JEE Advanced 2026 Paper 2 - Chemistry Solutions

Section 1: Single Correct Option Type

Q.1

Using Kohlrausch's law for strong electrolytes: $\Lambda_m = \Lambda_m^\circ - A\sqrt{C}$
For $NaNO_3$:

$$111 = \Lambda^\circ_{NaNO_3} - A(0.1)$$
$$101 = \Lambda^\circ_{NaNO_3} - A(0.2)$$

Subtracting the two equations gives $10 = 0.1A \implies A = 100$.
Thus, $\Lambda^\circ_{NaNO_3} = 111 + 10 = 121$ S cm^2 mol^{-1}.

Similarly for NaCl:

$$117 = \Lambda^\circ_{NaCl} - 0.1A \implies A = 100 \implies \Lambda^\circ_{NaCl} = 127 \text{ S cm}^2 \text{ mol}^{-1}.$$

For $AgNO_3$:

$$125 = \Lambda^\circ_{AgNO_3} - 0.1A \implies A = 90 \implies \Lambda^\circ_{AgNO_3} = 134 \text{ S cm}^2 \text{ mol}^{-1}.$$

Using Kohlrausch's law of independent migration of ions for AgCl:

$$\Lambda^\circ_{AgCl} = \Lambda^\circ_{AgNO_3} + \Lambda^\circ_{NaCl} - \Lambda^\circ_{NaNO_3} = 134 + 127 - 121 = 140 \text{ S cm}^2 \text{ mol}^{-1}.$$

For a saturated solution, $\Lambda_m \approx \Lambda_m^\circ = \frac{\kappa \times 1000}{S}$

$$140 = \frac{1.40 \times 10^{-6} \times 1000}{S} \implies S = \frac{1.40 \times 10^{-3}}{140} = 10^{-5} \text{ mol L}^{-1}.$$

So, $X = 10^{-5} \implies X^{-1} = 10^5 \implies \log_{10}(10^5) = 5$.
Correct Option: (C)

Q.2

The ONO bond angles depend on hybridization and lone pair repulsions:

- NO_2^+ : sp hybridized, linear $\implies 180^\circ$
- NO_2 : sp^2 hybridized with one odd electron. The repulsion is less than a full lone pair $\implies \approx 134^\circ$
- NO_3^- : sp^2 hybridized, perfectly trigonal planar $\implies 120^\circ$
- NO_2^- : sp^2 hybridized with a full lone pair. Strongest repulsion reduces angle $\implies \approx 115^\circ$

Order: $NO_2^- < NO_3^- < NO_2 < NO_2^+$.
Correct Option: (A)

Q.3

Natural rubber is cis-1,4-polyisoprene $[-CH_2 - C(CH_3) = CH - CH_2-]_n$.

Complete ozonolysis cleaves the double bonds, producing 4-oxopentanal (levulinic aldehyde): $CH_3 - CO - CH_2 - CH_2 - CHO$.
This is Compound **X**, which yields a positive iodoform test (due to the methyl ketone group) and a positive Tollen's test (due to the aldehyde).
Heating X with aqueous NaOH induces an intramolecular aldol condensation. The enolate forms at the methyl group of the ketone (C5) and attacks the aldehyde carbonyl (C1) to form a stable 5-membered ring. Dehydration follows, giving the α,β-unsaturated cyclic ketone: **2-cyclopenten-1-one**. (Option C visually represents this unbranched enone).
Correct Option: (C)

Q.4
The artificial sweetener sucralose is described.

- **Galactose part:** 4-chloro-4-deoxy-α-D-galactose. In normal D-galactose, the C4 OH is axial (UP). Since the substituent replaces OH retaining the geometry, the Cl atom at C4 must be UP.
- **Fructose part:** 1,6-dichloro-1,6-dideoxy-β-D-fructose. In the β-anomer of fructofuranose, the C2 stereocenter has the anomeric oxygen UP and the CH_2Cl group DOWN.

Matching these specific 3D orientations isolates the correct stereochemical structure.
Correct Option: (D)

Section 2: Multiple Correct Options Type

Q.5
For a first-order reaction $R \to P$:

- (A) $[P] = [R]_0(1 - e^{-kt})$. The plot of $[P]$ vs t correctly shows an exponentially increasing curve plateauing at $[R]_0$. **(TRUE)**
- (B) $d[R]/dt$ is negative (decay rate).
- (C) Rate of formation of P is $d[P]/dt = k[R]$. This translates to a straight line passing through the origin. **(TRUE)**
- (D) The rate constant k is independent of time, producing a horizontal line. **(TRUE)**

Correct Options: (A), (C), (D)

Q.6

- **P** is XeF_4 (formed by 1:5 ratio of Xe to F_2). It is square planar with two lone pairs on Xe. **(A is TRUE)**
- **Q** is XeF_6 ($XeF_4 + O_2F_2 \to XeF_6 + O_2$). It has a distorted octahedral geometry (sp^3d^3), not perfect. **(B is FALSE)**
- XeF_6 is a potent fluorinating agent. **(C is TRUE)**
- **R** is XeO_3 (formed by complete hydrolysis of XeF_6). It is sp^3 hybridized with one lone pair, rendering it trigonal pyramidal. **(D is TRUE)**

Correct Options: (A), (C), (D)

Q.7

- (A) Removing the second electron from Boron ($1s^2 2s^2$) breaks a fully-filled $2s$ subshell, requiring more energy than removing the second electron from Carbon ($1s^2 2s^2 2p^1$). Thus, IE_2 of C is less than B. **(TRUE)**
- (B) Al^{3+}, Mg^{2+}, and Na^+ are isoelectronic (10 electrons). The ionic radius strictly decreases as nuclear charge (protons) increases. $Al^{3+}(13) < Mg^{2+}(12) < Na^+(11)$. **(TRUE)**
- (C) Potassium is anomalously less dense than Sodium because of a disproportionate increase in atomic volume due to empty 3d orbitals. **(FALSE)**
- (D) The F–F bond (159 kJ/mol) is exceptionally weak due to lone-pair repulsion, making it much weaker than the H–H bond (436 kJ/mol). **(FALSE)**

Correct Options: (A), (B)

Q.8

The reaction sequences describe standard aromatic synthesis:

- **P** is generated by protecting m-toluidine and mono-nitrating it. It is NOT a dinitro compound. **(C is FALSE)**
- **Q** is the diazonium salt (4-nitro-3-methylbenzenediazonium chloride). Reacting Q with ethanol reduces it to an arene, oxidizing ethanol to acetaldehyde (an *aliphatic*, not aromatic, aldehyde). **(A is FALSE)**
- **S** is Salicylic acid (synthesized via cumene hydroperoxide to phenol, then Kolbe-Schmitt). Phenols generally give a positive phthalein dye test. **(B is TRUE)**
- **T** is formed by coupling the diazonium salt Q with salicylic acid S in alkaline NaOH. The product is an Azo dye, which is deeply colored. **(D is TRUE)**

Correct Options: (B), (D)

Q.9

- (A) Dilute HNO_3 oxidizes both the $-CHO$ and terminal $-CH_2OH$ of glucose to yield saccharic acid. **(FALSE)**
- (B) Fructose reduces Fehling's solution because the basic medium facilitates Lobry de Bruyn-van Ekenstein rearrangement, isomerizing fructose into glucose and mannose. **(TRUE)**
- (C) Hydrolysis of sucrose yields an equimolar mixture of D-glucose and D-fructose, termed invert sugar. **(TRUE)**
- (D) The specific rotation of invert sugar is the arithmetic mean of the components in equimolar amounts: $\frac{(+52.5^\circ - 92.5^\circ)}{2} = -20^\circ$. **(FALSE)**

Correct Options: (B), (C)

Section 3: Numerical Value Type

Q.10

Using the Rydberg equation $\frac{1}{\lambda} \propto Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$:

For X^{a+}:

$$\frac{1}{\lambda} \propto Z_X^2 \left(1 - \frac{1}{4}\right) = \frac{3}{4} Z_X^2$$

For Y^{b+}:

$$\frac{1}{9\lambda} \propto Z_Y^2 \left(\frac{1}{4} - \frac{1}{16}\right) = \frac{3}{16} Z_Y^2$$

Dividing the two equations:

$$9 = \frac{\frac{3}{4} Z_X^2}{\frac{3}{16} Z_Y^2} = 4 \frac{Z_X^2}{Z_Y^2} \implies \frac{Z_X}{Z_Y} = \frac{3}{2}$$

The lowest integers are $Z_X = 3$ (Lithium) and $Z_Y = 2$ (Helium).
For them to be hydrogen-like (1 electron), Li must be Li^{2+} ($a = 2$) and He must be He^{+} ($b = 1$).
$(a + b) = 2 + 1 = 3$.
Answer: 3

Q.11

Initial moles of acetic acid $= \frac{0.45 \text{ g}}{60 \text{ g/mol}} = 0.0075$ mol.
Initial concentration $C_0 = \frac{0.0075 \text{ mol}}{0.05 \text{ L}} = 0.15$ M.
At equilibrium, pH $= 3 \implies [H^+] = 10^{-3}$ M.
Using $K_a = \frac{[H^+]^2}{C_{eq}} \implies 10^{-5} = \frac{10^{-6}}{C_{eq}} \implies C_{eq} = 0.1$ M.
Equilibrium moles $= 0.1 \times 0.05 = 0.005$ mol $= 0.30$ g.
Mass adsorbed $(x) = 0.45$ g $- 0.30$ g $= 0.15$ g.
From the Freundlich isotherm $x/m = kC^{1/n}$, a slope of 1 means $n = 1$.

$$k = \frac{x/m}{C} = \frac{0.15/1.0}{0.1} = 1.5 \text{ L mol}^{-1}.$$

Answer: 1.5

Q.12

Using the elevation in boiling point formula: $\Delta T_b = i K_b m$.

$$K_b = \frac{R T_b^2 M_{S,kg}}{\Delta H_{\text{vap}}} = \frac{R(400)^2 (M_{S,g} \times 10^{-3})}{10R} = 16 M_{S,g}.$$

Molality of 0.25% solution $m \approx \frac{0.25}{10 M_{S,g}} \times \frac{1000}{100} = \frac{0.25}{M_{S,g}}$.

$$8 = i \times (16 M_{S,g}) \times \left(\frac{0.25}{M_{S,g}}\right) \implies 8 = 4i \implies i = 2.$$

For $B \rightleftharpoons 2C + 2D$, $i = 1 + \alpha(n - 1) \implies 2 = 1 + \alpha(4 - 1) \implies 3\alpha = 1 \implies \alpha = 1/3$.
Mole percent dissociated $= 33.33\%$.
Answer: 33.33

Q.13

- ***cis*-isomer:** The two Cl atoms are adjacent. They form one edge of the octahedron. Any edge on an octahedron is shared by exactly 2 triangular faces. The other vertex for both faces must be an N atom. Total = 2 faces.
- ***mer*-isomer:** The three Cl atoms form a T-shape. There are 2 separate edges connecting Cl to Cl (at 90° to each other). Each edge is shared by 2 triangular faces terminated by N atoms. Total = $2 + 2 = 4$ faces.

Total sum = $2 + 4 = 6$.
Answer: 6

Q.14
Reaction traces:

- **X** is Glycine (aminoethanoic acid). Molar mass = 75 g/mol.
- **Y** is ϵ-aminocaproic acid (6-aminohexanoic acid). Molar mass = 131 g/mol.

An *acyclic* copolymer **Z** formed exclusively from 500 moles of X and 500 moles of Y implies a single polymer chain consisting of 1000 monomeric units.
Total peptide bonds = $1000 - 1 = 999$. Thus, 999 moles of H_2O are lost.
Mass of Z = $(500 \times 75) + (500 \times 131) - (999 \times 18) = 37500 + 65500 - 17982 = 85018$ g.
Answer: 85018

Section 4: Question Stem Numerical Types

Q.15
Mole fractions in liquid: $x_A = \frac{1000/50}{(1000/50)+5} = \frac{20}{25} = 0.8$, $x_B = 0.2$.
Using Raoult's Law:

$$P_T = P_A^\circ x_A + P_B^\circ x_B \implies 100 = (105)(0.8) + P_B^\circ(0.2) \implies P_B^\circ = 80 \text{ mm Hg}.$$

Molar volume of pure B (liquid):

$$V_{m,\text{liq}} = \frac{M_B}{\rho} = \frac{57}{0.5} = 114 \text{ mL/mol} = 0.114 \text{ L/mol}.$$

Molar volume of pure B (vapour) at its pure vapour pressure:

$$V_{m,\text{vap}} = \frac{RT}{P} = \frac{0.08 \times 300}{80/760} = 228 \text{ L/mol}.$$

Ratio = $228/0.114 = 2000$.
Answer: 2000

Q.16
Mole fraction of B in vapour phase (y_B):

$$y_B = \frac{P_B}{P_T} = \frac{P_B^\circ x_B}{P_T} = \frac{80 \times 0.2}{100} = \frac{16}{100} = 0.16.$$

Answer: 0.16

Q.17
The sequence performs an acylation, Finkelstein halide exchange, Williamson-type substitution, reduction, bromination, and ultimately S_N2 amination to form molecule **L**.

Molar mass of **L** ($C_{16}H_{18}N_2O_3$) = 286 g/mol.
Moles of L = 5.72 g/286 g/mol = 0.02 mol.
Important: Kjeldahl's method does *not* estimate nitrogen from nitro ($-NO_2$) groups. It exclusively releases NH_3 from the amine group.
Ammonia evolved = 0.02 mol.
Neutralization: $2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$.
Moles of H_2SO_4 required = 0.02/2 = 0.01 mol.
Volume = $\frac{0.01 \text{ mol}}{1 \text{ M}}$ = 0.01 L = 10 mL.
Answer: 10

Q.18
Molecule **M** replaces the Bromine with a $-$SPh group.
Molar mass of **M** ($C_{22}H_{21}NO_3S$) = 379 g/mol.
Moles of M = 3.79 g/379 g/mol = 0.01 mol.
Since each molecule holds 1 sulfur atom, 0.01 mol of S reacts to form 0.01 mol of $BaSO_4$.
Mass of $BaSO_4$ = 0.01 mol $\times$ 233 g/mol = 2.33 g.
Answer: 2.33