SRMJEEE Chemistry Sample Paper – 8

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 in water to make exactly 500 mL of solution. The molarity of the solution is:

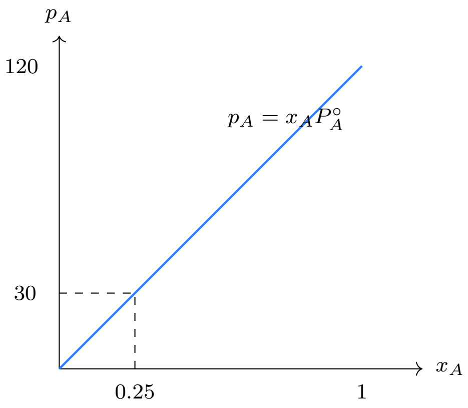
(A) 0.1 M

(B) 0.2 M

(C) 0.4 M

(D) 1.0 M

Q2. For an ideal binary solution, the partial pressure of component A varies linearly with its mole fraction x_A, as shown. If the vapour pressure of pure A is 120 mmHg, the partial pressure of A in a solution with $x_A = 0.25$ is:



(A) 60 mmHg

(B) 30 mmHg

(C) 90 mmHg

(D) 120 mmHg

Q3. The van't Hoff factor i for an aqueous solution of $K_4[Fe(CN)_6]$, assuming complete dissociation, is:

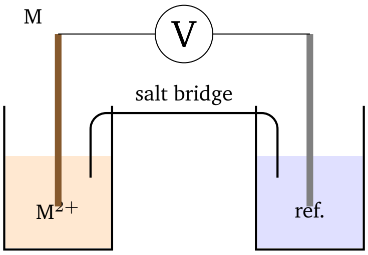
(A) 2

(B) 4

(C) 5

(D) 6

Q4. For the half-cell $M^{2+}(aq) + 2e^- \rightarrow M(s)$, the electrode potential follows the Nernst equation. In the cell shown, if the concentration of M^{2+} in the electrode compartment is *increased*, the electrode potential of this half-cell:



(A) increases (becomes more positive)

(B) decreases (becomes more negative)

(C) stays exactly the same

(D) falls to zero

Q5. The SI-derived unit in which molar conductivity Λ_m is conventionally expressed is:

(A) S cm^2 mol^{-1}

(B) S cm^{-1}

(C) S mol cm^{-2}

(D) Ω cm^2 mol^{-1}

Q6. The quantity of electric charge required to deposit one mole of silver from a $AgNO_3$ solution is $(1\ F = 96500\ \text{C})$:

(A) 48250 C

(B) 193000 C

(C) 96500 C

(D) 289500 C

Q7. For the reaction $2N_2O_5 \rightarrow 4NO_2 + O_2$, the rate of the reaction is correctly expressed as:

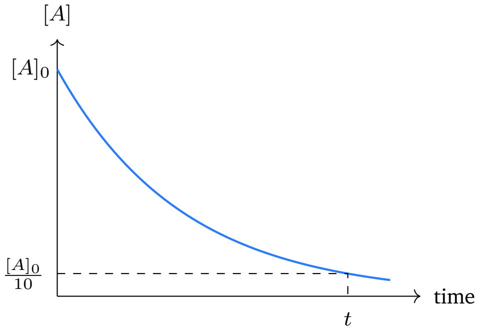
(A) $+\dfrac{d[N_2O_5]}{dt}$

(B) $+\dfrac{1}{4}\dfrac{d[NO_2]}{dt}$ only, ignoring O_2

(C) $-\dfrac{d[N_2O_5]}{dt}$

(D) $-\dfrac{1}{2}\dfrac{d[N_2O_5]}{dt} = +\dfrac{1}{4}\dfrac{d[NO_2]}{dt} = +\dfrac{d[O_2]}{dt}$

Q8. A first-order reaction has rate constant $k = 2.303 \times 10^{-3}\ \text{s}^{-1}$. The decay of the reactant is shown. The time required for the concentration to fall to one-tenth of its initial value is:



(A) 1000 s

(B) 100 s

(C) 2303 s

(D) 230.3 s

Q9. For most reactions the rate constant approximately doubles for a $10\ ^\circ$C rise in temperature. Hence the ratio k_2/k_1 (temperature coefficient) for a $10\ ^\circ$C rise is of the order of:

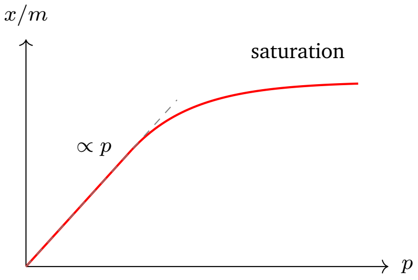
(A) 0.5

(B) 2

(C) 10

(D) 0

Q10. The Freundlich isotherm $\dfrac{x}{m} = k\,p^{1/n}$ approaches a limiting form at very *low* pressure. As shown by the initial part of the curve, at low p the extent of adsorption x/m is:



(A) directly proportional to p $(1/n \to 1)$

(B) independent of p $(1/n \to 0)$

(C) proportional to p^2

(D) proportional to $1/p$

Q11. The electric charge on the particles of a colloidal sol arises mainly from:

(A) the Tyndall scattering of light

(B) the preferential adsorption of ions from the dispersion medium

(C) the Brownian motion of the particles

(D) dialysis through a membrane

Q12. In the Haber process for the manufacture of ammonia, the catalyst used is:

(A) V_2O_5

(B) Pt

(C) finely divided iron (with Mo as promoter)

(D) Ni

Q13. The correct order of *thermal stability* of the hydrogen halides is:

(A) $HF > HCl > HBr > HI$

(B) $HI > HBr > HCl > HF$

(C) $HCl > HF > HBr > HI$

(D) $HBr > HCl > HF > HI$

Q14. The oxidation state of xenon in the compound XeF_4 is:

(A) $+2$

(B) $+4$

(C) $+6$

(D) $+8$

Q15. As we move from left to right across a period, the nature of the oxides of the elements generally changes in the order:

(A) acidic → amphoteric → basic

(B) acidic → basic → amphoteric

(C) amphoteric → basic → acidic

(D) basic → amphoteric → acidic

Q16. Which of the following ions has the *highest* spin-only magnetic moment?

(A) Ti^{3+}

(B) Ni^{2+}

(C) Mn^{2+}

(D) Cu^{2+}

Q17. In aqueous solution Cu^{2+} is more stable than Cu^{+}, even though removing the second electron costs more energy. The main reason is that:

(A) Cu^{+} has a half-filled d-subshell

(B) Cu^{2+} is colourless and hence inert

(C) Cu^{+} has a higher ionisation enthalpy than Cu^{2+}

(D) the much greater hydration enthalpy of Cu^{2+} more than compensates for its higher ionisation enthalpy

Q18. Across the $3d$ transition series, the enthalpy of atomisation is found to be *maximum* near the middle of the series. This is mainly because elements in the middle:

(A) have completely filled d-orbitals

(B) have the largest number of unpaired d-electrons available for metallic bonding

(C) have the lowest melting points

(D) show no metallic bonding at all

Q19. In the complex ion $[Cr(en)_2Cl_2]^+$ (en = ethylenediamine, a bidentate ligand), the coordination number of chromium is:

(A) 3

(B) 4

(C) 6

(D) 8

Q20. The two compounds $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5SO_4]Br$, shown schematically, give different ions in solution. This pair is an example of:

$$\begin{array}{c}[Co(NH_3)_5Br]^{2+}\\ +\ SO_4^{2-}\ \text{(free)}\end{array}\xrightarrow{\text{isomers}}\begin{array}{c}[Co(NH_3)_5SO_4]^{+}\\ +\ Br^{-}\ \text{(free)}\end{array}$$

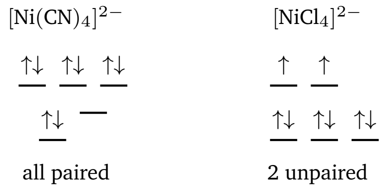
(A) ionisation isomerism

(B) geometrical isomerism

(C) optical isomerism

(D) linkage isomerism

Q21. $[Ni(CN)_4]^{2-}$ is diamagnetic whereas $[NiCl_4]^{2-}$ is paramagnetic. The crystal-field d-orbital fillings of Ni^{2+} (d^8) are shown. The diamagnetism of the cyanide complex is because the strong-field CN^- ligand causes:



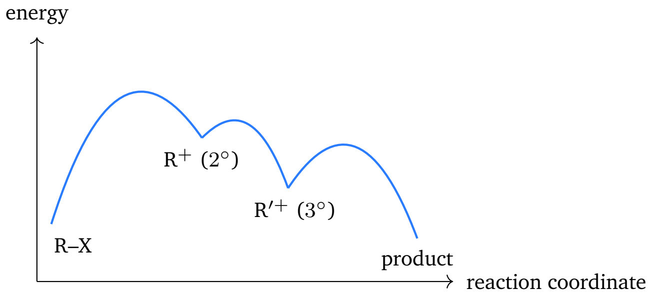
(A) sp^3 hybridisation with two unpaired electrons

(B) a high-spin tetrahedral arrangement

(C) no change in the number of unpaired electrons

(D) pairing of the d-electrons, giving dsp^2 (square-planar) hybridisation

Q22. During the S_N1 solvolysis of neopentyl-type substrates, the first-formed carbocation rearranges to a more stable one before the nucleophile attacks, as the energy profile shows. The driving force for this rearrangement is:



(A) formation of a less stable primary cation

(B) conversion of a tertiary cation into a primary one

(C) a 1,2-shift (hydride or methyl) giving a more stable carbocation

(D) loss of the leaving group only

Q23. When 2-bromobutane is treated with alcoholic KOH, the *major* alkene formed is but-2-ene rather than but-1-ene. This preference for the more substituted alkene is explained by:

(A) Markovnikov's rule

(B) the peroxide (anti-Markovnikov) effect

(C) Hofmann's rule

(D) Saytzeff's rule

Q24. A reliable way to introduce a chlorine atom onto a benzene ring at a specific position (via the corresponding diazonium salt) is the:

(A) Wurtz–Fittig reaction

(B) Sandmeyer reaction (diazonium salt + CuCl/HCl)

(C) Friedel–Crafts alkylation

(D) Cannizzaro reaction

Q25. Mild oxidation of a *secondary* alcohol, such as propan-2-ol, gives:

(A) a ketone (propanone)

(B) a carboxylic acid (propanoic acid)

(C) an aldehyde (propanal)

(D) an ester

Q26. Nitration of phenol with dilute nitric acid gives, as the main products, a mixture of:

(A) only m-nitrophenol

(B) nitrobenzene and water

(C) o-nitrophenol and p-nitrophenol

(D) 2,4,6-trinitrophenol only

Q27. When methyl tert-butyl ether, CH_3–O–C$(CH_3)_3$, is heated with *excess* HI, the products are:

(A) CH_3OH and $(CH_3)_3CI$

(B) CH_3I and $(CH_3)_3COH$ only

(C) CH_3OH and $(CH_3)_3COH$

(D) CH_3I and $(CH_3)_3CI$ (tert-butyl carbocation route)

Q28. An organic compound gives an orange-yellow precipitate with 2,4-dinitrophenylhy (Brady's reagent). The compound must contain:

(A) a hydroxyl ($-$OH) group

(B) a carbonyl ($>$C$=$O) group of an aldehyde or ketone

(C) a carboxyl ($-$COOH) group

(D) an amino ($-NH_2$) group

Q29. Which reagent gives a positive test (silver mirror) with an aldehyde but *not* with a ketone, and is therefore used to distinguish the two?

(A) Tollens' reagent (ammoniacal $AgNO_3$)

(B) bromine water

(C) 2,4-DNP reagent

(D) neutral $FeCl_3$

Q30. A carboxylic acid (R–COOH) is most conveniently converted into its acid chloride (R–COCl) by treatment with:

(A) dilute NaOH

(B) $LiAlH_4$

(C) thionyl chloride, $SOCl_2$ (or PCl_5)

(D) Tollens' reagent

Q31. Hinsberg's reagent (benzenesulphonyl chloride, $C_6H_5SO_2Cl$) is used to distinguish primary, secondary and tertiary amines. A *tertiary* amine, when treated with this reagent:

(A) gives a product soluble in alkali

(B) gives a product insoluble in alkali

(C) forms a foul-smelling isocyanide

(D) does not react at all (no substitutable N–H)

Q32. Benzene diazonium chloride couples with aniline in mildly acidic medium to give:

(A) chlorobenzene

(B) p-aminoazobenzene (a yellow azo compound)

(C) phenol

(D) benzene

Q33. The Hofmann bromamide degradation converts an amide R–$CONH_2$ into a primary amine. The amine formed has:

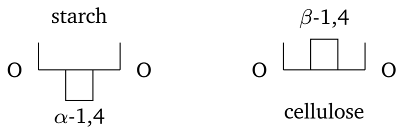
(A) one carbon atom *fewer* than the starting amide (R–NH_2)

(B) the same number of carbon atoms as the amide

(C) one carbon atom more than the amide

(D) two carbon atoms fewer than the amide

Q34. Starch and cellulose are both polymers of glucose, but they differ in the type of glycosidic linkage joining the glucose units, as shown. Cellulose contains:



(A) α-1,4-glycosidic linkages

(B) ester linkages

(C) β-1,4-glycosidic linkages

(D) peptide linkages

Q35. Which one of the following sets contains only *fat-soluble* vitamins?

(A) vitamin B and vitamin C

(B) vitamin C and vitamin D

(C) vitamin B_{12} and vitamin K

(D) vitamins A, D, E and K

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:

- (A) 0.1 uses 1 L instead of 0.5 L.
- (C),(D) use the wrong moles or volume.

Final Answer: $M = 0.2\text{ M} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Raoult's law (partial pressure): for an ideal solution the partial pressure of a component is $p_A = x_A P_A^\circ$, a straight line through the origin.

Step 1 — Substitute:

$$p_A = 0.25 \times 120 = 30\text{ mmHg}.$$

Step 2 — Read the graph: the dashed construction at $x_A = 0.25$ meets the line at 30 mmHg.

Why other options are wrong:

- (A),(C) use $x_A = 0.5$ or 0.75 by mistake.
- (D) 120 is the pure-A value at $x_A = 1$.

Final Answer: $p_A = 30\text{ mmHg} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q2

Q3.

Solution

Concept — van't Hoff factor: i equals the number of particles released per formula unit on complete dissociation; it scales every colligative property.

Step 1 — Dissociate $K_4[Fe(CN)_6]$:

$$K_4[\mathrm{Fe(CN)}_6] \rightarrow 4\,K^+ + [\mathrm{Fe(CN)}_6]^{4-}.$$

Step 2 — Count the ions: four K^+ plus one complex anion $= 5$ particles, so $i = 5$.

Why other options are wrong:

- (A),(B) $2/4$ undercount the ions.
- (D) 6 wrongly splits the intact $[\mathrm{Fe(CN)}_6]^{4-}$ anion.

Final Answer: $i = 5 \Rightarrow \boxed{\text{C}}$

Answer: (C)

Go Back to Q3

Q4.

Solution

Concept — Nernst equation for a reduction half-cell:

$$E = E^\circ - \frac{0.059}{n}\log\frac{1}{[\mathrm{M}^{2+}]} = E^\circ + \frac{0.059}{n}\log[\mathrm{M}^{2+}].$$

Step 1 — Effect of increasing $[\mathrm{M}^{2+}]$: a larger $[\mathrm{M}^{2+}]$ makes $\log[\mathrm{M}^{2+}]$ larger, so the $+\frac{0.059}{n}\log[\mathrm{M}^{2+}]$ term increases E.

Step 2 — Conclusion: the electrode potential rises (becomes more positive) as the reactant-ion concentration is increased.

Why other options are wrong:

- (B) the potential increases, not decreases.
- (C),(D) the Nernst term changes E; it does not stay constant or vanish.

Final Answer: increases (more positive) $\Rightarrow \boxed{\text{A}}$

Answer: (A)

Go Back to Q4

Q5.

Solution

Concept — Molar conductivity: $\Lambda_m = \dfrac{\kappa \times 1000}{c}$, where κ is in S cm^{-1} and c in mol per litre; the units therefore work out to S cm^2 mol^{-1}.

Step 1 — Dimensional check: $\dfrac{\text{S cm}^{-1}}{\text{mol cm}^{-3}} = \text{S cm}^2\ \text{mol}^{-1}$.

Why other options are wrong:

- (B) S cm^{-1} is the unit of conductivity κ, not molar conductivity.
- (C) is dimensionally incorrect; (D) Ω cm^2 mol^{-1} is the unit of molar *resistance*, the reciprocal quantity.

Final Answer: S cm^2 mol^{-1} $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept — Faraday's law: depositing one mole of a metal of charge $+n$ needs n faradays of charge.

Step 1 — Charge on the ion: Ag$^+$ needs only one electron, so $n = 1$.

Step 2 — Total charge: $Q = nF = 1 \times 96500 = 96500$ C.

Why other options are wrong:

- (A) 48250 is half a faraday; (B) 193000 is for a $+2$ ion.
- (D) 289500 is for a $+3$ ion such as Al^{3+}.

Final Answer: $Q = 96500$ C (1 F) $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — Rate of a reaction: for $aA \to bB$, the unique rate is each species' rate divided by its stoichiometric coefficient, with a minus sign for reactants.

Step 1 — Write for $2N_2O_5 \to 4NO_2 + O_2$:

$$\text{rate} = -\frac{1}{2}\frac{d[N_2O_5]}{dt} = +\frac{1}{4}\frac{d[NO_2]}{dt} = +\frac{d[O_2]}{dt}.$$

Step 2 — Identify the correct full expression: option (D) lists all three equal terms with the correct coefficients and signs.

Why other options are wrong:

- (A),(C) omit the factor $\frac{1}{2}$ (and (A) has the wrong sign).
- (B) ignores the O_2 term and the N_2O_5 term entirely.

Final Answer: the full balanced rate expression $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q7

Q8.

Solution

Concept — First-order integrated law: $t = \dfrac{2.303}{k}\log\dfrac{[A]_0}{[A]}$.

Step 1 — Set $[A] = [A]_0/10$: $\dfrac{[A]_0}{[A]} = 10$, so $\log 10 = 1$.

Step 2 — Substitute:

$$t = \frac{2.303}{2.303 \times 10^{-3}} \times 1 = 10^3 = 1000 \text{ s}.$$

Graph check: the dashed line at $[A]_0/10$ meets the decay curve at this time.

Why other options are wrong:

- (B) 100 s uses $\log 10$ with a misplaced power of ten.
- (C),(D) confuse the 2.303 factor with the final time.

Final Answer: $t = 1000$ s $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q8

Q9.

Solution

Concept — Temperature coefficient: the ratio of rate constants for a $10\ ^\circ\mathrm{C}$ rise, $\dfrac{k_{(T+10)}}{k_T} = \dfrac{k_2}{k_1}$, is called the temperature coefficient.

Step 1 — Apply the rule of thumb: for most ordinary reactions the rate (and hence k) roughly *doubles* for every $10\ ^\circ\mathrm{C}$ rise, so $k_2/k_1 \approx 2$.

Why other options are wrong:

- (A) 0.5 would mean the rate halves on heating, which is wrong.
- (C) 10 is far too large; (D) 0 would mean the reaction stops.

Final Answer: $k_2/k_1 \approx 2 \Rightarrow \boxed{\mathrm{B}}$

Answer: (B) Go Back to Q9

Q10.

Solution

Concept — Freundlich isotherm limits: $\dfrac{x}{m} = k\,p^{1/n}$. The exponent $1/n$ tells how x/m depends on pressure in different ranges.

Step 1 — Low-pressure region: at very low p the isotherm approaches a straight line through the origin, i.e. $\dfrac{x}{m} \propto p\ (1/n \to 1)$. The initial linear part of the graph shows exactly this.

Step 2 — High-pressure region: at very high p the surface saturates and x/m becomes nearly independent of p $(1/n \to 0)$.

Why other options are wrong:

- (B) describes the *high*-pressure limit, not the low one.
- (C),(D) the Freundlich exponent never gives p^2 or $1/p$ behaviour.

Final Answer: $x/m \propto p$ at low pressure $\Rightarrow \boxed{\mathrm{A}}$

Answer: (A) Go Back to Q10

Q11.

Solution

Concept — Charge on colloidal particles: sol particles carry a definite charge because they *preferentially adsorb* either positive or negative ions from the surrounding medium (the Helmholtz double layer).

Step 1 — Example: a freshly prepared AgI sol adsorbs Ag^+ (in excess $AgNO_3$) to become positive, or I^- (in excess KI) to become negative.

Why other options are wrong:

- (A) the Tyndall effect is light scattering, not charging.
- (C) Brownian motion is random movement; (D) dialysis purifies a sol but does not create its charge.

Final Answer: preferential adsorption of ions $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q11

Q12.

Solution

Concept — Industrial catalysts: the Haber process synthesises NH_3 from N_2 and H_2 over a heterogeneous catalyst.

Step 1 — Identify the catalyst: the catalyst is finely divided *iron*, with molybdenum (or K_2O/Al_2O_3) acting as a promoter to enhance activity.

Why other options are wrong:

- (A) V_2O_5 is the catalyst for the Contact process ($SO_2 \rightarrow SO_3$).
- (B) Pt is used in catalytic converters/Ostwald process; (D) Ni is used in hydrogenation of oils.

Final Answer: finely divided iron $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q12

Q13.

Solution

Concept — Thermal stability of hydrogen halides: stability depends on the strength of the H–X bond, which decreases as the halogen atom gets larger (poorer overlap with the small hydrogen 1s orbital).

Step 1 — Bond strength trend: H–F (shortest, strongest) $>$ H–Cl $>$ H–Br $>$ H–I.

Step 2 — Stability order: HF $>$ HCl $>$ HBr $>$ HI; HI decomposes most readily on heating.

Why other options are wrong:

- (B) is the exact reverse (that is the order of reducing power/acid strength in water).
- (C),(D) misplace HF, which is the most stable.

Final Answer: HF $>$ HCl $>$ HBr $>$ HI $\Rightarrow \boxed{\text{A}}$

$\boxed{\textbf{Answer: (A)}}$ **Go Back to Q13**

Q14.

Solution

Concept — Oxidation state in a fluoride: fluorine is always -1, and the molecule XeF_4 is neutral.

Step 1 — Set up: $x + 4(-1) = 0 \Rightarrow x - 4 = 0$.

Step 2 — Solve: $x = +4$. (XeF_4 is square planar, with two lone pairs on Xe.)

Why other options are wrong:

- (A) $+2$ is the state in XeF_2; (C) $+6$ is in XeF_6.
- (D) $+8$ occurs in XeO_4, not XeF_4.

Final Answer: oxidation state of Xe $= +4 \Rightarrow \boxed{\text{B}}$

$\boxed{\textbf{Answer: (B)}}$ **Go Back to Q14**

Q15.

Solution

Concept — Acid–base nature of oxides across a period: as we go left to right, the elements change from metals to non-metals, so their oxides change from basic through amphoteric to acidic.

Step 1 — Period-3 illustration: Na_2O, MgO (basic) $\rightarrow$ Al_2O_3 (amphoteric) $\rightarrow$ SiO_2, P_4O_{10}, SO_3, Cl_2O_7 (acidic).

Step 2 — Order: basic $\rightarrow$ amphoteric $\rightarrow$ acidic.

Why other options are wrong:

- (A),(B),(C) reverse or scramble the correct left-to-right trend.

Final Answer: basic $\rightarrow$ amphoteric $\rightarrow$ acidic $\Rightarrow \boxed{\text{D}}$

$\boxed{\text{Answer: (D)}}$ Go Back to Q15

Q16.

Solution

Concept — Spin-only magnetic moment: $\mu = \sqrt{n(n+2)}$ BM, where n is the number of unpaired electrons; more unpaired electrons give a larger moment.

Step 1 — Count unpaired electrons: Ti^{3+} (d^1, $n = 1$), Ni^{2+} (d^8, $n = 2$), Mn^{2+} (d^5, $n = 5$), Cu^{2+} (d^9, $n = 1$).

Step 2 — Maximum: Mn^{2+} has $n = 5$, so $\mu = \sqrt{5 \times 7} = \sqrt{35} \approx 5.9$ BM, the highest.

Why other options are wrong:

- (A),(D) have only one unpaired electron ($\mu \approx 1.73$ BM).
- (B) has two unpaired electrons ($\mu \approx 2.83$ BM).

Final Answer: Mn^{2+} (d^5, $\mu \approx 5.9$ BM) $\Rightarrow \boxed{\text{C}}$

$\boxed{\text{Answer: (C)}}$ Go Back to Q16

Q17.

Solution

Concept — Stability of Cu^{2+} vs Cu^{+} in water: although the second ionisation enthalpy of copper is large, the energy released when the ion is hydrated decides the overall stability in aqueous solution.

Step 1 — Compare hydration enthalpies: Cu^{2+}, being smaller and more highly charged, has a much greater (more negative) hydration enthalpy than Cu^{+}.

Step 2 — Net effect: this large hydration energy of Cu^{2+} more than compensates for its higher second ionisation enthalpy, so Cu^{2+} is the stable ion in water (Cu^{+} disproportionates).

Why other options are wrong:

- (A) Cu^{+} is d^{10} (fully filled), not half-filled, and that alone does not make it stable in water.
- (B),(C) are factually wrong statements.

Final Answer: greater hydration enthalpy of Cu^{2+} $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q17

Q18.

Solution

Concept — Enthalpy of atomisation of $3d$ metals: it measures the strength of metallic bonding, which depends on the number of unpaired d (and s) electrons available for bonding.

Step 1 — Trend across the series: the number of unpaired electrons rises to a maximum near the middle of the series (around Cr, V, Mn), giving the strongest metallic bonding and hence the highest enthalpy of atomisation there.

Step 2 — Conclusion: more unpaired d-electrons $\Rightarrow$ stronger bonds $\Rightarrow$ maximum atomisation enthalpy in the middle.

Why other options are wrong:

- (A) completely filled d-orbitals (Zn) give *weak* bonding and low values.
- (C),(D) middle elements have high melting points and strong metallic bonding, the opposite of these claims.

Final Answer: maximum unpaired d-electrons in the middle $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q18

Q19.

Solution

Concept — Coordination number: it is the total number of donor atoms (sigma bonds) directly bonded to the central metal; a bidentate ligand contributes *two*.

Step 1 — Count donor atoms in $[Cr(en)_2Cl_2]^+$: two en ligands $= 2 \times 2 = 4$ donor N atoms, plus two Cl^- $= 2$ donor atoms.

Step 2 — Add up: $4 + 2 = 6$, so the coordination number of Cr is 6.

Why other options are wrong:

- (A),(B) count en as if it were monodentate or ignore the chlorides.
- (D) 8 over-counts the donor atoms.

Final Answer: coordination number $= 6 \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Ionisation isomerism: isomers that give *different ions* in solution because a ligand inside the coordination sphere and the counter-ion outside it are interchanged.

Step 1 — Compare the two: in $[Co(NH_3)_5Br]SO_4$ the SO_4^{2-} is the free counter-ion (Br is coordinated); in $[Co(NH_3)_5SO_4]Br$ the Br^- is free (SO_4 is coordinated).

Step 2 — Test: the first gives a precipitate with $BaCl_2$ (free SO_4^{2-}), the second with $AgNO_3$ (free Br^-) — different ions, so they are ionisation isomers.

Why other options are wrong:

- (B),(C) geometrical/optical isomers have the *same* ions, differing only in spatial arrangement.
- (D) linkage isomerism needs an ambidentate ligand (e.g. NO_2^-), not present here.

Final Answer: ionisation isomerism $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q20

Q21.

Solution

Concept — Strong- vs weak-field ligands (Ni^{2+}, d^8): a strong-field ligand causes large splitting and forces electron pairing, while a weak-field ligand leaves electrons unpaired.

Step 1 — [Ni(CN)$_4$]$^{2-}$: CN$^-$ is a strong-field ligand, so the two d-electrons that would otherwise be unpaired are *paired up*, giving dsp^2 hybridisation and a square-planar, diamagnetic complex.

Step 2 — [NiCl$_4$]$^{2-}$: Cl$^-$ is a weak-field ligand, so Ni^{2+} keeps its two unpaired electrons in an sp^3, tetrahedral, paramagnetic complex.

Why other options are wrong:

- (A),(B) describe the tetrahedral chloride complex, not the cyanide one.
- (C) the whole point is that CN$^-$ *changes* (reduces) the number of unpaired electrons to zero.

Final Answer: CN$^-$ pairs the electrons, giving dsp^2 square-planar diamagnetic Ni $\Rightarrow \boxed{\text{D}}$

$\boxed{\textbf{Answer: (D)}}$ **Go Back to Q21**

Q22.

Solution

Concept — Carbocation rearrangement in S$_N$1: once the leaving group departs, a less stable carbocation can rearrange to a more stable one by a 1,2-shift of a hydrogen (hydride shift) or an alkyl group (methyl shift).

Step 1 — Read the energy profile: the first cation (2°) sits at a higher energy minimum; a 1,2-shift takes it to the lower-energy (3°) cation before the nucleophile attacks.

Step 2 — Driving force: the rearrangement occurs because the new carbocation is *more stable* (tertiary $>$ secondary), lowering the overall energy.

Why other options are wrong:

- (A),(B) cations rearrange *towards* greater stability, never towards a primary cation.
- (D) loss of the leaving group is only the first step; it does not explain the rearrangement.

Final Answer: a 1,2-shift giving a more stable cation $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q22

Q23.

Solution

Concept — Saytzeff's rule: in a β-elimination (dehydrohalogenation), the major product is the *more substituted*, more stable alkene, formed by removing the β-hydrogen from the carbon with fewer hydrogens.

Step 1 — Apply to 2-bromobutane: elimination can give but-1-ene (terminal) or but-2-ene (internal, disubstituted). The internal but-2-ene is more substituted and more stable, so it predominates.

Why other options are wrong:

- (A),(B) Markovnikov/peroxide rules govern *addition* to alkenes, not elimination.
- (C) Hofmann's rule gives the *less* substituted alkene (with bulky bases/quaternary ammonium hydroxides).

Final Answer: Saytzeff's rule (more substituted alkene major) $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q23

Q24.

Solution

Concept — Sandmeyer reaction: an aromatic primary amine is diazotised, and the diazonium group is then replaced by a halogen using a copper(I) halide, giving an aryl halide at the exact position the amine occupied.

Step 1 — Steps: $\text{Ar–NH}_2 \xrightarrow{\text{NaNO}_2/\text{HCl},\ 0\text{–}5^\circ\text{C}} \text{Ar–N}_2^+\text{Cl}^- \xrightarrow{\text{CuCl/HCl}} \text{Ar–Cl} + \text{N}_2$.

Step 2 — Use: this gives clean, position-specific aryl chlorides (or bromides with CuBr).

Why other options are wrong:

- (A) Wurtz–Fittig couples aryl/alkyl halides; it does not introduce a halogen via diazonium.
- (C),(D) Friedel–Crafts and Cannizzaro are unrelated to diazonium halogenation.

Final Answer: Sandmeyer reaction $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q24

Q25.

Solution

Concept — Oxidation of alcohols: a secondary alcohol is oxidised to a ketone (which resists further oxidation), while a primary alcohol gives an aldehyde and then a carboxylic acid.

Step 1 — Propan-2-ol: $(CH_3)_2CHOH \xrightarrow{[O]} (CH_3)_2C{=}O$, i.e. propanone (a ketone).

Step 2 — Why it stops: the ketone carbon has no H to remove, so it is not easily oxidised further.

Why other options are wrong:

- (B),(C) propanoic acid/propanal would come from a *primary* alcohol (propan-1-ol).
- (D) an ester needs an acid plus an alcohol, not simple oxidation.

Final Answer: a ketone (propanone) $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — Nitration of phenol: the –OH group is strongly activating and *ortho/para*-directing, so nitration occurs mainly at those positions.

Step 1 — Products with dilute HNO_3: a mixture of o-nitrophenol and p-nitrophenol is obtained (the ortho isomer is steam-volatile owing to intramolecular H-bonding, the para is not).

Step 2 — Note: with concentrated HNO_3 the reaction goes further to picric acid (2,4,6-trinitrophenol).

Why other options are wrong:

- (A) –OH does not direct to the meta position.
- (B) the ring is not removed; (D) trinitrophenol needs *concentrated* acid, not dilute.

Final Answer: o- and p-nitrophenol $\Rightarrow \boxed{\text{C}}$

$\boxed{\textbf{Answer: (C)}}$ **Go Back to Q26**

Q27.

Solution

Concept — Ether cleavage by HI: HI cleaves the C–O bond by an S_N mechanism. For an alkyl–aryl or branched ether, the bond that breaks is decided by which carbon better supports the substitution.

Step 1 — Mechanism for CH_3–O–C$(CH_3)_3$: the protonated ether cleaves at the tert-butyl C–O bond because a stable 3° carbocation forms (S_N1). This gives the tert-butyl group as $(CH_3)_3C^+$ (trapped by I^-) and methanol initially.

Step 2 — Excess HI: with excess HI the methanol is further converted to CH_3I, so the final products are CH_3I and $(CH_3)_3CI$.

Why other options are wrong:

- (A) gives the alcohol/halide pairing backwards.
- (B),(C) ignore that *excess* HI converts the alcohol(s) fully to iodides.

Final Answer: CH_3I and $(CH_3)_3CI$ (tert-butyl C–O cleaves) $\Rightarrow \boxed{\text{D}}$

$\boxed{\textbf{Answer: (D)}}$ **Go Back to Q27**

Q28.

Solution

Concept — 2,4-DNP (Brady's) test: 2,4-dinitrophenylhydrazine condenses with the carbonyl group of aldehydes and ketones to give an orange/yellow 2,4-dinitrophenylhydrazone precipitate.

Step 1 — Reaction: $>C{=}O + H_2N\text{–}NH\text{–}Ar \rightarrow >C{=}N\text{–}NH\text{–}Ar + H_2O$ (Ar = 2,4-dinitrophenyl).

Step 2 — Conclusion: a positive test confirms a carbonyl group of an aldehyde or ketone.

Why other options are wrong:

- (A),(C),(D) alcohols, acids and amines do not give this hydrazone precipitate.

Final Answer: a carbonyl (>C=O) group $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q28

Q29.

Solution

Concept — Distinguishing aldehydes from ketones: aldehydes are easily oxidised and so reduce mild oxidising reagents; ketones do not.

Step 1 — Tollens' reagent: ammoniacal $AgNO_3$ is reduced by an aldehyde to metallic silver (a bright silver mirror), while ketones give no reaction.

Step 2 — Conclusion: the silver mirror cleanly distinguishes an aldehyde from a ketone (Fehling's gives a red Cu_2O precipitate with aliphatic aldehydes similarly).

Why other options are wrong:

- (B) bromine water tests unsaturation/phenols, not the aldehyde/ketone difference.
- (C) 2,4-DNP reacts with *both*; (D) neutral $FeCl_3$ tests phenols.

Final Answer: Tollens' reagent (silver mirror) $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q29

Q30.

Solution

Concept — Making acid chlorides: the –OH of a carboxylic acid is replaced by –Cl using a chlorinating reagent such as $SOCl_2$, PCl_5 or PCl_3.

Step 1 — With $SOCl_2$:

$$\text{R–COOH} + SOCl_2 \rightarrow \text{R–COCl} + SO_2\uparrow + HCl\uparrow.$$

$SOCl_2$ is preferred because the gaseous by-products escape, leaving a pure acid chloride.

Why other options are wrong:

- (A) NaOH would give the carboxylate salt.
- (B) $LiAlH_4$ reduces the acid to a primary alcohol; (D) Tollens' is an oxidation/test reagent.

Final Answer: thionyl chloride, $SOCl_2$ (or PCl_5) $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q30

Q31.

Solution

Concept — Hinsberg's test: benzenesulphonyl chloride reacts with 1° and 2° amines (which have N–H bonds) but *not* with 3° amines (no replaceable N–H).

Step 1 — Behaviour of each class: a 1° amine gives a sulphonamide that is soluble in alkali (acidic N–H); a 2° amine gives a sulphonamide insoluble in alkali; a 3° amine has no N–H, so there is *no reaction*.

Step 2 — Conclusion: a tertiary amine does not react with Hinsberg's reagent.

Why other options are wrong:

- (A) describes the 1° amine product; (B) describes the 2° amine product.
- (C) the isocyanide (carbylamine) test is a separate test for 1° amines.

Final Answer: a tertiary amine does not react (no N–H) $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q31

Q32.

Solution

Concept — Diazo coupling with aniline: a diazonium ion is a weak electrophile that couples at the highly activated *para* position of aniline to form a coloured azo compound containing the –N=N– chromophore.

Step 1 — Product: $C_6H_5N_2^+ + C_6H_5NH_2 \rightarrow p\text{-}(C_6H_5N{=}N)C_6H_4NH_2$, i.e. p-aminoazobenzene (a yellow dye).

Step 2 — Conditions: mildly acidic medium keeps aniline reactive while preserving the diazonium ion.

Why other options are wrong:

- (A) chlorobenzene comes from the Sandmeyer reaction, not coupling.
- (C),(D) phenol/benzene are not the products of coupling with aniline.

Final Answer: p-aminoazobenzene (azo dye) $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q32

Q33.

Solution

Concept — Hofmann bromamide degradation: an amide treated with Br_2 and aqueous (or alcoholic) KOH/NaOH loses the carbonyl carbon as carbonate and gives a primary amine with *one carbon fewer*.

Step 1 — Reaction: $R\text{–}CONH_2 \xrightarrow{Br_2/KOH} R\text{–}NH_2 + K_2CO_3 + KBr + H_2O$.

Step 2 — Carbon count: the amine $R\text{–}NH_2$ has one carbon fewer than the starting amide $R\text{–}CONH_2$.

Why other options are wrong:

- (B) the carbonyl carbon is lost, so the count cannot stay the same.
- (C),(D) the degradation removes exactly one carbon, not adds or removes two.

Final Answer: an amine with one carbon fewer ($R\text{–}NH_2$) $\Rightarrow \boxed{A}$

Answer: (A) **Go Back to Q33**

Q34.

Solution

Concept — Glycosidic linkages in polysaccharides: both starch and cellulose are glucose polymers, but they differ in the orientation of the C-1 oxygen of the glycosidic bond.

Step 1 — Starch: the glucose units are joined by α-1,4-glycosidic linkages (amylose), which makes it digestible and helically coiled.

Step 2 — Cellulose: the glucose units are joined by β-1,4-glycosidic linkages, giving long straight chains held by H-bonds; humans cannot digest this β-linkage.

Why other options are wrong:

- (A) α-1,4 linkages are those of starch, not cellulose.
- (B),(D) ester/peptide linkages occur in fats/proteins, not in these carbohydrates.

Final Answer: β-1,4-glycosidic linkages $\Rightarrow \boxed{C}$

Answer: (C) **Go Back to Q34**

Q35.

Solution

Concept — Classifying vitamins by solubility: vitamins are grouped as water-soluble (B-complex and C) or fat-soluble (A, D, E and K).

Step 1 — Fat-soluble set: the fat-soluble vitamins are exactly A, D, E and K; they are stored in fatty tissue and the liver.

Step 2 — Conclusion: option (D) lists all four fat-soluble vitamins and only those.

Why other options are wrong:

- (A) vitamins B and C are both water-soluble.
- (B),(C) mix a water-soluble vitamin (C or B_{12}) with a fat-soluble one, so the set is not purely fat-soluble.

Final Answer: vitamins A, D, E and K $\Rightarrow \boxed{\text{D}}$

$\boxed{\textbf{Answer: (D)}}$ **Go Back to Q35**

Answer Key

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