea plant, the percentage of tall pea plants in F_1 and F_2 generation pea plants will be respectively : **1**

(a) 100% ; 25%

(b) 100% ; 50%

(c) 100% ; 75%

(d) 100% ; 100%

Correct Answer: (c) 100% ; 75%

Solution: Let 'T' be the allele for tallness (dominant) and 't' be the allele for dwarfness (recessive). A pure-tall pea plant has genotype TT. A pure-dwarf pea plant has genotype tt.

Parental Cross (P generation): TT × tt Gametes from TT parent: T Gametes from tt parent: t **F_1 Generation:** All offspring will have the genotype Tt. Since T is dominant over t, all F_1 plants will be tall. Percentage of tall plants in F_1 generation = 100%.

F_2 Generation (Selfing F_1): Tt × Tt Gametes from Tt parent: T, t Using a Punnett square:

	T	t
T	TT	Tt
t	Tt	tt

The genotypes in the F_2 generation are TT, Tt, Tt, tt in the ratio 1:2:1. The phenotypes are: TT (Tall) - 1 part Tt (Tall) - 2 parts tt (Dwarf) - 1 part So, the ratio of tall to dwarf plants is 3:1. Percentage of tall plants in F_2 generation = $\frac{3}{4} \times 100\% = 75\%$. Percentage of dwarf plants in F_2 generation = $\frac{1}{4} \times 100\% = 25\%$.

Therefore, the percentage of tall pea plants in F_1 is 100% and in F_2 is 75%.

$$\boxed{100\%; 75\%}$$

Quick Tip

Quick Tip:

- In Mendelian genetics, a monohybrid cross between a homozygous dominant (e.g., TT) and a homozygous recessive (e.g., tt) parent results in an F_1 generation where all offspring are heterozygous (Tt) and express the dominant phenotype.
- Selfing the F_1 generation (Tt x Tt) results in an F_2 generation with a genotypic ratio of 1 TT : 2 Tt : 1 tt and a phenotypic ratio of 3 dominant : 1 recessive.

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15. In a bisexual flower the male gametes are present in the : **1**

(a) anther

(b) ovary

(c) stigma

(d) filament

Correct Answer: (a) anther

Solution: In a bisexual flower, the male reproductive part is the stamen, which consists of the anther and the filament.

- (a) Anther: The anther is the part of the stamen that produces pollen grains. Pollen grains contain the male gametes.
- (b) Ovary: The ovary is part of the pistil (female reproductive part) and contains ovules, which house the female gamete (egg cell).
- (c) Stigma: The stigma is the receptive tip of the pistil where pollen lands.
- (d) Filament: The filament is the stalk that supports the anther.

The male gametes are developed within the pollen grains, which are produced in the anther.

anther

Quick Tip

Quick Tip:

- Stamen = Anther + Filament (Male part)
- Pistil/Carpel = Stigma + Style + Ovary (Female part)
- Anthers produce pollen grains, which contain male gametes.
- Ovules (inside the ovary) contain the female gamete (egg cell).

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16. To get an image of magnification –1 on a screen using a lens of focal length 20 cm, the object distance must be : **1**

(a) Less than 20 cm

(b) 30 cm

(c) 40 cm

(d) 80 cm

Correct Answer: (c) 40 cm

Solution: Magnification $m = -1$. A negative magnification indicates a real and inverted image. $m = \frac{v}{u} = -1 \Rightarrow v = -u$. Since the image is real, it is formed on the opposite side of the lens from the object for a convex lens (which is needed to form a real image on a screen). For a real image formed by a convex lens, v is positive if u is negative (standard sign convention). The magnification $m = -1$ means the image is real, inverted, and the same size as the object. This occurs when the object is placed at $2f$ (twice the focal length) from a convex lens. The image is then also formed at $2f$ on the other side. Given focal length $f = 20$ cm. Object distance u must be $2f$. So, $u = 2 \times 20 = 40$ cm. (Using sign convention, $u = -40$ cm, then $v = -(-40 \text{ cm}) = 40$ cm). The object distance (magnitude) must be 40 cm. Let's verify with the lens formula: $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$. If $u = -40$ cm, then $v = 40$ cm (since $v = -u$ and image is real). $\frac{1}{20} = \frac{1}{40} - \frac{1}{-40} = \frac{1}{40} + \frac{1}{40} = \frac{2}{40} = \frac{1}{20}$. This is correct.

$$\boxed{40 \text{ cm}}$$

Quick Tip

Quick Tip:

- Magnification $m = -1$ means the image is real, inverted, and the same size as the object.
- For a convex lens, this occurs when the object is placed at a distance of $2f$ from the lens. The image is also formed at $2f$ on the other side.
- A real image can be formed on a screen.

Question Nos. 17 to 20 consist of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option (a), (b), (c) and (d) as given below : (a) Both, Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of Assertion (A). (b) Both, Assertion (A) and Reason (R) are true, and Reason (R) is not the correct explanation of Assertion (A). (c) Assertion (A) is true, but Reason (R) is false. (d) Assertion (A) is false, but Reason (R) is true.

17. Assertion (A) : In reptiles, the temperature at which the fertilized eggs are kept decides the sex of the offsprings. **1**
Reason (R) : Sex is not genetically determined in some animals.

Correct Answer: (a) Both, Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of Assertion (A).

Solution: Assertion (A): In many reptiles (like crocodiles, some turtles, and lizards), Temperature-dependent Sex Determination (TSD) occurs. The incubation temperature of the eggs during a critical period of development determines whether the offspring will be male or female. This statement is true. **Reason (R):** Sex is not genetically determined (e.g., by sex chromosomes like XX/XY or ZZ/ZW) in some animals. TSD is an example of environmental sex determination, where sex is determined by environmental factors rather than solely by genetics. This statement is

true. **Explanation:** The reason (R) explains why the assertion (A) is true. Because sex is not genetically determined in these reptiles (it's environmentally determined by temperature), the temperature at which eggs are kept decides the sex.

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

Quick Tip

Quick Tip:

- Temperature-dependent Sex Determination (TSD) is a type of environmental sex determination found in many reptiles and some fish.
- In TSD, specific temperature ranges during egg incubation lead to the development of males, while other ranges lead to females (or vice-versa, or a mix).
- This contrasts with Genotypic Sex Determination (GSD) found in mammals and birds, where sex is determined by sex chromosomes.

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18. Assertion (A) : In large animals, oxygen can reach different parts of the animal's body easily. **1**
Reason (R) : Respiratory pigments take up oxygen from the air and carry it to body tissues.

Correct Answer: (d) Assertion (A) is false, but Reason (R) is true.

Solution: Assertion (A): In large animals, oxygen cannot reach different parts of the animal's body "easily" just by simple diffusion from the surface. The surface area to volume ratio is too small, and diffusion distances are too large for efficient oxygen supply to all cells. Specialized respiratory and circulatory systems are required. So, the statement "easily" makes the assertion false. **Reason (R):** Respiratory pigments (like hemoglobin in vertebrates or hemocyanin in some invertebrates) bind to oxygen in areas of high oxygen concentration (e.g., lungs, gills) and release it in areas of low oxygen concentration (body tissues). They play a crucial role in transporting oxygen.

This statement is true. **Explanation:** Assertion (A) is false because oxygen transport in large animals is a complex process, not "easy" by simple means. Reason (R) is a true statement about how oxygen is transported, which is precisely why such pigments are needed in large animals where simple diffusion is insufficient. The reason highlights a mechanism that makes oxygen transport possible but doesn't support the idea that it's "easy" without these mechanisms.

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

Quick Tip

Quick Tip:

- Simple diffusion is only efficient for oxygen transport over very short distances or in small organisms with a high surface area to volume ratio.
- Large, complex animals require specialized respiratory surfaces (lungs, gills) and circulatory systems with respiratory pigments to transport oxygen effectively to all body tissues.

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19. Assertion (A) : Concentrated nitric acid is diluted by adding water slowly to acid with constant stirring. **1**
Reason (R) : Concentrated nitric acid is easily soluble in water.

Correct Answer: (d) Assertion (A) is false, but Reason (R) is true. (Note: Standard lab safety procedure is to add acid to water, not water to acid, especially for concentrated strong acids).

Solution: Assertion (A): The standard safety procedure for diluting concentrated acids (like nitric acid, sulfuric acid) is to add the acid slowly to water, with constant stirring, not the other way around. Adding water to concentrated acid can cause vigorous exothermic reaction, leading to splashing and boiling of the acid, which is dangerous. So, the assertion describes an incorrect and unsafe procedure. Thus,

Assertion (A) is false. **Reason (R):** Concentrated nitric acid is highly soluble in water; it mixes with water in all proportions. This statement is true. **Explanation:** Assertion (A) is false as it describes the wrong method for diluting concentrated acid. Reason (R) is true, nitric acid is indeed very soluble in water, and this dissolution is highly exothermic.

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

Quick Tip

Quick Tip:

- **Safety Rule for Dilution:** Always add acid to water (A.A.W.) slowly and with stirring. This helps dissipate the heat generated during dilution more effectively.
- Adding water to concentrated acid can generate a lot of heat rapidly in a small volume, potentially causing the solution to boil and splash, posing a safety hazard.

---

20. Assertion (A) : White light is dispersed by a glass prism into seven colours. **1**

Reason (R) : The red light bends the least while the violet the most when a beam of white light passes through a glass prism.

Correct Answer: (a) Both, Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of Assertion (A).

Solution: Assertion (A): When white light passes through a glass prism, it splits into its constituent spectrum of colors (typically observed as violet, indigo, blue, green, yellow, orange, red - VIBGYOR). This phenomenon is called dispersion. The assertion states it splits into seven colors, which is a common way to describe the visible spectrum. This is true. **Reason (R):** Different colors of light have different

wavelengths. The refractive index of glass varies slightly with the wavelength of light. Violet light (shorter wavelength) has a higher refractive index in glass than red light (longer wavelength). Due to this difference in refractive index, violet light bends (deviates) more than red light when passing through a prism. Red light bends the least. This statement is true. **Explanation:** The reason (R) correctly explains why dispersion (Assertion A) occurs. The differential bending of different colors of light due to their different speeds (and hence refractive indices) in the prism material is the cause of white light splitting into its spectrum.

Both (A) and (R) are true, and (R) correctly explains (A).

Quick Tip

Quick Tip:

- Dispersion of light is the splitting of white light into its constituent colors.
- This occurs because the refractive index of the prism material is different for different wavelengths (colors) of light.
- Shorter wavelengths (like violet) bend more, and longer wavelengths (like red) bend less.

Section: B

Question Nos. 21 to 26 are very short answer type questions. Each question carries 2 marks.

21. Name the compound used in black and white photography. State whether the reaction that occurs is exothermic or endothermic. Give justification for your answer. **2**

Solution: The compound commonly used in black and white photography is **silver chloride (AgCl)** or **silver bromide (AgBr)**. The reaction that occurs is a

photochemical decomposition reaction, which is **endothermic**. **Justification:** The decomposition of silver chloride (or silver bromide) into silver and chlorine (or bromine) occurs when light energy is absorbed. For example:

$$2AgCl(s) \xrightarrow{\text{Sunlight}} 2Ag(s) + Cl_2(g)$$

Since the reaction requires energy (in the form of light) to proceed, it is an endothermic reaction. Energy is absorbed from the surroundings (light) to break the bonds in AgCl.

Compound: Silver Chloride (AgCl) or Silver Bromide (AgBr).

Reaction: Endothermic.
Justification: Requires light energy for decomposition.

Quick Tip

Quick Tip:

- Photochemical reactions are those initiated by the absorption of light.
- Endothermic reactions absorb energy from their surroundings. Exothermic reactions release energy.
- Decomposition reactions often require an input of energy (heat, light, or electricity).

---

22. (A) Show the formation of calcium chloride by the transfer of electrons from one element to the other. Atomic Number of calcium and chlorine is 20 and 17 respectively. **2**

Solution (A): Calcium (Ca): Atomic number = 20. Electronic configuration = 2, 8, 8, 2. Calcium has 2 valence electrons. To achieve a stable octet, it tends to lose these 2 electrons to form a Ca^{2+} ion. Ca $\rightarrow$ Ca^{2+} + $2e^-$ (2, 8, 8, 2) $\rightarrow$ (2, 8, 8)

Chlorine (Cl): Atomic number = 17. Electronic configuration = 2, 8, 7. Chlorine has 7 valence electrons. To achieve a stable octet, it tends to gain 1 electron to form a Cl^- ion. $Cl + e^- \rightarrow Cl^-$ (2, 8, 7) $\rightarrow$ (2, 8, 8)

Formation of Calcium Chloride ($CaCl_2$): One calcium atom loses 2 electrons. Each of these electrons is gained by one chlorine atom. Therefore, one calcium atom combines with two chlorine atoms.

$$\begin{array}{ccc} Ca & \xrightarrow{\text{loses } 2e^-} & Ca^{2+} \\ Cl & \xrightarrow{\text{gains } 1e^- \text{ each}} & Cl^- \\ Cl & & Cl^- \end{array}$$

The calcium ion (Ca^{2+}) and two chloride ions (Cl^-) are held together by electrostatic forces of attraction (ionic bond) to form calcium chloride ($CaCl_2$). Overall reaction: $Ca + 2Cl \rightarrow Ca^{2+} + 2Cl^- \rightarrow CaCl_2$

Electron-dot structure representation (optional but good for showing transfer): Ca (with 2 dots for valence electrons) + 2 Cl (each with 7 dots for valence electrons) $\rightarrow$ Ca^{2+} [Cl (with 8 dots)]$^-$ [Cl (with 8 dots)]$^-$

$$\mathbf{Ca \rightarrow Ca^{2+} + 2}e^-\mathbf{,\ 2Cl + 2e^- \rightarrow 2Cl^-,\ forming\ CaCl_2}$$

OR

(B) "Aluminium oxide is an amphoteric oxide." Justify this statement giving chemical equation for the reactions involved. 2

Solution (B): An amphoteric oxide is an oxide that can react with both acids and bases to form salt and water. Aluminium oxide (Al_2O_3) is an example of an amphoteric oxide.

Justification with chemical equations: 1. **Reaction of Aluminium oxide with an acid (e.g., Hydrochloric acid, HCl):** Aluminium oxide behaves as a basic oxide when it reacts with an acid.

$$Al_2O_3(s) + 6HCl(aq) \rightarrow 2AlCl_3(aq) + 3H_2O(l)$$

Here, aluminium chloride ($AlCl_3$), a salt, and water are formed.

2. **Reaction of Aluminium oxide with a base (e.g., Sodium hydroxide, NaOH):** Aluminium oxide behaves as an acidic oxide when it reacts with a strong base.

$$Al_2O_3(s) + 2NaOH(aq) + 3H_2O(l) \rightarrow 2Na[Al(OH)_4](aq)$$

(Sodium tetrahydroxoaluminate(III) or Sodium aluminate) Alternatively, a simpler representation often used:

$$Al_2O_3(s) + 2NaOH(aq) \rightarrow 2NaAlO_2(aq) + H_2O(l)$$

(Sodium meta-aluminate) In both cases, a salt and water (implied or explicit) are formed.

Since aluminium oxide reacts with both acids and bases, it is classified as an amphoteric oxide.

$$\mathbf{Al_2O_3 + HCl/NaOH \rightarrow salt + H_2O}$$

(Amphoteric - see equations above)

Quick Tip

Quick Tip:

- For ionic bond formation, show electron loss by metal and electron gain by non-metal leading to ion formation and then the ionic compound.
- Amphoteric oxides react with both acids and bases. Common examples include Al_2O_3, ZnO, PbO, SnO.
- When writing reactions of amphoteric oxides, show one reaction with an acid and one with a base.

---

23. Name the tissues which form the vascular bundle. State their function in plants. **2**

Solution: The tissues that form the vascular bundle in plants are: 1. **Xylem** 2. **Phloem**

Functions: 1. **Xylem:**

- Its primary function is the **transport of water and dissolved minerals** from the roots to all other parts of the plant (stems, leaves).
- It also provides **mechanical support** to the plant due to its lignified cell walls.

2. **Phloem:**

- Its primary function is the **transport of food** (mainly sugars like sucrose), synthesized during photosynthesis in the leaves, to other parts of the plant where it is needed for growth or storage (e.g., roots, fruits, seeds, growing tips). This process is called translocation.

Plant Vascular Tissues:

Xylem (water/minerals/support), Phloem (sugars).

Quick Tip

Quick Tip:

- Vascular bundles are the transport system in vascular plants.
- Xylem transports "sap" upwards (water and minerals).
- Phloem transports "food" (sugars) both upwards and downwards to where it's needed.

---

24. (A) Draw a ray diagram to show the refraction of a ray of light passing through an equilateral glass prism. Mark the angle through which the

emergent ray bends from the direction of the incident ray and also name it. 2

Solution (A): *(A diagram should be drawn here. It is difficult to represent accurately in text. The description is as follows:)*

1. Draw an equilateral triangle to represent the prism (ABC, with AB and AC as refracting surfaces).
2. Draw an incident ray (say PQ) striking surface AB obliquely.
3. At point Q on AB, draw a normal (N_1N_1') to AB.
4. Show the ray refracting (bending towards the normal as it enters the denser medium) inside the prism as QR.
5. Let the refracted ray QR strike the second surface AC at point R.
6. At point R on AC, draw a normal (N_2N_2') to AC.
7. Show the ray emerging from the prism (RS), bending away from the normal as it enters the rarer medium (air).
8. Extend the incident ray PQ forward (dotted line).
9. Extend the emergent ray RS backward (dotted line).
10. The angle between the extended incident ray and the extended emergent ray is the **angle of deviation (D or δ)**. This angle should be marked on the diagram.

The angle through which the emergent ray bends from the direction of the incident ray is called the **Angle of Deviation**.

- **Ray diagram** of light refraction through prism
- **Marked angle:** Angle of Deviation (D or δ)

OR

(B) Name the type of lenses required by the persons for the correction of their defect of vision called presbyopia. Write the structure of the lenses commonly used for the correction of this defect giving reason for such designs. **2**

Solution (B): The type of lenses required by persons suffering from presbyopia is typically **bifocal lenses** or **progressive lenses**.
Structure and Reason:

- **Bifocal lenses:** These lenses have two distinct optical powers.
  - The **upper part** of the lens is usually a **concave lens** (or less convex) to correct myopia (difficulty seeing distant objects), or it may have no power if distant vision is normal.
  - The **lower part** of the lens is a **convex lens** to correct hypermetropia or the inability to see near objects clearly (difficulty with reading), which is the primary symptom of presbyopia due to weakening of ciliary muscles and diminishing flexibility of the eye lens.
- **Progressive lenses (Varifocals):** These lenses offer a gradual change in power from the top (for distance vision) to the bottom (for near vision), without a visible line separating the different zones. This provides correction for distance, intermediate, and near vision.

Reason for such designs: Presbyopia is an age-related condition where the eye gradually loses its ability to focus on near objects. Often, elderly people may also suffer from myopia (nearsightedness) or hypermetropia (farsightedness) along with presbyopia. Bifocal or progressive lenses are designed to provide clear vision for both distant and near objects. The upper portion helps with distant vision, and the lower portion helps with near vision (like reading). This multi-power design addresses the multiple focusing needs of a person with presbyopia, often combined with other refractive errors.

- **Type:** Bifocal/Progressive lenses
- **Design:**
  - Upper segment: Distant vision (concave/less convex)
  - Lower segment: Near vision (convex)
- **Purpose:** Corrects presbyopia (dual vision impairment)

Quick Tip

Quick Tip:

- For prism refraction, remember: incident ray, refracted ray, emergent ray, angle of incidence (i), angle of refraction (r), angle of emergence (e), and angle of deviation (D). Light bends towards the base of the prism.
- Presbyopia is the age-related loss of accommodation. Bifocal lenses have two focal lengths. Progressive lenses have a continuous change in focal length.

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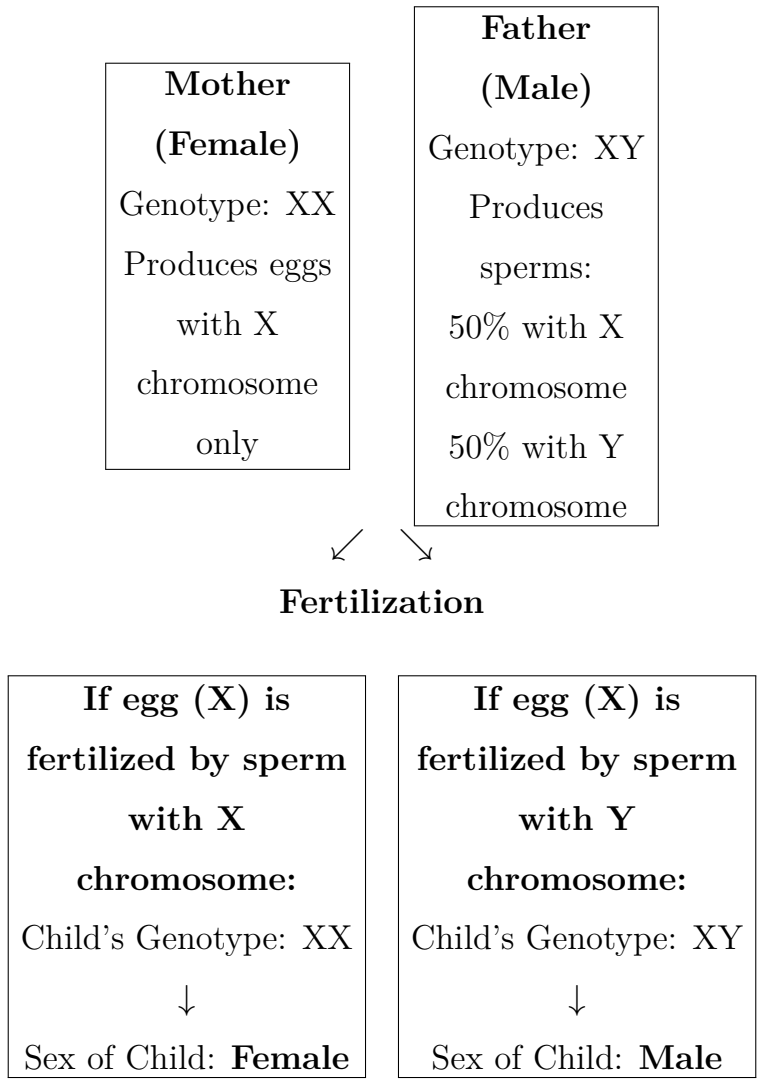
25. Explain with the help of a flow chart that in human beings father is responsible for the sex (male or female) of the child. 2

Solution: Flow Chart Explaining Father's Role in Sex Determination:

Human Parents

↓



Explanation: Human females have two X chromosomes (XX) and produce eggs that all carry an X chromosome. Human males have one X and one Y chromosome (XY) and produce two types of sperm: half carry an X chromosome and half carry a Y chromosome. During fertilization, if an egg (X) is fertilized by a sperm carrying an X chromosome, the resulting zygote will have an XX genotype, developing into a female child. If an egg (X) is fertilized by a sperm carrying a Y chromosome, the resulting zygote will have an XY genotype, developing into a male child. Since the mother can only contribute an X chromosome, the sex of the child is determined by the type of chromosome (X or Y) carried by the sperm from the father that fertilizes the egg.

Therefore, the father is responsible for the sex of the child.

Parental Contribution:

Mother (XX) $\rightarrow$ Only X eggs

Father (XY) $\rightarrow$ X or Y sperm (50% each)

Offspring Sex Determination:

X (egg) + X (sperm) $\rightarrow$ XX

X (egg) + Y (sperm) $\rightarrow$ XY

Critical Factor: Paternal sperm chromosome

Quick Tip

Quick Tip:

- Human sex determination is based on XX (female) and XY (male) chromosomes.
- Females are homogametic (produce only X-bearing gametes).
- Males are heterogametic (produce X-bearing and Y-bearing gametes).
- The Y chromosome carries genes responsible for male development.

---

26. Draw the pattern of magnetic field lines due to a current carrying straight conductor. Mark on it the direction of current in the conductor and the direction of the magnetic field developed. Name the rule that helps us to determine the direction of magnetic field lines in this case. 2

Solution: *(A diagram should be drawn here. Description below.)* **Diagram Description:**

1. Draw a straight vertical line segment representing the straight conductor.
2. Mark an arrow along this line segment to indicate the direction of current (e.g., upwards). Label it 'Current (I)'.

3. Around the conductor, draw several concentric circles in a plane perpendicular to the conductor. These circles represent the magnetic field lines.

4. On these circular field lines, mark arrows to indicate the direction of the magnetic field. If the current is upwards, the magnetic field lines will be anti-clockwise when viewed from above (or following the right-hand thumb rule).

Pattern of Magnetic Field Lines: The magnetic field lines due to a current-carrying straight conductor are **concentric circles** around the conductor. The plane of these circles is perpendicular to the conductor, and the conductor is at the center of these circles.

Direction of Current and Magnetic Field:

- **Direction of Current (I):** Should be clearly marked on the straight conductor (e.g., an arrow pointing upwards or downwards).
- **Direction of Magnetic Field (B):** Should be marked with arrows on the concentric circular field lines. The direction is tangential to the field line at any point.

Rule to Determine Direction: The rule that helps determine the direction of magnetic field lines in this case is the **Right-Hand Thumb Rule** (also known as Maxwell's Corkscrew Rule). **Statement of the Right-Hand Thumb Rule:** If you imagine holding the current-carrying straight conductor in your right hand such that your thumb points in the direction of the current, then the direction in which your fingers curl around the conductor gives the direction of the magnetic field lines.

Current-Carrying Conductor:

- Shows $\vec{B}$ field lines as concentric circles
- Direction follows right-hand rule

Right-Hand Rule:

Thumb $\parallel$ current (I), fingers curl $\parallel$ $\vec{B}$

Quick Tip

Quick Tip:

- Magnetic field lines around a straight current-carrying wire are concentric circles.
- The Right-Hand Thumb Rule is used to find the direction of these circular magnetic field lines.
- The strength of the magnetic field decreases as the distance from the conductor increases (field lines are further apart).

Section: C

Question Nos. 27 to 33 are short answer type questions. Each question carries 3 marks.

27. If we want to obtain a virtual and magnified image of an object by using a concave mirror of focal length 18 cm, where should the object be placed? Use mirror formula to determine the object distance for an image of magnification +2 produced by this mirror to justify your answer. 3

Solution: To obtain a virtual and magnified image using a concave mirror, the object must be placed between the pole (P) and the principal focus (F) of the mirror. Given focal length $f = -18$ cm (concave mirror). Given magnification $m = +2$. A positive magnification indicates a virtual and erect image. Magnification $m = -\frac{v}{u}$. So, $+2 = -\frac{v}{u} \Rightarrow v = -2u$.

Using the mirror formula: $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$. Substitute $f = -18$ cm and $v = -2u$: $\frac{1}{-18} = \frac{1}{-2u} + \frac{1}{u}$ $\frac{1}{-18} = \frac{-1+2}{2u}$ $\frac{1}{-18} = \frac{1}{2u}$ $2u = -18$ $u = -9$ cm.

The object should be placed 9 cm in front of the concave mirror. This object distance $u = -9$ cm is between the pole (0 cm) and the focus (-18 cm), i.e., $|u| < |f|$, which

is consistent with the condition for forming a virtual, erect, and magnified image by a concave mirror.

Justification: The calculated object distance is $u = -9$ cm. The focal length is $f = -18$ cm. Since $|u| = 9$ cm is less than $|f| = 18$ cm, the object is placed between the pole and the focus. This position results in a virtual, erect, and magnified image, which matches the required magnification of $+2$.

Object distance $u = -9$ cm (9 cm in front of the mirror). Object placed between P and F.

Quick Tip

Quick Tip:

- For a concave mirror to form a virtual, erect, and magnified image, the object must be between P and F ($u < f$).
- Mirror formula: $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$. Magnification: $m = -\frac{v}{u} = \frac{h_i}{h_o}$.
- Sign conventions: For a concave mirror, f is negative. u is negative if object is in front. v is positive for virtual image, negative for real image. m is positive for virtual/erect, negative for real/inverted.

---

28. Name and describe the most widely used method for refining impure metals? 3

Solution: The most widely used method for refining impure metals is **electrolytic refining**.

Description of Electrolytic Refining: Electrolytic refining is a process used to obtain high-purity metals from impure metals. It is based on the principle of electrolysis.

1. **Setup:**
   - **Anode:** A thick block of the impure metal is made the anode.
   - **Cathode:** A thin strip of pure metal is made the cathode.
   - **Electrolyte:** A solution of a soluble salt of the metal being refined is used as the electrolyte.

2. **Process:** When an electric current is passed through the electrolytic solution:

    - At the **anode (impure metal)**, metal atoms from the impure block lose electrons (oxidize) and go into the electrolyte solution as positive ions. Example: $M(\text{impure}) \rightarrow M^{n+}(\text{aq}) + ne^-$
    - These metal ions (M^{n+}) from the electrolyte move towards the **cathode (pure metal strip)**.
    - At the **cathode**, the metal ions gain electrons (reduce) and get deposited as pure metal on the cathode. Example: $M^{n+}(\text{aq}) + ne^- \rightarrow M(\text{pure})$

3. **Impurities:**

    - **Soluble impurities** from the anode dissolve in the electrolyte.
    - **Insoluble impurities** from the anode settle down below the anode as **anode mud** or anode slime. These often contain valuable metals like gold, silver, platinum.

This method is very effective for refining metals like copper, zinc, tin, nickel, silver, gold, etc., to a high degree of purity.

Electrolytic Refining Process:

Anode (Impure): $\text{M} \rightarrow \text{M}^{n+} + \text{ne}^-$ (Oxidation)

Cathode (Pure): $\text{M}^{n+} + \text{ne}^- \rightarrow \text{M}$ (Reduction)

Impurity Fate:

- Soluble: Remain in electrolyte
- Insoluble: Anode mud (Au, Ag, Pt in Cu refining)

Quick Tip

Quick Tip:

- Remember **OIL RIG**: Oxidation Is Loss (of electrons), Reduction Is Gain (of electrons). Or **LEO says GER**: Loss of Electrons is Oxidation, Gain of Electrons is Reduction.
- In electrolytic refining: Anode = Impure metal (gets thinner), Cathode = Pure metal (gets thicker).
- Anode mud can be a valuable byproduct.

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29. What is the first step of cellular respiration? In which part of the cell does it occur ? Write the equation for the process of breakdown of glucose in a human cell : (i) in the presence of oxygen (ii) due to lack of oxygen 3

Solution: The first step of cellular respiration is **Glycolysis**. It occurs in the **cytoplasm** of the cell.

Equation for the process of breakdown of glucose in a human cell:

(i) In the presence of oxygen (Aerobic Respiration): Glucose ($C_6H_{12}O_6$) is first broken down into pyruvate through glycolysis in the cytoplasm. Then, in the presence of oxygen, pyruvate enters the mitochondria and is completely oxidized. The overall equation for aerobic respiration is:

$$C_6H_{12}O_6 \text{ (Glucose)} + 6O_2 \text{ (Oxygen)} \xrightarrow{\text{In mitochondria}} 6CO_2 \text{ (Carbon dioxide)} + 6H_2O \text{ (Water)} + \text{En}$$

More detailed steps:

- **Glycolysis (in cytoplasm):** Glucose $\rightarrow$ 2 Pyruvate + Energy (ATP, NADH)
- **Link reaction Krebs Cycle (in mitochondria):** Pyruvate $\rightarrow$ Acetyl-CoA $\rightarrow$ CO_2 + Energy (ATP, NADH, $FADH_2$)
- **Oxidative Phosphorylation (in mitochondria):** Uses O_2 to produce a large amount of ATP.

(ii) Due to lack of oxygen (Anaerobic Respiration in human muscle cells - Lactic Acid Fermentation): When there is a lack of oxygen, such as during strenuous exercise, human muscle cells undergo anaerobic respiration. Pyruvate formed during glycolysis is converted into lactic acid. Equation:

$$C_6H_{12}O_6 \text{ (Glucose)} \xrightarrow{\text{Glycolysis in cytoplasm}} 2 \text{ Pyruvate} \xrightarrow{\text{Lack of } O_2 \text{ in cytoplasm}} 2 \text{ Lactic Acid} + \text{Small amo}$$

Specifically for the conversion of pyruvate:

$$\text{Pyruvic acid} \xrightarrow{\text{Lack of } O_2} \text{Lactic acid} + \text{Energy}$$

The overall from glucose would be:

$$C_6H_{12}O_6 \text{ (Glucose)} \xrightarrow{\text{In cytoplasm, lack of } O_2} 2C_3H_6O_3 \text{ (Lactic Acid)} + \text{Energy (2 ATP)}$$

1. **Glycolysis:** Cytoplasmic glucose breakdown
2. **Aerobic:** $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + ATP$
3. **Anaerobic:** $C_6H_{12}O_6 \rightarrow 2C_3H_6O_3$ (lactate) + 2ATP

Quick Tip

Quick Tip:

- Glycolysis is common to both aerobic and anaerobic respiration.
- Aerobic respiration yields significantly more ATP than anaerobic respiration.
- Anaerobic respiration in human muscles produces lactic acid, which can cause muscle fatigue.

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30. (A) Why do we balance a chemical equation? Name and state the law that suggests the balancing of a chemical equation? Balance the following chemical equation :

$$Zn + H_3PO_4 \rightarrow Zn_3(PO_4)_2 + H_2$$

3

Solution (A): Why we balance a chemical equation: We balance a chemical equation to ensure that it adheres to the Law of Conservation of Mass. This means the total mass of reactants must equal the total mass of products. Balancing ensures that the number of atoms of each element is the same on both sides of the equation, reflecting that atoms are neither created nor destroyed during a chemical reaction, only rearranged.

Name and state the law: The law that suggests the balancing of a chemical equation is the **Law of Conservation of Mass**. **Statement of the Law of Conservation of Mass:** This law states that in any closed system, mass is neither created nor destroyed by chemical reactions or physical transformations. The total mass of the reactants before a chemical reaction is equal to the total mass of the products after the reaction.

Balance the following chemical equation:

$$\mathrm{Zn} + \mathrm{H_3PO_4} \rightarrow \mathrm{Zn_3(PO_4)_2} + \mathrm{H_2}$$

1. **Balance Zn atoms:** There are 3 Zn atoms on the product side and 1 on the reactant side. So, put a coefficient of 3 in front of Zn on the reactant side.

$$3\mathrm{Zn} + \mathrm{H_3PO_4} \rightarrow \mathrm{Zn_3(PO_4)_2} + \mathrm{H_2}$$

2. **Balance $\mathrm{PO_4}$ groups:** There are 2 $\mathrm{PO_4}$ groups on the product side and 1 on the reactant side. So, put a coefficient of 2 in front of $\mathrm{H_3PO_4}$ on the reactant side.

$$3\mathrm{Zn} + 2\mathrm{H_3PO_4} \rightarrow \mathrm{Zn_3(PO_4)_2} + \mathrm{H_2}$$

3. **Balance H atoms:** There are $2 \times 3 = 6$ H atoms on the reactant side and 2 H atoms on the product side. So, put a coefficient of 3 in front of $\mathrm{H_2}$ on the product side.

$$3\mathrm{Zn} + 2\mathrm{H_3PO_4} \rightarrow \mathrm{Zn_3(PO_4)_2} + 3\mathrm{H_2}$$

Check atoms: Zn: Reactants = 3, Products = 3 (Balanced) H: Reactants = $2 \times 3 = 6$, Products = $3 \times 2 = 6$ (Balanced) P: Reactants = 2, Products = 2 (Balanced) O: Reactants = $2 \times 4 = 8$, Products = $2 \times 4 = 8$ (Balanced) The equation is balanced.

Conservation Principle: Mass conserved in chemical reactions

Mathematically: $\sum m_{\text{reactants}} = \sum m_{\text{products}}$

Example: $3\mathrm{Zn} + 2\mathrm{H_3PO_4} \rightarrow \mathrm{Zn_3(PO_4)_2} + 3\mathrm{H_2}$

OR

(B) Define a precipitation reaction. Give its example and also express the reaction that occurs in the form of a balanced chemical equation. 3

Solution (B): Definition of a Precipitation Reaction: A precipitation reaction is a type of chemical reaction in which two soluble ionic compounds in aqueous solution react to form an insoluble solid product, called a precipitate. This precipitate settles out of the solution.

Example: A common example is the reaction between silver nitrate ($AgNO_3$) solution and sodium chloride (NaCl) solution, which forms a white precipitate of silver chloride (AgCl).

Balanced Chemical Equation for the Example: When aqueous solutions of silver nitrate and sodium chloride are mixed:

$$AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) \downarrow + NaNO_3(aq)$$

In this reaction:

- Silver nitrate ($AgNO_3$) is soluble in water.
- Sodium chloride (NaCl) is soluble in water.
- Silver chloride (AgCl) is an insoluble solid (precipitate), indicated by (s) and often by a downward arrow (↓).
- Sodium nitrate ($NaNO_3$) remains dissolved in the solution (soluble).

The formation of the white, insoluble AgCl is the visual evidence of the precipitation reaction.

Precipitation Reaction: Soluble salts → Insoluble product**Example:**$AgNO_3(aq)$ + NaCl(aq) −

Quick Tip

Quick Tip:

- Balancing equations ensures the number of atoms of each element is conserved.
- Precipitation reactions are often double displacement reactions where one product is insoluble.
- Use solubility rules to predict precipitates (e.g., most chlorides are soluble, except AgCl, $PbCl_2$, Hg_2Cl_2).

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31. What are decomposers? Give two examples. State how they maintain a balance in an ecosystem. 3

Solution: Decomposers: Decomposers are organisms, primarily bacteria and fungi, that break down dead organic matter (like dead plants and animals, and waste products) into simpler inorganic substances. They obtain nutrients for their own growth and release these simpler substances back into the ecosystem.

Two Examples of Decomposers: 1. **Bacteria** (e.g., *Bacillus subtilis*, *Pseudomonas* species) 2. **Fungi** (e.g., Mushrooms, Molds like *Aspergillus*, Yeast)

How Decomposers Maintain Balance in an Ecosystem: Decomposers play a crucial role in maintaining the balance in an ecosystem in several ways: 1. **Nutrient Cycling:** They break down complex organic compounds in dead organisms into simpler inorganic nutrients (like nitrates, phosphates, sulfates, carbon dioxide). These nutrients are released back into the soil, water, and air, making them available for producers (plants) to use again. This recycling of nutrients is essential for the continuous functioning of the ecosystem, ensuring that essential elements are not locked up in dead matter. 2. **Cleaning the Environment:** By decomposing dead organic matter and waste, decomposers prevent the accumulation of dead bodies and waste products, thus keeping the environment clean and preventing the spread of diseases. 3. **Soil Fertility:** The decomposition process enriches the soil with humus and essential nutrients, im-

proving soil structure and fertility, which supports plant growth (the base of most food webs). Without decomposers, nutrients would remain locked in dead organisms, and ecosystems would eventually collapse due to a lack of available nutrients for producers.

Decomposers: Microorganisms (bacteria/fungi) that mineralize organic matter

Functions:

- Convert detritus → inorganic nutrients
- Clean ecosystems by waste breakdown
- Enhance soil structure & fertility

Quick Tip

Quick Tip:

- Decomposers are the "recyclers" of the ecosystem.
- They are saprophytes, meaning they feed on dead and decaying organic matter.
- Their activity is vital for biogeochemical cycles (e.g., carbon cycle, nitrogen cycle).

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32. Define the term "potential difference" between two points in an electric circuit carrying current. Name and define its S.I. unit. Also express it in terms of S.I. unit of work and charge. 3

Solution: Definition of Potential Difference: Potential difference (V) between two points in an electric circuit carrying current is defined as the work done (W) to move a unit positive charge (q) from one point to the other. Mathematically, $V = \frac{W}{q}$.

S.I. Unit of Potential Difference: The S.I. unit of potential difference is the **Volt** (symbol: V).

Definition of Volt: One volt is defined as the potential difference between two points in a current-carrying conductor when 1 joule of work is done to move a charge of 1 coulomb from one point to the other. So, 1 Volt $= \frac{1 \text{ Joule}}{1 \text{ Coulomb}}$ or 1 V = 1 J/C.

Expression in terms of S.I. unit of work and charge: As per the definition, potential difference (V) is work done (W) per unit charge (q). The S.I. unit of work is the Joule (J). The S.I. unit of charge is the Coulomb (C). Therefore, the S.I. unit of potential difference (Volt) can be expressed as:

$$\text{Volt (V)} = \frac{\text{Joule (J)}}{\text{Coulomb (C)}}$$

Definition: Work done per unit charge

Mathematical Form: $\Delta V = \frac{W}{q}$

S.I. Unit: Volt (V)

Dimensional Formula: $[\mathrm{ML^2T^{-3}I^{-1}}]$

Base Unit Equivalence: 1 V = 1 J/C

Quick Tip

Quick Tip:

- Potential difference is also known as voltage.
- It is the "electrical pressure" or "force" that causes current to flow.
- Remember the relationship: $V = W/q$.

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33. State two limitations of electrical impulses in multicellular organisms. Why is chemical communication better than electrical impulses as a means of communication between cells in multicellular organisms? 3

Solution: Two Limitations of Electrical Impulses in Multicellular Organisms:
1. **Limited Reach/Specificity:** Electrical impulses can only reach cells that are directly connected by neurons (nerve cells). They cannot reach every single cell in the

body. Also, while fast, the transmission is limited to the neuronal network. 2. **Refractory Period/Cannot be Continuously Generated:** Once an electrical impulse is generated in a neuron and transmitted, the neuron takes some time (refractory period) to reset before it can generate and transmit another impulse. This limits the frequency of impulse transmission and prevents continuous stimulation.

Why Chemical Communication is Better than Electrical Impulses (in some aspects): Chemical communication (e.g., via hormones) is often considered "better" or more advantageous than electrical impulses for certain types of communication in multicellular organisms due to the following reasons: 1. **Wider Reach and Broader Effects:** Chemical signals (hormones) are transported through the bloodstream and can reach all cells in the body. This allows for widespread and coordinated responses across different organs and tissues, even those not directly innervated. 2. **Persistent and Long-Lasting Effects:** Chemical signals can have more sustained and longer-lasting effects compared to the transient nature of electrical impulses. Hormones can regulate slow, ongoing processes like growth, development, and metabolism over extended periods. 3. **Specificity through Receptors:** While chemical signals can reach many cells, they typically only affect target cells that possess specific receptors for them. This allows for targeted responses despite widespread distribution. 4. **No Refractory Period for the Signal Itself:** Unlike neurons, glands can often release chemical signals continuously or in pulses as needed, without the same kind of immediate refractory limitation on signal generation, allowing for more varied patterns of stimulation. 5. **Graded Responses:** The intensity of response to chemical signals can often be graded depending on the concentration of the hormone, allowing for finer control over physiological processes.

While electrical impulses are extremely fast and ideal for rapid, precise responses (like reflexes or muscle control), chemical communication complements this by providing a slower, more widespread, and often longer-lasting mode of regulation essential for many physiological processes.

Electrical Signaling:

- Restricted to directly connected neurons
- Recovery period required (refractory phase)

Chemical Signaling:

- Paracrine/endocrine distribution
- Longer-lasting postsynaptic effects
- Ligand-receptor specificity
- Diverse modulation possibilities
- Response proportional to signal

Quick Tip

Quick Tip:

- Electrical impulses (nervous system) are fast, targeted, and short-lived.
- Chemical signals (endocrine system - hormones) are generally slower, widespread (via bloodstream), and can have longer-lasting effects.
- Both systems are crucial and work together to coordinate bodily functions.

Section: D

Question Nos. 34 to 36 are long answer type questions. Each question carries 5 marks.

34. (A) (i) Draw the pattern of the magnetic field lines for the two parallel straight conductors carrying current of same magnitude 'I' in opposite directions as shown. Show the direction of magnetic field at a point O which

is equidistant from the two conductors. (Consider that the conductors are inserted normal to the plane of a rectangular cardboard.)

Solution (A)(i): *(A diagram should be drawn here. Description below.)* **Diagram Description:**

1. Draw two points representing the cross-sections of the two parallel straight conductors, normal to the plane of the paper (cardboard). Let's call them C1 and C2.

2. For C1, mark the current 'I' going into the plane (e.g., with a cross $\otimes$). For C2, mark the current 'I' coming out of the plane (e.g., with a dot $\odot$).

3. Around C1, draw concentric circular magnetic field lines. Using the Right-Hand Thumb Rule (thumb into the plane), the field lines will be clockwise.

4. Around C2, draw concentric circular magnetic field lines. Using the Right-Hand Thumb Rule (thumb out of the plane), the field lines will be anti-clockwise.

5. Mark point O midway between C1 and C2.

6. At point O, the magnetic field due to C1 (B_1) will be directed downwards (tangential to its circle).

7. At point O, the magnetic field due to C2 (B_2) will also be directed downwards (tangential to its circle).

8. Since both B_1 and B_2 are in the same direction (downwards) at point O, the resultant magnetic field at O will be the sum of these two and will also be directed downwards.

The pattern shows overlapping concentric circles. At point O, the individual magnetic fields from both conductors add up because they are in the same direction.

Configuration:

- Parallel conductors

- Currents: I_1 ($\rightarrow$), I_2 ($\leftarrow$) (equal magnitude)

Magnetic Fields:

- Circular field lines (right-hand grip rule)
- At midpoint O: $\vec{B}_1 \parallel \vec{B}_2$ (same direction)

Example:

- Horizontal wires
- Both fields downward at O

(ii) In our houses we receive A.C. electric power of 220 V. In electric iron or electric heater cables having three wires with insulation of three different colours – red, black and green are used to draw current from the mains. (a) What are these three different wires called? Name them colourwise. (b) What is the potential difference between the red wire and the black wire? (c) What is the role of the wire with green insulation in case of accidental leakage of electric current to the metallic body of an electrical appliance? 5

Solution (A)(ii): (a) What are these three different wires called? Name them colourwise.

- **Red wire:** This is the **Live wire** (or Phase wire).
- **Black wire:** This is the **Neutral wire**.
- **Green wire:** This is the **Earth wire** (or Ground wire).

(b) What is the potential difference between the red wire and the black wire? The potential difference between the red wire (Live wire) and the black wire (Neutral wire) in household AC supply in India is typically **220 V**. The live wire is at a high potential (220 V AC), and the neutral wire is maintained at approximately zero potential.

(c) What is the role of the wire with green insulation in case of accidental leakage of electric current to the metallic body of an electrical appliance? The role of the wire with green insulation (Earth wire) is to provide a **safety path for fault currents**. If, due to some defect, the live wire comes into contact with the metallic body of an electrical appliance, the metallic body becomes live and can cause a severe electric shock if touched. The earth wire connects the metallic body of the appliance to the earth (ground), which is at zero potential. In case of leakage:

1. The current flows from the live metallic body directly to the earth through the low-resistance earth wire.
2. This results in a very large current flowing through the circuit (a short circuit path to ground).
3. This large current blows the fuse in the circuit or trips the circuit breaker, thus disconnecting the appliance from the mains supply and preventing electric shock and further damage.

Thus, the earth wire ensures that the metallic body of the appliance remains at earth potential (zero potential) even if there is a leakage, making the appliance safe to touch.

(a) Color Coding:

- Red: Live
- Black: Neutral
- Green: Earth

(b) Standard Voltage: 220 V

(c) Earth Wire Purpose:

- Low-resistance path for leakage
- Triggers fuse/breaker
- Prevents electric shock

OR

(B) (i) By using the given experimental set-up. How can it be shown that : (a) a force is exerted on the current-carrying conductor AB when it is placed in a magnetic field. (b) the direction of force can be reversed in two ways. (ii) When will the magnitude of the force be highest? (iii) State Fleming's left hand rule. 5

Solution (B): (i) (a) How to show that a force is exerted on the current-carrying conductor AB when it is placed in a magnetic field:

1. Set up the experiment as shown in the figure: a conductor AB is suspended freely between the poles of a horseshoe magnet.
2. Connect the ends of the conductor AB to a battery through a key K.
3. When the key K is closed, current flows through the conductor AB.
4. Observe that the conductor AB deflects or moves (e.g., upwards or downwards, or into/out of the magnet).
5. This movement or deflection of the conductor demonstrates that a force is exerted on it when it carries current and is placed in a magnetic field.

(i) (b) How to show that the direction of force can be reversed in two ways: The direction of the force on the current-carrying conductor can be reversed by: 1. **Reversing the direction of the current:** Keep the magnetic field direction the same (i.e., do not change the magnet poles). Reverse the connections to the battery terminals so that the current flows through conductor AB in the opposite direction. Observe that the conductor now deflects or moves in the opposite direction compared to before. 2. **Reversing the direction of the magnetic field:** Keep the direction of current the same. Reverse the poles of the horseshoe magnet (e.g., flip the magnet so that the N pole is where S was, and S is where N was). Observe that the conductor again deflects or moves in the opposite direction compared to the initial observation.

(ii) When will the magnitude of the force be highest? The magnitude of the force exerted on a current-carrying conductor placed in a magnetic field is given by $F = BIL\sin\theta$, where:

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

The magnitude of the force will be highest when:

- The magnetic field strength (B) is strong.
- The current (I) flowing through the conductor is large.
- The length (L) of the conductor within the magnetic field is long.
- The conductor is placed **perpendicular** to the direction of the magnetic field, i.e., when $\theta = 90°$. In this case, $\sin 90° = 1$, which is the maximum value of $\sin\theta$. So, $F_{max} = BIL$.

(iii) State Fleming's left hand rule. Fleming's Left-Hand Rule states: Stretch the thumb, forefinger (first finger), and middle finger (second finger) of your left hand such that they are mutually perpendicular to each other.

- If the **Forefinger** points in the direction of the **Magnetic Field** (Field),
- and the **Middle finger** points in the direction of the **Current** (Current),
- then the **Thumb** will point in the direction of the **Force** or Motion (Motion) experienced by the conductor.

(Often remembered by associating letters: F-Force/Thumb, B-Field/Forefinger, I-Current/Middle finger).

(i) Conditions for motion:

(a) Close key, conductor moves

(b) Reverse current or magnetic field

(ii) Max force when:

Current $\parallel$ Field strength $\parallel$ Length max

and conductor $\perp$ field

(iii) Fleming's Left-Hand Rule statement

Quick Tip

Quick Tip:

- For 34(A)(i): Use Right-Hand Thumb Rule for each wire. At midpoint between wires with opposite currents, fields add up.
- For 34(A)(ii): Live wire (red/brown) at high potential, Neutral (black/blue) at zero potential, Earth (green/yellow-green) for safety.
- For 34(B): Force on a current-carrying conductor in a magnetic field is the basis of electric motors. Fleming's Left-Hand Rule helps determine the direction of this force. Force is maximum when current and magnetic field are perpendicular.

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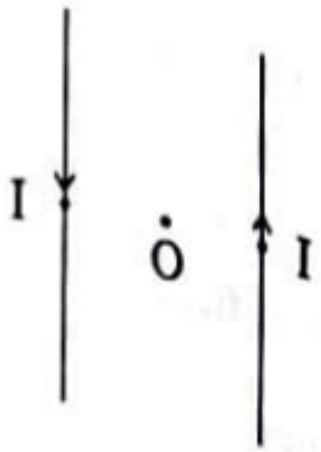
35. (A) Name the parts marked as 'A' and 'B' in the given diagram. Write in detail the changes that take place in a flower when the product of 'B' reaches 'A' till a fruit is formed.



Solution (A): Naming the parts:

- **Part A:** Stigma (the receptive tip of the pistil/carpel)
- **Part B:** Anther (part of the stamen that produces pollen grains) or Pollen grain (if 'B' is pointing to a pollen grain on the anther or stigma). Assuming B is the anther producing pollen. The "product of B" is pollen.

Changes from pollination to fruit formation: When the product of 'B' (pollen grain, produced by the anther) reaches 'A' (stigma), the following changes occur: 1. **Pollination:** The transfer of pollen grains from the anther (B) to the stigma (A) is called pollination. 2. **Pollen Germination:** On the stigma, the pollen grain absorbs moisture and nutrients and germinates. A pollen tube grows out from the pollen grain. 3. **Growth of Pollen Tube:** The pollen tube grows down through the style (part of the pistil connecting stigma to ovary) towards the ovule located inside the ovary. The male gametes move down the pollen tube. 4. **Fertilization:** The pollen tube enters an ovule. One male gamete fuses with the female gamete (egg cell) inside the ovule to form a zygote. This fusion is called syngamy or fertilization. (In angiosperms, another male gamete fuses with the polar nuclei to form the primary endosperm nucleus - this is double fertilization). 5. **Post-Fertilization Changes:**

- **Zygote develops into Embryo:** The zygote divides multiple times to form the embryo within the ovule.

- **Ovule develops into Seed:** The entire ovule, containing the embryo and stored food (endosperm), develops a tough protective coat and becomes a seed.
- **Ovary develops into Fruit:** The ovary (the basal, swollen part of the pistil) enlarges and ripens to become the fruit. The wall of the ovary becomes the pericarp (fruit wall).
- **Other Floral Parts Wither:** Petals, sepals, stamens, style, and stigma usually wither and fall off. Sometimes, remnants of these parts may persist with the fruit (e.g., sepals in brinjal).

Thus, a fruit is formed from the ovary, and it encloses the seed(s) which developed from the ovule(s).

Flower Anatomy:

- A: Stigma (pollen landing platform)
- B: Anther (microsporangium containing pollen)

Post-Pollination Events:

- Pollen-stigma recognition
- Tube growth through style
- Double fertilization:
  - Zygote formation (2n)
  - Endosperm formation (3n)
- Embryogenesis and fruit maturation

OR

(B) In human female reproductive system state the changes that take place once fertilisation has taken place. Write the role of placenta in this process. What happens when the egg is not fertilised ? 5

Solution (B): Changes after Fertilization in Human Female Reproductive System: Once fertilization (fusion of sperm and egg) occurs, typically in the fallopian tube, the following changes take place: 1. **Zygote Formation:** Fertilization results in the formation of a single-celled zygote. 2. **Cleavage and Morula Formation:** The zygote undergoes rapid mitotic divisions (cleavage) as it travels down the fallopian tube towards the uterus. It forms a solid ball of cells called a morula. 3. **Blastocyst Formation:** The morula continues to divide and transforms into a blastocyst, which is a hollow ball of cells with an inner cell mass (which will form the embryo) and an outer layer called the trophoblast. 4. **Implantation:** The blastocyst reaches the uterus and embeds itself into the thickened lining of the uterine wall (endometrium). This process is called implantation and usually occurs about 6-12 days after fertilization. 5. **Embryonic Development and Placenta Formation:** After implantation, the inner cell mass differentiates to form the embryo. The trophoblast cells, along with uterine tissues, contribute to the formation of the placenta. 6. **Hormonal Changes:** The developing embryo and placenta start producing hormones (like hCG - human chorionic gonadotropin) which maintain the corpus luteum in the ovary. The corpus luteum continues to secrete progesterone, which is essential for maintaining the pregnancy and preventing menstruation.

Role of Placenta: The placenta is a vital organ that connects the developing fetus to the uterine wall. Its roles include: 1. **Nutrition:** It facilitates the transfer of nutrients (glucose, amino acids, vitamins, minerals) from the mother's blood to the fetal blood. 2. **Respiration:** It allows the exchange of respiratory gases – oxygen passes from mother to fetus, and carbon dioxide passes from fetus to mother. 3. **Excretion:** It helps in the removal of metabolic waste products (like urea) from the fetal blood to the mother's blood for excretion by the mother's kidneys. 4. **Endocrine Function:** It produces several hormones (like hCG, progesterone, estrogen, hPL) that are crucial for maintaining pregnancy and fetal development. 5. **Barrier Function:** It acts as a selective barrier, preventing some harmful substances and pathogens from passing from the mother to the fetus, although some (like certain viruses, drugs) can cross.

What happens when the egg is not fertilized? If the egg is not fertilized within about 24-48 hours of ovulation: 1. The unfertilized egg disintegrates and is

reabsorbed or expelled from the body. 2. The corpus luteum (formed from the ruptured ovarian follicle after ovulation) degenerates. 3. As the corpus luteum degenerates, the levels of progesterone and estrogen decrease. 4. The thickened lining of the uterus (endometrium), which was prepared for a potential pregnancy, is no longer maintained by these hormones. 5. The endometrium breaks down and is shed along with blood and mucus. This shedding is known as **menstruation** (menses or period). 6. A new menstrual cycle begins.

Embryonic Stages: Zygote → Morula → Blastocyst → Implanted Embryo

Placenta Roles:

- Nutrient/waste exchange
- hCG/Progesterone secretion
- Maternal-fetal barrier

Without Fertilization:

- Egg degeneration
- CL regression → Progesterone ↓
- Endometrial shedding

Quick Tip

Quick Tip:

- For 35(A): Pollination → Fertilization → Ovule to Seed → Ovary to Fruit.
- For 35(B): Placenta is the lifeline between mother and fetus. If no fertilization, the uterine lining sheds (menstruation).

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36. (A) A carbon compound 'A' on heating with excess conc. H_2SO_4 forms a compound 'B', which on addition of one mole of hydrogen gas in the presence of nickel catalyst forms a compound 'C'. 'C'. on combustion in air forms 2 moles of carbon dioxide and 3 moles of water. Identify 'A', 'B' and 'C' and write their structures. Give chemical equations of the reactions involved.

Also state the role of concentrated sulphuric acid in the formation of 'B' from 'A'. **5**

Solution (A): 1. **Analysis of compound 'C':** Compound 'C' on combustion forms 2 moles of CO_2 and 3 moles of H_2O. This means 'C' contains 2 carbon atoms (from $2CO_2$) and $3 \times 2 = 6$ hydrogen atoms (from $3H_2O$). So, the molecular formula of 'C' is C_2H_6. This is **Ethane**. Structure of Ethane (C): CH_3–CH_3.

2. **Formation of 'C' from 'B':** Compound 'B' on addition of one mole of hydrogen gas (H_2) in the presence of nickel catalyst forms compound 'C' (Ethane, C_2H_6). This is a hydrogenation reaction. Since 'C' is an alkane (C_2H_6), 'B' must be an alkene or alkyne with 2 carbon atoms. Addition of one mole of H_2 to an alkene gives an alkane. So, 'B' is an alkene with 2 carbon atoms: C_2H_4, which is **Ethene**. Structure of Ethene (B): CH_2=CH_2. Reaction: CH_2=CH_2 (B) + H_2 $\xrightarrow{\text{Ni catalyst}}$ CH_3–CH_3 (C)

3. **Formation of 'B' from 'A':** Compound 'A' on heating with excess conc. H_2SO_4 forms compound 'B' (Ethene, C_2H_4). This reaction is dehydration of an alcohol to form an alkene. Ethene is formed from an alcohol with 2 carbon atoms. So, 'A' is Ethanol (C_2H_5OH). Structure of Ethanol (A): CH_3–CH_2–OH. Reaction: CH_3–CH_2–OH (A) $\xrightarrow{\text{conc. } H_2SO_4, \text{Heat}}$ CH_2=CH_2 (B) + H_2O

Identified Compounds and Structures:

- **A:** Ethanol (C_2H_5OH), Structure: CH_3–CH_2–OH
- **B:** Ethene (C_2H_4), Structure: CH_2=CH_2
- **C:** Ethane (C_2H_6), Structure: CH_3–CH_3

Chemical Equations Involved: 1. Formation of 'B' from 'A' (Dehydration of Ethanol):

$$CH_3CH_2OH \text{ (Ethanol, A)} \xrightarrow[\text{Heat (approx. } 170^\circ C)]{\text{conc. } H_2SO_4} CH_2{=}CH_2 \text{ (Ethene, B)} + H_2O$$

2. Formation of 'C' from 'B' (Hydrogenation of Ethene):

$$CH_2{=}CH_2 \text{ (Ethene, B)} + H_2 \xrightarrow{\text{Ni catalyst, Heat}} CH_3{-}CH_3 \text{ (Ethane, C)}$$

3. Combustion of 'C' (Ethane):

$$2CH_3–CH_3 \text{ (Ethane, C)} + 7O_2 \rightarrow 4CO_2 + 6H_2O + \text{Heat} + \text{Light}$$

(The question states 'C' on combustion forms 2 moles of CO_2 and 3 moles of H_2O, implying combustion of 1 mole of 'C'. So, $C_2H_6 + \frac{7}{2}O_2 \rightarrow 2CO_2 + 3H_2O$)

Role of concentrated sulphuric acid in the formation of 'B' from 'A': Concentrated sulphuric acid (conc. H_2SO_4) acts as a **dehydrating agent**. It removes a molecule of water from ethanol (A) to form ethene (B).

Molecular Structures:

- A: Ethanol (Hydroxyl functional group)
- B: Ethene (Double bond)
- C: Ethane (Saturated hydrocarbon)

Sulfuric Acid Role:

- Protonates -OH group
- Promotes -elimination
- Forms H_2O leaving group

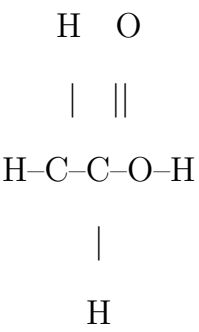
Process: Dehydration reaction (see equations)

OR

(B) A carbon compound 'A' is widely used as a preservative in pickles and has a molecular formula $C_2H_4O_2$. This compound reacts with ethanol to form a sweet smelling compound 'B'. (i) Identify the compound 'A' and write its structure. (ii) Write the chemical equation for the reaction of 'A' with ethanol to form compound 'B'. State the role of presence of an acid in the reaction. (iii) How can we get compound 'A' back from 'B' ? (iv) How can

'A' be obtained from ethanol ? (v) Name the gas produced when compound 'A' reacts with washing soda. **5**

Solution (B): (i) Identify the compound 'A' and write its structure. Compound 'A' is used as a preservative in pickles and has molecular formula $C_2H_4O_2$. This is characteristic of Ethanoic acid (Acetic acid). Compound A: **Ethanoic acid** (Acetic acid) Structure: CH_3COOH



(ii) Write the chemical equation for the reaction of 'A' with ethanol to form compound 'B'. State the role of presence of an acid in the reaction. Compound 'A' (Ethanoic acid) reacts with ethanol (C_2H_5OH) to form a sweet-smelling compound 'B', which is an ester. This reaction is called esterification. Compound 'B' is Ethyl ethanoate (Ethyl acetate). Equation:

$$CH_3COOH \text{ (Ethanoic acid, A)} + CH_3CH_2OH \text{ (Ethanol)} \xrightarrow[\text{Heat}]{\text{conc. } H_2SO_4 \text{ (acid catalyst)}} CH_3COOCH_2CH_3$$

Role of acid (e.g., conc. H_2SO_4): The acid acts as a **catalyst** to speed up the reaction and also acts as a **dehydrating agent** to remove water, which shifts the equilibrium towards the formation of the ester, thereby increasing the yield of ester.

(iii) How can we get compound 'A' back from 'B' ? Compound 'A' (Ethanoic acid) can be obtained back from compound 'B' (Ethyl ethanoate) by hydrolysis. This can be done by either acid hydrolysis or alkaline hydrolysis (saponification) followed by acidification. **Alkaline Hydrolysis (Saponification) followed by acidification:** 1. React 'B' with an alkali like sodium hydroxide (NaOH):

$$CH_3COOCH_2CH_3 \text{ (B)} + NaOH(aq) \rightarrow CH_3COONa \text{ (Sodium ethanoate)} + CH_3CH_2OH \text{ (Ethanol)}$$

2. Acidify the sodium ethanoate with a strong acid (e.g., HCl):

$$CH_3COONa + HCl(aq) \rightarrow CH_3COOH \text{ (Ethanoic acid, A)} + NaCl(aq)$$

Acid Hydrolysis:

$$CH_3COOCH_2CH_3 \text{ (B)} + H_2O \xrightarrow[\text{Heat}]{H^+ \text{ (acid catalyst)}} CH_3COOH \text{ (Ethanoic acid, A)} + CH_3CH_2OH \text{ (Eth}$$

This is the reverse of esterification and is an equilibrium reaction.

(iv) How can 'A' (Ethanoic acid) be obtained from ethanol ? Ethanoic acid can be obtained from ethanol by oxidation. 1. **Using an oxidizing agent** like alkaline potassium permanganate ($KMnO_4$) or acidified potassium dichromate ($K_2Cr_2O_7$):

$$CH_3CH_2OH \text{ (Ethanol)} \xrightarrow{\text{Alkaline } KMnO_4 \text{ or Acidified } K_2Cr_2O_7, \text{Heat}} CH_3COOH \text{ (Ethanoic acid, A)}$$

2. **Biological oxidation (fermentation):** With certain bacteria (e.g., Acetobacter), ethanol can be oxidized to ethanoic acid in the presence of air (vinegar production).

$$CH_3CH_2OH + O_2 \xrightarrow{\text{Acetobacter}} CH_3COOH + H_2O$$

(v) Name the gas produced when compound 'A' (Ethanoic acid) reacts with washing soda. Washing soda is sodium carbonate (Na_2CO_3). Ethanoic acid (a carboxylic acid) reacts with carbonates to produce carbon dioxide gas.

$$2CH_3COOH \text{ (Ethanoic acid, A)} + Na_2CO_3 \text{ (Washing soda)} \rightarrow 2CH_3COONa \text{ (Sodium ethanoate)}$$

The gas produced is **Carbon dioxide (CO_2)**.

(i) Identification: CH_3COOH (Carboxylic acid)

(ii) Ester Formation:

R-OH + R'-COOH [Hydrolysis]H^+ R'-COOR + H_2O

(iii) B Reaction: Ester hydrolysis (acid/base-catalyzed)

(iv) Ethanol Oxidation: $CH_3CH_2OH \rightarrow CH_3COOH$

(v) Product: CO_2 (from decarboxylation)

Quick Tip

Quick Tip:

- For 36(A): Work backwards from combustion products. Dehydration of alcohols gives alkenes. Hydrogenation of alkenes gives alkanes.
- For 36(B): Ethanoic acid is $C_2H_4O_2$. Esterification: Acid + Alcohol $\rightleftharpoons$ Ester + Water. Hydrolysis is the reverse. Acids react with carbonates to give CO_2.

Section: E

Question Nos. 37 to 39 are Source-based/Case-based questions.

37. The students in a class took a thick sheet of cardboard and made a small hole in its centre. Sunlight was allowed to fall on this small hole and they obtained a narrow beam of white light. A glass prism was taken and this white light was allowed to fall on one of its faces. The prism was turned slowly until the light that comes out of the opposite face of the prism appeared on the nearby screen. They studied this beautiful band of light and concluded that it is a spectrum of white light. (i) Give any one more instance in which this type of spectrum is observed. 1 (ii) What happens to white light in the above case? 1 (iii) (A) List two conditions necessary to observe a rainbow. 2 OR (iii) (B) Draw a ray diagram to show the formation of a rainbow. Mark on it, points (a), (b) and (c) as given below : (a) Where dispersion of light occurs. (b) Where light gets reflected internally. (c) Where final refraction occurs. 2

Solution: (i) Give any one more instance in which this type of spectrum is observed. One more instance where a spectrum similar to that produced by a prism is observed is a **rainbow** formed in the sky after rainfall when sunlight passes through raindrops. (Other examples: spectrum formed by a CD, soap bubbles).

(ii) What happens to white light in the above case (passing through a prism)? When white light passes through a glass prism, it undergoes **dispersion**. This means the white light splits into its constituent colors (the spectrum, typically VIBGYOR - Violet, Indigo, Blue, Green, Yellow, Orange, Red). This happens because different colors of light bend by different amounts as they pass through the prism, with violet light bending the most and red light bending the least.

(iii) (A) List two conditions necessary to observe a rainbow. Two conditions necessary to observe a rainbow are: 1. **Presence of Raindrops:** There must be water droplets (rain, mist, or spray) suspended in the air. 2. **Position of the Sun and Observer:** The sun must be shining, and the observer must be positioned with their back towards the sun, looking towards the region with raindrops. The sun should typically be relatively low in the sky.

OR

(iii) (B) Draw a ray diagram to show the formation of a rainbow. Mark on it, points (a), (b) and (c) as given below : (a) Where dispersion of light occurs. (b) Where light gets reflected internally. (c) Where final refraction occurs. *(A diagram should be drawn here. Description below.)* **Diagram Description (Single raindrop acting as a prism):**

1. Draw a large circle representing a spherical raindrop.
2. Draw a ray of sunlight entering the raindrop from one side (e.g., left).
3. **(a) Where dispersion of light occurs:** As the sunlight enters the raindrop (at the air-water interface), it refracts and disperses into its constituent colors. Show the white light splitting into at least two colors (e.g., red on top, violet at bottom, relative to the path inside). Mark this point of entry and splitting as (a).
4. The dispersed rays travel through the raindrop to the opposite inner surface.
5. **(b) Where light gets reflected internally:** At this inner surface, the light undergoes total internal reflection (or partial reflection that contributes significantly to the primary rainbow). Show the rays reflecting off this back surface. Mark this point of reflection as (b).

6. The reflected rays travel to another point on the front surface of the raindrop.

7. **(c) Where final refraction occurs:** As the light rays emerge from the raindrop back into the air (at the water-air interface), they undergo another refraction, bending away from the normal and further separating the colors. Mark this point of exit and final refraction as (c).

8. Show the emergent rays (e.g., red and violet) directed towards an observer's eye (observer not usually shown, but implied direction).

(i) Rainbow. (ii) Dispersion (splits into spectrum). (iii)(A) Raindrops present; Sun behind obser

Quick Tip

Quick Tip:

- Dispersion is the splitting of white light due to different refractive indices for different colors.
- Rainbows are formed by dispersion, refraction, and total internal reflection of sunlight by raindrops.
- For a primary rainbow, there is one internal reflection. Red light is on the outer arc, violet on the inner.

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38. Common salt is a very important chemical compound for our daily life. It's chemical name is sodium chloride and it is used as a raw material in the manufacture of caustic soda, washing soda, baking soda etc. It is also used in the preservation of pickles, butter, meat etc. (i) Name the acid and the base from which common salt can be obtained. 1 (ii) State the nature (acidic/basic/neutral) of sodium chloride. Give reason for the justification for your answer. 1 (iii) (A) What happens when electric current is passed through an aqueous solution

of sodium chloride (called brine)? Name the products obtained along with the corresponding places in the electrolytic cell where each of these products is obtained. 2 OR (iii) (B) How is washing soda obtained from sodium chloride? Give chemical equation of the reactions involved in the process. 2

Solution: (i) Name the acid and the base from which common salt can be obtained. Common salt (Sodium chloride, NaCl) can be obtained from the reaction of:

- Acid: **Hydrochloric acid (HCl)**
- Base: **Sodium hydroxide (NaOH)**

Reaction: $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$

(ii) State the nature (acidic/basic/neutral) of sodium chloride. Give reason for the justification for your answer. Sodium chloride (NaCl) is a **neutral** salt. **Reason:** Sodium chloride is formed from the neutralization reaction between a strong acid (HCl) and a strong base (NaOH). Salts formed from a strong acid and a strong base are neutral because the ions formed (Na^+ from NaOH and Cl^- from HCl) do not hydrolyze significantly in water to produce an excess of H^+ or OH^- ions. Therefore, an aqueous solution of NaCl has a pH of approximately 7.

(iii) (A) What happens when electric current is passed through an aqueous solution of sodium chloride (called brine)? Name the products obtained along with the corresponding places in the electrolytic cell where each of these products is obtained. When electric current is passed through an aqueous solution of sodium chloride (brine), it undergoes electrolysis. This process is known as the **Chlor-alkali process**. The products obtained are: 1. **Sodium hydroxide (NaOH):** Obtained near the **cathode**. 2. **Chlorine gas (Cl_2):** Obtained at the **anode**. 3. **Hydrogen gas (H_2):** Obtained at the **cathode**. Equation for electrolysis of brine:

$$2NaCl(aq) + 2H_2O(l) \xrightarrow{\text{Electrolysis}} 2NaOH(aq) + Cl_2(g) + H_2(g)$$

At cathode: $2H_2O(l) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$ (and Na^+ ions combine with OH^- to form NaOH) At anode: $2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$

OR

(iii) (B) How is washing soda obtained from sodium chloride? Give chemical equation of the reactions involved in the process. Washing soda (Sodium carbonate decahydrate, $Na_2CO_3 \cdot 10H_2O$) is obtained from sodium chloride using the **Solvay process** (or Ammonia-Soda process). The main steps involved are: 1. **Formation of Ammoniacal Brine:** Ammonia gas is passed through a saturated solution of sodium chloride (brine) to get ammoniacal brine. 2. **Carbonation of Ammoniacal Brine:** Carbon dioxide gas is passed through the ammoniacal brine. Sodium bicarbonate ($NaHCO_3$), being sparingly soluble, precipitates out.

$$NaCl(aq) + NH_3(g) + H_2O(l) + CO_2(g) \rightarrow NaHCO_3(s) + NH_4Cl(aq)$$

(Sodium bicarbonate) 3. **Filtration and Calcination of Sodium Bicarbonate:** The precipitated sodium bicarbonate is filtered and then heated (calcined) to obtain anhydrous sodium carbonate (soda ash).

$$2NaHCO_3(s) \xrightarrow{\text{Heat}} Na_2CO_3(s) + H_2O(l) + CO_2(g)$$

(Soda ash) 4. **Recrystallization to form Washing Soda:** Anhydrous sodium carbonate (soda ash) is dissolved in water and recrystallized to get crystals of washing soda (sodium carbonate decahydrate).

$$Na_2CO_3(s) + 10H_2O(l) \rightarrow Na_2CO_3 \cdot 10H_2O(s)$$

(Washing soda) (Note: The Solvay process also involves recovery of ammonia from ammonium chloride).

(i) Acid: HCl, Base: NaOH. (ii) Neutral; salt of strong acid strong base. (iii)(A) Chlor-alkali pr

Quick Tip

Quick Tip:

- Common salt (NaCl) is neutral.
- Electrolysis of brine (Chlor-alkali process) produces NaOH, Cl_2, and H_2.
- Washing soda ($Na_2CO_3 \cdot 10H_2O$) is manufactured by the Solvay process, starting with NaCl.

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39. In life there are certain changes in the environment called 'stimuli' to which we respond appropriately. Touching a flame suddenly is a dangerous situation for us. One way is to think consciously about the possibility of burning and then moving the hand. But our body has been designed in such a way that we save ourself from such situations immediately. (i) Name the action by which we protect ourself in the situation mentioned above and define it. 1 (ii) Write the role of (a) motor and (b) relay neuron. 1 (iii) (A) What are the two types of nervous system in human body? Name the components of each of them. 2 OR (iii) (B) Which part of the human brain is responsible for : (a) thinking (b) picking up a pencil (c) controlling blood pressure (d) controlling hunger 2

Solution: (i) Name the action by which we protect ourself in the situation mentioned above and define it. The action is called a **Reflex Action**. **Definition:** A reflex action is a rapid, automatic, and involuntary response to a stimulus, which is not under the conscious control of the brain. It is mediated by a neural pathway called a reflex arc.

(ii) Write the role of (a) motor and (b) relay neuron.

- **(a) Motor Neuron (Efferent Neuron):** Its role is to transmit nerve impulses from the central nervous system (brain or spinal cord) to an effector organ (like a muscle or a gland) to bring about a response. For example, causing a muscle to contract.

- **(b) Relay Neuron (Interneuron or Association Neuron):** Its role is to connect sensory neurons to motor neurons within the central nervous system (spinal cord or brain). It processes information from the sensory neuron and transmits the impulse to the appropriate motor neuron, often involved in reflex arcs and complex neural pathways.

(iii) (A) What are the two types of nervous system in human body? Name the components of each of them. The two main types (divisions) of the nervous system in the human body are: 1. **Central Nervous System (CNS):** Components:

- **Brain**
- **Spinal Cord**

2. **Peripheral Nervous System (PNS):** Components:

- **Nerves** arising from the brain (cranial nerves) and spinal cord (spinal nerves).
- The PNS can be further divided into the Somatic Nervous System (controls voluntary movements) and the Autonomic Nervous System (controls involuntary functions), which in turn has Sympathetic and Parasympathetic divisions.

OR

(iii) (B) Which part of the human brain is responsible for : (a) thinking The **Cerebrum** (specifically the cerebral cortex) is primarily responsible for thinking, reasoning, memory, intelligence, and other higher cognitive functions. **(b) picking up a pencil** Picking up a pencil involves voluntary muscle movement coordinated by the **Cerebellum** (for precision, coordination, and balance) and initiated by the motor areas of the **Cerebrum**. **(c) controlling blood pressure** Controlling blood pressure (an involuntary action) is primarily regulated by the **Medulla Oblongata** (part of the hindbrain/brainstem). **(d) controlling hunger** The **Hypothalamus** (part of the forebrain, located below the thalamus) is responsible for controlling hunger, thirst, and body temperature.

(i) Reflex Action: Rapid, automatic, involuntary response to stimulus. (ii) Motor neuron: CNS t

Quick Tip

Quick Tip:

- Reflex arcs involve a sensory receptor, sensory neuron, relay neuron (in CNS), motor neuron, and effector.
- Cerebrum: Largest part, higher functions. Cerebellum: Coordination, balance. Medulla: Involuntary vital functions. Hypothalamus: Homeostasis, drives.
