WBJEE Chemistry Sample Paper-6

Duration: 60 Minutes **Maximum Marks: 50**

Instructions

- This paper contains a total of **40** Multiple Choice Questions.
- **Section A (Q1–Q30):** Each correct answer carries +1 mark. Incorrect answer: **0.25 marks**. Only **one** correct option.
- **Section B (Q31–Q35):** Each correct answer carries +2 mark. Incorrect answer: **0.5 marks**. Only **one** correct option.
- **Section C (Q36–Q40)**: Each correct answer carries **+2 marks**. **No negative marking.** One or **more** correct options may be correct; full marks only if all correct options are marked.
- Use of mobile phones, smartwatches, or any electronic gadgets is strictly prohibited.

Section–A — 30 Questions × 1 Mark Each
(Negative Marking: 0.25) [Single Correct]

Q1. A solid mixture (10.0 g) containing only Na_2CO_3 and $NaHCO_3$ is heated until its mass becomes constant at 8.45 g. The residue is then completely dissolved in water to make a 250 mL solution. What volume of 0.25 M H_2SO_4 is required to completely neutralize 25 mL of this newly prepared solution?

(A) 18.5 mL

(B) 31.8 mL

(C) 15.9 mL

(D) 42.4 mL

Q2. An aqueous solution of a weak hexavalent acid H_6A has a molality of m. If the freezing point depression of this solution is ΔT_f and the freezing point depression constant of water is K_f, assuming only the first three dissociation steps occur with degrees of ionization α_1, α_2, and α_3 respectively, the apparent van 't Hoff factor i is given by:

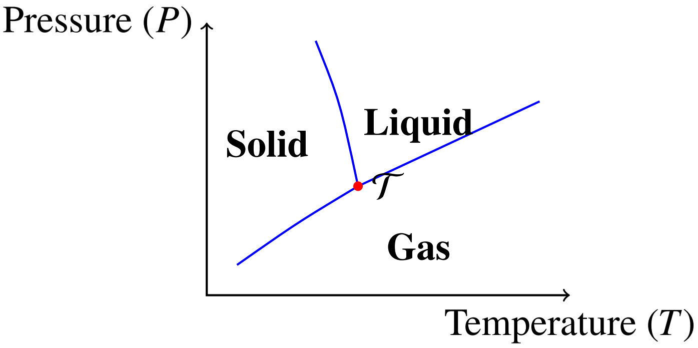
(A) $1 + \alpha_1 + \alpha_1\alpha_2 + \alpha_1\alpha_2\alpha_3$

(B) $1 + \alpha_1 + 2\alpha_1\alpha_2 + 3\alpha_1\alpha_2\alpha_3$

(C) $1 + \alpha_1(1 + \alpha_2(1 + \alpha_3))$

(D) $1 + \alpha_1 + 2\alpha_2 + 3\alpha_3$

Q3. The phase diagram of a pure substance exhibiting a highly dense solid phase is shown in the figure below. Based on the slopes of the phase equilibrium boundaries, which statement correctly predicts the physical behavior of this substance?



(A) The solid phase floats on its liquid melt because the fusion curve has a positive slope.

(B) The melting point of the substance decreases with an increase in external pressure.

(C) Sublimation is entirely impossible at any pressure below the triple point $\mathcal{T}$.

(D) Liquid phase cannot be converted to gas isothermally above the critical point.

Q4. A certain quantum mechanical state of a hydrogen-like atom has a radial wave function defined as $R(r) = N\left(6 - 6\sigma + \sigma^2\right)e^{-\sigma/3}$ where $\sigma = \frac{2Zr}{a_0}$. The number of radial nodes and the corresponding principal quantum number (n) for this state are:

(A) 2 radial nodes, $n = 3$

(B) 2 radial nodes, $n = 4$

(C) 3 radial nodes, $n = 4$

(D) 1 radial node, $n = 3$

Q5. A radioactive substance A decays into B via an alpha emission (λ_1), and simultaneously decays into C via a beta emission (λ_2). If the total half-life of the sample is 60 days and it is observed that after a long time the molar ratio of B to C in the container stabilizes at $1 : 3$, the partial half-life of A for alpha emission is:

(A) 80 days

(B) 180 days

(C) 240 days

(D) 120 days

Q6. Which of the following molecules possesses a permanent electric dipole moment ($\mu \neq 0$) and contains a central atom with an unshared pair of electrons lying in a pure d-orbital platform due to extensive back-bonding steric constraints?

(A) $O(SiH_3)_2$

(B) SF_4

(C) XeO_3F_2

(D) ClO_2

Q7. The correct order of increasing M – C bond length among the given homoleptic carbonyl complexes is:
(I) $[V(CO)_6]^-$ (II) $[Cr(CO)_6]$ (III) $[Mn(CO)_6]^+$

(A) I < II < III

(B) III < II < I

(C) II < I < III

(D) III < I < II

Q8. The correct decreasing order of the structural bond angles for the species NO_2^+, NO_2, NO_2^-, and NH_4^+ is:

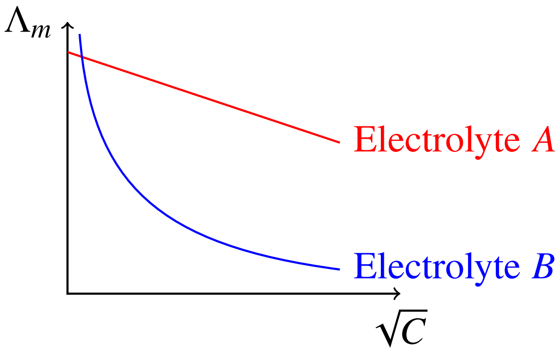
(A) $NO_2^+ > NO_2 > NO_2^- > NH_4^+$

(B) $NO_2^+ > NH_4^+ > NO_2 > NO_2^-$

(C) $NH_4^+ > NO_2^+ > NO_2 > NO_2^-$

(D) $NO_2^+ > NO_2 > NH_4^+ > NO_2^-$

Q9. The variation of molar conductivity (Λ_m) with respect to the square root of concentration ($\sqrt{C}$) for two distinct electrolytes (A and B) at 298 K is shown graphically. Choose the option that correctly identifies the nature of the electrolytes and the application of Kohlrausch's law.



(A) A is a weak electrolyte (CH_3COOH), and its Λ_m° can be found by direct extrapolation.

(B) B is a strong electrolyte (KCl), obeying the Debye-Hückel-Onsager equation perfectly.

(C) A is a strong electrolyte (NaCl), and Λ_m° for B can be determined using Kohlrausch's law of independent migration of ions.

(D) Both A and B show identical dissociation behavior at infinite dilution limit.

Q10. A crystalline mineral of a transition metal forms a lattice where oxide ions (O^{2-}) are arranged in a cubic close-packed (ccp) array. Metal cations M^{x+} occupy $\frac{1}{6}$ of the tetrahedral voids and $\frac{1}{3}$ of the octahedral voids. The empirical formula of the mineral and the oxidation state x of the metal are:

(A) M_2O_3, $x = +3$

(B) $MO_2, x = +4$

(C) $M_2O_3, x = +4$

(D) $M_3O_4, x = +8/3$

Q11. For the reversible process $A(s) \rightleftharpoons B(g) + 2C(g)$, the total equilibrium pressure is P_1 at temperature T_1. When the temperature is raised to T_2, the solid A is completely consumed, and the partial pressure of B becomes double its initial equilibrium value at T_1. If the total pressure at T_2 is P_2, then the relationship between P_1 and P_2 is:

(A) $P_2 = 2P_1$

(B) $P_2 > 2P_1$

(C) $P_2 < 2P_1$

(D) Cannot be determined without knowing $\Delta H°$

Q12. The solubility product (K_{sp}) of a sparingly soluble salt $M\mathrm{X}_2$ in water is 4×10^{-12}. Its solubility in a 0.01 M solution of a complexing agent L which forms a stable soluble coordination complex $M\mathrm{L}_4^{2+}$ (with an overall stability constant $\beta_4 = 10^{10}$) is:

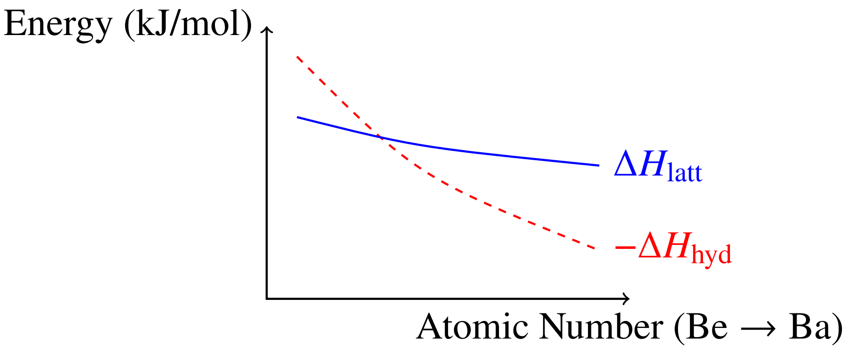
(A) 1×10^{-2} M

(B) 2×10^{-3} M

(C) 1×10^{-3} M

(D) 4×10^{-4} M

Q13. Consider the extraction profiles and thermal stability trends plotted as a function of atomic number for the second group (s-block, Alkaline Earth Metals). The diagram maps the relative hydration enthalpies ($-\Delta H_{\text{hyd}}$) versus lattice enthalpies (ΔH_{latt}) for their sulfates. Which statement correctly evaluates the solubility trend down the group?



(A) Solubility increases down the group because hydration enthalpy drops much faster than lattice enthalpy.

(B) Solubility decreases down the group because the lattice enthalpy becomes heavily dominant for heavier ions.

(C) Solubility decreases down the group because hydration enthalpy diminishes rapidly due to increase in ionic size.

(D) $BaSO_4$ is highly soluble in water due to its minimal lattice configuration energy.

Q14. A definite amount of an ideal gas undergoes a non-reversible adiabatic expansion against a constant external pressure of 1 atm from an initial volume of 5 L to a final volume of 25 L. If the initial temperature was 300 K and $C_{v,m} = \frac{3}{2}R$, the final temperature (T_2) of the gas is:

(A) 137.6 K

(B) 210.4 K

(C) 180.0 K

(D) 162.2 K

Q15. An excess of KI solution is added to 100 mL of an acidic $K_2Cr_2O_7$ solution. The liberated iodine requires 45 mL of 0.2 N $Na_2S_2O_3$ solution for complete titration. The strength of the original $K_2Cr_2O_7$ solution in grams per litre (g L^{-1}) is closest to: [Molar mass of $K_2Cr_2O_7$ = 294.2 g mol^{-1}]

(A) 4.41 g L^{-1}

(B) 22.06 g L^{-1}

(C) 7.35 g L^{-1}

(D) 1.32 g L^{-1}

Q16. A chemical solution containing 1.0 mol of FeC_2O_4 and 1.0 mol of $Fe_2(C_2O_4)_3$ is completely oxidized in an acidic medium by a 0.25 M $KMnO_4$ solution via permanganometric pathway. The volume of the $KMnO_4$ solution consumed during this reaction is:

(A) 3.6 L

(B) 4.8 L

(C) 2.4 L

(D) 4.0 L

Q17. The standard reduction potentials of three metallic electrodes A, B, and C are +0.34 V, −0.76 V, and −0.44 V respectively. These electrodes are configured into three separate galvanic cells under standard states: (I) $A-B$, (II) $B-C$, and (III) $C-A$. The correct sequence of the decreasing order of maximum electrical work (W_{max}) obtainable per mole of electrons transferred is:

(A) I > III > II

(B) II > III > I

(C) I > II > III

(D) III > I > II

Q18. When a concentrated aqueous solution of LiCl is subjected to high-current electrolysis using inert platinum electrodes, the products obtained at the cathode and anode under high overvoltage constraints are respectively:

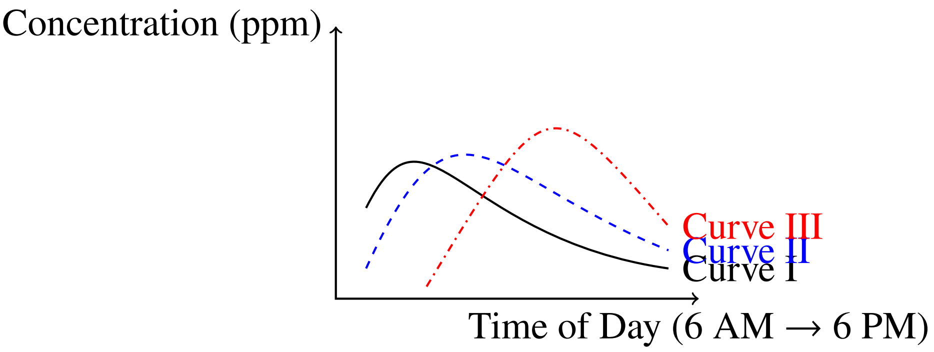
(A) $Li(s)$, $Cl_2(g)$

(B) $H_2(g)$, $Cl_2(g)$

(C) $H_2(g)$, $O_2(g)$

(D) $Li(s)$, $O_2(g)$

Q19. An environmental monitoring station records the daily variations in concentrations of primary and secondary pollutants during a heavy photochemical smog event in an urban center. The concentration profiles of hydrocarbons, nitric oxide (NO), nitrogen dioxide (NO_2), and ozone (O_3) are graphed below. Identify the curve corresponding to Ozone (O_3).



(A) Curve I, because it represents a primary pollutant directly emitted by automobile exhausts at dawn.

(B) Curve II, because NO_2 must peak before solar intensity reaches its absolute maximum.

(C) Curve III, because ozone is a secondary pollutant formed via solar photolysis of NO_2 later in the afternoon.

(D) Curve I, because hydrocarbons are consumed immediately to form ozone molecules at noon.

Q20. When metallic sodium is dissolved in liquid ammonia, a deep blue solution is formed which is highly conducting and paramagnetic. Upon standing for a long duration, the blue color gradually fades away giving a colorless solution with the release of a gas. The primary chemical species responsible for the colorless residue and the liberated gas are respectively:

(A) $NaNH_2$, H_2

(B) NaH, N_2

(C) NaN_3, H_2

(D) $NaNH_2$, N_2

Q21. An inorganic compound *X* on heating with excess carbon at high temperature forms a hard material *Y* which is used as an abrasive. *X* on hydrolytic condensation yields a high-molecular-weight polymer stabilized by strong linear silicon-oxygen-silicon structural frames. The compound *X* and *Y* are respectively:

(A) SiO_2, SiC

(B) $SiCl_4$, SiC

(C) SiO_2, CO_2

(D) Na_2SiO_3, SiC

Q22. The balanced structural reaction of white phosphorus (P_4) with hot, concentrated sodium hydroxide solution in an inert atmosphere of CO_2 produces a poisonous gas *P* and a salt *Q*. Salt *Q* when treated with $AgNO_3$ shows strong reducing tendencies. The compound *P* and the basicity of the acid derived from salt *Q* are:

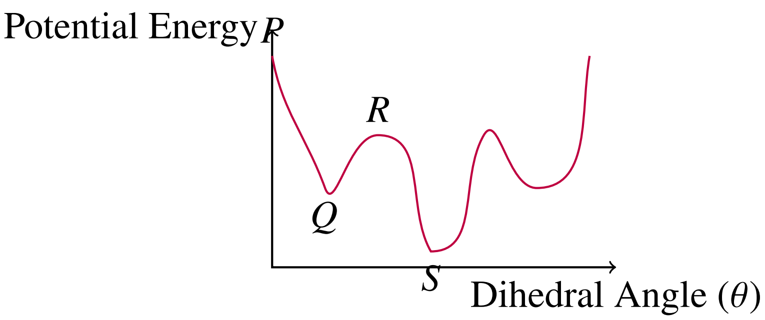
(A) PH_3, Monobasic

(B) P_2H_4, Dibasic

(C) PH_3, Dibasic

(D) P_2H_4, Monobasic

Q23. The energy profile diagram for the conformational analysis of *n*-butane through a 360° rotation about the $C_2 - C_3$ bond is displayed below. What is the correct structural description of the conformation representing the highest energetic state?



(A) State S, which corresponds to the Anti-conformation where bulky $-CH_3$ groups are furthest apart.

(B) State R, which represents the Gauche conformation due to steric hindrance.

(C) State P, which corresponds to the Fully Eclipsed conformation where methyl groups experience maximum torsional strain.

(D) State Q, which represents the partially eclipsed state with zero net dipole moment.

Q24. The complex $[Cr(H_2O)_6]Cl_3$ and $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$ display a deep violet and a dark green coloration respectively. This pair represents which type of structural isomerism, and what is the spin-only magnetic moment of the chromium central ion?

(A) Coordination isomerism, 4.90 BM

(B) Hydrate isomerism, 3.87 BM

(C) Ionization isomerism, 3.87 BM

(D) Linkage isomerism, 2.83 BM

Q25. A coordination compound with the empirical formula $PtCl_4 \cdot 2NH_3$ does not yield any precipitate when treated with an excess of cold $AgNO_3$ solution. However, its electrical conductivity measurements match with a 1 : 1 electrolyte system due to dimerization. The correct structural formulation of this complex is:

(A) $[Pt(NH_3)_4Cl_2][PtCl_6]$

(B) $[Pt(NH_3)_2Cl_4]$

(C) $[Pt(NH_3)_3Cl_3][Pt(NH_3)Cl_5]$

(D) $[Pt(NH_3)_4][PtCl_6]$

Q26. Stratospheric ozone layer depletion is catalyzed by various radical chain pathways. Which of the following radical species is considered the most potent chain-initiating agent generated via the photolysis of chlorofluorocarbons (CFCs) by solar ultraviolet radiation?

(A) $CF_2Cl^{\bullet}$

(B) $Cl^{\bullet}$

(C) $ClO^{\bullet}$

(D) $F^{\bullet}$

Q27. The IUPAC name of the compound given below is:

$$CH_3 - CH(CH_2CH_3) - CH(CHO) - CH_2 - CO - CH_3$$

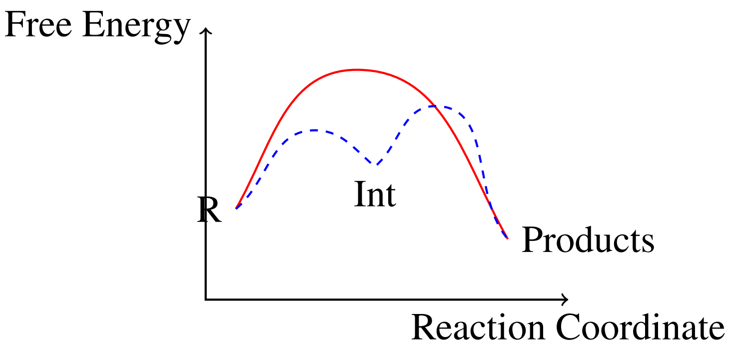
(A) 3-sec-butyl-4-oxopentanal

(B) 3-formyl-4-methylhexan-2-one

(C) 2-acetyl-3-methylpentanal

(D) 3-(1-methylpropyl)-4-oxopentanal

Q28. An organic substrate undergoes a substitution reaction via two competing kinetic pathways: S_N1 and S_N2. The reaction coordinate diagram below highlights the energy landscapes of both pathways. Which statement correctly deduces the operational conditions and mechanism based on the graph?



(A) The solid red curve signifies the S_N1 mechanism because it features a stable carbocation intermediate.

(B) The dashed blue curve signifies the S_N1 mechanism, showing a two-step process controlled by intermediate stability.

(C) Polar aprotic solvents lower the activation energy barrier of the dashed pathway specifically.

(D) A strong nucleophile at high concentration favors the mechanism given by the dashed blue line.

Q29. In the following reaction sequence, identify the major organic product Z:

$$\text{Benzene} \xrightarrow{CH_3CH_2CH_2Cl\,/\,AlCl_3} X \xrightarrow{O_2\,/\,\Delta} Y \xrightarrow{H_3O^+} Z + \text{Acetone}$$

(A) Phenol

(B) Benzoic acid

(C) Benzyl alcohol

(D) Acetophenone

Q30. An organic compound A ($C_4H_{11}N$) reacts with benzenesulfonyl chloride (Hinsberg's reagent to give a clean clear solution which on acidification with dilute HCl precipitates a solid material. When compound A is treated with $NaNO_2$ and HCl at 0°C, a gas is evolved with the formation of a primary alcohol. The structure of compound A is:

(A) $CH_3CH_2CH_2CH_2NH_2$

(B) $(CH_3CH_2)_2NH$

(C) $(CH_3)_3C-NH_2$

(D) $CH_3CH_2CH(NH_2)CH_3$

Section B – 5 Questions × 2 Marks Each
(Negative Marking: 0.5) [Single Correct]

Q31. An organic liquid compound X containing C, H, and O undergoes complete combustion. It is found that the volume of oxygen gas consumed is exactly equal to the volume of carbon dioxide gas liberated at standard states, and the mass ratio of carbon to hydrogen in the compound is $6:1$. If 0.1 mol of X reacts with excess sodium metal to liberate 1.12 L of $H_2(g)$ at STP, the true structural formula of X is:

(A) CH_3OH

(B) $HO - CH_2 - CH_2 - OH$

(C) $CH_3 - CH_2 - OH$

(D) $HO - CH_2 - CH(OH) - CH_2 - OH$

Q32. The half-life period for the first-order decomposition of a liquid substance A is 20 minutes at 300 K. The rate of reaction increases by 4 times when the temperature is raised to 320 K. If the reaction is carried out at 310 K starting with an initial concentration of $[A]_0 = 0.8$ M, the concentration of A left behind after 40 minutes will be: [Given: $\ln 2 = 0.693$]

(A) 0.20 M

(B) 0.10 M

(C) 0.40 M

(D) 0.05 M

Q33. The standard reduction potential (E°) of the conjugate redox couple $O_2(g) + 4H^+(aq) + 4e^- \rightleftharpoons 2H_2O(l)$ is +1.23 V. What will be the reduction potential (E) of this half-cell at 298 K if the partial pressure of O_2 gas is maintained at 0.1 atm and the solution pH is adjusted to 4.0? [Given: $\frac{2.303RT}{F} = 0.059$ V]

(A) +0.981 V

(B) +0.875 V

(C) +1.023 V

(D) +0.764 V

Q34. The crystal field stabilization energy (CFSE) of an octahedral coordination complex $[Fe(H_2O)_6]^{3+}$ is Δ_1 and that of a tetrahedral coordination complex $[FeCl_4]^-$ is Δ_2. Assuming both are high-spin complex configurations and the ligand field splitting parameter follows $\Delta_t = \frac{4}{9}\Delta_o$, the ratio $\Delta_1 : \Delta_2$ and the true spin-only magnetic moments are respectively:

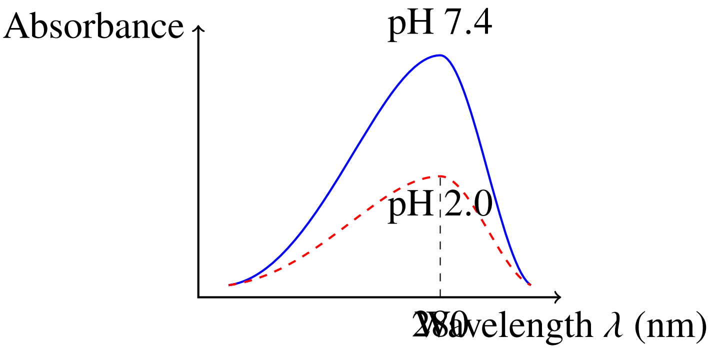
(A) 0 : 0 and 5.92 BM

(B) 1 : 1 and 4.90 BM

(C) 4 : 9 and 5.92 BM

(D) 0 : 0 and 1.73 BM

Q35. The UV-Visible absorption profiles of a specific globular protein under normal physiological conditions (pH = 7.4) and under highly acidic conditions (pH = 2.0) are recorded below. The significant drop and shift in the absorption band at 280 nm can be attributed to which structural change?



(A) The complete cleavage of primary peptide bonds yielding individual amino acids.

(B) Acid-induced denaturation of the tertiary structure, exposing and altering the microenvironment of aromatic residues like tryptophan and tyrosine.

(C) Complete oxidation of disulfide bridges into sulfonic acid groups.

(D) Hydrolysis of the prosthetic carbohydrate groups linked to the surface of the protein backbone.

Section C — 5 Questions × 2 Marks Each (No Negative Marking) [One or More Correct]

Q36. For a real gas displaying non-ideal behavior, the van der Waals equation can be adapted into the Virial equation of state: $Z = 1 + \frac{B}{V_m} + \frac{C}{V_m^2} + \dots$. Which of the following deductions regarding the inversion temperature (T_i), Boyle temperature (T_b), and Virial coefficient B are accurate?

(A) At the Boyle temperature ($T_b = \frac{a}{Rb}$), the second Virial coefficient B becomes zero.

(B) The mathematical relationship between inversion temperature and Boyle temperature is given by $T_i = 2T_b$.

(C) Below the Boyle temperature ($T < T_b$), the second Virial coefficient B is negative, which means attractive forces dominate.

(D) At low pressures, the van der Waals equation simplifies to $Z = 1 + \frac{b}{V_m}$, proving repulsive forces dominate.

Q37. The electronic configurations and properties of lanthanoids ($4f$-block elements) show smooth alterations due to the lanthanoid contraction effect. Which of the following statements are completely correct?

(A) Ce^{4+} ($Z = 58$) is a stable configuration and acts as a powerful oxidizing agent in aqueous solution, eventually reducing to Ce^{3+}.

(B) Eu^{2+} ($Z = 63$) acts as a strong reducing agent because it easily oxidizes to the highly stable $[Xe]4f^7$ half-filled core of Eu^{3+}.

(C) The basic character of the lanthanoid hydroxides $Ln(OH)_3$ increases from $La(OH)_3$ to $Lu(OH)_3$.

(D) Zr ($Z = 40$) and Hf ($Z = 72$) have almost identical atomic and ionic radii due to the intervention of the $4f$ electron shells.

Q38. Identify the chemically correct statements regarding the constitutional properties of s-block elements and their derived structures:

(A) Beryllium chloride ($BeCl_2$) forms a polymeric chain structure in the solid state containing three-centre-two-electron chlorido bridges.

(B) Lithium shows a diagonal relationship with magnesium; both form ionic nitrides directly when heated in a nitrogen atmosphere.

(C) Potassium superoxide (KO_2) is paramagnetic and colored due to the presence of an unpaired electron in the antibonding molecular orbital (π^*) of the O_2^- ion.

(D) Beryllium hydroxide ($Be(OH)_2$) is completely basic in nature, matching perfectly with the structural trends of the lower alkaline earth elements.

Q39. An organic compound containing a carbohydrate backbone is subjected to structural mapping tests. If the compound is a non-reducing disaccharide composed of D-glucose and D-fructose units, which of the following analytical observations hold true?

(A) It will not show mutarotation in an aqueous solution.

(B) It will form a clear red precipitate of Cu_2O when heated with Fehling's solution.

(C) The glycosidic linkage is formed between the $C-1$ of α-D-glucose and $C-2$ of β-D-fructose.

(D) Acid-catalyzed hydrolysis of this disaccharide turns the dextrorotatory solution into a levorotatory mixture.

Q40. A synthetic block of polymer is prepared by the condensation copolymerization of hexamethylenediamine and adipic acid. Choose the correct statements regarding this polymer block and related systems:

(A) The polymer formed is named Nylon-6,6 and is classified structurally as a polyamide.

(B) The polymerization reaction involves the elimination of small water molecules at each subsequent step.

(C) It is a classic thermoplastic polymer that possesses high tensile strength due to intermolecular hydrogen bonding.

(D) If adipic acid is replaced by terephthalic acid in a similar setup with ethylene glycol, the resulting polymer is a polyester known as Dacron.

Detailed Solutions

Q1.

Solution

Concept: Heating $NaHCO_3$ releases CO_2 and H_2O.

Mass loss:

$$10.0 - 8.45 = 1.55\text{ g}$$

$$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$$

$$168\text{ g } NaHCO_3 \rightarrow 62\text{ g loss}$$

Mass of $NaHCO_3$:

$$= \frac{168}{62} \times 1.55 = 4.2\text{ g}$$

Moles formed:

$$Na_2CO_3 = 0.0797$$

In 25 mL:

$$0.00797\text{ mol}$$

Using:

$$Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + CO_2 + H_2O$$

$$V = \frac{0.00797}{0.25} = 0.0318\text{ L}$$

$$= 31.8\text{ mL}$$

Final Answer: $\boxed{31.8\text{ mL}}$

$\boxed{\textbf{Answer: (B)}}$

Go Back to Question 1

Q2.

Solution

Concept: Total van't Hoff factor equals total particles formed after successive dissociation.

Solution:

Stepwise dissociation:

$$\mathrm{H_6A \rightleftharpoons H^+ + H_5A^-}$$

After first stage:

$$1 + \alpha_1$$

Second stage contributes:

$$+\alpha_1\alpha_2$$

Third stage contributes:

$$+\alpha_1\alpha_2\alpha_3$$

Hence:

$$i = 1 + \alpha_1 + \alpha_1\alpha_2 + \alpha_1\alpha_2\alpha_3$$

Final Answer: $\boxed{1 + \alpha_1 + \alpha_1\alpha_2 + \alpha_1\alpha_2\alpha_3}$

Answer: (A)

Go Back to Question 2

Q3.

Solution

Concept: The solid–liquid equilibrium line (fusion curve) determines how melting point changes with pressure.

From the phase diagram:

$$\frac{dP}{dT} < 0$$

for the fusion curve (negative slope).

Using Clapeyron equation:

$$\frac{dP}{dT} = \frac{\Delta H}{T\Delta V}$$

A negative slope implies:

$$\Delta V < 0$$

meaning the liquid occupies less volume than the solid.

Hence:

- Liquid is denser than solid.
- Increasing pressure favors the liquid phase.
- Therefore, melting point decreases with increase in pressure.

Final Answer: $\boxed{\text{Melting point decreases with increasing pressure.}}$

$\boxed{\textbf{Answer: (B)}}$

Go Back to Question 3

Q4.

Solution

Concept: Number of radial nodes is:

$$n - l - 1$$

Solution:

Given:

$$R(r) = N(6 - 6\sigma + \sigma^2)e^{-\sigma/3}$$

Polynomial:

$$6 - 6\sigma + \sigma^2 = 0$$

Two positive roots exist.

Hence:

$$\text{Radial nodes} = 2$$

From:

$$e^{-\sigma/3}$$

we get:

$$n = 3$$

Thus orbital is:

$$3s$$

Final Answer: $\boxed{2 \text{ radial nodes}, n = 3}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 4

Q5.

Solution

Concept: Total decay constant equals sum of partial decay constants.

Solution:

Given:

$$t_{1/2} = 60 \text{ days}$$

$$\lambda = \frac{0.693}{60}$$

Ratio:

$$\lambda_1 : \lambda_2 = 1 : 3$$

Let:

$$\lambda_1 = x, \quad \lambda_2 = 3x$$

Then:

$$4x = \frac{0.693}{60}$$

$$x = \frac{0.693}{240}$$

Partial half-life:

$$t_{1/2,\alpha} = \frac{0.693}{\lambda_1}$$

$$= 240 \text{ days}$$

Final Answer: $\boxed{240 \text{ days}}$

Answer: (C)

Go Back to Question 5

Q6.

Solution

Concept: Molecular dipole moment depends upon geometry and lone-pair arrangement.

Solution:

(A) $O(SiH_3)_2$

Bent molecule but no dominant d-orbital lone pair.

(B) SF_4

Sulfur has:

$$4 \text{ bond pairs} + 1 \text{ lone pair}$$

Geometry:

$$\text{Seesaw}$$

Because of asymmetric shape:

$$\mu \neq 0$$

Lone pair occupies equatorial position and shows expanded-shell d-character.

(C) XeO_3F_2

No stereochemically active lone pair satisfying condition.

(D) ClO_2

Polar but does not satisfy required lone-pair condition.

Hence correct molecule:

$$SF_4$$

Final Answer: $\boxed{SF_4}$

$\boxed{\textbf{Answer: (B)}}$

Go Back to Question 6

Q7.

Solution

Concept: Greater π-back bonding shortens metal–carbon bond length.

Solution:

Complexes:

$$\text{(I) } [\mathrm{V(CO)_6}]^-$$

$$\text{(II) } [\mathrm{Cr(CO)_6}]$$

$$\text{(III) } [\mathrm{Mn(CO)_6}]^+$$

Electron density:

$$[\mathrm{V(CO)_6}]^- > [\mathrm{Cr(CO)_6}] > [\mathrm{Mn(CO)_6}]^+$$

Hence back bonding:

$$\mathrm{I} > \mathrm{II} > \mathrm{III}$$

Stronger back bonding gives shorter bond length.

Therefore:

$$\mathrm{I} < \mathrm{II} < \mathrm{III}$$

Final Answer: $\boxed{\mathrm{I} < \mathrm{II} < \mathrm{III}}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 7

Q8.

Solution

Concept: Bond angle depends upon geometry and lone-pair repulsion.

Solution:

$$\mathbf{NO_2^+}$$

Linear:

$$180^\circ$$

$$\mathbf{NO_2}$$

Bent radical:

$$134^\circ$$

$$\mathbf{NO_2^-}$$

Bent with lone pair:

$$115^\circ$$

$$\mathbf{NH_4^+}$$

Tetrahedral:

$$109.5^\circ$$

Hence decreasing order:

$$NO_2^+ > NO_2 > NO_2^- > NH_4^+$$

Final Answer: $\boxed{NO_2^+ > NO_2 > NO_2^- > NH_4^+}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 8

Q9.

Solution

Concept:

- Strong electrolytes show a nearly linear decrease of molar conductivity with $\sqrt{C}$.
- Weak electrolytes show a highly curved plot because dissociation increases strongly on dilution.

From the graph:

- Electrolyte A shows a straight-line behavior

$$\Rightarrow \text{Strong electrolyte}$$

- Electrolyte B shows a curved plot

$$\Rightarrow \text{Weak electrolyte}$$

Kohlrausch's Law:

$$\Lambda_m^\circ \text{ of weak electrolytes cannot be obtained directly by extrapolation}$$

It is determined using:

$$\text{Law of independent migration of ions}$$

Final Answer: $\boxed{A \text{ is a strong electrolyte and } \Lambda_m^\circ \text{ of } B \text{ is found using Kohlrausch's law.}}$

Answer: (C)

Go Back to Question 9

Q10.

Solution

Concept: In ccp lattices:

$$\text{Octahedral voids} = N$$

$$\text{Tetrahedral voids} = 2N$$

Solution:

Occupied tetrahedral voids:

$$\frac{1}{6}(2N) = \frac{N}{3}$$

Occupied octahedral voids:

$$\frac{1}{3}(N) = \frac{N}{3}$$

Total metal ions:

$$\frac{2N}{3}$$

Oxide ions:

$$N$$

Ratio:

$$M : O = 2 : 3$$

Formula:

$$M_2O_3$$

Charge balance:

$$2x = 3(2)$$

$$x = +3$$

Final Answer: $\boxed{M_2O_3,\ x = +3}$

Answer: (A)

Go Back to Question 10

Q11.

Solution

Concept: For heterogeneous gaseous equilibria, solids do not contribute to pressure. Total pressure depends only on gaseous species present. If temperature increases and equilibrium shifts forward, gaseous mole fractions and total pressure both increase according to stoichiometry.

Solution:

Given equilibrium:

$$A(s) \rightleftharpoons B(g) + 2C(g)$$

At temperature T_1, let equilibrium partial pressure of B be:

$$p_B = x$$

Then by stoichiometry:

$$p_C = 2x$$

Hence total pressure at T_1:

$$P_1 = x + 2x = 3x$$

Now temperature is raised to T_2, and it is given that solid A is completely consumed.

Also:

$$p_B(T_2) = 2x$$

Since $B : C = 1 : 2$,

$$p_C(T_2) = 4x$$

Therefore total pressure at T_2:

$$P_2 = 2x + 4x = 6x$$

Thus:

$$P_2 = 2P_1$$

Hence:

$$\boxed{P_2 = 2P_1}$$

Final Answer: $\boxed{P_2 = 2P_1}$

Answer: (A)

Go Back to Question 11

Q12.

Solution

Concept: Complex formation increases solubility.

$$MX_2(s) \rightleftharpoons M^{2+} + 2X^-$$

$$K_{sp} = 4 \times 10^{-12}$$

$$M^{2+} + 4L \rightleftharpoons ML_4^{2+}, \qquad \beta_4 = 10^{10}$$

Let solubility be s.

$$[X^-] = 2s$$

Using:

$$K_{sp} = [M^{2+}](2s)^2$$

$$[M^{2+}]s^2 = 10^{-12}$$

Also,

$$[ML_4^{2+}] = 10^{10}[M^{2+}](10^{-2})^4 = 100[M^{2+}]$$

Thus,

$$s \approx 100[M^{2+}]$$

$$[M^{2+}] = \frac{s}{100}$$

Substituting:

$$\frac{s}{100}s^2 = 10^{-12}$$

$$s^3 = 10^{-10}$$

$$s \approx 4.6 \times 10^{-4}\ \text{M}$$

$$\boxed{4 \times 10^{-4}\ \text{M}}$$

Final Answer: $\boxed{4 \times 10^{-4}\ \text{M}}$

Answer: (D)

Go Back to Question 12

Q13.

Solution

Concept: The solubility of alkaline earth metal sulfates depends on the balance between:

$$\text{Hydration enthalpy } (-\Delta H_{\text{hyd}})$$

and

$$\text{Lattice enthalpy } (\Delta H_{\text{latt}})$$

- Down the group, ionic size increases.
- Hence, hydration enthalpy decreases rapidly.
- Lattice enthalpy decreases only slightly.

Therefore:

$$|\Delta H_{\text{hyd}}| \text{ decreases faster than } \Delta H_{\text{latt}}$$

As a result:

$$\text{Solubility decreases down the group}$$

Trend:

$$BeSO_4 > MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$$

Key Point:

$$BaSO_4 \text{ is nearly insoluble in water}$$

Final Answer: $\boxed{\text{Solubility decreases down the group due to lower hydration enthalpy.}}$

$\boxed{\textbf{Answer: (C)}}$

Go Back to Question 13

Q14.

Solution

Concept: For adiabatic process:

$$q = 0$$

Thus:

$$\Delta U = w$$

Solution:

Given:

$$V_1 = 5\text{ L}, \quad V_2 = 25\text{ L}$$

$$P_{\text{ext}} = 1\text{ atm}$$

Work done:

$$w = -P_{\text{ext}}(V_2 - V_1)$$

$$= -20\text{ L atm}$$

$$= -2026\text{ J}$$

Now:

$$\Delta U = nC_v(T_2 - T_1)$$

$$\frac{3}{2}R(T_2 - 300) = -2026$$

Using:

$$R = 8.314$$

$$12.471(T_2 - 300) = -2026$$

$$T_2 \approx 137.6\text{ K}$$

Final Answer: $\boxed{137.6\text{ K}}$

Answer: (A)

Go Back to Question 14

Q15.

Solution

Concept: In iodometric titration:

$$\text{Equivalents oxidant} = \text{Equivalents reductant}$$

Solution:

Given:

$$V = 45 \text{ mL}$$

$$N = 0.2N$$

Equivalents of thiosulfate:

$$= 0.2 \times \frac{45}{1000}$$

$$= 0.009$$

Thus equivalents of dichromate:

$$= 0.009$$

Volume of dichromate:

$$= 0.1 \text{ L}$$

Normality:

$$N = \frac{0.009}{0.1}$$

$$= 0.09N$$

Equivalent weight:

$$= \frac{294.2}{6} = 49.03$$

Strength:

$$= 0.09 \times 49.03$$

$$\approx 4.41 \text{ g L}^{-1}$$

Final Answer: $\boxed{4.41 \text{ g L}^{-1}}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 15

Q16.

Solution

Concept: In acidic medium:

$$MnO_4^-$$

accepts:

$$5e^-$$

Solution:

For:

$$FeC_2O_4$$

Total electrons released:

$$1 + 2 = 3$$

For:

$$Fe_2(C_2O_4)_3$$

Only oxalate oxidizes:

$$3 \times 2 = 6$$

Total electrons:

$$= 9$$

Required moles of:

$$KMnO_4$$

$$= \frac{9}{5} = 1.8$$

Using:

$$M = 0.25$$

Volume:

$$V = \frac{1.2}{0.25} = 4.8 \text{ L}$$

Final Answer: $\boxed{4.8 \text{ L}}$

$\boxed{\textbf{Answer: (B)}}$

Go Back to Question 16

Q17.

Solution

Concept:

$$W_{\text{max}} = nFE^\circ_{\text{cell}}$$

Larger emf gives larger maximum work.

Solution:

Given:

$$A = +0.34\text{ V}$$

$$B = -0.76\text{ V}$$

$$C = -0.44\text{ V}$$

For cell I:

$$E^\circ = 0.34 - (-0.76) = 1.10\text{ V}$$

For cell II:

$$E^\circ = -0.44 - (-0.76) = 0.32\text{ V}$$

For cell III:

$$E^\circ = 0.34 - (-0.44) = 0.78\text{ V}$$

Therefore:

$$1.10 > 0.78 > 0.32$$

Hence:

$$\boxed{\text{I} > \text{III} > \text{II}}$$

Final Answer: $\boxed{\text{I} > \text{III} > \text{II}}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 17

Q18.

Solution

Concept: During electrolysis of aqueous alkali metal halides, reduction at cathode and oxidation at anode depend upon discharge potentials and overvoltage effects.

Solution:

In concentrated aqueous LiCl solution:

At cathode, lithium metal is not discharged because:

$$E^\circ(\mathrm{Li^+/Li}) = -3.04\ \mathrm{V}$$

which is much lower than reduction of water.

Hence water gets reduced:

$$2\mathrm{H_2O} + 2e^- \rightarrow \mathrm{H_2} + 2\mathrm{OH^-}$$

Therefore cathode product is:

$$\mathrm{H_2}(g)$$

At anode, in concentrated chloride solution under high overvoltage conditions, chloride ions are preferentially oxidized:

$$2\mathrm{Cl^-} \rightarrow \mathrm{Cl_2} + 2e^-$$

Therefore anode product is:

$$\mathrm{Cl_2}(g)$$

Thus products obtained are:

$$\boxed{\mathrm{H_2}(g),\ \mathrm{Cl_2}(g)}$$

Final Answer: $\boxed{\mathrm{H_2}(g),\ \mathrm{Cl_2}(g)}$

Answer: (B)

Go Back to Question 18

Q19.

Solution

Concept: Ozone (O_3) in photochemical smog is a **secondary pollutant** formed by photochemical reactions involving:

$$NO_2 + h\nu \rightarrow NO + O$$

$$O + O_2 \rightarrow O_3$$

- Ozone concentration increases later in the day as sunlight intensity rises.
- Therefore, its concentration peaks during afternoon hours.

From the graph:

- Curve III rises later and peaks in the afternoon.
- Hence, Curve III represents ozone.

Key Point:

O_3 is a secondary pollutant formed by photochemical reactions

Final Answer: $\boxed{\text{Curve III — ozone forms secondarily from } NO_2 \text{ under sunlight}}$

$\boxed{\textbf{Answer: (C)}}$

Go Back to Question 19

Q20.

Solution

Concept: Alkali metals dissolve in liquid ammonia producing solvated electrons responsible for blue color, conductivity, and paramagnetism.

Solution:

When sodium dissolves in liquid ammonia:

$$\mathrm{Na} + \mathrm{NH_3} \longrightarrow \mathrm{Na}^+(am) + e^-(am)$$

The solvated electrons cause:

- deep blue color
- high electrical conductivity
- paramagnetic nature

On standing, sodium slowly reacts with ammonia:

$$2\mathrm{Na} + 2\mathrm{NH_3} \longrightarrow 2\mathrm{NaNH_2} + \mathrm{H_2}$$

Thus:

$$\mathrm{NaNH_2}$$

is formed as residue and

$$\mathrm{H_2}$$

gas is liberated.

Hence:

$$\boxed{\mathrm{NaNH_2},\ \mathrm{H_2}}$$

Final Answer: $\boxed{\mathrm{NaNH_2},\ \mathrm{H_2}}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 20

Q21.

Solution

Concept: Silicon dioxide reacts with carbon at high temperature to produce silicon carbide, a very hard abrasive material.

Solution:

At very high temperature:

$$SiO_2 + 3C \rightarrow SiC + 2CO$$

The hard abrasive material formed is:

$$SiC$$

called carborundum.

Also, SiO_2 on hydrolytic condensation forms silicates and silicones containing:

$$Si - O - Si$$

linkages.

Therefore:

$$X = SiO_2$$

and

$$Y = SiC$$

Hence:

$$\boxed{SiO_2,\ SiC}$$

Final Answer: $\boxed{SiO_2,\ SiC}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 21

Q22.

Solution

Concept: White phosphorus reacts with hot alkali producing phosphine and sodium hypophosphite.

Solution:

Reaction of white phosphorus with hot concentrated NaOH:

$$P_4 + 3NaOH + 3H_2O \rightarrow PH_3 + 3NaH_2PO_2$$

The poisonous gas formed is:

$$PH_3$$

(phosphine)

The salt formed is:

$$NaH_2PO_2$$

which is sodium hypophosphite.

The corresponding acid is:

$$H_3PO_2$$

Structure:

$$HOPH_2$$

Only one hydrogen is attached to oxygen and is ionizable.

Hence it is:

$$\text{Monobasic}$$

Therefore:

$$\boxed{PH_3,\ \text{Monobasic}}$$

Final Answer: $\boxed{PH_3,\ \text{Monobasic}}$

Answer: (A)

Go Back to Question 22

Q23.

Solution

Concept: During rotation about the $C_2 - C_3$ bond in *n*-butane:

- **Anti-conformation** has minimum energy.
- **Gauche-conformation** has intermediate energy.
- **Fully eclipsed conformation** has maximum energy because the two bulky CH_3 groups eclipse each other.

From the energy profile:

$$P \text{ has the highest potential energy}$$

Hence, point P corresponds to the:

$$\text{Fully eclipsed conformation}$$

Reason:

$$CH_3 - CH_3 \text{ eclipsing} \Rightarrow \text{Maximum torsional + steric strain}$$

Energy Order:

$$\text{Fully eclipsed} > \text{Eclipsed} > \text{Gauche} > \text{Anti}$$

Final Answer: $\boxed{\text{State } P, \text{ Fully Eclipsed conformation}}$

$\boxed{\textbf{Answer: (C)}}$

Go Back to Question 23

Q24.

Solution

Concept: Compounds differing in number of water molecules inside and outside coordination sphere show hydrate isomerism.

Solution:

Given complexes:

$$[Cr(H_2O)_6]Cl_3$$

and

$$[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$$

These differ in arrangement of water molecules:

- one water molecule moves from coordination sphere to crystal lattice

Hence they exhibit:

$$\text{Hydrate isomerism}$$

Oxidation state of chromium:

Let oxidation state be x:

$$x + 0 = +3$$

Thus:

$$Cr^{3+}$$

Electronic configuration:

$$3d^3$$

Number of unpaired electrons:

$$n = 3$$

Spin-only magnetic moment:

$$\mu = \sqrt{n(n+2)}$$

$$= \sqrt{3(3+2)}$$

$$= \sqrt{15}$$

$$\approx 3.87 \text{ BM}$$

Therefore:

$$\boxed{\text{Hydrate isomerism, } 3.87 \text{ BM}}$$

Final Answer: $\boxed{\text{Hydrate isomerism, } 3.87 \text{ BM}}$

$\boxed{\textbf{Answer: (B)}}$

Go Back to Question 24

Q25.

Solution

Concept: Coordination compounds that do not give AgCl precipitate contain no free chloride ions outside the coordination sphere.

Solution:

Given empirical formula:

$$PtCl_4 \cdot 2NH_3$$

The compound does not give precipitate with excess cold $AgNO_3$.

Hence:

$$\text{No free Cl}^-$$

ions are present outside the coordination sphere.

Therefore all chloride ions must be coordinated directly to platinum.

Among the given options:

$$[Pt(NH_3)_2Cl_4]$$

contains all chloride ions inside coordination sphere.

Thus no AgCl precipitate is formed.

Also, due to dimerization behavior, conductivity corresponds effectively to a 1 : 1 electrolyte system.

Hence correct structure is:

$$\boxed{[Pt(NH_3)_2Cl_4]}$$

Final Answer: $\boxed{[Pt(NH_3)_2Cl_4]}$

Answer: (B)

Go Back to Question 25

Q26.

Solution

Concept: Ozone depletion occurs through free-radical chain reactions initiated by chlorine radicals generated from CFC photolysis.

Solution:

Under ultraviolet radiation:

$$CF_2Cl_2 \xrightarrow{h\nu} CF_2Cl^{\bullet} + Cl^{\bullet}$$

The highly reactive radical responsible for catalytic ozone destruction is:

$$Cl^{\bullet}$$

Chain reactions:

$$Cl^{\bullet} + O_3 \rightarrow ClO^{\bullet} + O_2$$

$$ClO^{\bullet} + O \rightarrow Cl^{\bullet} + O_2$$

Overall:

$$O_3 + O \rightarrow 2O_2$$

Thus chlorine radical continuously destroys ozone molecules.

Hence:

$$\boxed{Cl^{\bullet}}$$

Final Answer: $\boxed{Cl^{\bullet}}$

$\boxed{\textbf{Answer: (B)}}$

Go Back to Question 26

Q27.

Solution

Concept: Aldehyde group has highest priority over ketone group in IUPAC nomenclature.

Solution:

Given compound:

$$CH_3 - CH(CH_2CH_3) - CH(CHO) - CH_2 - CO - CH_3$$

The aldehyde group:

$$(-CHO)$$

gets highest priority.

Hence parent chain must contain:

$$CHO$$

Longest chain containing aldehyde carbon:

$$CHO - CH - CH - CH_2 - CH_3$$

Thus parent compound is:

$$\text{pentanal}$$

Substituents:

At carbon-2:

$$\text{Acetyl group } (-COCH_3)$$

At carbon-3:

$$\text{Methyl group}$$

Therefore IUPAC name:

$$\boxed{\text{2-acetyl-3-methylpentanal}}$$

Final Answer: $\boxed{\text{2-acetyl-3-methylpentanal}}$

$\boxed{\textbf{Answer: (C)}}$

Go Back to Question 27

Q28.

Solution

Concept:

$$S_N1 \text{ reactions occur in two steps with a carbocation intermediate}$$

- A two-step energy profile contains:
  - Two transition states
  - One intermediate valley
- An S_N2 reaction occurs in a single concerted step and therefore has only one energy barrier.

From the graph:

- The dashed blue curve shows:

$$\text{Reactants} \longrightarrow \text{Intermediate} \longrightarrow \text{Products}$$

- Hence, it represents the:

$$S_N1 \text{ mechanism}$$

Key Point:

$$S_N1 \Rightarrow \text{Two-step pathway with carbocation intermediate}$$

Explanation of Other Options:

- The red solid curve corresponds to one-step S_N2.
- Polar aprotic solvents favor S_N2, not S_N1.
- Strong nucleophiles favor S_N2 pathway.

Final Answer: $\boxed{\text{The dashed blue curve signifies the } S_N1 \text{ mechanism}}$

$\boxed{\textbf{Answer: (B)}}$

Go Back to Question 28

Go Back to Question 29

Solution

Concept: Friedel-Crafts alkylation with propyl chloride forms isopropylbenzene due to carbocation rearrangement.

Solution:

Step-1:

$$\text{Benzene} \xrightarrow{\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl/AlCl}_3} X$$

Primary carbocation rearranges:

$$\text{CH}_3\text{CH}_2\text{CH}_2^+ \rightarrow (\text{CH}_3)_2\text{CH}^+$$

Thus:

$$X = \text{Cumene}$$

(isopropylbenzene)

Step-2:

Cumene reacts with oxygen:

$$\text{Cumene} \xrightarrow{\text{O}_2} \text{Cumene hydroperoxide}$$

Step-3:

Acidic hydrolysis:

$$\text{Cumene hydroperoxide} \xrightarrow{\text{H}_3\text{O}^+} \text{Phenol} + \text{Acetone}$$

Thus:

$$Z = \text{Phenol}$$

Hence:

$$\boxed{\text{Phenol}}$$

Final Answer: $\boxed{\text{Phenol}}$

$\boxed{\textbf{Answer: (A)}}$

b

Solution

Concept: Primary amines react with Hinsberg reagent to form soluble sulfonamides and with nitrous acid liberate nitrogen gas forming alcohols.

Solution:

Given:

$$C_4H_{11}N$$

The compound gives clear solution with Hinsberg reagent.

Hence it is a:

$$\text{Primary amine}$$

Reaction:

$$RNH_2 + C_6H_5SO_2Cl \longrightarrow \text{Sulfonamide}$$

Sulfonamide dissolves in alkali and precipitates on acidification.

Also:

$$RNH_2 + HONO \longrightarrow ROH + N_2$$

Nitrogen gas evolution confirms primary aliphatic amine.

Among given options, suitable primary amine is:

$$CH_3CH_2CH_2CH_2NH_2$$

Hence:

$$\boxed{CH_3CH_2CH_2CH_2NH_2}$$

Final Answer: $\boxed{CH_3CH_2CH_2CH_2NH_2}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 30

Solution

Concept: Alcohol liberates hydrogen gas with sodium. One OH group gives half mole of H_2 per mole of alcohol.

Solution:

$$0.1 \text{ mol compound} \longrightarrow 0.05 \text{ mol } H_2$$

Hence compound contains:

$$1 \text{ OH group}$$

Using combustion condition:

$$y = 2z$$

Compound satisfying condition:

$$CH_3OH$$

Hence:

$$\boxed{CH_3OH}$$

Final Answer: $\boxed{CH_3OH}$

Answer: (A)

Go Back to Question 31

Solution

Concept: For first-order reactions:

$$t_{1/2} = \frac{0.693}{k}$$

Solution:

At 310 K:

$$k = 2k_{300} = 0.0693 \text{ min}^{-1}$$

Using:

$$[A] = [A]_0 e^{-kt}$$

$$[A] = 0.8e^{-(0.0693)(40)}$$

$$= 0.8\left(\frac{1}{2}\right)^4$$

$$= 0.05 \text{ M}$$

Hence:

$$\boxed{0.05 \text{ M}}$$

Final Answer: $\boxed{0.05 \text{ M}}$

$\boxed{\textbf{Answer: (D)}}$

Go Back to Question 32

Solution

Concept: Nernst equation gives electrode potential under non-standard conditions.

Solution:

Using:

$$E = E^{\circ} - \frac{0.059}{4} \log Q$$

$$Q = \frac{1}{0.1(10^{-4})^4} = 10^{17}$$

$$E = 1.23 - \frac{0.059}{4}(17)$$

$$\approx 0.98 \text{ V}$$

Hence:

$$\boxed{+0.981 \text{ V}}$$

Final Answer: $\boxed{+0.981 \text{ V}}$

Answer: (A)

Go Back to Question 33

Solution

Concept: High-spin d^5 complexes have zero CFSE.

Solution:

For both complexes:

$$\text{Fe}^{3+} = 3d^5$$

Thus:

$$\Delta_1 = \Delta_2 = 0$$

Magnetic moment:

$$\mu = \sqrt{5(5+2)}$$

$$= \sqrt{35} \approx 5.92 \text{ BM}$$

Hence:

$$\boxed{0 : 0 \text{ and } 5.92 \text{ BM}}$$

Final Answer: $\boxed{0 : 0 \text{ and } 5.92 \text{ BM}}$

Answer: (A)

Go Back to Question 34

Solution

Concept: Proteins absorb strongly near:

$$280 \text{ nm}$$

due to aromatic amino acids such as:

$$\text{Tryptophan, Tyrosine, and Phenylalanine}$$

At highly acidic pH:

$$\text{Protein denaturation occurs}$$

which disrupts:

$$\text{Secondary and tertiary structures}$$

This changes the microenvironment around aromatic residues, causing:

- Decrease in absorbance
- Shift in absorption profile

Key Point:

$$\text{Primary peptide bonds remain largely intact during denaturation}$$

Final Answer: $\boxed{\text{Acid-induced denaturation of the tertiary structure, exposing aromatic residues}}$

$\boxed{\textbf{Answer: (B)}}$

Go Back to Question 35

Solution

Concept: Boyle temperature occurs when second Virial coefficient becomes zero.

Solution:

$$B = b - \frac{a}{RT}$$

At Boyle temperature:

$$T_b = \frac{a}{Rb}$$

Also:

$$T_i = \frac{2a}{Rb} = 2T_b$$

For:

$$T < T_b$$

$$B < 0$$

Thus attractive forces dominate.

Hence:

$$\boxed{\text{A, B and C}}$$

Final Answer: $\boxed{\text{A, B and C}}$

$\boxed{\textbf{Answer: (A,B,C)}}$

Go Back to Question 36

Solution

Concept: Lanthanoid contraction causes gradual variation in properties.

Solution:

$$\mathrm{Ce}^{4+} \rightarrow \mathrm{Ce}^{3+}$$

acts as oxidizing agent.

$$\mathrm{Eu}^{2+}$$

is stable due to:

$$4f^7$$

$$\text{Zr and Hf}$$

have similar radii due to lanthanoid contraction.

Hence correct statements:

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

Final Answer: $\boxed{\text{A and D}}$

$\boxed{\textbf{Answer: (A,D)}}$

Go Back to Question 37

Solution

Concept: s-Block elements show anomalous behavior due to small size and high charge density.

Solution:

$$\mathrm{BeCl_2}$$

is polymeric.

$$\text{Li and Mg}$$

form nitrides.

$$\mathrm{KO_2}$$

contains paramagnetic superoxide ion.

$$\mathrm{Be(OH)_2}$$

is amphoteric.

Hence:

$$\boxed{\text{A, B and C}}$$

Final Answer: $\boxed{\text{A, B and C}}$

$\boxed{\textbf{Answer: (A,B,C)}}$

Go Back to Question 38

Solution

Concept: Sucrose is a non-reducing disaccharide.

Solution:

Sucrose does not show mutarotation.

Linkage:

$$\alpha(1 \to 2)\beta$$

Hydrolysis gives:

$$\text{glucose + fructose}$$

Hence:

$$\boxed{\text{A, C and D}}$$

Final Answer: $\boxed{\text{A, C and D}}$

$\boxed{\textbf{Answer: (A,C,D)}}$

Go Back to Question 39

Solution

Concept: Nylon-6, 6 is a condensation polymer containing amide linkage.

Solution:

Formed from:

$$\text{Hexamethylenediamine} + \text{Adipic acid}$$

Contains:

$$-\text{CONH}-$$

Water is eliminated during polymerization.

Hence:

$$\boxed{\text{A, B, C and D}}$$

Final Answer: $\boxed{\text{A, B, C and D}}$

Answer: (A,B,C,D)

Go Back to Question 40

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	A	3	B	4	A	5	C
6	B	7	A	8	A	9	C	10	A
11	A	12	D	13	C	14	A	15	A
16	B	17	A	18	B	19	C	20	A
21	A	22	A	23	C	24	B	25	B
26	B	27	C	28	B	29	A	30	A
31	A	32	D	33	A	34	A	35	B
36	A,B,C	37	A,D	38	A,B,C	39	A,C,D	40	A,B,C,D