JEE Main 2025 April 4 Shift 2 Chemistry Question Paper with Solutions

Time Allowed :3 Hours	Maximum Marks :300	Total Questions :75

General Instructions

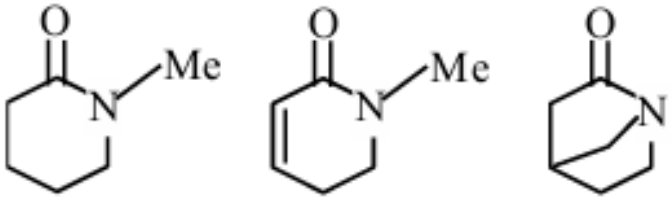
Read the following instructions very carefully and strictly follow them:

1. Multiple choice questions (MCQs)
2. Questions with numerical values as answers.
3. There are three sections: **Mathematics, Physics, Chemistry**.
4. **Mathematics:** 25 (20+5) 10 Questions with answers as a numerical value. Out of 10 questions, 5 questions are compulsory.
5. **Physics:** 25 (20+5) 10 Questions with answers as a numerical value. Out of 10 questions, 5 questions are compulsory..
6. **Chemistry:** 25 (20+5) 10 Questions with answers as a numerical value. Out of 10 questions, 5 questions are compulsory.
7. Total: 75 Questions (25 questions each).
8. 300 Marks (100 marks for each section).
9. **MCQs:** Four marks will be awarded for each correct answer and there will be a negative marking of one mark on each wrong answer.
10. **Questions with numerical value answers:** Candidates will be given four marks for each correct answer and there will be a negative marking of 1 mark for each wrong answer.

Chemistry

Section - A

51.
The correct order of basicity for the following molecules is:

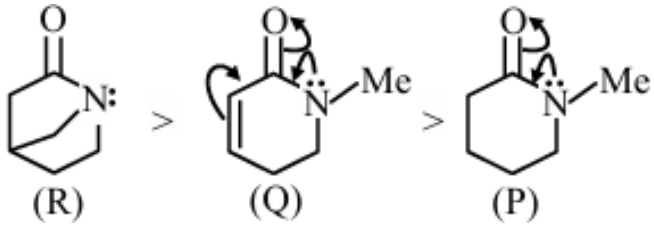


(P) (Q) (R)

(1) P > Q > R
(2) R > P > Q
(3) Q > P > R
(4) R > Q > P

Correct Answer: (4)

Solution:



According to Bredt's rule, R has a more localized lone pair, making it the most basic, followed by Q, which has cross conjugation, and finally P which is the least basic.
Thus, the correct order is R > Q > P.

Quick Tip

Bredt's rule helps explain basicity based on the localization of lone pairs.

52.
The incorrect relationship in the following pairs in relation to ionisation enthalpies is:
(1) $Mn^{2+} < Cr^{3+}$
(2) $Mn^{2+} < Mn^{3+}$
(3) $Fe^{2+} < Fe^{3+}$
(4) $Fe^{2+} < Fe^{3+}$

Correct Answer: (4)

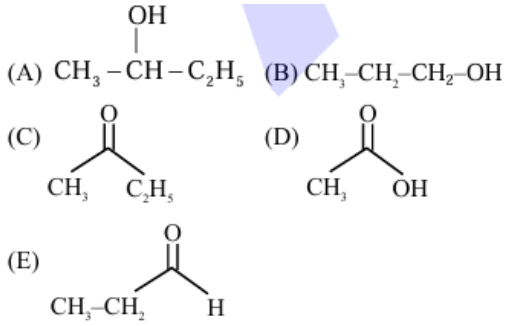
Solution:
The incorrect relationship is between Fe^{2+} and Fe^{3+}. According to ionisation enthalpies, Mn^{2+} has more ionisation energy than Fe^{2+}, and Mn^{3+} has more ionisation energy than Fe^{3+}.
Thus, the correct answer is (4).

Quick Tip

Ionisation enthalpy depends on the electron configuration, stability, and half-filled stability of orbitals.

53.

Which among the following compounds give yellow solid when reacted with NaOI/NaOH?



Choose the **correct** answer from the options given below:

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

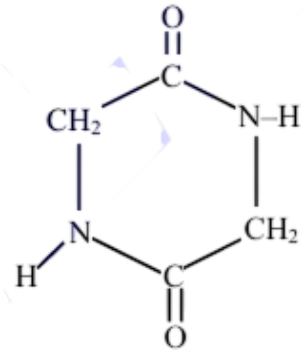
Correct Answer: (2)

Solution:
When alcohols are reacted with NaOI/NaOH, a yellow solid is produced due to the formation of iodine complexes. Upon examining the compounds:
- (A) $CH_3CH_2C_2H_5$ (an alcohol) reacts with NaOI/NaOH, producing a yellow solid. - (B) $CH_3CH_2C_2H_2OH$ (an alcohol) reacts with NaOI/NaOH, producing a yellow solid. - (C) $CH_3C_2H_5$ (an aldehyde) does not react with NaOI/NaOH to produce a yellow solid. - (D) CH_3OH does not react with NaOI/NaOH to form a yellow solid. - (E) CH_3CH_2H does not react with NaOI/NaOH to form a yellow solid.
Thus, the correct answer is (2).

Quick Tip

The reaction of alcohols with NaOI/NaOH often leads to yellow solid formation due to iodine complexation.

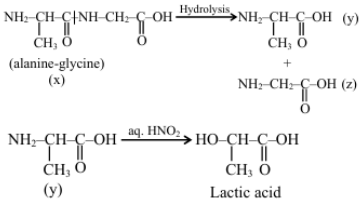
54.
A dipeptide, "x", on complete hydrolysis gives "y" and "z"; "y" on treatment with aqueous HNO_2, produces lactic acid. On the other hand, "z" on heating gives the following cyclic molecule.

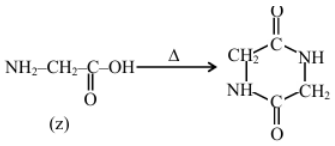


Based on the information given, the dipeptide X is:
(1) valine-glycine
(2) alanine-glycine
(3) valine-leucine
(4) alanine-alanine

Correct Answer: (2)

Solution:
Let's break down the key information provided:
1. Hydrolysis of "x": - The dipeptide "x" undergoes complete hydrolysis to produce two amino acids: y and z. - y is a compound that, when treated with aqueous HNO_2, produces lactic acid. This strongly suggests that y is glycine, as glycine reacts with nitrous acid to form lactic acid. Therefore, glycine must be one of the products after hydrolysis.
2. Heating of "z": - z on heating forms a cyclic molecule. This strongly indicates that z is proline, as proline is an amino acid that can form a cyclic structure under heating conditions.
3. Identifying the Dipeptide: - The dipeptide must be one that hydrolyzes to give glycine (which produces lactic acid upon treatment with HNO_2) and proline (which forms a cyclic structure upon heating). - The only dipeptide in the given options that fits this pattern is alanine-glycine (option 2), as alanine can undergo cyclization to form proline under heat.
Thus, the correct dipeptide x is alanine-glycine.

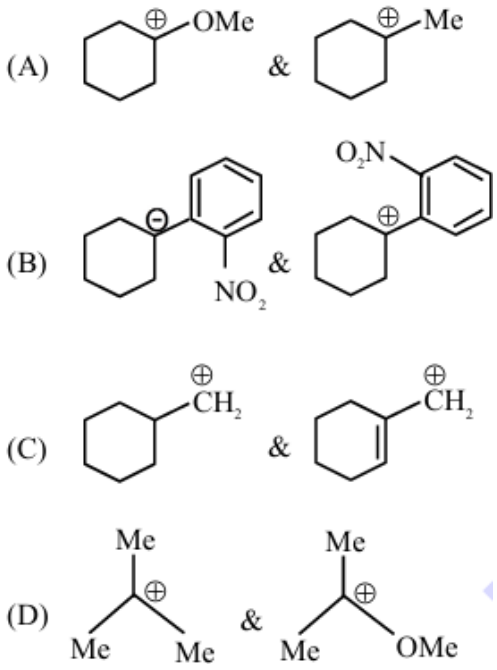




Quick Tip

The key to solving this question lies in recognizing that glycine reacts with HNO_2 to produce lactic acid, and proline (formed from alanine) can form a cyclic structure when heated.

55.
In which pairs, the first ion is more stable than the second?



(1) (B) & (D) only
(2) (A) & (B) only
(3) (B) & (C) only
(4) (A) & (C) only

Correct Answer: (2)

Solution:
In the pair (A), the ion with the methoxy group (OMe) is more stable than the one with the methyl group (Me) because the oxygen in the methoxy group can donate electron density via resonance, making it more stable.
In pair (B), the nitro group (NO_2) is an electron-withdrawing group, making the ion less stable than the one with the oxygen-nitrogen double bond (O,N), which stabilizes the ion through resonance.
Thus, the correct answer is (2).

Quick Tip

Resonance and inductive effects play a key role in the stability of ions, with electron-donating groups increasing stability and electron-withdrawing groups decreasing it.

56.
Given below are two statements:
Statement (I): Alcohols are formed when alkyl chlorides are treated with aqueous potassium hydroxide by elimination reaction.
Statement (II): In alcoholic potassium hydroxide, alkyl chlorides form alkenes by abstracting the hydrogen from the β-carbon.
In the light of the above statements, choose the most appropriate answer from the options given below:
(1) Both Statement I and Statement II are incorrect
(2) Statement I is incorrect but Statement II is correct
(3) Statement I is correct but Statement II is incorrect
(4) Both Statement I and Statement II are correct

Correct Answer: (2)

Solution:
Statement (I) is incorrect because alkyl chlorides react with aqueous potassium hydroxide to undergo substitution (SN) reactions, not elimination. Alcohols are typically formed through substitution reactions, not elimination.
Statement (II) is correct because in alcoholic potassium hydroxide, alkyl chlorides undergo elimination (E2) reactions, forming alkenes by abstracting the hydrogen from the β-carbon.
Thus, the correct answer is (2).

Quick Tip

Elimination and substitution reactions are key processes for forming alkenes and alcohols, respectively, based on the conditions (e.g., solvent, temperature).

57.
Given below are two statements:

- **Statement (I)**: Molal depression constant k_f is given by $\frac{M_1 R T_f}{\Delta S_{\text{fus}}}$, where symbols have their usual meaning.
- **Statement (II)**: k_f for benzene is less than the k_f for water.

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

(1) Statement I is incorrect but Statement II is correct
(2) Both Statement I and Statement II are incorrect

(3) Both Statement I and Statement II are correct
(4) Statement I is correct but Statement II is incorrect

Correct Answer: (4)

Solution:
1. Statement I: The formula for the molal depression constant is correctly given by:

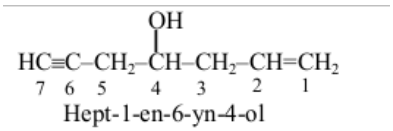
$$k_f = \frac{M_1 R T_f}{\Delta S_{\text{fus}}}$$

Here, M_1 represents the molality of the solution, R is the gas constant, T_f is the freezing point depression, and ΔS_{fus} is the enthalpy of fusion. Therefore, Statement I is correct.
2. Statement II: The molal depression constant k_f for benzene is greater than for water, not less. Specifically, k_f for water is 1.86 °C/molal and for benzene is 5.12 °C/molal. Hence, Statement II is incorrect.
Thus, the correct answer is (4).

Quick Tip

The molal depression constant depends on the solvent. Water has a lower k_f than benzene, which is why Statement II is incorrect.

58.
The IUPAC name of the following compound is:



(1) 4-Hydroxyhept-1-en-6-yne
(2) 4-Hydroxyhept-6-en-1-yne
(3) Hept-6-en-1-yn-4-ol
(4) Hept-1-en-6-yn-4-ol

Correct Answer: (4)

Solution:
The structure contains a hydroxyl group at position 4, an alkene at position 1, and an alkyne at position 6. Based on the IUPAC naming conventions, the correct name for this compound is Hept-1-en-6-yn-4-ol.
Thus, the correct answer is (4).

Quick Tip

When naming organic compounds, identify and number the substituents, functional groups, and multiple bonds to derive the correct IUPAC name.

59.
Match List-I with List-II:

List-I	**List-II**
(A) Aniline from aniline-water mixture	(I) Simple distillation
(B) Glycerol from spent-lye in soap industry	(II) Fractional distillation
(C) Different fractions of crude oil in petroleum industry	(III) Distillation at reduced pressure
(D) Chloroform-Aniline mixture	(IV) Steam distillation

Choose the correct answer from the options given below:

(1) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
(2) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
(3) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)
(4) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)

Correct Answer: (2)

Solution:
- (A) Aniline from aniline-water mixture: This is typically done using steam distillation (IV). - (B) Glycerol from spent-lye in soap industry: This is done using fractional distillation (II). - (C) Different fractions of crude oil: This is done using distillation at reduced pressure (III). - (D) Chloroform-Aniline mixture: This is separated using simple distillation (I).
Thus, the correct answer is (2).

Quick Tip

The method of distillation is chosen based on the boiling points and volatility of the components involved.

60.
A toxic compound "A" when reacted with NaCN in aqueous acidic medium yields an edible cooking component and food preservative "B". "B" is converted to "C" by dibromane and can be used as an additive to petrol to reduce emission. "C" upon reaction with oleum at 140°C yields an inhalable anesthetic "D". Identify "A", "B", "C", and "D", respectively.
(1) Methanol; formaldehyde; methyl chloride; chloroform
(2) Ethanol; acetonitrile; ethylamine; ethylene
(3) Methanol; acetic acid; ethanol; diethyl ether
(4) Acetaldehyde; 2-hydroxyethane; acetic acid; propanoic acid

Correct Answer: (3)

Solution:
- A is methanol because it reacts with NaCN in an acidic medium to form formaldehyde (B). - B is formaldehyde, which is then converted to methyl chloride (C) by dibromane. - C (methyl chloride) reacts with oleum at 140°C to form chloroform (D), which is an anesthetic.

Thus, the correct answer is (3).

Quick Tip

Organic compound transformations depend on reactions like nucleophilic substitution and addition of reagents like dibromane and oleum.

61.
The correct order of $[FeF_6]^{3-}$, $[CoF_6]^{3-}$,$[Ni(CO)_4]$ and $[Ni(CN)_4]^{2-}$ complex species based on the number of unpaired electrons present is:
(1) $[FeF_6]^{3-} > [CoF_6]^{3-} > [Ni(CN)_4]^{2-} > [Ni(CO)_4]$
(2) $[Ni(CN)_4]^{2-} > [FeF_6]^{3-} > [CoF_6]^{3-} > [Ni(CO)_4]$
(3) $[CoF_6]^{3-} > [FeF_6]^{3-} > [Ni(CO)_4] > [Ni(CN)_4]^{2-}$
(4) $[FeF_6]^{3-} > [CoF_6]^{3-} > [Ni(CN)_4]^{2-} = [Ni(CO)_4]$

Correct Answer: (4)

Solution:
- Electronic configuration of each complex: - $[FeF_6]^{3-}$: $[Ar]3d^5 4s^0$. There are 5 unpaired electrons in the $3d$-orbitals. - $[CoF_6]^{3-}$: $[Ar]3d^6 4s^0$. There are 4 unpaired electrons in the $3d$-orbitals. - $[Ni(CO)_4]$: $[Ar]3d^8 4s^2$. The CO ligand is a strong field ligand, so the pairing of electrons leads to 0 unpaired electrons. - $[Ni(CN)_4]^{2-}$: $[Ar]3d^8 4s^0$. The CN ligand is a strong field ligand, leading to the pairing of all electrons, so there are 0 unpaired electrons. Thus, the order of the unpaired electrons is:

$$[FeF_6]^{3-} > [CoF_6]^{3-} > [Ni(CN)_4]^{2-} = [Ni(CO)_4]$$

Quick Tip

The number of unpaired electrons in transition metal complexes can be determined based on the electronic configuration of the metal ion and the nature of the ligands.

62.
Consider the given data:

$$\text{(a) HCl(g) + 10H}_2\text{O(l)} \rightarrow \text{HCl.10 H}_2\text{O} \quad \Delta H = -69.01\,\text{kJ/mol}^{-1}$$

$$\text{(b) HCl(g) + 40H}_2\text{O(l)} \rightarrow \text{HCl.40 H}_2\text{O} \quad \Delta H = -72.79\,\text{kJ/mol}^{-1}$$

Choose the correct statement:
(1) Dissolution of gas in water is an endothermic process
(2) The heat of solution depends on the amount of solvent
(3) The heat of dilution for the HCl ($HCl.10H_2O$ to $HCl.40H_2O$) is 3.78 kJ/mol
(4) The heat of formation of HCl solution is represented by both (a) and (b)

Correct Answer: (2)

Solution:
In the given data, we have two reactions:
1. Reaction (a): The dissolution of HCl in 10 moles of water gives a heat of solution of $\Delta H = -69.01\,\text{kJ/mol}$. 2. Reaction (b): The dissolution of HCl in 40 moles of water gives a heat of solution of $\Delta H = -72.79\,\text{kJ/mol}$.
The negative values for both enthalpy changes indicate that both processes are exothermic, meaning heat is released when HCl dissolves in water. This contradicts the statement (1), which suggests that the dissolution is endothermic.
Step 1: Calculation of the Heat of Dilution Now, to understand how the heat of solution changes with the amount of solvent, we subtract the enthalpy change of reaction (a) from that of reaction (b):

$$\Delta H = -72.79\,\text{kJ/mol} - (-69.01\,\text{kJ/mol}) = -3.78\,\text{kJ/mol}$$

This value represents the difference in heat of solution when the amount of solvent changes from 10 moles of water to 40 moles of water. This shows that the heat of solution depends on the amount of solvent used, confirming that statement (2) is correct.
Step 2: Why Statement (3) is Incorrect Statement (3) suggests that the heat of dilution for the HCl ($HCl.10H_2O$ to $HCl.40H_2O$) is 3.78 kJ/mol. However, the value we calculated is actually the difference in heat of solution, not the heat of dilution itself. Therefore, statement (3) is incorrect.

Quick Tip

The heat of solution for a substance can depend on the amount of solvent used. A larger amount of solvent typically reduces the heat released during dissolution, as seen in the negative change in ΔH between reactions (a) and (b).

63.
Consider the ground state of an atom (Z = 24). How many electrons are arranged with Azimuthal quantum number $l = 1$ and $l = 2$ respectively?
(1) 12 and 4
(2) 16 and 4
(3) 12 and 5
(4) 12 and 5 and 6

Correct Answer: (3)

Solution:
For $Z = 24$, the electron configuration is $[Ar]3d^6 4s^2$. - $l = 1$ corresponds to the p-orbital, which can hold 6 electrons. - $l = 2$ corresponds to the d-orbital, which can hold 10 electrons. Thus, there are 12 electrons in the $l = 1$ shell and 5 electrons in the $l = 2$ shell.
Therefore, the correct answer is (3).

Quick Tip

The number of electrons in orbitals depends on the quantum numbers, with the p-orbitals having a maximum of 6 electrons and d-orbitals having a maximum of 10.

64.
Given below are two statements:
Statement (I): The first ionisation enthalpy of group 14 elements is higher than the corresponding elements of group 13.
Statement (II): Melting points and boiling points of group 13 elements are in general much higher than those of the corresponding elements of group 14.
Choose the most appropriate answer from the options given below:

(1) Statement I is correct but Statement II is incorrect
(2) Statement I is incorrect but Statement II is correct
(3) Both Statement I and Statement II are incorrect
(4) Both Statement I and Statement II are correct

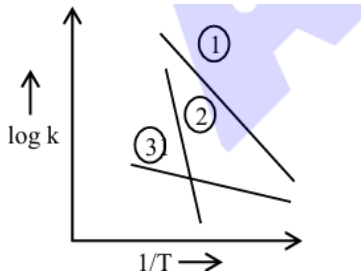
Correct Answer: (1)

Solution:
- **Statement I:** The first ionisation enthalpy of group 14 elements is indeed higher than that of group 13 elements, as the number of valence electrons increases from group 13 to 14, leading to a higher ionisation energy. Thus, Statement I is **correct**.
- **Statement II:** This statement is **incorrect**. The melting points and boiling points of group 13 elements are generally **lower** than those of group 14 elements due to the stronger metallic bonding in group 14 elements. Thus, Statement II is incorrect.
Therefore, the correct answer is **(1)**.

Quick Tip

Ionisation enthalpy increases across a period as the nuclear charge increases, but the melting and boiling points of the elements generally follow the trends in atomic size and bonding strength.

65.
Consider the following plots of log of rate constant $k(logk)$ vs $\frac{1}{T}$ for three different reactions. The correct order of activation energies of these reactions is:



Choose the correct answer from the options given below:
(1) $Ea_2 > Ea_1 > Ea_3$
(2) $Ea_1 > Ea_3 > Ea_2$
(3) $Ea_1 > Ea_2 > Ea_3$
(4) $Ea_3 > Ea_2 > Ea_1$

Correct Answer: (1)

Solution:
The activation energy E_a of a reaction is related to the slope of the plot of $\log k$ vs $\frac{1}{T}$ by the Arrhenius equation:

$$\log k = -\frac{E_a}{2.303R} \times \frac{1}{T} + \text{constant}$$

where: - $\log k$ is the log of the rate constant, - T is the temperature, - R is the gas constant. The steeper the slope, the higher the activation energy. In this plot: - Reaction 1 (the line with the steepest slope) corresponds to the highest activation energy, i.e., E_{a1}. - Reaction 2 (the line with a less steep slope) corresponds to the middle activation energy, i.e., E_{a2}. - Reaction 3 (the line with the least steep slope) corresponds to the lowest activation energy, i.e., E_{a3}.
Thus, the correct order of activation energies is $E_{a2} > E_{a1} > E_{a3}$, which corresponds to option **(1)**.

Quick Tip

The slope of the Arrhenius plot is directly related to the activation energy. A steeper slope corresponds to a higher activation energy.

66.
'X' is the number of electrons in t_2g orbitals of the most stable complex ion among $[Fe(NH_3)_6]^{3+}$, $[Fe(Cl)_6]^{3-}$, $[Fe(C_2O_4)_3]^{3-}$ and $[Fe(H_2O)_6]^{3+}$.
The nature of oxide of vanadium of the type V_2O_x is:

(1) Acidic
(2) Neutral
(3) Basic
(4) Amphoteric

Correct Answer: (4)

Solution:
1. Identifying the most stable complex ion:
The stability of the complex depends on factors like ligand field strength and the charge on the metal ion. Among the given complexes, the most stable complex is $[Fe(C_2O_4)_3]^{3-}$ because oxalate (C_2O_4) is a bidentate ligand and provides a strong ligand field, stabilizing the iron(III) ion effectively.
2. Electron Configuration of Iron in $[Fe(C_2O_4)_3]^{3-}$:

- Iron in the $[Fe(C_2O_4)_3]^{3-}$ complex is in the +3 oxidation state, so its electron configuration is $[Ar]3d^5$. This means it has 5 electrons in its $3d$-orbitals. - For the octahedral $[Fe(C_2O_4)_3]^{3-}$ complex, these 5 d-electrons will occupy the t_{2g} orbitals, as these orbitals are lower in energy in an octahedral field.
Thus, the number of electrons in the t_{2g} orbitals is **5**, and X = 5.
3. The nature of V_2O_x:
- Vanadium oxides, such as V_2O_5, exhibit amphoteric properties. This means they can act as both acids and bases depending on the reaction conditions. Therefore, the correct answer for the nature of vanadium oxide is amphoteric.
Thus, the correct answer is (4).

Quick Tip

The stability of a complex ion depends on the ligand field and the metal ion's charge. The presence of strong ligands, like oxalate, increases the stability of the complex.

67.
The elements of Group 13 with highest and lowest first ionisation enthalpies are respectively:

(1) B & Ga
(2) B & Tl
(3) Ti & B
(4) B & In

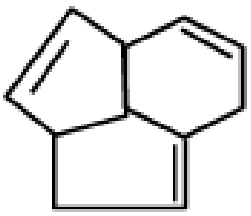
Correct Answer: (1)

Solution:
- The ionisation enthalpy decreases as we move down a group. Boron (B) has the highest ionisation enthalpy in Group 13, while Gallium (Ga) has the lowest due to the larger atomic radius and shielding effect as we move down the group.
Thus, the correct answer is **(1)**.

Quick Tip

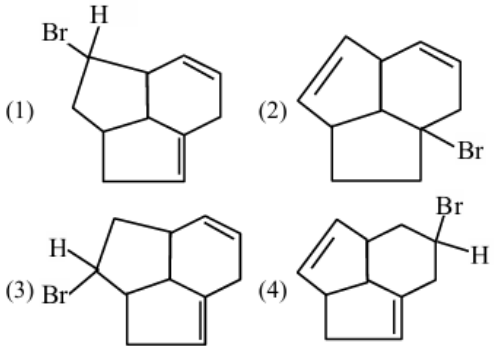
Ionisation enthalpy decreases down the group because of increasing atomic size and electron shielding.

68.
Consider the following molecule (X).



(X)

The structure of X is:



Correct Answer: (2)

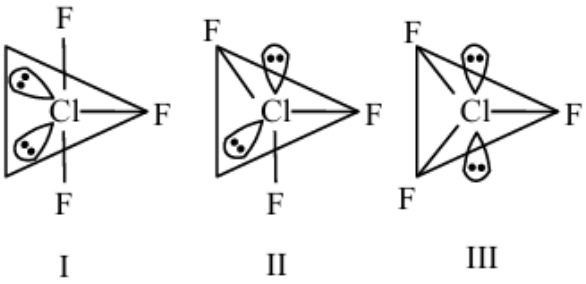
Solution:
The structure of X is the molecule shown in Option 2. Upon the addition of H^+, a tertiary carbocation is formed, which is stable and leads to the formation of the major product, which involves the substitution of the bromine atom at the most stable position. Therefore, the structure of X corresponds to the molecule in Option 2.

Quick Tip

In reactions involving carbocation formation, the stability of the carbocation determines the major product. Tertiary carbocations are more stable than secondary and primary ones.

69.
Given below are two statements:

Statement (I) : for $C\ell F_3$, all three possible structures may be drawn as follows.



Statement (II): Structure III is most stable, as the orbitals having the lone pairs are axial, where the $\ell p - \beta p$ repulsion is minimum.
In light of the above statements, choose the most appropriate answer from the options given below:
(1) Statement I is incorrect but Statement II is correct
(2) Statement I is correct but Statement II is incorrect
(3) Both Statement I and Statement II are correct
(4) Both Statement I and Statement II are incorrect

Correct Answer: (2)

Solution:
- Statement I is correct. The structure involves all three possible resonance structures where the fluorine atoms are positioned at different bond angles with respect to the central atom. The lone pairs on fluorine atoms may vary depending on the electron distribution.
- Statement II is incorrect. In sp^3d hybridization, the lone pairs occupy equatorial positions, not axial, due to minimizing $\ell p - \beta p$ repulsion. Therefore, the statement about lone pairs occupying axial positions in structure III is incorrect.
Thus, the correct answer is **(2)**.

Quick Tip

In reactions involving lone pairs, remember that in sp^3d hybridization, lone pairs prefer equatorial positions to minimize $\ell p - \beta p$ repulsion, not axial positions.

70.
Half-life of zero-order reaction $A \rightarrow$ product is 1 hour, when initial concentration of reaction is 2.0 mol L^{-1}. The time required to decrease concentration of A from 0.50 to 0.25 mol L^{-1} is:
(1) 0.5 hour
(2) 4 hour
(3) 15 min
(4) 60 min

Correct Answer: (3)

Solution:
For zero-order reaction:
The half-life is given by:

$$\text{Half life} = \frac{A_0}{2k}$$

Given, half-life = 1 hour and the initial concentration $A_0 = 2.0\,\text{mol/L}$, we can write:

$$60\,\text{min} = \frac{2}{2k}$$

Solving for k:

$$k = \frac{1}{60}\,\text{M/min}$$

Now, using the formula for zero-order reaction:

$$A_t = A_0 - kt$$

$$t = \frac{A_0 - A_t}{k}$$

Substitute the values:

$$t = \frac{0.5 - 0.25}{\frac{1}{60}} = 0.25 \times 60 = 15\,\text{min}$$

Thus, the time required to decrease the concentration of A from 0.50 to 0.25 mol L^{-1} is 15 minutes.

Quick Tip

For zero-order reactions, the concentration of reactant decreases linearly with time, and the rate constant k is directly related to the half-life.

SECTION-B

71.
Sea water, which can be considered as a 6 molar (6 M) solution of NaCl, has a density of 2 g mL^{-1}. The concentration of dissolved oxygen (O_2) in sea water is 5.8 ppm. Then the concentration of dissolved oxygen (O_2) in sea water, in x $\times$ 10^{-6} m. x = _____. (Nearest integer)
Given: Molar mass of NaCl is 58.5 g mol^{-1}
Molar mass of O_2 is 32 g mol^{-1}.

Correct Answer: (2) 2.19

Solution:
We are given that sea water is a 6 molar (6 M) solution of NaCl and has a density of 2 g mL^{-1}. We also know that the concentration of dissolved oxygen (O_2) in sea water is 5.8 ppm. First, we need to calculate the concentration of O_2 in mol/L using the given data:

1. Molar mass of NaCl = 58.5 g/mol - Sea water has a molarity of 6 M, meaning each liter of sea water contains 6 moles of NaCl. - Therefore, in 1 liter of sea water, the mass of NaCl is:

$$\text{mass of NaCl} = 6 \times 58.5 = 351 \text{ grams}$$

2. Given that the density of the solution is 2 g/mL, the mass of 1000 mL (1 L) of sea water is:

$$\text{mass of solution} = 2 \times 1000 = 2000 \text{ grams}$$

3. Now, we can calculate the mass of O_2 dissolved in 1 liter of sea water using the given ppm value of 5.8 ppm:

$$\text{ppm of } O_2 = \frac{\text{mass of } O_2}{\text{mass of solution}} \times 10^6$$

$$\text{mass of } O_2 = 5.8 \times 10^{-3} \text{ g}$$

$$\text{mass of } O_2 = 5.8 \text{ mg} = 5.8 \times 10^{-3} \text{ grams}$$

4. To calculate the molarity (mol/L) of O_2 in the solution, we use the molar mass of O_2:

$$\text{molality for } O_2 = \frac{5.8 \times 10^{-3}}{32} = 1.81 \times 10^{-4} \text{ moles}$$

This corresponds to a concentration of O_2 as:

$$= 2.19 \times 10^{-4} \text{ mol/L}$$

Therefore, the concentration of O_2 in sea water is $\mathbf{2.19 \times 10^{-4}}$ mol/L, which is approximately 2.19×10^{-6}.

Quick Tip

When dealing with ppm and molarity, remember that ppm represents parts per million, and it can be converted to mass per volume. Once you have the mass of a solute, converting it to moles using the molar mass will give you the molarity.

72.
The amount of calcium oxide produced on heating 150 kg limestone (75% pure) is _____ kg. (Nearest integer)
Given: Molar mass (in g mol^{-1}) of Ca-40, O-16, C-12

Correct Answer: (63)

Solution:
Given that:

$$CaCO_3 \rightarrow CaO + CO_2$$

We start by calculating the mass of $CaCO_3$:

$$\text{mass of } CaCO_3 = \frac{150 \times 75}{100} = 112.5\,\text{kg}$$

Next, calculate the moles of $CaCO_3$:

$$n_{CaCO_3} = \frac{\text{mass}}{\text{molar mass of } CaCO_3} = \frac{1125000}{100} = 1125 \text{ moles}$$

Since each mole of $CaCO_3$ produces 1 mole of CaO, the moles of CaO formed will be the same:

$$n_{CaO} = 1125 \text{ moles}$$

Now, we calculate the mass of CaO:

$$\text{mass of CaO} = n_{CaO} \times \text{molar mass of CaO} = 1125 \times 56 = 63000 \text{ grams} = 63 \text{ kg}$$

Thus, the amount of calcium oxide produced is **63 kg**.

Quick Tip

When calculating mass from moles, always use the correct molar masses and conversion factors (grams to kilograms) to ensure accurate results.

73.

A metal complex with a formula $MC\ell_4 3NH_3$ is involved in sp^3d^2 hybridisation. It upon reaction with excess of $AgNO_3$ solution gives 'x' moles of AgCl. Consider 'x' is equal to the number of lone pairs of electron present in central atom of BrF_5. Then the number of geometrical isomers exhibited by the complex is _____
Correct Answer: (2)

Solution:
The complex $MC\ell_4 3NH_3$ undergoes sp^3d^2 hybridisation. The central atom of BrF_5 has 1 lone pair, so x = 1.
The complex $MC\ell_4 3NH_3$ has octahedral geometry, leading to 2 possible geometrical isomers: fac and mer.
Thus, the number of geometrical isomers is 2.

Quick Tip

When dealing with octahedral complexes, the number of geometrical isomers is determined by how the ligands are arranged. For complexes with three identical ligands and three other different ligands, two possible isomers (fac and mer) exist.

74.

The molar conductance of an infinitely dilute solution of ammonium chloride was found to be 185 S cm^{-1} mol^{-1} and the ionic conductance of hydroxyl and chloride ions are 170 and 70 S cm^{-1} mol^{-1}, respectively. If molar conductance of 0.02 M solution of ammonium hydroxide is 85.5 S cm^{-1} mol^{-1}, its degree of dissociation is given by x $\times$ 10^{-1}. The value of x is _____. (Nearest integer)

Correct Answer: (3)

Solution:
For ammonium chloride, the molar conductance at infinite dilution is:

$$\lambda^0_{NH_4Cl} = 185\,\text{S cm}^{-1}\text{mol}^{-1}$$

The ionic conductance of hydroxyl and chloride ions are given as 170 and 70, respectively.
The dissociation of ammonium hydroxide is represented by:

$$\lambda^0_{NH_4OH} = \lambda^0_{NH_4^+} + \lambda^0_{OH^-}$$

The molar conductance of the 0.02 M solution of ammonium hydroxide is 85.5 S cm^{-1} mol^{-1}, and we use the following relation to find the degree of dissociation α:

$$\lambda = \alpha \cdot \lambda^0$$

where α is the degree of dissociation, so

$$85.5 = 0.02 \times (170 + 70) \times \alpha$$

Solving for α:

$$\alpha = \frac{85.5}{0.02 \times 240} = 0.177 \quad \text{or} \quad x = 3$$

Thus, the degree of dissociation is $x = 3 \times 10^{-1}$.

Quick Tip

To calculate degree of dissociation, use the formula $\lambda = \alpha \cdot \lambda^0$, where λ^0 is the molar conductance at infinite dilution and λ is the observed molar conductance.

75.
x mg of $Mg(OH)_2$ (molar mass = 58) is required to be dissolved in 1.0 L of water to produce a pH of 10.0 at 298 K. The value of x is ____ mg. (Nearest integer) (Given: $Mg(OH)_2$ is assumed to dissociate completely in H_2O)

Correct Answer: (3)

Solution:
Given:
- pH = 10.0
- pOH = 4.0
- $[OH^-] = 10^{-4}$ M

The concentration of OH^- is 10^{-4} M, and since $Mg(OH)_2$ dissociates completely in water, the number of moles of OH^- will be equal to the number of moles of $Mg(OH)_2$.
Step-by-step solution:
1. Number of moles of $OH^- = 10^{-4}$ moles (from the concentration of OH^-). 2. Number of moles of $Mg(OH)_2 = \frac{10^{-4}}{2} = 5 \times 10^{-5}$ moles, because one mole of $Mg(OH)_2$ gives two moles of OH^-. 3. The mass of $Mg(OH)_2$ is then calculated as:

$$\text{mass of } Mg(OH)_2 = 5 \times 10^{-5} \times 58 \times 10^3\,\text{mg}$$

$$= 2.9\,\text{mg}$$

Thus, the value of x is 2.9 mg, which is approximately 3 mg.

Quick Tip

When calculating the mass of a compound from its concentration, remember that dissociation of salts like $Mg(OH)_2$ can provide multiple moles of ions for each mole of the compound. The number of moles of the compound is related to the ion concentration through the dissociation stoichiometry.
