

AIIMS B.Sc Nursing 2026 Shift 1

Question Paper (Memory-Based) with Solutions

Conducted by AIIMS Delhi



General Instructions

- (i) The test is of 2 hours duration.
- (ii) This test paper consists of 100 questions.
- (iii) Each question carries +1 marks for correct answer and there is negative marking of 1/3 for incorrect answers.

1. One mole of glucose molecules contains approximately:

- (A) 3.01×10^{23} molecules
- (B) 6.02×10^{23} molecules
- (C) 1.204×10^{24} molecules
- (D) 9.03×10^{23} molecules

Correct Answer: (B) 6.02×10^{23} molecules

Solution:

Step 1: Understanding the Question:

The question is from the topic "Some Basic Concepts of Chemistry," specifically focusing on the Mole Concept.

Our objective is to identify the number of molecules present in a single mole of glucose ($C_6H_{12}O_6$).

Step 2: Key Formula or Approach:

We use the definition of the mole and Avogadro's constant.

The formula relating the number of moles (n) to the number of molecules (N) is:

$$N = n \times N_A$$

where N_A is Avogadro's number, approximately equal to 6.022×10^{23} molecules/mol.

Step 3: Detailed Explanation:

- A mole is defined as the amount of a substance that contains exactly the same number of fundamental entities (such as atoms, molecules, or ions) as there are atoms in 12 grams of pure Carbon-12.
- This constant value is designated as Avogadro's number, $N_A \approx 6.022 \times 10^{23}$.
- Glucose ($C_6H_{12}O_6$) is a molecular compound, which means that its basic constituent units are molecules.
- Therefore, exactly one mole of glucose contains $1 \times N_A$ glucose molecules, which is approximately 6.02×10^{23} molecules.
- If we were to calculate the number of individual atoms, one mole of glucose contains 6 moles of Carbon atoms, 12 moles of Hydrogen atoms, and 6 moles of Oxygen atoms, totaling $24 \times 6.02 \times 10^{23}$ atoms.

Step 4: Final Answer:

Thus, one mole of glucose molecules contains approximately 6.02×10^{23} molecules, matching option (B).

Quick Tip: Remember that the value of Avogadro's number ($N_A = 6.022 \times 10^{23}$) is independent of the identity of the chemical species.

Whether you are dealing with one mole of glucose, one mole of water, or one mole of electrons, the count of those fundamental entities will always be 6.02×10^{23} .

2. Benzaldehyde on treatment with concentrated NaOH undergoes Cannizzaro reaction to form:

- (A) Benzyl alcohol and sodium benzoate
- (B) Benzoic acid and ethanol
- (C) Benzyl chloride and sodium benzoate
- (D) Benzene and sodium formate

Correct Answer: (A) Benzyl alcohol and sodium benzoate

Solution:

Step 1: Understanding the Question:

This question belongs to the topic "Aldehydes, Ketones and Carboxylic Acids," specifically focusing on the Cannizzaro reaction.

We need to determine the reaction products when benzaldehyde (C_6H_5CHO) is treated with a concentrated solution of sodium hydroxide (NaOH).

Step 2: Key Formula or Approach:

The Cannizzaro reaction is a self-redox (disproportionation) reaction of aldehydes that lack an α -hydrogen.

In the presence of concentrated alkali, one molecule of the aldehyde undergoes oxidation to form a salt of carboxylic acid, while the second molecule is reduced to form a primary alcohol.

Step 3: Detailed Explanation:

- Benzaldehyde (C_6H_5CHO) does not contain any α -hydrogen atoms because the carbon

adjacent to the carbonyl carbon (the α -carbon) is part of the aromatic ring and has no hydrogen attached to it.

- Because of the lack of α -hydrogens, it cannot undergo base-catalyzed aldol condensation.
- When treated with a concentrated alkali like NaOH, a nucleophilic attack by a hydroxide ion (OH^-) occurs at the carbonyl carbon of one benzaldehyde molecule.
- This forms a tetrahedral intermediate which then transfers a hydride ion (H^-) to the carbonyl carbon of another benzaldehyde molecule.
- This hydride transfer is the rate-determining step.
- Consequently, the first benzaldehyde molecule is oxidized to benzoic acid, which quickly reacts with the sodium hydroxide to yield its salt, sodium benzoate ($\text{C}_6\text{H}_5\text{COONa}$).
- Meanwhile, the second molecule of benzaldehyde, which accepted the hydride ion, is reduced to benzyl alcohol ($\text{C}_6\text{H}_5\text{CH}_2\text{OH}$).

Step 4: Final Answer:

The products formed in this reaction are benzyl alcohol and sodium benzoate, which corresponds to option (A).

Quick Tip: To quickly identify if an aldehyde undergoes the Cannizzaro reaction, check for the presence of α -hydrogen atoms.

Aldehydes like formaldehyde (HCHO) and benzaldehyde ($\text{C}_6\text{H}_5\text{CHO}$) lack α -hydrogen and will undergo Cannizzaro reaction, whereas acetaldehyde (CH_3CHO) contains α -hydrogens and undergoes aldol condensation.

3. At equilibrium for the reaction $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$, the concentrations are $[\text{N}_2] = 0.20 \text{ M}$, $[\text{H}_2] = 0.60 \text{ M}$ and $[\text{NH}_3] = 0.80 \text{ M}$. The value of K_c is:

- (A) 7.4
- (B) 14.8
- (C) 22.2
- (D) 44.4

Correct Answer: (B) 14.8

Solution:

Step 1: Understanding the Question:

This question is from the topic "Chemical Equilibrium," specifically involving the calculation of the equilibrium constant (K_c) for a given gaseous reaction using the given equilibrium concentrations of the reactants and products.

Step 2: Key Formula or Approach:

The equilibrium constant (K_c) is written as the ratio of the product of the equilibrium concentrations of the products to that of the reactants, with each concentration term raised to the power of its stoichiometric coefficient:

$$K_c = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$$

Step 3: Detailed Explanation:

- We are given the equilibrium concentrations of the species involved in the reaction:
 $[\text{N}_2] = 0.20 \text{ M}$
 $[\text{H}_2] = 0.60 \text{ M}$
 $[\text{NH}_3] = 0.80 \text{ M}$

- Substituting these values into the equilibrium constant expression:

$$K_c = \frac{(0.80)^2}{(0.20) \times (0.60)^3}$$

- Calculating the numerator:

$$(0.80)^2 = 0.64$$

- Calculating the denominator:

$$(0.60)^3 = 0.216$$

$$0.20 \times 0.216 = 0.0432$$

- Substituting these calculated parts back into the expression:

$$K_c = \frac{0.64}{0.0432}$$

- Simplifying the division:

$$K_c \approx 14.81$$

Step 4: Final Answer:

The value of the equilibrium constant K_c is approximately 14.8, which is option (B).

Quick Tip: Always pay close attention to the stoichiometric coefficients in the chemical equation.

These coefficients become the exponents in the K_c expression.

A common mistake is to forget to raise the concentration to its respective power (e.g., squaring $[\text{NH}_3]$ and cubing $[\text{H}_2]$).

4. A solution is prepared by dissolving 5.85 g of NaCl (Molar mass = 58.5 g mol^{-1}) in water to make 500 mL of solution. The molarity of the solution is:

- (A) 0.1 M
- (B) 0.2 M
- (C) 0.5 M
- (D) 1.0 M

Correct Answer: (B) 0.2 M

Solution:**Step 1: Understanding the Question:**

This question belongs to the topic "Solutions," focusing on the concentration terms, specifically Molarity (M).

We are asked to calculate the molarity of a sodium chloride (NaCl) solution prepared by dissolving a given mass of solute in a specified volume of solution.

Step 2: Key Formula or Approach:

Molarity (M) is defined as the number of moles of solute dissolved per liter of solution:

$$M = \frac{\text{Number of moles of solute } (n)}{\text{Volume of solution in liters } (V)}$$

The number of moles (n) is calculated by dividing the given mass (w) of the solute by its molar mass (M_w):

$$n = \frac{w}{M_w}$$

Step 3: Detailed Explanation:

- We are given the following values:

Mass of NaCl (w) = 5.85 g

Molar mass of NaCl (M_w) = 58.5 g mol⁻¹

Volume of solution (V) = 500 mL

- First, calculate the number of moles of NaCl solute:

$$n = \frac{5.85 \text{ g}}{58.5 \text{ g mol}^{-1}} = 0.1 \text{ mol}$$

- Next, convert the volume of the solution from milliliters to liters:

$$V = \frac{500 \text{ mL}}{1000 \text{ mL/L}} = 0.5 \text{ L}$$

- Finally, substitute the values of n and V into the molarity formula:

$$M = \frac{0.1 \text{ mol}}{0.5 \text{ L}} = 0.2 \text{ M}$$

- Molarity is a temperature-dependent property because the volume of the solution can expand or contract with temperature variations.

Step 4: Final Answer:

The molarity of the prepared NaCl solution is 0.2 M, which corresponds to option (B).

Quick Tip: If the volume is given in milliliters, you can use the combined formula for molarity to save time during the exam:

$$M = \frac{\text{Weight of solute (g)} \times 1000}{\text{Molar mass of solute} \times \text{Volume of solution (mL)}}$$

Substituting: $M = \frac{5.85 \times 1000}{58.5 \times 500} = \frac{10 \times 1000}{100 \times 500} = 0.2 \text{ M}.$

5. According to Valence Bond Theory, the hybridization of the central metal ion in $[\text{Ni}(\text{CN})_4]^{2-}$ is:

- (A) sp^3
- (B) dsp^2
- (C) d^2sp^3
- (D) sp^2

Correct Answer: (B) dsp^2

Solution:

Step 1: Understanding the Question:

This question belongs to the topic "Coordination Compounds," specifically dealing with the Valence Bond Theory (VBT) to determine the hybridization, geometry, and magnetic behavior of a nickel coordination complex, $[\text{Ni}(\text{CN})_4]^{2-}$.

Step 2: Key Formula or Approach:

1. Identify the oxidation state of the central metal ion (Ni).
2. Write down the electronic configuration of the metal ion.
3. Analyze the field strength of the ligand (CN^-) to determine if pairing of electrons in the d -orbitals occurs.
4. Determine the vacant hybrid orbitals required to accommodate coordinate bonds from the ligands.

Step 3: Detailed Explanation:

- Let the oxidation state of Ni in the complex $[\text{Ni}(\text{CN})_4]^{2-}$ be x . Since CN has a charge of -1 , we have:

$$x + 4(-1) = -2 \implies x = +2$$

Thus, nickel is in the +2 oxidation state (Ni^{2+}).

- The atomic number of Nickel is 28. Its ground state electronic configuration is $[\text{Ar}]3d^84s^2$.
- For the Ni^{2+} ion, the configuration is $[\text{Ar}]3d^84s^0$.
- In the presence of cyanide (CN^-), which is a strong-field ligand, spin-pairing of the $3d$ electrons occurs against Hund's rule.
- The eight $3d$ electrons, which occupied the five $3d$ orbitals leaving two unpaired, now pair up completely, occupying only four $3d$ orbitals.
- This leaves one $3d$ orbital empty, along with the vacant $4s$ and $4p$ orbitals:
Vacant orbitals available: one $3d$, one $4s$, and two $4p$ orbitals.

- These four vacant orbitals hybridize to form four equivalent dsp^2 hybrid orbitals.
- These four hybrid orbitals accept four lone pairs of electrons from the four cyanide ligands.
- The resulting geometry is square-planar, and since there are no unpaired electrons, the complex is diamagnetic.

Step 4: Final Answer:

The hybridization of the central metal ion in $[\text{Ni}(\text{CN})_4]^{2-}$ is dsp^2 , which corresponds to option (B).

Quick Tip: For complexes of coordination number 4:

If the metal is Ni^{2+} (d^8 configuration) and the ligand is a strong-field ligand (like CN^- , CO), pairing occurs, resulting in dsp^2 (square planar, diamagnetic).

If the ligand is a weak-field ligand (like Cl^- , F^-), no pairing occurs, resulting in sp^3 (tetrahedral, paramagnetic).

6. According to Molecular Orbital Theory, the bond order of O_2 is:

- (A) 1
- (B) 1.5
- (C) 2
- (D) 3

Correct Answer: (C) 2

Solution:

Step 1: Understanding the Question:

This question is from "Chemical Bonding and Molecular Structure," focusing on Molecular Orbital Theory (MOT).

We are required to determine the bond order of the diatomic oxygen molecule (O_2).

Step 2: Key Formula or Approach:

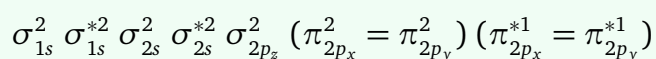
According to Molecular Orbital Theory, the bond order of a homonuclear diatomic molecule is:

$$\text{Bond Order} = \frac{N_b - N_a}{2}$$

where N_b is the number of electrons in bonding molecular orbitals, and N_a is the number of electrons in antibonding molecular orbitals.

Step 3: Detailed Explanation:

- Each oxygen atom contains 8 electrons, so the diatomic oxygen molecule (O_2) contains a total of 16 electrons.
- According to the electronic filling rules of MOT, the molecular orbital configuration for O_2 is written as:



- Let us count the bonding electrons (N_b), which are in orbitals without an asterisk (*):
 - σ_{1s} : 2 electrons
 - σ_{2s} : 2 electrons
 - σ_{2p_z} : 2 electrons
 - π_{2p_x} and π_{2p_y} : 4 electrons

$$N_b = 2 + 2 + 2 + 4 = 10$$

- Let us count the antibonding electrons (N_a), which are in orbitals with an asterisk (*):
 - σ_{1s}^* : 2 electrons
 - σ_{2s}^* : 2 electrons
 - $\pi_{2p_x}^*$ and $\pi_{2p_y}^*$: 2 electrons

$$N_a = 2 + 2 + 2 = 6$$

- Now we substitute these values into the bond order formula:

$$\text{Bond Order} = \frac{10 - 6}{2} = 2$$

- A bond order of 2 represents a double bond consisting of one σ bond and one π bond.
- Note that because of the presence of two unpaired electrons in the degenerate $\pi_{2p_x}^*$ and $\pi_{2p_y}^*$ antibonding orbitals, O_2 is paramagnetic.

Step 4: Final Answer:

The bond order of O_2 is 2, which is option (C).

Quick Tip: A quick trick for finding bond orders of second-period diatomic species (total electrons 10 to 18):

14 electrons (like N_2) $\implies$ Bond Order = 3.0

Each addition or subtraction of 1 electron decreases the bond order by 0.5.

For O_2 (16 electrons): $3.0 - (2 \times 0.5) = 2.0$.

For O_2^+ (15 electrons): $3.0 - 0.5 = 2.5$.

7. 100 mL of 2 M HCl is diluted to 500 mL. The molarity of the diluted solution is:

- (A) 0.2 M
- (B) 0.4 M
- (C) 0.5 M
- (D) 1.0 M

Correct Answer: (B) 0.4 M

Solution:

Step 1: Understanding the Question:

This question belongs to the topic "Solutions," specifically focusing on the dilution of solutions. We are required to determine the final molarity of a hydrochloric acid (HCl) solution when its volume is increased from 100 mL to 500 mL.

Step 2: Key Formula or Approach:

During dilution, the total amount (moles) of solute remains constant because only the solvent is added to the solution.

The relation between initial and final concentrations and volumes is given by the Dilution Equation:

$$M_1V_1 = M_2V_2$$

where M_1 and V_1 are the initial molarity and volume, and M_2 and V_2 are the final molarity and volume.

Step 3: Detailed Explanation:

- We are given the following values:

Initial molarity (M_1) = 2 M

Initial volume (V_1) = 100 mL

Final volume (V_2) = 500 mL

- We need to solve for the final molarity (M_2).
- Rearranging the dilution formula to isolate M_2 :

$$M_2 = \frac{M_1 V_1}{V_2}$$

- Substituting the values into the equation:

$$M_2 = \frac{2 \text{ M} \times 100 \text{ mL}}{500 \text{ mL}}$$

- Simplifying the calculations:

$$M_2 = \frac{200}{500} = 0.4 \text{ M}$$

- The process of dilution reduces the concentration of ions per unit volume, which lowers the molarity.

Step 4: Final Answer:

The final molarity of the diluted solution is 0.4 M, which is option (B).

Quick Tip: Whenever a solution is diluted, the dilution factor is given by $\frac{V_2}{V_1}$.

Here, the volume is increased from 100 mL to 500 mL (a factor of 5).

Thus, the concentration must decrease by a factor of 5:

$$M_2 = \frac{M_1}{5} = \frac{2}{5} = 0.4 \text{ M}$$

This mental math technique helps save time in the exam.

8. The IUPAC name of $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$ is:

- (A) Butan-1-ol
- (B) Butan-2-ol
- (C) Propan-2-ol
- (D) 2-Methylpropan-1-ol

Correct Answer: (B) Butan-2-ol

Solution:

Step 1: Understanding the Question:

This question is from "Organic Chemistry - Nomenclature of Organic Compounds."

We need to determine the official IUPAC name of the compound whose structural formula is $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$.

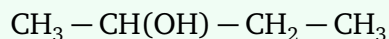
Step 2: Key Formula or Approach:

The IUPAC rules for naming acyclic alcohols are:

1. Identify the longest carbon chain containing the functional carbon (the one bonded to $-\text{OH}$). This gives the parent alkane.
2. Number the carbon chain from the end closer to the hydroxyl group (lowest locant rule).
3. Replace the suffix "-e" of the parent alkane with the position locant and the suffix "-ol".

Step 3: Detailed Explanation:

- The given compound is:

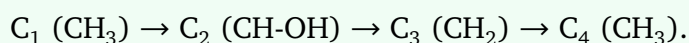


- Let us trace the longest carbon chain:

There are four continuous carbon atoms in a straight line, so the parent hydrocarbon is butane.

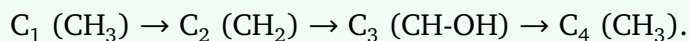
- Let us number the carbon chain to locate the $-\text{OH}$ group:

- Numbering from left to right:



The $-\text{OH}$ group is on Carbon-2.

- Numbering from right to left:



The $-\text{OH}$ group is on Carbon-3.

- We choose the left-to-right numbering system because 2 is a smaller number than 3 (lowest locant rule).
- The parent name "butane" loses its ending "-e" and gains "-2-ol", yielding "butan-2-ol".

Step 4: Final Answer:

The IUPAC name of the compound is Butan-2-ol, which matches option (B).

Quick Tip: When naming simple alcohols, always count the total number of carbon atoms in the longest continuous chain first.

Here, 4 carbons means "butan-".

Since the —OH group is on a non-terminal carbon, it must be on position 2, as counting from the other end would give 3.

Thus, Butan-2-ol is the correct answer.

9. The coordination number of cobalt in $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ is:

- (A) 3
- (B) 4
- (C) 6
- (D) 8

Correct Answer: (C) 6

Solution:

Step 1: Understanding the Question:

This question is from the topic "Coordination Compounds."

The goal is to determine the coordination number of the cobalt metal ion in the complex compound $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$.

Step 2: Key Formula or Approach:

The coordination number (CN) of a central metal ion is defined as the number of ligand donor atoms to which the metal is directly bonded.

It is calculated as:

$$\text{Coordination Number} = \text{Number of ligands} \times \text{Denticity of the ligand}$$

Step 3: Detailed Explanation:

- Let us analyze the formula of the complex compound: $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$.
- The square brackets enclose the coordination sphere: $[\text{Co}(\text{NH}_3)_6]^{3+}$.
- The chloride ions (Cl^-) lie outside the coordination sphere as counter-ions and do not form coordinate bonds with the cobalt ion.
- Inside the coordination sphere, we have the Cobalt ion surrounded by ammonia (NH_3) ligands.
- Ammonia (NH_3) is a monodentate ligand because it contains a single donor nitrogen atom with a lone pair of electrons.
- There are exactly 6 ammonia molecules coordinated to the central Cobalt ion.
- Using the formula:

$$\text{CN} = 6 (\text{ligands}) \times 1 (\text{denticity}) = 6$$

- This coordinate bonding forms an octahedral geometry around the central cobalt ion.

Step 4: Final Answer:

The coordination number of cobalt in $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ is 6, which is option (C).

Quick Tip: Do not confuse coordination number with the oxidation state of the metal.

In $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$, the coordination number is 6, while the oxidation state of cobalt is +3.

Only count the ligands inside the square brackets; counter-ions outside the brackets do not contribute to the coordination number.

10. Which reagent converts ethanol into bromoethane?

- (A) KMnO_4
- (B) PBr_3
- (C) NaOH
- (D) H_2SO_4

Correct Answer: (B) PBr_3

Solution:

Step 1: Understanding the Question:

This question is from "Haloalkanes and Haloarenes" and concerns the synthesis of alkyl halides from alcohols.

We are asked to identify the chemical reagent that transforms ethanol ($\text{C}_2\text{H}_5\text{OH}$) into bromoethane ($\text{C}_2\text{H}_5\text{Br}$).

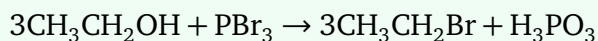
Step 2: Key Formula or Approach:

Replacing a hydroxyl group ($-\text{OH}$) in an alcohol with a halogen atom is a classic nucleophilic substitution reaction ($\text{S}_{\text{N}}2$ or $\text{S}_{\text{N}}1$).

Phosphorus tribromide (PBr_3) is an excellent reagent for converting primary and secondary alcohols to alkyl bromides.

Step 3: Detailed Explanation:

- The reaction between ethanol and phosphorus tribromide can be represented as:



- In this reaction, phosphorus tribromide acts as a nucleophilic brominating agent.
- The $-\text{OH}$ group of ethanol is converted into a better leaving group by reacting with phosphorus, which is then displaced by the bromide ion (Br^-) via an $\text{S}_{\text{N}}2$ mechanism.
- Let us analyze why the other options are incorrect:
 - KMnO_4 is a powerful oxidizing agent that would oxidize ethanol to acetaldehyde and then to ethanoic acid.
 - NaOH is a strong base and nucleophile, but it cannot displace the $-\text{OH}$ group because hydroxide is a very poor leaving group.
 - H_2SO_4 is a strong acid and dehydrating agent, which would dehydrate ethanol to form ethene or diethyl ether depending on the temperature.

Step 4: Final Answer:

The reagent that converts ethanol into bromoethane is PBr_3 , which matches option (B).

Quick Tip: Alcohols can be converted to alkyl halides using phosphorus halides (PX_3 or PX_5) or thionyl chloride (SOCl_2).

Specifically for bromination, PBr_3 is the standard choice.

For chlorination, PCl_3 , PCl_5 , or SOCl_2 are commonly used.

11. A diode is forward biased by 0.7 V. If the forward resistance is $10\ \Omega$, the current through the diode is:

(A) 0.007 A

- (B) 0.07 A
- (C) 0.7 A
- (D) 7 A

Correct Answer: (B) 0.07 A

Solution:

Step 1: Understanding the Question:

This question is from "Semiconductor Electronics," focusing on the electrical characteristics of a semiconductor diode in its forward-biased state.

We are given the voltage across the diode and its forward resistance, and we need to find the resulting current.

Step 2: Key Formula or Approach:

For a diode operating in the forward-bias region, we can determine the current (I) flowing through it using Ohm's Law:

$$I = \frac{V}{R_f}$$

where V is the forward bias voltage across the diode, and R_f is the forward resistance of the diode.

Step 3: Detailed Explanation:

- We are given the following parameters:

Forward bias voltage (V) = 0.7 V

Forward resistance (R_f) = 10 Ω

- Substituting these values into the Ohm's law formula:

$$I = \frac{0.7 \text{ V}}{10 \Omega}$$

- Performing the division:

$$I = 0.07 \text{ A}$$

- In a real silicon p - n junction diode, the barrier potential is approximately 0.7 V.
- When the forward voltage reaches this value, the depletion region narrows significantly, allowing current to flow easily, limited only by the dynamic resistance of the semiconductor.

Step 4: Final Answer:

The current through the diode is 0.07 A, which corresponds to option (B).

Quick Tip: A simple application of Ohm's Law ($I = V/R$) is sufficient here.

Always pay attention to units: $0.7/10 = 0.07 \text{ A}$ (or 70 mA).

In exams, make sure you do not misplace the decimal point.

12. In Young's double-slit experiment, the slit separation is 0.4 mm and the screen is 2 m away. If light of wavelength 600 nm is used, the fringe width is:

- (A) 2 mm
- (B) 3 mm
- (C) 4 mm
- (D) 5 mm

Correct Answer: (B) 3 mm

Solution:

Step 1: Understanding the Question:

This question belongs to the topic "Wave Optics," focusing on the interference of light in Young's Double Slit Experiment (YDSE).

We are required to compute the fringe width (β) using the given slit separation, distance of the screen from the slits, and wavelength of the light.

Step 2: Key Formula or Approach:

The fringe width (β) in Young's Double Slit Experiment is calculated using:

$$\beta = \frac{\lambda D}{d}$$

where:

λ = wavelength of light used

D = distance between the slits and the screen

d = slit separation (distance between the two coherent sources)

Step 3: Detailed Explanation:

- We are given the following values:

Slit separation (d) = 0.4 mm = 0.4×10^{-3} m

Distance of screen (D) = 2 m

Wavelength of light (λ) = 600 nm = 600×10^{-9} m = 6×10^{-7} m

- Substitute these values in the fringe width equation:

$$\beta = \frac{(6 \times 10^{-7} \text{ m}) \times (2 \text{ m})}{0.4 \times 10^{-3} \text{ m}}$$

- Simplify the numerator:

$$6 \times 10^{-7} \times 2 = 1.2 \times 10^{-6} \text{ m}^2$$

- Simplify the denominator:

$$0.4 \times 10^{-3} = 4 \times 10^{-4} \text{ m}$$

- Calculate the final value of β :

$$\beta = \frac{1.2 \times 10^{-6}}{4 \times 10^{-4}} = 0.3 \times 10^{-2} \text{ m} = 3 \times 10^{-3} \text{ m}$$

- Convert the answer from meters to millimeters:

$$\beta = 3 \text{ mm}$$

Step 4: Final Answer:

The fringe width is 3 mm, which is option (B).

Quick Tip: Always convert all physical quantities to their standard SI units (meters) before performing calculations.

Conversion factors:

$$1 \text{ nm} = 10^{-9} \text{ m}$$

$$1 \text{ mm} = 10^{-3} \text{ m}$$

Keeping the powers of 10 sorted makes calculations straightforward and error-free.

13. The entropy change when 400 J of heat is absorbed reversibly at 400 K is:

- (A) 0.5 J K^{-1}
- (B) 1 J K^{-1}
- (C) 2 J K^{-1}
- (D) 4 J K^{-1}

Correct Answer: (B) 1 J K^{-1}

Solution:

Step 1: Understanding the Question:

This question is from "Thermodynamics" (both in Physics and Chemistry) and asks us to find the entropy change (ΔS) of a system when it absorbs a given amount of heat reversibly at a constant temperature.

Step 2: Key Formula or Approach:

The entropy change (ΔS) of a thermodynamic system during a reversible isothermal process is given by the formula:

$$\Delta S = \frac{q_{\text{rev}}}{T}$$

where q_{rev} is the heat absorbed reversibly, and T is the absolute temperature in Kelvin.

Step 3: Detailed Explanation:

- We are given:

Heat absorbed (q_{rev}) = +400 J (the positive sign denotes that heat is absorbed by the system)

Absolute temperature (T) = 400 K

- Substituting these values into the entropy change formula:

$$\Delta S = \frac{400 \text{ J}}{400 \text{ K}}$$

- Performing the division:

$$\Delta S = 1 \text{ J K}^{-1}$$

- Entropy is a state function that measures the degree of randomness or disorder in the system.
- When a system absorbs heat, its molecular motion increases, causing a positive change in its entropy ($\Delta S > 0$).

Step 4: Final Answer:

The change in entropy is 1 J K^{-1} , which corresponds to option (B).

Quick Tip: Ensure that the temperature is always in Kelvin (K) when calculating thermodynamic properties like entropy change.

If the temperature is given in Celsius, add 273.15 to convert it to Kelvin.

Pay attention to the sign: absorption of heat increases entropy (+q), while release of heat decreases entropy (−q).

14. In Young's double-slit experiment, the wavelength of light is doubled while all other parameters remain unchanged. The fringe width becomes:

- (A) Half of the original
- (B) Unchanged
- (C) Double the original
- (D) Four times the original

Correct Answer: (C) Double the original

Solution:

Step 1: Understanding the Question:

This question is from "Wave Optics" and concerns the dependence of the fringe width (β) in Young's Double Slit Experiment (YDSE) on the wavelength of light (λ) when all other experimental parameters are held constant.

Step 2: Key Formula or Approach:

The fringe width (β) in a standard YDSE is defined by:

$$\beta = \frac{\lambda D}{d}$$

where λ is the wavelength, D is the distance to the screen, and d is the slit separation.

Step 3: Detailed Explanation:

- From the formula for fringe width, we can see that:

$$\beta \propto \lambda$$

This means the fringe width is directly proportional to the wavelength of the light used, provided the screen distance (D) and the slit separation (d) remain unchanged.

- Let the initial wavelength be $\lambda_1 = \lambda$, and the corresponding initial fringe width be $\beta_1 = \beta$.

- The new wavelength is doubled: $\lambda_2 = 2\lambda$.
- The new fringe width β_2 is:

$$\beta_2 = \frac{\lambda_2 D}{d} = \frac{2\lambda D}{d} = 2\beta_1$$

- Thus, doubling the wavelength results in exactly doubling the fringe width.

Step 4: Final Answer:

The fringe width becomes double the original, which corresponds to option (C).

Quick Tip: Since β is directly proportional to λ , any modification factor applied to the wavelength is directly transferred to the fringe width.

If λ is doubled, β is doubled.

If λ is halved, β is halved.

This direct proportionality simplifies conceptual questions in YDSE.

15. The resistance of a semiconductor decreases when its temperature increases because:

- (A) the number of free charge carriers increases
- (B) electron mass decreases
- (C) atomic spacing increases
- (D) mobility becomes zero

Correct Answer: (A) the number of free charge carriers increases

Solution:

Step 1: Understanding the Question:

This question is from "Semiconductor Electronics" and "Current Electricity."

It asks for the physical reason behind the characteristic decrease in electrical resistance of a semiconductor with an increase in temperature.

Step 2: Key Formula or Approach:

The resistivity (ρ) of a material is given by:

$$\rho = \frac{m}{ne^2\tau}$$

where:

m = mass of charge carriers

n = concentration of free charge carriers

e = charge of an electron

τ = relaxation time (average time between collisions)

Step 3: Detailed Explanation:

- In semiconductors, the energy gap (band gap) between the filled valence band and the empty conduction band is relatively small (typically < 3 eV).
- At low temperatures, there is insufficient thermal energy for electrons to cross this gap, meaning the number of free charge carriers in the conduction band is very small, and resistance is high.
- When the temperature of a semiconductor increases, thermal energy is supplied to the lattice.
- This thermal energy breaks covalent bonds, allowing a large number of electrons to transition from the valence band to the conduction band.

- Consequently, the concentration of free charge carriers (n) increases exponentially with temperature.
- Although the relaxation time (τ) decreases slightly due to increased thermal vibrations and collisions, the exponential increase in the carrier concentration (n) completely dominates.
- As a result, the overall resistivity (ρ) decreases significantly, which in turn decreases the electrical resistance ($R = \rho L/A$) of the semiconductor.
- This explains why semiconductors have a negative temperature coefficient of resistance ($\alpha < 0$).

Step 4: Final Answer:

The resistance of a semiconductor decreases because the number of free charge carriers increases, which is option (A).

Quick Tip: Contrast conductors and semiconductors:

In conductors (metals), n is constant, and increasing temperature decreases τ (more collisions), so resistance increases (positive α).

In semiconductors, increasing temperature increases n exponentially, dominating over the change in τ , so resistance decreases (negative α).

16. An electromagnetic wave has a frequency of 150 MHz. Its wavelength in air is approximately:

- (A) 0.5 m
- (B) 1 m

(C) 2 m

(D) 4 m

Correct Answer: (C) 2 m

Solution:

Step 1: Understanding the Question:

This question belongs to the topic "Electromagnetic Waves."

The goal is to calculate the wavelength (λ) of an electromagnetic wave in air when its frequency is given as 150 MHz.

Step 2: Key Formula or Approach:

The fundamental relation between the speed of a wave (v), its frequency (ν), and its wavelength (λ) is:

$$v = \nu\lambda \implies \lambda = \frac{v}{\nu}$$

For electromagnetic waves traveling in air or vacuum, the wave speed (v) is approximately equal to the speed of light ($c \approx 3 \times 10^8$ m/s).

Step 3: Detailed Explanation:

- We are given the following values:

Frequency of the electromagnetic wave (ν) = 150 MHz

Since 1 MHz = 10^6 Hz, we can convert this to standard units:

$$\nu = 150 \times 10^6 \text{ Hz} = 1.5 \times 10^8 \text{ Hz}$$

- The speed of light in air (c) is:

$$c = 3 \times 10^8 \text{ m/s}$$

- Now, substitute these values into the wavelength formula:

$$\lambda = \frac{c}{\nu} = \frac{3 \times 10^8 \text{ m/s}}{1.5 \times 10^8 \text{ Hz}}$$

- Simplifying the fraction by dividing the terms:

$$\lambda = \frac{3}{1.5} = 2 \text{ m}$$

- This wavelength of 2 m falls within the VHF (Very High Frequency) band of the radio wave spectrum, commonly used for FM radio transmissions and television broadcasting.

Step 4: Final Answer:

The wavelength of the electromagnetic wave in air is approximately 2 m, which corresponds to option (C).

Quick Tip: A useful shortcut when working with electromagnetic waves:

Wavelength in meters is given by:

$$\lambda \text{ (m)} \approx \frac{300}{\text{Frequency in MHz}}$$

Substituting the given frequency: $\lambda \approx \frac{300}{150} = 2 \text{ m}$.

This formula is highly effective for solving RF and antenna questions.

17. A radioactive substance has a half-life of 5 days. If its initial mass is 80 g, the mass remaining after 15 days is:

- (A) 40 g
- (B) 20 g
- (C) 10 g
- (D) 5 g

Correct Answer: (C) 10 g

Solution:

Step 1: Understanding the Question:

This question is from "Modern Physics," specifically focusing on Radioactive Decay (or "Chemical Kinetics" in physical chemistry).

We are asked to find the remaining mass of a radioactive sample after a given amount of time, using the initial mass and the half-life.

Step 2: Key Formula or Approach:

The mass of a radioactive substance remaining after n half-lives is calculated using the formula:

$$N = N_0 \left(\frac{1}{2} \right)^n$$

where N_0 is the initial mass, and n is the number of half-lives that have elapsed:

$$n = \frac{t}{T_{1/2}}$$

Step 3: Detailed Explanation:

- We are given the following values:

Initial mass (N_0) = 80 g

Half-life ($T_{1/2}$) = 5 days

Total elapsed time (t) = 15 days

- First, let us calculate the number of half-lives (n) that have passed:

$$n = \frac{15 \text{ days}}{5 \text{ days}} = 3$$

- This means the substance undergoes decay through exactly 3 half-lives.
- Substituting the values into our decay formula:

$$N = 80 \times \left(\frac{1}{2}\right)^3$$

$$N = 80 \times \frac{1}{8} = 10 \text{ g}$$

- Alternatively, we can trace this step-by-step:
 - Initially: 80 g
 - After 1st half-life (5 days): $\frac{80}{2} = 40$ g remaining.
 - After 2nd half-life (10 days): $\frac{40}{2} = 20$ g remaining.
 - After 3rd half-life (15 days): $\frac{20}{2} = 10$ g remaining.

Step 4: Final Answer:

The mass of the radioactive substance remaining after 15 days is 10 g, which corresponds to option (C).

Quick Tip: For small integers of half-lives (like 1, 2, 3, or 4), the step-by-step halving method is usually faster and less prone to calculation errors than using the formula.

Simply divide the mass by 2 successively for each half-life: $80 \rightarrow 40 \rightarrow 20 \rightarrow 10$.

18. A coil of 100 turns experiences a change in magnetic flux from 0.05 Wb to 0.01 Wb in 0.2 s. The induced emf is:

(A) 10 V

(B) 15 V

(C) 20 V

(D) 25 V

Correct Answer: (C) 20 V

Solution:

Step 1: Understanding the Question:

This question belongs to the topic "Electromagnetic Induction."

We are required to determine the magnitude of the induced electromotive force (emf) in a coil of 100 turns when the magnetic flux passing through it changes by a given amount in a specified time interval.

Step 2: Key Formula or Approach:

According to Faraday's Law of Electromagnetic Induction, the magnitude of the induced electromotive force (e) is given by:

$$e = N \left| \frac{\Delta \Phi}{\Delta t} \right|$$

where:

N = number of turns of the coil

$\Delta \Phi = \Phi_2 - \Phi_1$ is the change in magnetic flux

Δt = time interval during which the change occurs

Step 3: Detailed Explanation:

- We are given the following experimental parameters:

Number of turns (N) = 100

Initial magnetic flux (Φ_1) = 0.05 Wb

Final magnetic flux (Φ_2) = 0.01 Wb

Time interval (Δt) = 0.2 s

- Calculate the change in magnetic flux ($\Delta\Phi$):

$$\Delta\Phi = \Phi_2 - \Phi_1 = 0.01 \text{ Wb} - 0.05 \text{ Wb} = -0.04 \text{ Wb}$$

- Taking the absolute value of the change in flux:

$$|\Delta\Phi| = 0.04 \text{ Wb}$$

- Substitute these values into the Faraday's Law formula:

$$e = 100 \times \frac{0.04 \text{ Wb}}{0.2 \text{ s}}$$

- Calculate the rate of change of flux:

$$\frac{0.04}{0.2} = 0.2 \text{ Wb/s}$$

- Multiply by the number of turns:

$$e = 100 \times 0.2 \text{ V} = 20 \text{ V}$$

- The negative sign in Lenz's law indicates that the direction of the induced emf is such that it would produce a current to oppose the change in magnetic flux.

Step 4: Final Answer:

The induced electromotive force in the coil is 20 V, which corresponds to option (C).

Quick Tip: Remember that the induced emf is directly proportional to the number of turns (N).

Do not forget to multiply the rate of change of flux by the number of turns.

A common error is calculating only the single-turn emf (0.2 V) and missing the factor of 100.

19. A convex lens of refractive index 1.5 has radii of curvature +20 cm and –20 cm. The focal length of the lens is:

- (A) 10 cm
- (B) 20 cm
- (C) 40 cm
- (D) 80 cm

Correct Answer: (B) 20 cm

Solution:

Step 1: Understanding the Question:

This question is from "Ray Optics and Optical Instruments."

We are asked to calculate the focal length (f) of a double convex lens of a known refractive index (μ) and radii of curvature of its two surfaces.

Step 2: Key Formula or Approach:

We use the Lens Maker's Formula, which relates the focal length of a lens to its refractive index and the radii of curvature:

$$\frac{1}{f} = (\mu - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

where:

f = focal length of the lens

μ = refractive index of the lens medium with respect to the surrounding medium (air, $\mu = 1$)

R_1 = radius of curvature of the first surface

R_2 = radius of curvature of the second surface

Step 3: Detailed Explanation:

- We are given the following values:

Refractive index (μ) = 1.5

Radius of curvature of first surface (R_1) = +20 cm

Radius of curvature of second surface (R_2) = -20 cm

- Substitute these values into the Lens Maker's Formula:

$$\frac{1}{f} = (1.5 - 1) \left(\frac{1}{+20} - \frac{1}{-20} \right)$$

- Calculate the refractive index term:

$$1.5 - 1 = 0.5 = \frac{1}{2}$$

- Calculate the term in the brackets:

$$\frac{1}{20} - \left(-\frac{1}{20}\right) = \frac{1}{20} + \frac{1}{20} = \frac{2}{20} = \frac{1}{10}$$

- Multiply the two terms to find the reciprocal of the focal length:

$$\frac{1}{f} = \frac{1}{2} \times \frac{1}{10} = \frac{1}{20}$$

- Taking the reciprocal gives the focal length:

$$f = 20 \text{ cm}$$

- The positive sign of the focal length indicates that the lens is indeed converging in nature, which matches the properties of a standard convex lens.

Step 4: Final Answer:

The focal length of the convex lens is 20 cm, which is option (B).

Quick Tip: For an equiconvex lens (where $R_1 = +R$ and $R_2 = -R$) made of glass with refractive index $\mu = 1.5$:

Substituting into the formula gives:

$$\frac{1}{f} = (1.5 - 1) \left(\frac{1}{R} + \frac{1}{R} \right) = 0.5 \left(\frac{2}{R} \right) = \frac{1}{R} \implies f = R$$

So, the focal length is exactly equal to the radius of curvature!

Recognizing this pattern helps solve such problems instantly.

20. The measured length of a rod is (20.0 ± 0.2) cm. The percentage error in the measurement is:

- (A) 0.5%
- (B) 1%
- (C) 2%
- (D) 5%

Correct Answer: (B) 1%

Solution:

Step 1: Understanding the Question:

This question is from the topic "Units and Measurements," specifically focusing on Error Analysis.

We are given the measurement of a rod along with its absolute error, and we need to calculate the percentage error.

Step 2: Key Formula or Approach:

The percentage error is defined as the relative error multiplied by 100:

$$\text{Percentage Error} = \frac{\text{Absolute Error } (\Delta L)}{\text{Measured Value } (L)} \times 100\%$$

Step 3: Detailed Explanation:

- We are given the measurement as:

$$\text{Length} = (20.0 \pm 0.2) \text{ cm}$$

This indicates:

Measured value of length (L) = 20.0 cm

Absolute error in length (ΔL) = 0.2 cm

- Substitute these values into the percentage error formula:

$$\text{Percentage Error} = \frac{0.2 \text{ cm}}{20.0 \text{ cm}} \times 100\%$$

- Simplify the fraction:

$$\frac{0.2}{20.0} = \frac{2}{200} = 0.01$$

- Multiply by 100 to get the percentage value:

$$\text{Percentage Error} = 0.01 \times 100\% = 1\%$$

- Percentage error indicates the relative precision of a measurement; a lower percentage error means higher precision and reliability of the measurement.

Step 4: Final Answer:

The percentage error in the measurement is 1%, which corresponds to option (B).

Quick Tip: To calculate percentage error quickly:

Shift the decimal point of both the absolute error and the measured value to make the math simpler.

Here, $\frac{0.2}{20} \times 100 = \frac{2}{200} \times 100 = \frac{2}{2} = 1\%$.

Always double check that both values have the same unit of measurement.

21. Who among the following is the ex-officio Chairman of the Rajya Sabha?

- (A) Leader of Opposition
- (B) President of India
- (C) Vice-President of India
- (D) Senior Member of Rajya Sabha

Correct Answer: (C) Vice-President of India

Solution:**Step 1: Understanding the Question:**

This question belongs to the General Knowledge and Civics section, focusing on the constitutional framework and legislative offices of the Republic of India.

We are asked to identify which high-ranking official serves as the ex-officio Chairman of the Rajya Sabha, the Upper House of India's bicameral Parliament.

Step 2: Key Concept or Approach:

According to Article 64 and Article 89(1) of the Constitution of India, the Vice-President of India is the ex-officio Chairman of the Rajya Sabha.

The term "ex-officio" indicates that by virtue of holding the office of the Vice-President, the individual automatically assumes the role and responsibilities of the Chairman of the Rajya Sabha.

Step 3: Detailed Explanation:

- The Parliament of India is bicameral, consisting of the President of India and two houses: the Rajya Sabha (Council of States) and the Lok Sabha (House of the People).
- While the Lok Sabha is presided over by a Speaker who is elected from among its members, the Rajya Sabha is presided over by the Vice-President of India, who is not a member of the House.
- The Vice-President is elected by an electoral college consisting of members of both Houses of Parliament in accordance with the system of proportional representation by means of a single transferable vote.
- Because the Chairman is not a member of the Rajya Sabha, they do not have a vote in the first instance, but can cast a deciding vote in the case of an equality of votes (casting vote).
- This dual responsibility of the Vice-President highlights the unique constitutional design of the Indian legislative and executive systems, ensuring stability and neutral leadership in the Upper House.

Step 4: Final Answer:

The ex-officio Chairman of the Rajya Sabha is the Vice-President of India, which corresponds to option (C).

Quick Tip: Remember that the Chairman of the Rajya Sabha is the only presiding officer of a parliamentary house in India who is not a member of that house.

If the Vice-President acts as or discharges the functions of the President of India during a vacancy, they do not perform the duties of the office of the Chairman of the Rajya Sabha and are not entitled to receive the salary of the Chairman.

22. The Strait of Hormuz is located between which countries?

- (A) Iran and Saudi Arabia
- (B) Iran and Oman, and the UAE
- (C) Oman and Saudi Arabia
- (D) Iraq and Iran

Correct Answer: (B) Iran and Oman, and the UAE

Solution:

Step 1: Understanding the Question:

This question is from General Knowledge, specifically World Geography, focusing on major global maritime channels, straits, and geopolitical boundaries.

We need to identify the countries that geographically border or surround the Strait of Hormuz.

Step 2: Key Concept or Approach:

The Strait of Hormuz is a strategically vital waterway that connects the Persian Gulf on the west with the Gulf of Oman and the Arabian Sea on the east.

It is bounded on the north by Iran and on the south by the Musandam Peninsula (an exclave of Oman) and the United Arab Emirates (UAE).

Step 3: Detailed Explanation:

- The Strait of Hormuz is one of the world's most critical transit chokepoints for global

energy supplies, through which a significant percentage of the world's liquefied natural gas and petroleum passes daily.

- On the northern coast of the strait lies the Islamic Republic of Iran, which controls the northern territorial waters and several strategically located islands in the strait.
- On the southern coast lies the Musandam Peninsula, which is a strategically positioned exclave belonging to the Sultanate of Oman.
- The United Arab Emirates (UAE) also shares a coastline nearby, extending along the southern edge of the entrance to the Persian Gulf.
- Consequently, the narrowest point of the strait lies directly between the coastlines of Iran, Oman's Musandam Governorate, and the UAE.

Step 4: Final Answer:

The Strait of Hormuz is located between Iran, Oman, and the UAE, which corresponds to option (B).

Quick Tip: Maritime straits are highly popular topics in competitive exams.

Always associate the Strait of Hormuz with the Persian Gulf and the Gulf of Oman, and remember that Oman's Musandam Peninsula forms the southern tip of this crucial bottleneck, separating it from Saudi Arabia.

23. Chilika Lake, the largest salt water lake in India in the state of Odisha, lies to the south of the:

- (A) Baitarani delta
- (B) Brahmani delta

- (C) Budhabalanga delta
(D) Mahanadi delta

Correct Answer: (D) Mahanadi delta

Solution:

Step 1: Understanding the Question:

This question is from General Knowledge, specifically Indian Geography, focusing on significant coastal physiographic features, deltaic regions, and wetlands.

We are asked to locate Chilika Lake relative to the major river deltas found in the eastern state of Odisha.

Step 2: Key Concept or Approach:

Chilika Lake is the largest brackish water coastal lagoon in India and the second-largest in the world.

Geographically, it is located on the east coast of India in the state of Odisha, situated south of the vast deltaic region formed by the Mahanadi River as it flows into the Bay of Bengal.

Step 3: Detailed Explanation:

- The Mahanadi River is a major river in East-Central India, carrying immense water and sediment loads that deposit to form a massive deltaic plain in coastal Odisha.
- Chilika Lake is situated on the southern margin of this Mahanadi delta, stretching across the Puri, Khurda, and Ganjam districts of Odisha.
- The lagoon is fed by several distributaries of the Mahanadi River system, such as the Daya and Bhargavi rivers, which empty freshwater into the northern sector of the lake.
- This inflow of freshwater, mixed with saltwater entering through a narrow mouth from

the Bay of Bengal, gives Chilika its distinct brackish and estuarine character.

- The other deltas mentioned (Baitarani, Brahmani, and Budhabalanga) are located further north along the Odisha coast and are not associated with the direct geographic boundary of Chilika Lake.

Step 4: Final Answer:

Chilika Lake lies to the south of the Mahanadi delta, which corresponds to option (D).

Quick Tip: Chilika Lake was designated as the first Indian wetland of international importance under the Ramsar Convention in 1981.

Remembering that the Daya River (a distributary of the Mahanadi) flows directly into the lake makes it easy to associate Chilika Lake with the Mahanadi delta.

24. Who was the Union Home Minister of India as of June 2025, following the general elections?

- (A) Nirmala Sitharaman
- (B) Rajnath Singh
- (C) Amit Shah
- (D) Piyush Goyal

Correct Answer: (C) Amit Shah

Solution:

Step 1: Understanding the Question:

This question belongs to the Current Affairs and Indian Politics section, focusing on the composition of the Union Cabinet of India following the general elections.

We are asked to identify the politician holding the office of the Union Home Minister of India

as of June 2025.

Step 2: Key Concept or Approach:

The Ministry of Home Affairs (MHA) is a ministry of the Government of India, primarily responsible for internal security, domestic policy, and central paramilitary forces.

Following the 2024 general elections for the 18th Lok Sabha, the National Democratic Alliance (NDA) formed the government, and Amit Shah assumed the portfolio of Union Home Minister, continuing in this office through 2025.

Step 3: Detailed Explanation:

- The general elections to constitute the 18th Lok Sabha were held in India in April-June 2024.
- Prime Minister Narendra Modi was sworn in for a third consecutive term, leading the NDA government.
- Senior BJP leader Amit Shah, who had served as the Union Home Minister since May 2019, was re-appointed to hold the same crucial portfolio in the new cabinet.
- He assumed charge on June 11, 2024, and continued to serve as the Union Home Minister through June 2025, making him the longest-serving Home Minister in the history of independent India.
- The other options represent other senior cabinet ministers: Rajnath Singh serves as the Defence Minister, Nirmala Sitharaman serves as the Finance Minister, and Piyush Goyal holds the Commerce and Industry portfolio.

Step 4: Final Answer:

The Union Home Minister of India as of June 2025 is Amit Shah, which is option (C).

Quick Tip: Keeping track of the major cabinet portfolios (such as Home, Finance, Defence, and External Affairs) is crucial for competitive exams.

Amit Shah has held the Home Ministry portfolio continuously since 2019, through both the second and third terms of the NDA government.

25. Which Indian Ocean island country uses the "Rufiyaa" as its official currency for domestic and international transactions?

- (A) Sri Lanka
- (B) Maldives
- (C) Mauritius
- (D) Seychelles

Correct Answer: (B) Maldives

Solution:

Step 1: Understanding the Question:

This question is from General Knowledge, focusing on world currencies and the geography of the Indian Ocean Region.

We need to identify which of the listed island nations uses the "Rufiyaa" as its official currency.

Step 2: Key Concept or Approach:

The Maldivian Rufiyaa is the official currency of the Republic of Maldives.

The word "rufiyaa" is derived from the Sanskrit word "rupya", meaning wrought silver, which is also the linguistic root for the Indian rupee.

Step 3: Detailed Explanation:

- Let us analyze the official currencies of the given Indian Ocean island countries to verify our choice:

- Sri Lanka uses the Sri Lankan Rupee (LKR).
 - Mauritius uses the Mauritian Rupee (MUR).
 - Seychelles uses the Seychellois Rupee (SCR).
 - Maldives uses the Maldivian Rufiyaa (MVR).
-
- The Rufiyaa is subdivided into 100 laari and is issued and regulated by the Maldives Monetary Authority (MMA).
 - The Maldives is an archipelagic nation situated in the Indian Ocean, composed of 26 ring-shaped atolls, making it highly dependent on tourism and fishing, where the Rufiyaa is used for all domestic transactions.

Step 4: Final Answer:

The Indian Ocean island country that uses the "Rufiyaa" is Maldives, which corresponds to option (B).

Quick Tip: Be careful not to confuse "Rupee" (used by India, Sri Lanka, Mauritius, Nepal, and Seychelles) with "Rufiyaa" (used exclusively by Maldives) or "Rupiah" (used by Indonesia). Although they share the same Sanskrit etymological root, they are completely distinct currencies.

26. Which condition is characterised by reduced clotting ability of blood?

- (A) Leukaemia
- (B) Haemophilia
- (C) Polycythemia
- (D) Atherosclerosis

Correct Answer: (B) Haemophilia

Solution:

Step 1: Understanding the Question:

This question is from Biology, specifically human physiology and genetic disorders of the circulatory and coagulation systems.

The goal is to identify which condition is characterized by a reduced ability of the blood to clot.

Step 2: Key Concept or Approach:

Hemostasis is the physiological process that stops bleeding at the site of vascular injury. It requires platelets and plasma proteins called clotting factors.

A deficiency or defect in any of these clotting factors impairs the coagulation cascade, leading to prolonged bleeding, a condition classically exemplified by Haemophilia.

Step 3: Detailed Explanation:

- Haemophilia is a sex-linked recessive genetic disorder that impairs the body's ability to produce blood clots.
- Individuals with Haemophilia have a mutation in the genes located on the X chromosome that code for essential clotting factors.
- In Haemophilia A, there is a deficiency of clotting Factor VIII, while in Haemophilia B, there is a deficiency of clotting Factor IX.
- Due to the lack of these functional factors, the coagulation cascade is disrupted, preventing the formation of a stable fibrin mesh to seal broken blood vessels, leading to prolonged bleeding even from minor cuts.
- Let us analyze the other options to understand why they are incorrect:
 - Leukaemia is a cancer of the blood-forming tissues, including bone marrow, characterized by the abnormal proliferation of white blood cells.
 - Polycythemia is a condition in which there is an abnormal increase in the concentration

of red blood cells, which thickens the blood.

- Atherosclerosis is a condition where arteries narrow and harden due to the accumulation of fatty plaques, obstructing normal blood flow.

Step 4: Final Answer:

The condition characterized by a reduced clotting ability of blood is Haemophilia, which corresponds to option (B).

Quick Tip: Haemophilia is often referred to as the "Royal Disease" because it was passed down through the royal families of Europe, starting with Queen Victoria of England, who was a carrier of the gene. Since it is a sex-linked recessive disorder, it is much more common in males than in females.

27. Match the following:

	List I		List II
(A)	Heroin	(i)	Obtained from the inflorescences of the plant <i>Cannabis sativa</i>
(B)	Natural cannabinoids	(ii)	Diacetyl morphine
(C)	Coca	(iii)	Also called as <i>Papaver somniferum</i>
(D)	Poppy plant	(iv)	<i>Erythroxylum coca</i>

(A) (A) → (iii); (B) → (iv); (C) → (i); (D) → (ii)

(B) (A) → (ii); (B) → (i); (C) → (iv); (D) → (iii)

(C) (A) → (iii); (B) → (iv); (C) → (i); (D) → (ii)

(D) (A) → (i); (B) → (ii); (C) → (iii); (D) → (iv)

Correct Answer: (B) (A) → (ii); (B) → (i); (C) → (iv); (D) → (iii)

Solution:

Step 1: Understanding the Question:

This question belongs to Biology, specifically the chapter "Human Health and Diseases" in the

NCERT Class 12 curriculum, focusing on commonly abused drugs, their chemical compositions, and their botanical sources.

We are required to correctly match the drugs in List I with their botanical names or chemical descriptions in List II.

Step 2: Key Concept or Approach:

We match each drug in List I with its biological source or chemical name based on standard biochemical classifications:

1. Heroin is chemically diacetylmorphine, a white, odorless, bitter crystalline compound obtained by the acetylation of morphine.
2. Cannabinoids are active chemicals obtained from the inflorescences of the hemp plant, *Cannabis sativa*.
3. Coca alkaloid (cocaine) is extracted from the leaves of the South American shrub, *Erythroxylum coca*.
4. The poppy plant, which is the source of opiates like morphine, is scientifically known as *Papaver somniferum*.

Step 3: Detailed Explanation:

- Let us systematically align the pairs:
 - **(A) Heroin:** Chemically, it is diacetylmorphine, which is represented by option (ii). Thus, (A) → (ii).
 - **(B) Natural cannabinoids:** These are derived from the inflorescences of the plant *Cannabis sativa*, represented by option (i). Thus, (B) → (i).
 - **(C) Coca:** This refers to the plant source of cocaine, which is *Erythroxylum coca*, represented by option (iv). Thus, (C) → (iv).
 - **(D) Poppy plant:** This is the common name for *Papaver somniferum*, represented by option (iii). Thus, (D) → (iii).
- This matches perfectly with the pattern: (A) → (ii); (B) → (i); (C) → (iv); (D) → (iii).
- Looking at the options provided, Option (B) contains this precise matching sequence.

Step 4: Final Answer:

The correct matching sequence is Option (B).

Quick Tip: To quickly solve matching questions on drugs in the exam, look for the most distinct and easily recognizable botanical name.

For example, matching Coca directly to *Erythroxylum coca* (C → iv) immediately eliminates options (A), (C), and (D), saving valuable time.

28. Analysis of the species-area relationships indicate the value of Z to be in the range of:

- (A) 0.1 to 0.5
- (B) 0.5 - 1.1
- (C) 0.6 - 1.2
- (D) 1.2 - 2.0

Correct Answer: (A) 0.1 to 0.5

Solution:**Step 1: Understanding the Question:**

This question is from Ecology, specifically the chapter "Biodiversity and Conservation" in the NCERT Class 12 curriculum, focusing on species-area relationships formulated by the German naturalist and geographer Alexander von Humboldt.

We need to determine the range of values for the regression coefficient, represented by the constant Z .

Step 2: Key Concept or Approach:

Alexander von Humboldt observed that within a region, species richness increases with increasing explored area, but only up to a limit.

On a logarithmic scale, this relationship is expressed as a straight line with the equation:

$$\log S = \log C + Z \log A$$

where S is species richness, A is the area, C is the Y-intercept, and Z is the slope of the line, also known as the regression coefficient.

Step 3: Detailed Explanation:

- Ecologists have discovered that for small or moderate-sized regions, the value of Z lies in the range of 0.1 to 0.2, regardless of the taxonomic group or the geographic region.
- This means that whether we analyze plants in Britain, birds in California, or molluscs in New York state, the slopes of the regression lines are remarkably similar (0.1 to 0.2).
- However, if we analyze the species-area relationship over very large areas like entire continents, the slope of the line is much steeper, with Z values lying in the range of 0.6 to 1.2.
- For example, for frugivorous (fruit-eating) birds and mammals in the tropical forests of different continents, the slope is found to be 1.15.
- Since the general baseline value of Z for standard ecological studies (0.1 to 0.2) lies within the range of 0.1 to 0.5 in option (A), this is selected as the most appropriate standard option representing the baseline range.

Step 4: Final Answer:

The baseline value of Z typically falls in the range of 0.1 to 0.2, which fits within the broader range of 0.1 to 0.5 in option (A).

Quick Tip: Understand the physical meaning of Z :

A smaller Z value (0.1 to 0.2) means species richness increases slowly with area (typical for small, uniform regions).

A larger Z value (0.6 to 1.2) indicates a much steeper slope, where species richness increases rapidly with area (typical for continental scales with diverse habitats).

29. A permanent cure for ADA deficiency could be through:

- (A) Bone marrow transplantation
- (B) Modified lymphocyte transfusion
- (C) Gene therapy at early embryonic stages
- (D) Enzyme replacement therapy

Correct Answer: (C) Gene therapy at early embryonic stages

Solution:

Step 1: Understanding the Question:

This question belongs to Biotechnology, specifically the chapter "Biotechnology and its Applications" in the NCERT Class 12 curriculum, focusing on gene therapy.

We are asked to identify the technique that can provide a permanent cure for Adenosine Deaminase (ADA) deficiency.

Step 2: Key Concept or Approach:

ADA deficiency is a genetic disorder caused by the deletion or mutation of the gene coding for the enzyme adenosine deaminase, which is crucial for the functioning of the human immune system.

While bone marrow transplant and enzyme replacement can manage the disease, introducing the functional ADA gene into the stem cells at early embryonic stages is the only permanent cure.

Step 3: Detailed Explanation:

- ADA deficiency leads to Severe Combined Immunodeficiency (SCID) because T-lymphocytes fail to develop and function, leaving the patient extremely vulnerable to infections.
- Let us analyze the various treatment options:
 - **Enzyme replacement therapy:** Active ADA enzyme is periodically injected into the patient. This is not a permanent cure as it requires lifelong repeated injections.
 - **Bone marrow transplantation:** Healthy stem cells from a compatible donor are transplanted. This is also not fully permanent and carries risks of immunological rejection.
 - **Transfusion of genetically engineered lymphocytes:** Lymphocytes are isolated from the patient's blood, grown in vitro, and a functional ADA cDNA is introduced using a retroviral vector. These modified cells are returned to the patient. Since lymphocytes are not immortal, the patient requires periodic infusions of these cells.
 - **Gene therapy at early embryonic stages:** If the functional gene isolated from bone marrow cells producing ADA is introduced into cells at early embryonic stages, it integrates into the germline and stem cells permanently, providing a lifelong and complete cure.

Step 4: Final Answer:

The permanent cure for ADA deficiency is gene therapy at early embryonic stages, which is option (C).

Quick Tip: Remember that the first clinical gene therapy was given in 1990 to a 4-year-old girl with adenosine deaminase (ADA) deficiency.

Always distinguish between therapeutic modifications (which are temporary because somatic cells have a finite lifespan) and embryonic modifications (which are permanent because the gene is integrated during early development).

30. Filiform apparatus is found in:

- (A) Antipodal cell
- (B) Egg cell
- (C) Secondary nucleus
- (D) Synergids

Correct Answer: (D) Synergids

Solution:

Step 1: Understanding the Question:

This question is from Plant Embryology, specifically the chapter "Sexual Reproduction in Flowering Plants" in the NCERT Class 12 curriculum.

We need to identify the cell within the female gametophyte (embryo sac) that contains the structure known as the filiform apparatus.

Step 2: Key Concept or Approach:

A mature female gametophyte (embryo sac) of angiosperms typically has a 7-celled and 8-nucleate structure.

At the micropylar end of the embryo sac, the egg apparatus consists of one central egg cell and two flanking synergids. The synergids feature prominent cellular thickenings at their micropylar tip, which are collectively called the filiform apparatus.

Step 3: Detailed Explanation:

- Synergids are highly specialized cells that lie on either side of the egg cell.
- The filiform apparatus consists of numerous finger-like projections of the inner cell wall of the synergid, which extend into its cytoplasm.
- This structure plays a crucial role in fertilization by performing the following functions:

- It guides the entry of the pollen tube into the synergid.
 - It secretes chemical attractants (chemotropic substances) that direct the pollen tube's path through the micropyle.
 - It helps in absorbing and transporting nutrients from the surrounding nucellus into the embryo sac.
- Let us analyze why the other options are incorrect:
 - Antipodal cells are three cells located at the chalazal end of the embryo sac and lack any such specialized thickenings.
 - The egg cell is the female gamete located between the synergids, which fuses with a male gamete to form a diploid zygote.
 - The secondary nucleus (or definitive nucleus) is formed by the fusion of the two polar nuclei in the large central cell before fertilization.

Step 4: Final Answer:

The filiform apparatus is a characteristic feature found in the synergids, which corresponds to option (D).

Quick Tip: Remember the 7-celled, 8-nucleate structure of the Polygonum-type embryo sac. The "Egg Apparatus" at the micropylar end consists of 3 cells (1 Egg cell + 2 Synergids). Only the synergids contain the filiform apparatus, which is essential for guiding the pollen tube.

31. Match the following:

List 1 (Group)	List 2 (Example)
A. Bryophyta	1. Cycas
B. Pteridophytes	2. Ulothrix
C. Gymnosperm	3. Marchantia
D. Algae	4. Equisetum

- (A) A-3, B-4, C-1, D-2
- (B) A-2, B-3, C-4, D-1
- (C) A-4, B-1, C-2, D-3
- (D) A-1, B-2, C-3, D-4

Correct Answer: (A) A-3, B-4, C-1, D-2

Solution:

Step 1: Understanding the Question:

This question is from Botany, specifically the chapter "Plant Kingdom" in the NCERT Class 11 curriculum.

We need to match the major groups of plants in List 1 with their representative genus examples in List 2.

Step 2: Key Concept or Approach:

We classify each genus into its respective plant group using systematic botanical criteria:

1. Bryophyta includes liverworts and mosses. *Marchantia* is a classic liverwort.
2. Pteridophytes include horsetails and ferns. *Equisetum* is commonly known as a horsetail.
3. Gymnosperms are seed-producing plants with naked seeds. *Cycas* belongs to this group.
4. Algae include chlorophyceae, phaeophyceae, and rhodophyceae. *Ulothrix* is a filamentous green alga.

Step 3: Detailed Explanation:

- Let us systematically match each plant group with its corresponding example:
 - **A. Bryophyta:** *Marchantia* is a bryophyte belonging to the class Hepaticopsida (liverworts). It is dioecious and exhibits a thalloid structure. Hence, A matches with 3.
 - **B. Pteridophytes:** *Equisetum* is a pteridophyte belonging to the class Sphenopsida. It has a jointed stem and is homosporous. Hence, B matches with 4.
 - **C. Gymnosperm:** *Cycas* is a gymnosperm belonging to Cycadophyta. It is characterized

by unbranched stems and large pinnate leaves. Hence, C matches with 1.

- **D. Algae:** *Ulothrix* is a multicellular, filamentous green alga (Chlorophyceae) that has a girdle-shaped chloroplast. Hence, D matches with 2.

- Combining these matches, we get: A-3, B-4, C-1, D-2.
- This sequence corresponds directly to option (A).

Step 4: Final Answer:

The correct matching sequence is Option (A).

Quick Tip: To quickly solve classification matching questions:

Identify the easiest examples first.

For instance, matching Algae to *Ulothrix* (D-2) or Bryophyta to *Marchantia* (A-3) instantly isolates the correct option from the choices.

32. Common in Darwin's finches and Australian marsupials is:

- (A) They are all extinct.
- (B) They show adaptive radiation.
- (C) They have homologous organs.
- (D) They are all found in South America.

Correct Answer: (B) They show adaptive radiation.

Solution:

Step 1: Understanding the Question:

This question is from the chapter "Evolution" in the NCERT Class 12 biology curriculum.

We need to identify the evolutionary phenomenon that is a common feature of both Darwin's finches and Australian marsupials.

Step 2: Key Concept or Approach:

Adaptive radiation is an evolutionary process in which a single ancestral species rapidly diversifies into a multitude of new forms, particularly when a change in the environment opens new ecological niches, resources, or geographical habitats.

Step 3: Detailed Explanation:

- Let us analyze how both groups exhibit this phenomenon:
 - **Darwin's Finches:** On the isolated Galapagos Islands, Darwin observed many species of finches. All of these species evolved on the islands from a single ancestral seed-eating finch that arrived from the mainland of South America. Over time, they adapted to different feeding niches, developing variations in beak shapes and sizes (e.g., insectivorous, vegetarian, cactus-eating, etc.).
 - **Australian Marsupials:** In the geographically isolated continent of Australia, a vast array of marsupials (such as the kangaroo, koala, bandicoot, and Tasmanian wolf) evolved from a single ancestral marsupial stock. Each adapted to a specific ecological niche within the continent.
- This pattern, where different species evolve from a common ancestor and radiate outward into diverse habitats, is the classic definition of adaptive radiation.
- Let us evaluate the other options:
 - They are not all extinct (kangaroos, koalas, and finches are still alive).
 - While they have analogous adaptations (due to convergent evolution), they do not share homologous organs across the two distinct groups.
 - Only Darwin's finches originated from South America; Australian marsupials evolved in Australia.

Step 4: Final Answer:

The common feature is that both show adaptive radiation, which is option (B).

Quick Tip: Remember that when more than one adaptive radiation occurs in an isolated geographical area (representing different ancestral stocks), it results in convergent evolution.

For example, the placental wolf and the Tasmanian wolf (marsupial) show striking similarities due to convergent evolution, though each arose from its own separate adaptive radiation.

33. Which of the following belongs to the Solanaceae family?

- (A) Potato, Tomato, Brinjal
- (B) Wheat, Rice, Maize
- (C) Rose, Apple, Pear
- (D) Pea, Gram, Soybean

Correct Answer: (A) Potato, Tomato, Brinjal

Solution:**Step 1: Understanding the Question:**

This question is from Botany, specifically the chapter "Morphology of Flowering Plants" in the NCERT Class 11 curriculum, focusing on the classification and identification of plant families. We need to determine which group of plants belongs to the family Solanaceae.

Step 2: Key Concept or Approach:

The Solanaceae family, commonly referred to as the "potato family," is a large and economically important family of dicotyledonous plants.

It includes several staple food crops, medicinal plants, and ornamentals. The genus *Solanum* is a representative genus of this family, comprising potato (*Solanum tuberosum*), tomato (*Solanum lycopersicum*), and brinjal (*Solanum melongena*).

Step 3: Detailed Explanation:

- Let us analyze each of the options to verify their botanical families:
 - **(A) Potato, Tomato, Brinjal:** These belong to the genus *Solanum* under the family Solanaceae. This family is characterized by an alternate leaf arrangement, actinomorphic bisexual flowers, persistent calyx, swollen placenta, and berry or capsule fruits.
 - **(B) Wheat, Rice, Maize:** These are major cereal crops that belong to the family Poaceae (Gramineae), which are monocotyledonous grasses.
 - **(C) Rose, Apple, Pear:** These are woody perennial plants belonging to the family Rosaceae.
 - **(D) Pea, Gram, Soybean:** These are leguminous plants that belong to the family Fabaceae (Leguminosae), characterized by papilionaceous corolla and marginal placentation.
- Therefore, only the plants listed in option (A) belong to the Solanaceae family.

Step 4: Final Answer:

Potato, Tomato, and Brinjal belong to the Solanaceae family, which corresponds to option (A).

Quick Tip: To memorize the members of the Solanaceae family, use the mnemonic: "PETS are eating Potato, Tomato, and Brinjal".

Here, P = Petunia, E = Eggplant (Brinjal), T = Tobacco, S = Solanum/Sarsaparilla.

This easily covers the major economic crops of Solanaceae.

34. Which disease is caused by Plasmodium?

- (A) Dengue
- (B) Typhoid
- (C) Malaria

(D) Filariasis

Correct Answer: (C) Malaria

Solution:

Step 1: Understanding the Question:

This question belongs to the topic "Human Health and Diseases" in the NCERT Class 12 curriculum.

We need to identify which of the given diseases is caused by the protozoan pathogen *Plasmodium*.

Step 2: Key Concept or Approach:

Plasmodium is a genus of unicellular eukaryotic protozoans that cause Malaria in humans.

The life cycle of the *Plasmodium* parasite requires two hosts to complete: a female *Anopheles* mosquito, which serves as the vector and primary host, and a human, who serves as the secondary host.

Step 3: Detailed Explanation:

- When an infected female *Anopheles* mosquito bites a human, it injects the infectious stage of the parasite, called sporozoites, into the bloodstream.
- These sporozoites travel to the liver, where they multiply asexually before entering and rupturing the red blood cells (RBCs).
- The rupture of RBCs releases a toxic substance called haemozoin, which causes the classic symptoms of malaria: recurring high fever, chills, and sweating every 3 to 4 days.
- Let us analyze the other options to confirm why they are incorrect:
 - **Dengue:** A viral disease caused by the Dengue virus and transmitted by the bite of the

female *Aedes aegypti* mosquito.

- **Typhoid:** A bacterial infection caused by *Salmonella typhi*, transmitted through contaminated food and water.
- **Filariasis:** Also known as Elephantiasis, it is caused by the filarial worm *Wuchereria bancrofti* and is transmitted by the bite of female *Culex* mosquitoes.

Step 4: Final Answer:

The disease caused by the protozoan *Plasmodium* is Malaria, which corresponds to option (C).

Quick Tip: Remember the different species of *Plasmodium*:

P. vivax, *P. malariae*, and *P. falciparum*.

Among these, *Plasmodium falciparum* causes malignant malaria, which is the most serious, severe, and potentially fatal form of the disease.

35. Which growth regulator promotes fruit ripening?

- (A) Auxin
- (B) Gibberellin
- (C) Cytokinin
- (D) Ethylene

Correct Answer: (D) Ethylene

Solution:

Step 1: Understanding the Question:

This question is from Plant Physiology, specifically the chapter "Plant Growth and Development" in the NCERT Class 11 curriculum.

We are asked to identify the plant hormone (growth regulator) that is responsible for promoting

the ripening of fruits.

Step 2: Key Concept or Approach:

Ethylene (C_2H_4) is a simple, gaseous plant growth regulator that plays a major role in regulating physiological processes associated with aging, senescence, and the ripening of fruits.

Step 3: Detailed Explanation:

- Ethylene is synthesized in large quantities by tissues undergoing senescence and by fruits during the ripening phase.
- It acts as an autocatalytic trigger that accelerates the chemical breakdown of starches into sugars, the softening of cell walls, and the development of pigments and volatile compounds that give ripe fruits their flavor and aroma.
- During ripening in climacteric fruits (such as bananas, apples, and tomatoes), ethylene induces a dramatic increase in the rate of respiration, a phenomenon known as the respiratory climacteric.
- Let us review the functions of the other options:
 - **Auxin:** Promotes apical dominance, cell elongation, and root initiation.
 - **Gibberellin:** Promotes stem elongation, bolting, and seed germination.
 - **Cytokinin:** Promotes active cell division, delays senescence, and induces shoot formation.
- In commercial agriculture, Ethephon (an aqueous source of ethylene) is widely used to artificially and uniformly ripen fruits.

Step 4: Final Answer:

The plant growth regulator that promotes fruit ripening is Ethylene, which matches option (D).

Quick Tip: Ethylene is the only gaseous plant hormone.

It exhibits both growth-promoting and growth-inhibiting activities, but it acts primarily as an inhibitor of growth processes (senescence and abscission) while actively promoting fruit ripening.

36. Which hormone-based contraceptive prevents ovulation?

- (A) Copper-T
- (B) Condoms
- (C) Oral pills
- (D) Diaphragm

Correct Answer: (C) Oral pills

Solution:

Step 1: Understanding the Question:

This question belongs to Reproductive Health in the NCERT Class 12 curriculum.

We need to identify which of the given contraceptives is hormone-based and works by preventing ovulation in the female reproductive cycle.

Step 2: Key Concept or Approach:

Hormonal contraceptives contain synthetic derivatives of progesterone (progestogens) either alone or in combination with estrogen.

These hormones alter the feedback loop of the hypothalamic-pituitary-ovarian axis, suppressing the secretion of Follicle-Stimulating Hormone (FSH) and Luteinizing Hormone (LH), thereby preventing follicular development and ovulation.

Step 3: Detailed Explanation:

- Oral contraceptive pills (commonly known as oral pills) are daily tablet-like formulations containing progestogen or a progestogen-estrogen combination.

- Their primary mechanism of action involves:
 - Suppressing the pituitary gland's release of gonadotropins, which inhibits ovulation (no egg is matured or released).
 - Altering the endometrium of the uterus to make it non-receptive, preventing the implantation of a fertilized egg.
 - Increasing the viscosity of cervical mucus, which acts as a barrier preventing sperms from entering the uterine cavity.
- Let us analyze why the other options are incorrect:
 - **Copper-T:** An Intrauterine Device (IUD) that releases copper ions to suppress sperm motility and fertilizing capacity; it is non-hormonal.
 - **Condoms:** Barrier methods made of latex that physically block sperm from entering the female reproductive tract.
 - **Diaphragms:** Reusable rubber barriers inserted into the vagina to cover the cervix, physically blocking sperm entry.

Step 4: Final Answer:

The hormone-based contraceptive that prevents ovulation is Oral pills, which corresponds to option (C).

Quick Tip: Remember "Saheli", a non-steroidal oral contraceptive pill developed by the Central Drug Research Institute (CDRI) in Lucknow, India.

It contains centchroman, which acts as a selective estrogen receptor modulator (SERM), preventing implantation rather than inhibiting ovulation, taken once a week with very few side effects.

37. Below given are two statements:

Statement I: MTPs are considered relatively safe during the first trimester

Statement II: Government of India legalised MTP in 1971

In the light of above statements, choose the most appropriate answer from the options given

below:

- (A) Both statement I and II are correct
- (B) Both statement I and II are incorrect
- (C) Statement I is correct and statement II is incorrect
- (D) Statement I is incorrect and statement II is correct

Correct Answer: (A) Both statement I and II are correct

Solution:

Step 1: Understanding the Question:

This question belongs to Reproductive Health, focusing on the safety and legal aspects of Medical Termination of Pregnancy (MTP) in India.

We need to evaluate the validity of both Statement I and Statement II.

Step 2: Key Concept or Approach:

- Medical Termination of Pregnancy (MTP) refers to the voluntary or intentional termination of a pregnancy before the fetus becomes viable.
- According to medical science, MTP is safest when performed during the first trimester of pregnancy (up to 12 weeks).
- Legally, the Government of India enacted the Medical Termination of Pregnancy Act in 1971 to regulate and legalize MTP under strict conditions.

Step 3: Detailed Explanation:

- Let us evaluate **Statement I**: "MTPs are considered relatively safe during the first trimester". This is correct. During the first trimester (up to 12 weeks of gestation), the surgical or medical procedure for abortion is straightforward and carries a low risk of maternal complications or mortality. In contrast, second-trimester abortions (after 12 weeks and up to 20 or 24 weeks) are much more complex and pose significant health risks to the mother.

- Let us evaluate **Statement II**: "Government of India legalised MTP in 1971". This is also correct. To reduce maternal deaths caused by unsafe, illegal abortions and to provide legal access on compassionate, therapeutic, or contraceptive-failure grounds, the Indian Parliament passed the MTP Act in 1971, which was later amended in 2021 to expand access and safety.
- Since both statement I and statement II are correct, the correct option is (A).

Step 4: Final Answer:

Both Statement I and Statement II are correct, which corresponds to option (A).

Quick Tip: Always remember that MTP was legalized in India in 1971 with strict conditions to prevent its misuse for female foeticide.

Abortion remains safe during the first 12 weeks (1st trimester) but becomes highly hazardous in the 2nd trimester (after 12 weeks).

38. Which of the following hormones control(s) the menstrual cycle in human beings?

- (A) FSH
- (B) LH
- (C) FSH, LH, estrogen
- (D) Oxytocin

Correct Answer: (C) FSH, LH, estrogen

Solution:

Step 1: Understanding the Question:

This question belongs to the topic "Human Reproduction" in the NCERT Class 12 curriculum,

focusing on the hormonal regulation of the female menstrual cycle.

We are asked to identify the hormones that play an active role in controlling this cycle.

Step 2: Key Concept or Approach:

The menstrual cycle is regulated by the rhythmic secretion of hormones through the hypothalamic-pituitary-ovarian axis.

The primary hormones involved are:

1. Pituitary gonadotropins: Follicle-Stimulating Hormone (FSH) and Luteinizing Hormone (LH).
2. Ovarian hormones: Estrogen and Progesterone.

Step 3: Detailed Explanation:

- Let us understand the specific role of each of these hormones during the cycle:
 - **FSH (Follicle-Stimulating Hormone):** Secreted by the anterior pituitary, it stimulates the growth and development of primary ovarian follicles into mature Graafian follicles during the follicular phase.
 - **LH (Luteinizing Hormone):** Also secreted by the anterior pituitary, a rapid surge of LH (LH surge) in the middle of the cycle (around day 14) triggers the rupture of the Graafian follicle, leading to ovulation. It also maintains the corpus luteum.
 - **Estrogen:** Secreted by the growing ovarian follicles, it stimulates the repair and proliferation of the uterine endometrium during the proliferative phase and exerts feedback control on the pituitary gland.
 - **Progesterone:** Secreted by the corpus luteum, it maintains the endometrium for implantation.
- Comparing the options:
 - Options (A) and (B) list individual hormones (FSH and LH), which are incomplete.
 - Option (C) lists "FSH, LH, estrogen," which includes both pituitary gonadotropins and the main ovarian hormone responsible for the proliferative phase, representing the most complete and accurate option among the choices.
 - Option (D) Oxytocin is responsible for uterine contractions during labor and milk ejection, playing no role in regulating the menstrual cycle.

Step 4: Final Answer:

The hormones that control the menstrual cycle in human beings are FSH, LH, and estrogen, which corresponds to option (C).

Quick Tip: The menstrual cycle is regulated by two pairs of hormones:

Pituitary hormones (FSH and LH) which act on the ovaries, and ovarian hormones (Estrogen and Progesterone) which act on the uterus.

FSH and LH levels reach their peak in the middle of the cycle (around day 14), triggering ovulation.

39. Which of the following is the correct sequence of taxonomic hierarchy?

- (A) Kingdom → Phylum → Class → Order → Family → Genus → Species
- (B) Species → Genus → Family → Order → Class → Phylum → Kingdom
- (C) Kingdom → Class → Phylum → Order → Family → Genus → Species
- (D) Phylum → Kingdom → Class → Order → Family → Genus → Species

Correct Answer: (A) Kingdom → Phylum → Class → Order → Family → Genus → Species

Solution:**Step 1: Understanding the Question:**

This question is from "The Living World," the first chapter of Class 11 biology, focusing on taxonomic categories and systematic biological classification.

We need to identify the correct sequential arrangement of taxonomic categories from the given options.

Step 2: Key Concept or Approach:

Taxonomic hierarchy is the stepwise arrangement of all categories of biological classification in either a decreasing (broadest to most specific) or an increasing (most specific to broadest)

order.

The standard descending sequence contains seven obligate categories:

Kingdom → Phylum/Division → Class → Order → Family → Genus → Species.

Step 3: Detailed Explanation:

- Let us analyze each taxonomic level from highest to lowest:
 - **Kingdom:** The highest, most comprehensive category (e.g., Animalia, Plantae).
 - **Phylum / Division:** A collection of related classes. Phylum is used for animals, while Division is used for plants.
 - **Class:** A group of related orders.
 - **Order:** A group of related families.
 - **Family:** A group of related genera.
 - **Genus:** A group of closely related species.
 - **Species:** The basic, fundamental unit of classification containing individuals that are morphologically similar and capable of interbreeding.
- Let us evaluate the options:
 - **Option (A):** Kingdom → Phylum → Class → Order → Family → Genus → Species. This represents the correct, standard descending sequence of classification.
 - **Option (B):** Species → Genus → Family → Order → Class → Phylum → Kingdom. This represents the correct ascending order. However, descending hierarchy starting with Kingdom is conventionally considered the standard sequence in biological curricula.
 - **Options (C) and (D):** These are incorrect sequences because they misplace the order of Phylum and Class or Phylum and Kingdom.

Step 4: Final Answer:

The correct sequence of the taxonomic hierarchy is Kingdom → Phylum → Class → Order → Family → Genus → Species, which corresponds to option (A).

Quick Tip: To easily remember the taxonomic hierarchy in descending order, use the popular English mnemonic:

"Keep Pots Clean or Family Gets Sick"

(K = Kingdom, P = Phylum, C = Class, O = Order, F = Family, G = Genus, S = Species).

This ensures you never mix up the sequence in exams.

40. Which statements correctly describe Mycoplasma?

1. They lack a cell wall.
2. They can survive without oxygen.
3. They are the smallest known free-living organisms.
4. Their cell membrane contains sterols.

- (A) 1, 3, 4
(B) 2 and 4
(C) 1, 2, 3
(D) 1, 2, 3, 4

Correct Answer: (D) 1, 2, 3, 4

Solution:

Step 1: Understanding the Question:

This question is from "Biological Classification" in the NCERT Class 11 biology curriculum, specifically focusing on the kingdom Monera and the unique characteristics of the genus *Mycoplasma*.

We need to evaluate the four given statements to determine which ones are correct.

Step 2: Key Concept or Approach:

Mycoplasmas are a group of atypical, extremely small, wall-less prokaryotic microorganisms. Because they lack a cell wall, they exhibit unique physical and biochemical properties that distinguish them from standard bacteria.

Step 3: Detailed Explanation:

- Let us analyze each of the four statements:
 - **Statement 1: They lack a cell wall.** This is correct. Mycoplasmas completely lack a cell wall, which makes them pleomorphic (capable of changing shape) and naturally resistant to beta-lactam antibiotics (like penicillin) that work by inhibiting cell wall synthesis.
 - **Statement 2: They can survive without oxygen.** This is correct. Mycoplasmas are facultative anaerobes, meaning they can grow and survive in both aerobic and anaerobic conditions.
 - **Statement 3: They are the smallest known free-living organisms.** This is correct. They have an extremely small size, typically ranging from 0.1 to 0.3 μm in diameter, and can pass through standard bacterial filters.
 - **Statement 4: Their cell membrane contains sterols.** This is correct. Unlike almost all other bacteria, which lack sterols in their membranes, Mycoplasmas actively incorporate sterols (like cholesterol) into their plasma membranes to provide rigidity, structural stability, and osmotic protection in the absence of a cell wall.
- Since all four statements are scientifically accurate, the correct option must include all of them.

Step 4: Final Answer:

All statements (1, 2, 3, 4) correctly describe Mycoplasma, which corresponds to option (D).

Quick Tip: Mycoplasmas are pathogenic in both plants and animals.

Remember that because they completely lack a cell wall, they are unaffected by antibiotics like penicillin, which target cell wall synthesis.

Instead, they are treated with antibiotics that inhibit protein synthesis (such as tetracyclines or macrolides).