SRMJEEE Chemistry Sample Paper – 3

Duration: 41 Minutes **Maximum Marks: 35**

Instructions

- This paper contains **35** Multiple Choice Questions (Single Correct Answer), modelled on the Chemistry section of **SRMJEEE** (SRM Joint Engineering Entrance Examination).
- Each correct answer carries **+1 mark**. There is **no negative marking**; an unattempted or wrong answer scores 0.
- Only **one** option is correct. Choose carefully.
- The actual SRMJEEE is a **computer-based test** conducted in remote-proctored online mode, with all sections sharing a common time window and no per-section limit.
- Personal calculators, mobile phones, log tables and other electronic gadgets are strictly prohibited.

Q1. 4.0 g of sodium hydroxide (molar mass $= 40$ g mol^{-1}) is dissolved and the solution is made up to 500 mL. The molarity of the solution is:

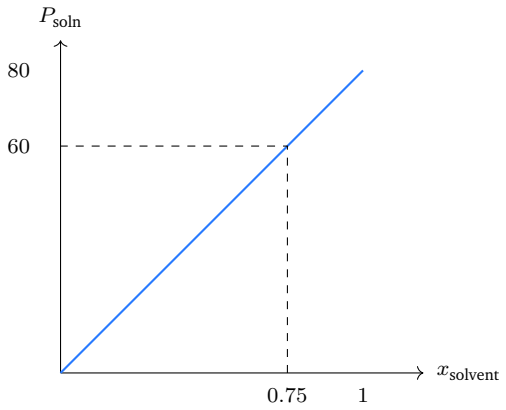
(A) 0.2 M

(B) 0.1 M

(C) 0.4 M

(D) 0.5 M

Q2. For a solution of a non-volatile solute in a volatile solvent, the vapour pressure of the solution equals $x_{\text{solvent}}\,P^{\circ}$. The graph shows how the solution's vapour pressure varies with the mole fraction of the solvent. If $P^{\circ} = 80$ mmHg for the pure solvent and the mole fraction of the solvent is 0.75, the vapour pressure of the solution is:



(A) 80 mmHg

(B) 60 mmHg

(C) 20 mmHg

(D) 75 mmHg

Q3. When 0.5 mol of NaCl is dissolved in 1 kg of water ($K_f = 1.86$ K kg mol^{-1}), assuming complete dissociation ($i = 2$), the depression in freezing point is:

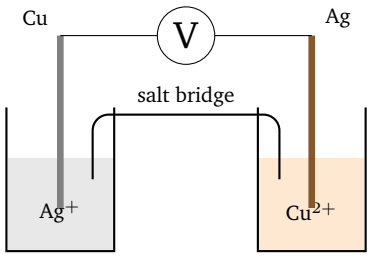
(A) 0.93 K

(B) 0.465 K

(C) 1.86 K

(D) 3.72 K

Q4. For the galvanic cell shown, the standard cell potential is found to be $E^\circ_{\text{cell}} = +0.46$ V. On the basis of the sign of E°_{cell}, the cell reaction as written is:



(A) non-spontaneous, since E°_{cell} is positive

(B) at equilibrium, since $E^\circ_{\text{cell}} = 0$

(C) non-spontaneous, since E°_{cell} is negative

(D) spontaneous, since E°_{cell} is positive

Q5. The molar conductivity Λ_m is related to the specific conductivity (conductivity) κ and the molar concentration c by:

(A) $\Lambda_m = \kappa \times c$

(B) $\Lambda_m = \dfrac{\kappa \times 1000}{c}$

(C) $\Lambda_m = \dfrac{c}{\kappa}$

(D) $\Lambda_m = \kappa \times c \times 1000$

Q6. According to Faraday's first law of electrolysis, the mass m of a substance deposited at an electrode is:

(A) directly proportional to the quantity of charge passed

(B) inversely proportional to the charge passed

(C) independent of the charge passed

(D) proportional to the square of the charge passed

Q7. For a reaction the rate law is found to be rate $= k[A][B]^2$. The overall order of the reaction is:

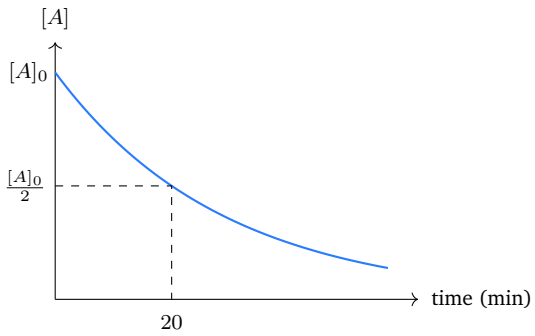
(A) 1

(B) 2

(C) 3

(D) 4

Q8. A first-order reaction has a half-life of 20 min, as shown by the decay curve. The rate constant k of the reaction is approximately $(\ln 2 = 0.693)$:



(A) $0.693\ \text{min}^{-1}$

(B) $20\ \text{min}^{-1}$

(C) $0.139\ \text{min}^{-1}$

(D) $0.0347\ \text{min}^{-1}$

Q9. A catalyst increases the rate of a chemical reaction by:

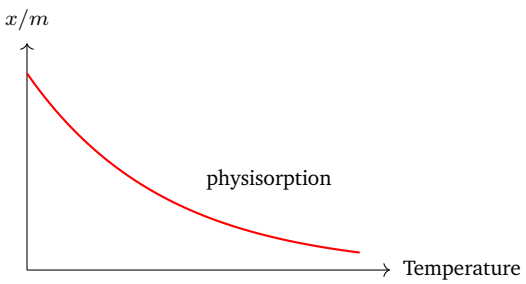
(A) providing an alternative path of lower activation energy

(B) increasing the activation energy of the reaction

(C) raising the enthalpy change of the reaction

(D) shifting the position of equilibrium to the right

Q10. Physical adsorption (physisorption) is an exothermic process. The graph shows the extent of physical adsorption (x/m) of a gas on a solid as a function of temperature at constant pressure. As the temperature is raised, the extent of physical adsorption:



(A) increases continuously

(B) decreases

(C) remains constant

(D) first increases, then becomes zero suddenly

Q11. When an electric field is applied across a colloidal sol, the charged colloidal particles migrate towards the oppositely charged electrode. This movement is called:

(A) the Tyndall effect

(B) Brownian motion

(C) electrophoresis

(D) dialysis

Q12. A characteristic feature of enzyme catalysis is its high specificity, which means that a particular enzyme:

(A) catalyses every reaction in the cell

(B) works only at very high temperatures

(C) is consumed during the reaction it speeds up

(D) catalyses only one particular reaction (or substrate)

Q13. The greater stability of the lower oxidation states Pb^{2+} (over Pb^{4+}) and Tl^{+} (over Tl^{3+}) for the heavier p-block elements is explained by:

(A) the inert-pair effect

(B) the lanthanide contraction

(C) hydrogen bonding

(D) the diagonal relationship

Q14. The oxidation state of nitrogen in nitric acid, HNO_3, is:

(A) $+3$

(B) $+4$

(C) $+5$

(D) -3

Q15. The correct order of reducing character of the group-15 hydrides is:

(A) $NH_3 > PH_3 > AsH_3 > SbH_3$

(B) $SbH_3 > AsH_3 > PH_3 > NH_3$

(C) $PH_3 > NH_3 > SbH_3 > AsH_3$

(D) $AsH_3 > SbH_3 > NH_3 > PH_3$

Q16. The number of unpaired electrons in the Fe^{3+} ion (atomic number of Fe $= 26$) is:

(A) 3

(B) 6

(C) 4

(D) 5

Q17. When potassium permanganate, $KMnO_4$, acts as an oxidant in acidic medium, manganese is reduced to:

(A) Mn^{2+}

(B) MnO_2

(C) MnO_4^{2-}

(D) Mn metal

Q18. Transition metals show variable oxidation states mainly because:

(A) their atoms are very large

(B) they have only s-electrons available for bonding

(C) the energies of the $(n-1)d$ and ns orbitals are close, so both sets of electrons take part in bonding

(D) they have completely filled d-orbitals

Q19. The correct formula of the complex potassium hexacyanoferrate(III) is:

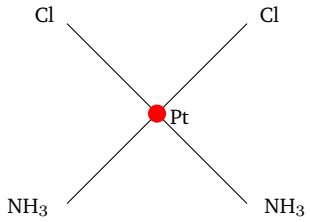
(A) $K_4[Fe(CN)_6]$

(B) $K_3[Fe(CN)_6]$

(C) $K_2[Fe(CN)_6]$

(D) $K[Fe(CN)_6]$

Q20. The square-planar complex $[Pt(NH_3)_2Cl_2]$ exists as two geometrical isomers. The structure drawn below, with the two Cl ligands on the same side, represents which isomer?



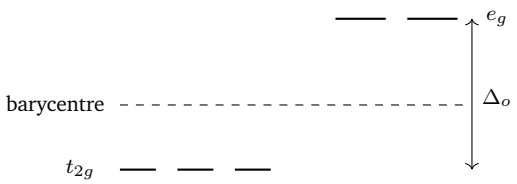
(A) the optical isomer

(B) an ionisation isomer

(C) the *trans* isomer

(D) the *cis* isomer

Q21. The crystal-field splitting diagram for an octahedral complex is shown, with the splitting energy Δ_o marked. A *strong-field* ligand is one that produces a *large* Δ_o. From the spectrochemical series, which of the following is the strongest-field ligand?



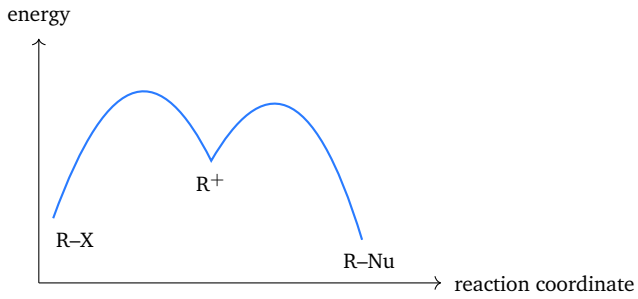
(A) CN^-

(B) Cl^-

(C) F^-

(D) H_2O

Q22. The two-step energy profile shown (with a carbocation R^+ intermediate) is that of an S_N1 reaction, whose rate depends on carbocation stability. The correct order of S_N1 reactivity of alkyl halides is:



(A) $1^\circ > 2^\circ > 3^\circ$

(B) $2^\circ > 3^\circ > 1^\circ$

(C) $3^\circ > 2^\circ > 1^\circ$

(D) all react at the same rate

Q23. When an alkyl halide is treated with sodium metal in dry ether (the Wurtz reaction), the main product is:

(A) an alcohol

(B) a symmetrical alkane with twice the number of carbon atoms

(C) an alkene

(D) an ether

Q24. In the Dow process, chlorobenzene is heated with aqueous NaOH at high temperature and pressure, then acidified. The product is:

(A) benzene

(B) aniline

(C) benzoic acid

(D) phenol

Q25. An alcohol is heated with concentrated H_2SO_4 at about 443 K. The reaction gives an alkene, and the ease of this dehydration follows the order:

(A) $3^\circ > 2^\circ > 1^\circ$ alcohol

(B) $1^\circ > 2^\circ > 3^\circ$ alcohol

(C) $2^\circ > 1^\circ > 3^\circ$ alcohol

(D) all alcohols dehydrate equally easily

Q26. When sodium phenoxide is treated with carbon dioxide under pressure and the product is acidified (Kolbe's reaction), the main product is:

(A) benzoic acid

(B) picric acid

(C) salicylic acid

(D) phenyl acetate

Q27. When excess ethanol is heated with concentrated H_2SO_4 at about 413 K, the main product is:

(A) ethene

(B) diethyl ether

(C) ethanal

(D) ethyl hydrogen sulphate only

Q28. Sodium bisulphite ($NaHSO_3$) forms a crystalline addition product (used to purify carbonyl compounds) with:

(A) only aromatic ketones such as benzophenone

(B) all ketones irrespective of size

(C) esters and carboxylic acids

(D) aldehydes and methyl ketones (small, less hindered carbonyls)

Q29. Tollens' reagent (ammoniacal silver nitrate) gives a bright silver mirror when warmed with:

(A) an aldehyde

(B) acetone

(C) a tertiary alcohol

(D) an ether

Q30. When the sodium salt of a carboxylic acid is heated with soda lime (NaOH and CaO), it undergoes decarboxylation to give:

(A) an alcohol with one more carbon

(B) an alkane with one less carbon

(C) an alkene

(D) a ketone

Q31. Compared with aniline, *p*-nitroaniline is a *weaker* base. This is because the $–NO_2$ group is:

(A) electron-donating, increasing the lone-pair density on nitrogen

(B) involved only in hydrogen bonding

(C) electron-withdrawing, reducing the availability of the lone pair on nitrogen

(D) too bulky, sterically blocking the lone pair

Q32. In the Sandmeyer reaction, a benzene diazonium salt is treated with cuprous chloride (CuCl/HCl) to give:

(A) phenol

(B) nitrobenzene

(C) an azo dye

(D) chlorobenzene

Q33. When treated with nitrous acid (HNO_2, i.e. $NaNO_2$ + HCl) at low temperature, an *aliphatic primary* amine characteristically gives:

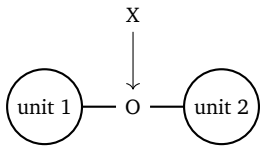
(A) nitrogen gas (brisk effervescence) with an alcohol

(B) a stable, coloured nitrosamine

(C) no reaction at all

(D) a stable diazonium salt at room temperature

Q34. In disaccharides such as sucrose and maltose, the two monosaccharide units are joined together, with loss of a water molecule, through the linkage marked X in the diagram. This linkage is a:



(A) a peptide linkage

(B) a glycosidic linkage

(C) an ester linkage

(D) a hydrogen bond

Q35. When a protein is heated or treated with acid, it loses its biological activity because of denaturation. Denaturation involves the disruption of the protein's:

(A) primary structure (the sequence of amino acids)

(B) peptide bonds, breaking it into free amino acids

(C) secondary and tertiary structure, while the primary structure remains intact

(D) only the order of amino acids in the chain

Detailed Solutions

Q1.

Solution

Concept — Molarity: Molarity $M = \dfrac{\text{moles of solute}}{\text{volume of solution in litres}}$.

Step 1 — Moles of NaOH: $n = \dfrac{4.0}{40} = 0.1$ mol.

Step 2 — Volume in litres: 500 mL $= 0.5$ L, so $M = \dfrac{0.1}{0.5} = 0.2$ M.

Why other options are wrong:

- (B) 0.1 is the number of moles, not divided by the volume.
- (C) uses 0.25 L; (D) uses 1 mol of solute incorrectly.

Final Answer: $M = 0.2$ M $\Rightarrow$ A

Answer: (A) Go Back to Q1

Q2.

Solution

Concept — Raoult's law (non-volatile solute): the vapour pressure of the solution is $P_{\text{soln}} = x_{\text{solvent}}\, P^{\circ}$, a straight line from the origin up to P° at $x_{\text{solvent}} = 1$.

Step 1 — Substitute the values:

$$P_{\text{soln}} = 0.75 \times 80 = 60 \text{ mmHg}.$$

Step 2 — Read the graph: the dashed construction at $x_{\text{solvent}} = 0.75$ meets the line at 60 mmHg, confirming the value.

Why other options are wrong:

- (A) 80 is the pure-solvent vapour pressure ($x_{\text{solvent}} = 1$).
- (C) 20 is the lowering $P^{\circ} - P_{\text{soln}}$, not the solution pressure; (D) 75 confuses the mole fraction with mmHg.

Final Answer: $P_{\text{soln}} = 60$ mmHg $\Rightarrow$ B

Answer: (B) Go Back to Q2

Q3.

Solution

Concept — Depression of freezing point: $\Delta T_f = i\,K_f\,m$, where i is the van't Hoff factor and m the molality.

Step 1 — Molality: 0.5 mol in 1 kg water $\Rightarrow m = 0.5$ mol kg^{-1}.

Step 2 — Substitute ($i = 2$ for NaCl):

$$\Delta T_f = 2 \times 1.86 \times 0.5 = 1.86 \text{ K}.$$

Why other options are wrong:

- (A) 0.93 ignores the factor $i = 2$ (1.86×0.5).
- (B) 0.465 uses $m = 0.25$; (D) 3.72 wrongly takes $i \times m = 2$.

Final Answer: $\Delta T_f = 1.86$ K $\Rightarrow$ C

Answer: (C) Go Back to Q3

Q4.

Solution

Concept — Sign of E°_{cell} and spontaneity: for a cell reaction, $\Delta G^\circ = -nFE^\circ_{\text{cell}}$. A *positive* E°_{cell} gives a *negative* ΔG°, so the reaction is spontaneous.

Step 1 — Read the sign: here $E^\circ_{\text{cell}} = +0.46$ V > 0, so $\Delta G^\circ < 0$.

Step 2 — Conclusion: the cell reaction proceeds spontaneously as written (Cu is oxidised, Ag^+ is reduced).

Why other options are wrong:

- (A),(C) a positive E°_{cell} means spontaneous, not non-spontaneous.
- (B) $E^\circ_{\text{cell}} = 0$ (equilibrium) would require zero potential, but it is $+0.46$ V.

Final Answer: spontaneous (positive E°_{cell}) $\Rightarrow$ D

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Specific vs molar conductivity: the specific conductivity (conductivity) κ is the conductance of unit volume; the molar conductivity Λ_m is the conducting power of all the ions from one mole of electrolyte.

Step 1 — The relation: with c in mol L^{-1} and κ in S cm^{-1},

$$\Lambda_m = \frac{\kappa \times 1000}{c} \quad (\text{S cm}^2\ \text{mol}^{-1}).$$

The factor 1000 converts litres to cm^3.

Why other options are wrong:

- (A),(D) Λ_m is κ divided by (not multiplied by) concentration.
- (C) inverts the ratio of κ and c.

Final Answer: $\Lambda_m = \frac{\kappa \times 1000}{c} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q5

Q6.

Solution

Concept — Faraday's first law: the mass of a substance liberated or deposited at an electrode is directly proportional to the quantity of electric charge ($Q = It$) passed through the electrolyte.

Step 1 — Statement: $m \propto Q$, i.e. $m = ZQ = ZIt$, where Z is the electrochemical equivalent.

Why other options are wrong:

- (B),(C) the mass rises with charge; it is neither inversely related nor independent.
- (D) the relationship is linear in Q, not quadratic.

Final Answer: m directly proportional to charge $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q6

Q7.

Solution

Concept — Overall order: the overall order of a reaction is the sum of the exponents of the concentration terms in the experimentally determined rate law.

Step 1 — Add the exponents: for rate $= k[A]^1[B]^2$, the orders are 1 (in A) and 2 (in B).

Step 2 — Sum: overall order $= 1 + 2 = 3$.

Why other options are wrong:

- (A),(B) 1 and 2 are the partial orders in A and B alone.
- (D) 4 would require an extra factor not present in the rate law.

Final Answer: overall order $= 3 \Rightarrow$ C

Answer: (C) Go Back to Q7

Q8.

Solution

Concept — Half-life of a first-order reaction: $t_{1/2} = \dfrac{0.693}{k}$, so $k = \dfrac{0.693}{t_{1/2}}$.

Step 1 — Substitute $t_{1/2} = 20$ min:

$$k = \frac{0.693}{20} = 0.0347 \text{ min}^{-1}.$$

Step 2 — Graph check: the curve falls to half its initial value at $t = 20$ min, the half-life, consistent with this k.

Why other options are wrong:

- (A) 0.693 uses $t_{1/2} = 1$ min; (C) 0.139 uses $t_{1/2} = 5$ min.
- (B) 20 min^{-1} confuses $t_{1/2}$ with k.

Final Answer: $k = 0.0347$ min$^{-1} \Rightarrow$ D

Answer: (D) Go Back to Q8

Q9.

Solution

Concept — Action of a catalyst: a catalyst speeds up a reaction by providing an alternative reaction pathway with a *lower activation energy*, so a larger fraction of molecules can cross the energy barrier.

Step 1 — Effect: lowering E_a increases the rate constant k (via $k = Ae^{-E_a/RT}$) for both forward and backward reactions equally.

Why other options are wrong:

- (B) a catalyst *lowers*, not raises, E_a.
- (C) it does not change the reaction enthalpy ΔH; (D) it does not shift the equilibrium position (only speeds attainment of equilibrium).

Final Answer: provides a path of lower activation energy $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Temperature and physisorption: physical adsorption is exothermic ($\Delta H < 0$). By Le Chatelier's principle, raising the temperature shifts the equilibrium away from the adsorbed state.

Step 1 — Effect of heating: for physical adsorption, increasing temperature *decreases* the extent of adsorption x/m, as the graph shows the curve falling with temperature.

Why other options are wrong:

- (A),(C) physisorption decreases (it does not increase or stay constant) on heating.
- (D) it falls smoothly; it does not drop abruptly to zero.

Final Answer: extent of physical adsorption decreases $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Charge on colloidal particles: colloidal particles carry a like charge. Under an applied electric field they migrate towards the electrode of opposite charge.

Step 1 — Name the phenomenon: this migration of charged sol particles in an electric field is called *electrophoresis* (e.g. a negatively charged sol moves to the anode).

Why other options are wrong:

- (A) the Tyndall effect is the scattering of light by sol particles.
- (B) Brownian motion is their random zig-zag movement; (D) dialysis removes dissolved ions through a membrane.

Final Answer: electrophoresis $\Rightarrow$ C

Answer: (C) Go Back to Q11

Q12.

Solution

Concept — Specificity of enzymes: enzymes are biological catalysts with active sites of a definite shape. Each enzyme is highly specific and usually catalyses only one particular reaction (or acts on one particular substrate).

Step 1 — Example: urease catalyses only the hydrolysis of urea, and no other amide; maltase acts only on maltose.

Why other options are wrong:

- (A) an enzyme does not catalyse every reaction; that contradicts specificity.
- (B) enzymes work best near body temperature; (C) like all catalysts, they are not consumed.

Final Answer: catalyses only one particular reaction $\Rightarrow$ D

Answer: (D) Go Back to Q12

Q13.

Solution

Concept — Inert-pair effect: for the heavier p-block elements (e.g. Tl, Pb, Bi), the two ns electrons are reluctant to take part in bonding (poor shielding by intervening d/f electrons makes them tightly held), so the oxidation state two units below the group state becomes more stable.

Step 1 — Apply to the ions: hence Pb^{2+} is more stable than Pb^{4+}, and Tl^{+} more stable than Tl^{3+}.

Why other options are wrong:

- (B) the lanthanide contraction affects radii of d/f-block elements.
- (C),(D) hydrogen bonding and the diagonal relationship are unrelated to this stability trend.

Final Answer: the inert-pair effect $\Rightarrow$ A

Answer: (A) Go Back to Q13

Q14.

Solution

Concept — Oxidation-state balance: the sum of oxidation states in a neutral molecule is zero. Take H $= +1$, O $= -2$.

Step 1 — Set up for HNO_3: $(+1) + x + 3(-2) = 0 \Rightarrow 1 + x - 6 = 0$.

Step 2 — Solve: $x = +5$, the maximum (group) oxidation state of nitrogen.

Why other options are wrong:

- (A),(B) $+3/+4$ occur in HNO_2/NO_2, not in HNO_3.
- (D) -3 is the state of N in NH_3.

Final Answer: oxidation state of N $= +5 \Rightarrow$ C

Answer: (C) Go Back to Q14

Q15.

Solution

Concept — Reducing character of group-15 hydrides: the thermal stability of the EH_3 hydrides falls down the group (E–H bond weakens), so the hydrides become *easier to oxidise*, i.e. their reducing power increases down the group.

Step 1 — Order: $SbH_3 > AsH_3 > PH_3 > NH_3$. NH_3 is the most stable and the poorest reducing agent.

Why other options are wrong:

- (A) is the reverse trend (that is the order of *stability*/basicity, not reducing power).
- (C),(D) jumble the order; reducing character must rise steadily from NH_3 to SbH_3.

Final Answer: $SbH_3 > AsH_3 > PH_3 > NH_3 \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q15

Q16.

Solution

Concept — Counting unpaired electrons: write the electronic configuration of the ion and apply Hund's rule to the d-orbitals.

Step 1 — Configuration of Fe^{3+}: Fe ($Z = 26$) is $[Ar]3d^6 4s^2$; removing three electrons (two $4s$, one $3d$) gives $Fe^{3+} = [Ar]3d^5$.

Step 2 — Apply Hund's rule: the five $3d$ electrons singly occupy the five d-orbitals $\Rightarrow 5$ unpaired electrons.

Why other options are wrong:

- (A) 3 would be d^3 or low-spin d^6; (B) 6 is the number of d-electrons in Fe^{2+}, not unpaired.
- (C) 4 corresponds to d^6 high spin (Fe^{2+}), not Fe^{3+}.

Final Answer: 5 unpaired electrons $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — Reduction of permanganate in acidic medium: in acidic solution, MnO_4^- (Mn in $+7$) is reduced by gaining five electrons to the colourless Mn^{2+} ion ($+2$).

Step 1 — Half-reaction:

$$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O.$$

Why other options are wrong:

- (B) MnO_2 ($+4$) is the product in *neutral/faintly alkaline* medium.
- (C) MnO_4^{2-} ($+6$, manganate) forms in *strongly alkaline* medium; (D) Mn metal is not produced.

Final Answer: Mn^{2+} (acidic medium) $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Variable oxidation states: in transition elements the $(n-1)d$ and ns orbitals are very close in energy. Because the energy gap is small, electrons from *both* the ns and the $(n-1)d$ sub-shells can be involved in bonding.

Step 1 — Consequence: a metal can lose different numbers of these electrons, giving several oxidation states that differ by one unit (e.g. Mn shows $+2$ to $+7$).

Why other options are wrong:

- (A) atomic size is not the cause of variable valency.
- (B) both s and d electrons take part, not s alone; (D) completely filled d-orbitals (e.g. Zn) actually limit variable states.

Final Answer: close $(n-1)d$ and ns energies $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q18

Q19.

Solution

Concept — Formula from IUPAC name: "hexacyano" = six CN^- ligands; "ferrate(III)" means the complex is an anion with iron in the $+3$ state; "potassium" is the counter-cation.

Step 1 — Charge on the complex ion: Fe^{3+} with six CN^- gives $(+3)+6(-1) = -3$, so the ion is $[Fe(CN)_6]^{3-}$.

Step 2 — Balance the charge: three K^+ are needed $\Rightarrow K_3[Fe(CN)_6]$.

Why other options are wrong:

- (A) $K_4[Fe(CN)_6]$ is the iron(II) (ferrate(II)) complex.
- (C),(D) do not balance the -3 charge of the complex ion.

Final Answer: $K_3[Fe(CN)_6] \Rightarrow$ B

Answer: (B) Go Back to Q19

Q20.

Solution

Concept — Geometrical isomerism in square-planar MA_2B_2: a square-planar complex with two pairs of ligands shows *cis* (identical ligands adjacent, $90°$) and *trans* (identical ligands opposite, $180°$) isomers.

Step 1 — Read the figure: the two Cl ligands occupy adjacent corners (same side) $\Rightarrow$ this is the *cis* isomer (cisplatin).

Why other options are wrong:

- (A) $[Pt(NH_3)_2Cl_2]$ is not optically active; this is geometrical isomerism.
- (B) ionisation isomerism needs exchangeable counter-ions; (C) *trans* would have the two Cl ligands opposite each other.

Final Answer: the *cis* isomer $\Rightarrow$ D

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Spectrochemical series: ligands are ordered by the size of the crystal-field splitting Δ_o they produce. Strong-field ligands give a large Δ_o; weak-field ligands a small one. A partial series is:

$$I^- < Br^- < Cl^- < F^- < H_2O < NH_3 < en < CN^- < CO.$$

Step 1 — Pick the strongest: of the four choices, CN^- lies farthest to the right, so it produces the largest Δ_o and is the strongest-field ligand.

Why other options are wrong:

- (B),(C) Cl^- and F^- are weak-field ligands (small Δ_o).
- (D) H_2O is intermediate but weaker than CN^-.

Final Answer: CN^- (strong field) $\Rightarrow$ A

Answer: (A) Go Back to Q21

Q22.

Solution

Concept — S_N1 reactivity and carbocation stability: the rate-determining step of an S_N1 reaction is ionisation to a carbocation. The more stable the carbocation, the faster the reaction.

Step 1 — Stability order of carbocations: $3^\circ > 2^\circ > 1^\circ$ (hyperconjugation and $+I$ effect of more alkyl groups stabilise the positive charge).

Step 2 — Reactivity order: therefore S_N1 reactivity is $3^\circ > 2^\circ > 1^\circ$, matching the two-hump energy profile shown.

Why other options are wrong:

- (A) $1^\circ > 2^\circ > 3^\circ$ is the reverse (and is the S_N2 trend).
- (B) scrambles the order; (D) the rates clearly differ with carbocation stability.

Final Answer: $3^\circ > 2^\circ > 1^\circ \Rightarrow$ C

Answer: (C) Go Back to Q22

Q23.

Solution

Concept — Wurtz reaction: two molecules of an alkyl halide react with sodium metal in dry ether to give a higher, symmetrical alkane, coupling the two alkyl groups.

Step 1 — General equation:

$$2\,\text{R–X} + 2\text{Na} \xrightarrow{\text{dry ether}} \text{R–R} + 2\text{NaX}.$$

For example, $2\,CH_3Br$ gives ethane (C_2H_6).

Why other options are wrong:

- (A),(C),(D) alcohols/alkenes/ethers are not the products of the Na coupling reaction.
- The product has *twice* the carbons of the starting halide, a symmetrical alkane.

Final Answer: a symmetrical alkane $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q23

Q24.

Solution

Concept — Dow process: chlorobenzene is converted to phenol by heating with aqueous NaOH (about 623 K, 300 atm); the sodium phenoxide formed is then acidified to phenol.

Step 1 — Reactions:

$$C_6H_5Cl + NaOH \rightarrow C_6H_5ONa + NaCl; \quad C_6H_5ONa + H^+ \rightarrow C_6H_5OH.$$

Why other options are wrong:

- (A),(B) benzene/aniline require different reagents (e.g. reduction, ammonia).
- (C) benzoic acid is not formed by hydrolysis of chlorobenzene.

Final Answer: phenol $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q24

Q25.

Solution

Concept — Acid-catalysed dehydration of alcohols: concentrated H_2SO_4 at high temperature removes a molecule of water from an alcohol to give an alkene (E1 mechanism via a carbocation).

Step 1 — Ease of dehydration: the reaction proceeds through a carbocation, so the more stable the carbocation, the easier the dehydration. Hence $3^\circ > 2^\circ > 1^\circ$ alcohol.

Why other options are wrong:

- (B) is the reverse order; 1° alcohols need the most forcing conditions.
- (C) scrambles the order; (D) the classes clearly differ in ease of dehydration.

Final Answer: $3^\circ > 2^\circ > 1^\circ$ alcohol $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — Kolbe's reaction: sodium phenoxide is treated with CO_2 under pressure (~ 400 K, 4–7 atm); the carboxyl group enters mainly at the *ortho* position. On acidification, salicylic acid (2-hydroxybenzoic acid) is obtained.

Step 1 — Outcome: $C_6H_5ONa + CO_2 \rightarrow$ sodium salicylate $\xrightarrow{H^+}$ salicylic acid.

Why other options are wrong:

- (A) benzoic acid lacks the ortho –OH group.
- (B) picric acid comes from nitration; (D) phenyl acetate is an ester, not a Kolbe product.

Final Answer: salicylic acid $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q26

Q27.

Solution

Concept — Ether by dehydration of alcohol: at a *moderate* temperature ($\sim$ 413 K) and with excess alcohol, conc. H_2SO_4 removes water *between two alcohol molecules*, giving an ether (intermolecular dehydration).

Step 1 — Reaction:

$$2\,C_2H_5OH \xrightarrow[413\ K]{\text{conc. } H_2SO_4} C_2H_5\text{–O–}C_2H_5 + H_2O.$$

Why other options are wrong:

- (A) ethene forms at the *higher* temperature (443 K, intramolecular).
- (C) ethanal needs an oxidising agent; (D) ethyl hydrogen sulphate is only the intermediate.

Final Answer: diethyl ether $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q27

Q28.

Solution

Concept — Sodium bisulphite addition: $NaHSO_3$ adds across the C=O of *less hindered* carbonyl compounds to give a crystalline bisulphite adduct, used to separate and purify them.

Step 1 — Which carbonyls react: only *aldehydes* and *methyl ketones* (small, sterically unhindered carbonyl carbons) form the adduct. Bulky ketones do not, because of steric crowding.

Why other options are wrong:

- (A),(B) hindered/aromatic ketones such as benzophenone do *not* form the adduct.
- (C) esters and acids have no reactive carbonyl-addition site here.

Final Answer: aldehydes and methyl ketones $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q28

Q29.

Solution

Concept — Tollens' test: ammoniacal silver nitrate, $[Ag(NH_3)_2]^+$, is a mild oxidising agent. An aldehyde reduces Ag^+ to metallic silver, which deposits as a bright *silver mirror* on the tube.

Step 1 — Reaction: $R\text{–}CHO + 2[Ag(NH_3)_2]^+ + 3OH^- \rightarrow R\text{–}COO^- + 2Ag\downarrow + \ldots$ The aldehyde is oxidised to a carboxylate.

Why other options are wrong:

- (B) acetone (a ketone) does *not* reduce Tollens' reagent.
- (C),(D) tertiary alcohols and ethers are not oxidised by Tollens' reagent.

Final Answer: an aldehyde $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to Q29

Q30.

Solution

Concept — Decarboxylation: heating the sodium salt of a carboxylic acid with soda lime ($NaOH + CaO$) removes CO_2, replacing –COONa by –H.

Step 1 — Reaction:

$$R\text{–}COONa + NaOH \xrightarrow{CaO,\,\Delta} R\text{–}H + Na_2CO_3.$$

The product is an alkane with *one carbon less* than the acid (e.g. $CH_3COONa \rightarrow CH_4$).

Why other options are wrong:

- (A) no alcohol is formed; (C) no C=C double bond is introduced.
- (D) a ketone is not the decarboxylation product of a single acid salt.

Final Answer: an alkane with one less carbon $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q30

Q31.

Solution

Concept — Substituent effect on aniline basicity: the basic strength of aniline depends on the electron density of the lone pair on the nitrogen. Electron-withdrawing groups reduce this density, weakening the base.

Step 1 — Effect of –NO_2: the –NO_2 group is strongly electron-withdrawing ($-I$ and $-M$). In p-nitroaniline it pulls electron density away from the N lone pair (especially via resonance), so the lone pair is less available to accept a proton.

Step 2 — Conclusion: p-nitroaniline is therefore a weaker base than aniline.

Why other options are wrong:

- (A) –NO_2 is electron-*withdrawing*, not donating.
- (B),(D) the dominant effect is electronic withdrawal, not mere H-bonding or sterics.

Final Answer: –NO_2 is electron-withdrawing $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q31

Q32.

Solution

Concept — Sandmeyer reaction: the –N_2^+ group of an aromatic diazonium salt is replaced by Cl, Br or CN using the corresponding cuprous halide/cyanide (CuCl, CuBr, CuCN).

Step 1 — With CuCl/HCl:

$$C_6H_5N_2^+Cl^- \xrightarrow{\text{CuCl/HCl}} C_6H_5Cl + N_2.$$

The product is chlorobenzene, with evolution of N_2.

Why other options are wrong:

- (A) phenol forms on *warming with water*, not with CuCl.
- (B) nitrobenzene is unrelated; (C) an azo dye forms by *coupling* with phenol/aniline.

Final Answer: chlorobenzene $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q32

Q33.

Solution

Concept — Reaction of amines with HNO_2: nitrous acid distinguishes the three classes of amine. An aliphatic *primary* amine forms a very unstable diazonium salt that at once decomposes, liberating N_2 gas (brisk effervescence) and giving an alcohol.

Step 1 — Primary amine: $R\text{–}NH_2 + HNO_2 \rightarrow R\text{–}OH + N_2\uparrow + H_2O$.

Step 2 — Contrast: secondary amines give a yellow oily nitrosamine, and tertiary amines form soluble nitrite salts (no N_2).

Why other options are wrong:

- (B) a nitrosamine is the test for a *secondary* amine.
- (C) primary amines do react; (D) aliphatic diazonium salts are *not* stable at room temperature (only aromatic ones are, at 0–5 °C).

Final Answer: N_2 gas + alcohol $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — Glycosidic linkage: in a disaccharide two monosaccharide units are joined when the –OH of one sugar reacts with the –OH (anomeric) of another, eliminating a water molecule to form a C–O–C bridge.

Step 1 — Name the linkage: this oxygen bridge (the bond marked X in the figure) joining the two sugar units is a *glycosidic linkage* (e.g. an α-1,4 linkage in maltose).

Why other options are wrong:

- (A) peptide linkages join amino acids in proteins.
- (C) ester linkages occur in fats; (D) a hydrogen bond is non-covalent and does not join the two units here.

Final Answer: a glycosidic linkage $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q34

Q35.

Solution

Concept — Denaturation of proteins: on heating or treatment with acid/heavy-metal salts, a protein loses its native three-dimensional shape. The hydrogen bonds and other forces holding the coiled and folded structure break.

Step 1 — What is lost: denaturation destroys the *secondary* (e.g. α-helix) and *tertiary* (folded) structure, so the globular protein uncoils. Its biological activity is lost (e.g. egg-white coagulating on boiling).

Step 2 — What is retained: the *primary* structure (peptide bonds, sequence of amino acids) is *not* broken during denaturation.

Why other options are wrong:

- (A),(D) the primary structure (amino-acid sequence) is unaffected.
- (B) covalent peptide bonds are not hydrolysed in denaturation.

Final Answer: loss of secondary and tertiary structure $\Rightarrow$ C

Answer: (C) Go Back to Q35

Answer Key

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