SRMJEEE Chemistry Sample Paper – 7

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. 1 mol of glucose is dissolved in 9 mol of water. The mole fraction of the solvent (water) in this solution is:

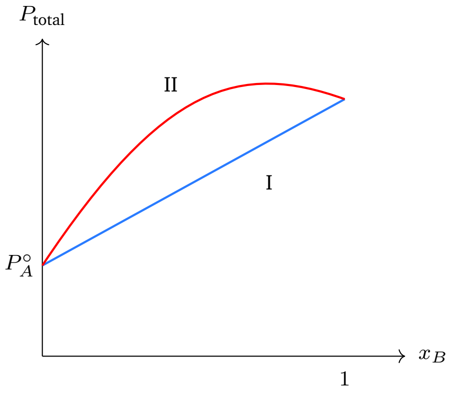
(A) 0.1

(B) 0.9

(C) 1.0

(D) 0.5

Q2. The plot below shows total vapour pressure against composition for two liquid mixtures. Curve I is a straight line while curve II bows above it. Curve II represents:



(A) an ideal solution obeying Raoult's law

(B) a non-ideal solution showing positive deviation

(C) a non-ideal solution showing negative deviation

(D) a solution at its freezing point

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

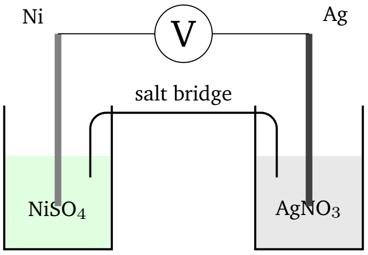
(A) 2

(B) 4

(C) 5

(D) 6

Q4. Two half-cells are combined as shown. Given $E^\circ_{\text{Ag}^+/\text{Ag}} = +0.80$ V and $E^\circ_{\text{Ni}^{2+}/\text{Ni}} = -0.25$ V, the standard cell potential of the galvanic cell is:



(A) 0.55 V

(B) −1.05 V

(C) 0.80 V

(D) 1.05 V

Q5. The limiting molar conductivities are $\lambda^\circ_{\text{Na}^+} = 50.1$ and $\lambda^\circ_{\text{Cl}^-} = 76.3$ S cm^{2}mol^{-1}. By Kohlrausch's law, Λ°_m for NaCl is:

(A) 126.4 S cm^{2}mol^{-1}

(B) 26.2 S cm^{2}mol^{-1}

(C) 63.2 S cm^{2}mol^{-1}

(D) 252.8 S cm^{2}mol^{-1}

Q6. The quantity of electric charge required to liberate one mole of H_2 gas at the cathode by electrolysis is $(1\ F = 96500$ C$)$:

(A) 96500 C

(B) 193000 C

(C) 48250 C

(D) 289500 C

Q7. For a reaction A $\rightarrow$ products, the rate becomes *four times* its original value when the concentration of A is doubled. The order of the reaction is:

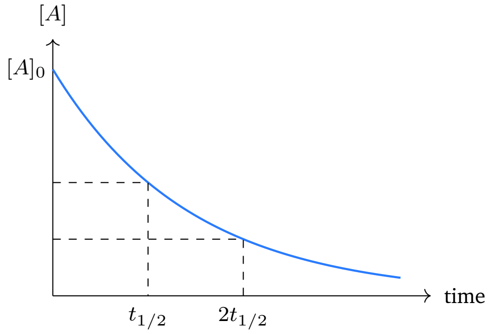
(A) 0

(B) 1

(C) 2

(D) 3

Q8. The decay curve below shows that for a first-order reaction each successive half-life takes the *same* time, regardless of how much reactant is left. This tells us that the half-life of a first-order reaction is:



(A) independent of the initial concentration

(B) directly proportional to the initial concentration

(C) inversely proportional to the initial concentration

(D) proportional to the square of the concentration

Q9. According to collision theory, even when colliding molecules possess energy greater than the activation energy, a reaction occurs only if the molecules are also:

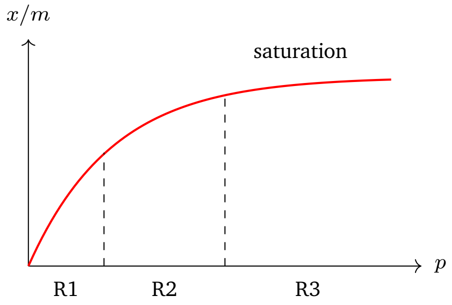
(A) moving at the same speed

(B) identical in mass

(C) electrically neutral

(D) properly oriented at the moment of collision

Q10. The graph shows how the extent of adsorption x/m varies with pressure p at constant temperature. In the high-pressure region marked R3 the curve becomes flat because:



(A) the surface is almost fully covered, so x/m is nearly independent of p

(B) adsorption is directly proportional to pressure

(C) desorption has completely stopped

(D) the temperature has begun to rise

Q11. A colloidal solution contaminated with dissolved ions is purified by placing it in a parchment bag suspended in running water, so the small ions diffuse out. This purification method is called:

(A) peptisation

(B) electrophoresis

(C) dialysis

(D) coagulation

Q12. Zeolites act as "shape-selective" catalysts in the petroleum industry mainly because:

(A) they dissolve completely in the reactants

(B) their pore size admits only molecules of a particular size and shape

(C) they raise the activation energy of the reaction

(D) they react chemically and are consumed

Q13. For the third-period oxides Na_2O, MgO, Al_2O_3 and SO_3, the correct order of *increasing* acidic character is:

(A) $SO_3 < Al_2O_3 < MgO < Na_2O$

(B) $MgO < Na_2O < Al_2O_3 < SO_3$

(C) $Al_2O_3 < SO_3 < MgO < Na_2O$

(D) $Na_2O < MgO < Al_2O_3 < SO_3$

Q14. Phosphorous acid, H_3PO_3, contains one P–H bond. The number of replaceable (ionisable) hydrogen atoms, i.e. its basicity, is:

(A) 2 (dibasic)

(B) 3 (tribasic)

(C) 1 (monobasic)

(D) 4 (tetrabasic)

Q15. The correct order of acidic strength of the hydrogen halides in aqueous solution is:

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

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

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

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

Q16. Using $\mu = \sqrt{n(n+2)}$ BM, where n is the number of unpaired electrons, the spin-only magnetic moment of the Fe^{3+} ion ($3d^5$) is:

(A) 1.73 BM

(B) 2.83 BM

(C) 4.90 BM

(D) 5.92 BM

Q17. In potassium ferrocyanide, $K_4[Fe(CN)_6]$, the oxidation state of iron is:

(A) $+3$

(B) $+2$

(C) $+4$

(D) 0

Q18. As one moves from left to right across the first (3d) transition series, the first ionisation enthalpy generally:

(A) increases gradually, though somewhat irregularly

(B) decreases sharply and steadily

(C) remains exactly constant

(D) falls to zero at the end of the series

Q19. The nitrite ion, NO_2^-, is an ambidentate ligand. When it bonds to a metal through nitrogen it is named “nitro”; when it bonds through oxygen it is named:

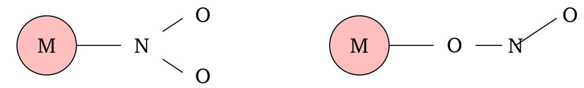
(A) cyano

(B) aqua

(C) ammine

(D) nitrito

Q20. The two structures below differ only in which donor atom of the same ligand binds to the metal M. This kind of isomerism, shown by ambidentate ligands, is called:



$M–NO_2$ (nitro) M–ONO (nitrito)

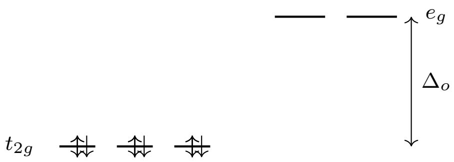
(A) geometrical isomerism

(B) optical isomerism

(C) linkage isomerism

(D) ionisation isomerism

Q21. The crystal-field diagram below shows the filling of the d-orbitals of a metal ion in a *strong* octahedral field (low-spin). The configuration written as $t_{2g}^{?}\,e_g^{?}$ corresponds to a d^6 ion such as Co^{3+}. The correct filling is:



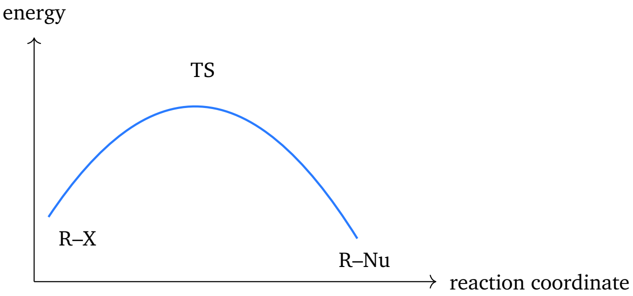
(A) $t_{2g}^{4}\,e_g^{2}$

(B) $t_{2g}^6\, e_g^0$

(C) $t_{2g}^3\, e_g^3$

(D) $t_{2g}^2\, e_g^4$

Q22. A primary alkyl halide reacts with a nucleophile through the single-hump energy profile shown, passing through one transition state and *no* intermediate. This mechanism is:



(A) S$_N$2 (single step, one transition state)

(B) S$_N$1 (via a carbocation)

(C) E1 elimination

(D) free-radical substitution

Q23. When an alkyl halide is heated with an excess of ammonia, the principal organic product is:

(A) an alkene

(B) an alcohol

(C) an ether

(D) a primary amine

Q24. Although a halogen atom on a benzene ring is mildly deactivating, in electrophilic aromatic substitution it directs the incoming group mainly to the:

(A) meta positions only

(B) carbon already bearing the halogen

(C) ortho and para positions

(D) ring carbon farthest from any position

Q25. The correct order of acidic strength among water and the simple alcohols is:

(A) 3° alcohol $>$ 2° alcohol $>$ 1° alcohol $>$ water

(B) water $>$ 1° alcohol $>$ 2° alcohol $>$ 3° alcohol

(C) water $>$ 3° alcohol $>$ 2° alcohol $>$ 1° alcohol

(D) all four have exactly the same acidity

Q26. Arrange phenol, p-nitrophenol and p-cresol (p-methylphenol) in order of *decreasing* acidic strength:

(A) p-nitrophenol $>$ phenol $>$ p-cresol

(B) p-cresol $>$ phenol $>$ p-nitrophenol

(C) phenol $>$ p-nitrophenol $>$ p-cresol

(D) p-cresol $>$ p-nitrophenol $>$ phenol

Q27. Ethers have considerably *lower* boiling points than their isomeric alcohols. This is because, unlike alcohols, ether molecules:

(A) have a much higher molar mass

(B) are ionic compounds

(C) are far more polar

(D) cannot form intermolecular hydrogen bonds with one another

Q28. Even a mild oxidising agent such as Tollens' reagent readily oxidises an aldehyde, RCHO, to a:

(A) primary alcohol, RCH_2OH

(B) ketone

(C) carboxylic acid, RCOOH

(D) hydrocarbon

Q29. Which one of the following compounds gives a *positive* iodoform (haloform) test?

(A) CH_3COCH_3 (acetone)

(B) HCHO (formaldehyde)

(C) $C_6H_5COC_6H_5$ (benzophenone)

(D) CH_3CH_2CHO (propanal)

Q30. Comparing formic acid (HCOOH) and acetic acid (CH_3COOH), the stronger acid is:

(A) acetic acid, because the CH_3 group withdraws electrons

(B) formic acid, because it has no electron-donating alkyl group

(C) both have exactly equal strength

(D) neither is acidic in water

Q31. Treating an aldehyde or ketone with ammonia followed by reduction (e.g. H_2/Ni), a process called reductive amination, converts the carbonyl compound into:

(A) a carboxylic acid

(B) an ether

(C) an alkene

(D) an amine

Q32. In the Balz–Schiemann reaction, an aryl diazonium salt is converted to an aryl fluoride by heating its:

(A) chloride with copper powder

(B) bromide with KBr

(C) tetrafluoroborate ($ArN_2^+BF_4^-$)

(D) hydroxide with HF

Q33. A primary *aromatic* amine is confirmed by treating it with HNO_2 at 0–5 °C and coupling the product with an alkaline solution of β-naphthol, which produces:

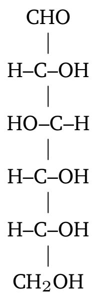
(A) a brightly coloured (orange-red) azo dye

(B) a colourless gas only

(C) a white precipitate of the amine salt

(D) a foul-smelling isocyanide

Q34. The open-chain Fischer projection of glucose is shown. From this structure, the number of –OH (hydroxyl) groups present and the nature of the carbonyl group are, respectively:



$$\begin{array}{c} \mathrm{CHO} \\ | \\ \mathrm{H{-}C{-}OH} \\ | \\ \mathrm{HO{-}C{-}H} \\ | \\ \mathrm{H{-}C{-}OH} \\ | \\ \mathrm{H{-}C{-}OH} \\ | \\ \mathrm{CH_2OH} \end{array}$$

(A) three –OH groups and a ketone group

(B) five –OH groups and an aldehyde group

(C) four –OH groups and a ketone group

(D) six –OH groups and a carboxyl group

Q35. The difference between a nucleoside and a nucleotide is that a nucleotide additionally contains:

(A) an extra nitrogenous base

(B) an extra sugar unit

(C) a phosphate group

(D) a peptide linkage

Detailed Solutions

Q1.

Solution

Concept — Mole fraction: the mole fraction of a component is its number of moles divided by the total number of moles of all components. The mole fractions of all components add up to 1.

Step 1 — Total moles: $n_{\text{total}} = n_{\text{glucose}} + n_{\text{water}} = 1 + 9 = 10$ mol.

Step 2 — Mole fraction of water: $x_{\text{water}} = \dfrac{9}{10} = 0.9$.

Why other options are wrong:

- (A) 0.1 is the mole fraction of the *solute* (glucose), not the solvent.
- (C) 1.0 would mean pure water; (D) 0.5 would need equal moles of each.

Final Answer: $x_{\text{water}} = 0.9 \Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q1**

Q2.

Solution

Concept — Ideal vs non-ideal solutions: an ideal solution obeys Raoult's law at all compositions, so its total-vapour-pressure plot is a *straight line* (curve I). A non-ideal solution deviates from this line.

Step 1 — Read the deviation: curve II lies *above* the ideal straight line, i.e. the measured vapour pressure is greater than that predicted by Raoult's law. This is a *positive deviation*.

Step 2 — Reason: positive deviation arises when A–B interactions are weaker than A–A and B–B interactions, so molecules escape more easily (e.g. ethanol + acetone).

Why other options are wrong:

- (A) the ideal solution is the straight line, curve I, not curve II.
- (C) negative deviation would bow *below* the line; (D) the plot is of vapour pressure, not freezing point.

Final Answer: positive deviation from Raoult's law $\Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q2**

Q3.

Solution

Concept — van't Hoff factor: i equals the number of particles (ions) produced per formula unit on complete dissociation.

Step 1 — Dissociate the salt: $K_4[Fe(CN)_6] \to 4K^+ + [Fe(CN)_6]^{4-}$.

Step 2 — Count the ions: four potassium ions plus one ferrocyanide complex ion $= 5$ particles, so $i = 5$.

Why other options are wrong:

- (A) 2 is for a $1{:}1$ salt like NaCl; (B) 4 counts only the K^+ ions.
- (D) 6 wrongly treats the complex anion as separate CN^- ions.

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

Answer: (C) **Go Back to Q3**

Q4.

Solution

Concept — Combining half-cells: $E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$. The electrode with the higher (more positive) reduction potential is the cathode.

Step 1 — Assign electrodes: Ag^+/Ag ($+0.80$ V) is the cathode (reduction); Ni^{2+}/Ni (-0.25 V) is the anode (oxidation).

Step 2 — Substitute:

$$E^\circ_{cell} = 0.80 - (-0.25) = 1.05 \text{ V}.$$

Why other options are wrong:

- (A) 0.55 subtracts wrongly; (C) -1.05 reverses cathode and anode.
- (B) 0.80 ignores the nickel potential entirely.

Final Answer: $E^\circ_{cell} = 1.05 \text{ V} \Rightarrow \boxed{D}$

Answer: (D) **Go Back to Q4**

Q5.

Solution

Concept — Kohlrausch's law of independent migration: at infinite dilution, Λ_m° of an electrolyte is the sum of the limiting molar conductivities of its constituent ions, each multiplied by the number of such ions.

Step 1 — Apply to NaCl: NaCl gives one Na^+ and one Cl^-, so

$$\Lambda_m^\circ = \lambda_{\mathrm{Na}^+}^\circ + \lambda_{\mathrm{Cl}^-}^\circ = 50.1 + 76.3.$$

Step 2 — Add: $\Lambda_m^\circ = 126.4\ \mathrm{S\ cm^2 mol^{-1}}$.

Why other options are wrong:

- (B) 26.2 subtracts the values; (C) 63.2 is the average, not the sum.
- (D) 252.8 doubles the correct sum.

Final Answer: $\Lambda_m^\circ = 126.4\ \mathrm{S\ cm^2 mol^{-1}} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept — Faraday's law at the cathode: the cathode half-reaction for hydrogen is $2\mathrm{H}^+ + 2e^- \rightarrow \mathrm{H}_2$. Producing one mole of H_2 therefore needs 2 moles of electrons.

Step 1 — Electrons required: $n = 2$ mol of electrons $= 2$ faradays.

Step 2 — Total charge: $Q = 2 \times 96500 = 193000$ C.

Why other options are wrong:

- (A) 96500 would liberate only half a mole of H_2.
- (C) 48250 is half a faraday; (D) 289500 $(3F)$ is for a $+3$ species.

Final Answer: $Q = 193000\ \mathrm{C} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q6

Q7.

Solution

Concept — Order from the rate law: if rate $\propto [A]^x$, doubling $[A]$ multiplies the rate by 2^x.

Step 1 — Match the data: the rate becomes *four-fold*, so $2^x = 4 = 2^2$, giving $x = 2$.

Step 2 — Conclusion: the reaction is second order with respect to A.

Why other options are wrong:

- (A) order 0 leaves the rate unchanged; (B) order 1 would only double it.
- (D) order 3 would increase the rate eight-fold.

Final Answer: order $= 2 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q7

Q8.

Solution

Concept — First-order half-life: $t_{1/2} = \dfrac{0.693}{k}$. The rate constant k does not contain any concentration term, so $t_{1/2}$ is fixed for a given reaction.

Step 1 — Read the graph: each successive halving of $[A]$ takes the same time interval ($t_{1/2}$ then another $t_{1/2}$), exactly as the two dashed constructions show.

Step 2 — Conclusion: the half-life is independent of the initial concentration $[A]_0$.

Why other options are wrong:

- (B),(C) dependence on $[A]_0$ is a feature of zero- and second-order reactions, not first order.
- (D) no such square dependence exists for a first-order half-life.

Final Answer: independent of the initial concentration $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q8

Q9.

Solution

Concept — Collision theory: a reaction occurs only when molecules collide with (i) energy $\geq E_a$ (the energy barrier) *and* (ii) the correct orientation. The fraction of collisions having the right orientation is accounted for by the steric/probability factor in the frequency factor.

Step 1 — The orientation requirement: even energetic collisions are ineffective if the molecules are wrongly aligned, so proper orientation is essential.

Why other options are wrong:

- (A),(B) equal speed or mass is not a requirement for an effective collision.
- (C) electrical neutrality is irrelevant to the orientation condition.

Final Answer: properly oriented at the moment of collision $\Rightarrow \boxed{\text{D}}$

$\boxed{\text{Answer: (D)}}$ **Go Back to Q9**

Q10.

Solution

Concept — Adsorption isotherm regions: at low pressure (R1) $x/m \propto p$; at intermediate pressure (R2) $x/m \propto p^{1/n}$; at high pressure (R3) x/m becomes nearly independent of p.

Step 1 — Why R3 is flat: at high pressure the adsorbent surface is almost completely covered with a layer of gas molecules, so further increases in pressure produce little extra adsorption and the curve levels off (saturation).

Why other options are wrong:

- (B) direct proportionality ($x/m \propto p$) describes the low-pressure region R1, not R3.
- (C) adsorption and desorption reach equilibrium; desorption does not stop.
- (D) the isotherm is drawn at constant temperature.

Final Answer: surface nearly saturated, so x/m is almost independent of $p \Rightarrow \boxed{\text{A}}$

$\boxed{\text{Answer: (A)}}$ **Go Back to Q10**

Q11.

Solution

Concept — Dialysis: colloidal particles are too large to pass through a parchment/cellophane membrane, but small dissolved ions and molecules can diffuse through. Surrounding the bag with flowing water continuously removes these impurities.

Step 1 — Match the description: the parchment bag in running water that lets ions out while retaining the colloid is exactly the dialysis set-up.

Why other options are wrong:

- (A) peptisation *makes* a colloid from a precipitate; it does not purify one.
- (B) electrophoresis is migration of charged colloid particles in a field; (D) coagulation aggregates the colloid.

Final Answer: dialysis $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q11

Q12.

Solution

Concept — Shape-selective catalysis: zeolites are porous aluminosilicates with a honeycomb of cavities of definite, uniform size. Only reactant molecules small enough to enter the pores can be adsorbed and react, so the catalysis depends on molecular shape and size.

Step 1 — Mechanism: reactions such as the conversion of alcohols to gasoline (ZSM-5) proceed selectively because the pore dimensions admit only certain molecules.

Why other options are wrong:

- (A),(D) a catalyst is recovered unchanged; zeolites do not dissolve or get consumed.
- (C) a catalyst *lowers* the activation energy, it does not raise it.

Final Answer: pores admit only molecules of a particular size/shape $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q12

Q13.

Solution

Concept — Acidic character of oxides across a period: moving left to right, oxides change from basic (metals) through amphoteric to acidic (non-metals), as the element becomes more electronegative.

Step 1 — Classify: Na_2O (strongly basic) $<$ MgO (basic) $<$ Al_2O_3 (amphoteric) $<$ SO_3 (strongly acidic).

Step 2 — Increasing acidity: this gives the order of increasing acidic character directly.

Why other options are wrong:

- (A) is the reverse (decreasing) order.
- (B),(C) misplace the basic oxides relative to the acidic ones.

Final Answer: $Na_2O < MgO < Al_2O_3 < SO_3 \Rightarrow \boxed{D}$

Answer: (D) **Go Back to Q13**

Q14.

Solution

Concept — Basicity of oxoacids: only the hydrogen atoms attached to *oxygen* (O–H bonds) are ionisable. Hydrogen bonded directly to phosphorus (P–H) is not acidic.

Step 1 — Structure of H_3PO_3: phosphorous acid has two P–O–H groups and one P–H bond, i.e. two ionisable hydrogens.

Step 2 — Conclusion: its basicity is 2 — it is a dibasic acid.

Why other options are wrong:

- (B) 3 wrongly counts the non-ionisable P–H hydrogen.
- (C) 1 undercounts; (D) 4 is more hydrogens than the molecule has.

Final Answer: dibasic (2 replaceable H) $\Rightarrow \boxed{A}$

Answer: (A) **Go Back to Q14**

Q15.

Solution

Concept — Acid strength of hydrogen halides: in water, acid strength is governed mainly by the H–X bond strength. The weaker the H–X bond, the more easily H^+ is released, so down the group acid strength increases.

Step 1 — Bond strength trend: H–F is the strongest (shortest) bond and H–I the weakest, so ease of ionisation increases F $<$ Cl $<$ Br $<$ I.

Step 2 — Acidity order: HI $>$ HBr $>$ HCl $>$ HF.

Why other options are wrong:

- (A) puts HF as strongest, which is wrong — HF is the weakest.
- (B),(D) jumble the order of the remaining halides.

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

Answer: (C) **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.

Step 1 — Configuration of Fe^{3+}: $3d^5$, with all five d-electrons unpaired ($n = 5$).

Step 2 — Compute:

$$\mu = \sqrt{5(5+2)} = \sqrt{35} \approx 5.92 \text{ BM}.$$

Why other options are wrong:

- (A) 1.73 is for $n = 1$; (B) 2.83 is for $n = 2$.
- (C) 4.90 is for $n = 4$, not 5.

Final Answer: $\mu \approx 5.92$ BM $\Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q16**

Q17.

Solution

Concept — Oxidation state in a complex salt: the overall charge is zero. Take K $= +1$ and the cyanide ligand CN $= -1$; let the oxidation state of Fe be x.

Step 1 — Set up for $K_4[Fe(CN)_6]$: $4(+1) + x + 6(-1) = 0 \Rightarrow 4 + x - 6 = 0$.

Step 2 — Solve: $x = +2$.

Why other options are wrong:

- (A) $+3$ is the iron state in ferricyanide, $K_3[Fe(CN)_6]$.
- (C) $+4$ and (D) 0 do not balance the charges here.

Final Answer: oxidation state of Fe $= +2 \Rightarrow \boxed{\text{B}}$

$\boxed{\text{Answer: (B)}}$ **Go Back to Q17**

Q18.

Solution

Concept — Ionisation enthalpy across the 3d series: as atomic number rises across the series, the increasing nuclear charge (only partly offset by added $3d$ electrons) pulls the electrons more strongly, so the first ionisation enthalpy rises overall.

Step 1 — Note the irregularity: the rise is gradual and not perfectly smooth because of small changes in d-electron screening and the stability of half-filled/filled sub-shells.

Why other options are wrong:

- (B) ionisation enthalpy increases, not decreases, across the series.
- (C) it is not constant; (D) it never falls to zero.

Final Answer: increases gradually (somewhat irregularly) $\Rightarrow \boxed{\text{A}}$

$\boxed{\text{Answer: (A)}}$ **Go Back to Q18**

Q19.

Solution

Concept — Ambidentate ligands: a ligand that can attach through either of two different donor atoms is ambidentate. NO_2^- can bind through N or through O, and each mode has its own name.

Step 1 — The two naming forms: bonding through nitrogen = "nitro" ($-NO_2$); bonding through oxygen = "nitrito" ($-ONO$).

Why other options are wrong:

- (A) "cyano" is the name for CN^-.
- (B) "aqua" is for H_2O; (C) "ammine" is for NH_3 — none of these are the O-bonded form of NO_2^-.

Final Answer: nitrito (O-bonded) $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q19

Q20.

Solution

Concept — Linkage isomerism: when an ambidentate ligand can coordinate to the metal through either of two donor atoms, the resulting isomers (which differ only in the point of attachment) are linkage isomers.

Step 1 — Read the figure: in the first structure the metal binds NO_2^- through N (nitro); in the second it binds the same ligand through O (nitrito). Only the donor atom differs.

Step 2 — Classify: this is linkage isomerism, classically shown by $[Co(NH_3)_5(NO_2)]^{2+}$ vs $[Co(NH_3)_5(ONO)]^{2+}$.

Why other options are wrong:

- (A),(B) geometrical/optical isomerism arise from spatial arrangement, not the donor atom.
- (D) ionisation isomerism swaps a ligand with a counter-ion.

Final Answer: linkage isomerism $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q20

Q21.

Solution

Concept — Strong-field (low-spin) filling: in a strong octahedral field Δ_o is large, exceeding the pairing energy. Electrons therefore pair up in the lower t_{2g} set before any occupy the higher e_g set.

Step 1 — Fill a d^6 ion: the six electrons all go into the three t_{2g} orbitals (fully paired), leaving e_g empty: $t_{2g}^6\,e_g^0$.

Step 2 — Read the figure: the three lower orbitals are each shown doubly occupied while the upper e_g pair is empty, matching $t_{2g}^6\,e_g^0$.

Why other options are wrong:

- (A) $t_{2g}^4 e_g^2$ is the *high*-spin (weak-field) d^6 arrangement.
- (C),(D) place electrons in e_g before filling t_{2g}, which violates the strong-field order.

Final Answer: $t_{2g}^6\,e_g^0$ (low-spin d^6) $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q21

Q22.

Solution

Concept — S$_N$2 mechanism: a bimolecular nucleophilic substitution is a single, concerted step — the nucleophile attacks as the leaving group departs. Its energy profile has just *one* transition state and no intermediate, i.e. a single hump.

Step 1 — Why primary: a primary carbon is sterically open, allowing back-side attack, so 1° halides strongly favour S$_N$2.

Step 2 — Match the profile: one maximum (TS) directly connecting R–X to R–Nu confirms a one-step S$_N$2 process.

Why other options are wrong:

- (B) S$_N$1 has *two* humps with a carbocation minimum between them.
- (C),(D) E1 and free-radical paths give different profiles and products.

Final Answer: S$_N$2 (single step, one transition state) $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Ammonolysis of alkyl halides: ammonia acts as a nucleophile, displacing the halide from the alkyl halide. With excess ammonia the main product is the primary amine.

Step 1 — Reaction: R–X + $NH_3 \rightarrow$ R–NH_2 + HX (the HX is neutralised by excess NH_3).

Step 2 — Role of excess NH_3: a large excess of ammonia suppresses further alkylation to $2^\circ/3^\circ$ amines, favouring the primary amine.

Why other options are wrong:

- (A) an alkene needs a base (alcoholic KOH), not ammonia.
- (B),(C) alcohols/ethers form with aqueous KOH or alkoxides, not NH_3.

Final Answer: a primary amine $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q23

Q24.

Solution

Concept — Directing effect of a halogen: a halogen withdraws electrons by induction (deactivating) but donates a lone pair into the ring by resonance. The resonance effect places extra electron density at the *ortho* and *para* positions.

Step 1 — Result: the incoming electrophile therefore attacks mainly at the ortho and para positions, so halogens are o/p-directing despite being deactivating.

Why other options are wrong:

- (A) meta direction is shown by strongly deactivating groups like –NO_2, not halogens.
- (B),(D) substitution does not occur on the substituted carbon, nor at some arbitrary “farthest” carbon.

Final Answer: ortho and para positions $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q24

Q25.

Solution

Concept — Acidity of alcohols vs water: acidity depends on the stability of the conjugate alkoxide. Electron-donating alkyl groups destabilise the alkoxide (intensify the negative charge), so more alkyl substitution means weaker acidity: $1^\circ > 2^\circ > 3^\circ$. Water, with no alkyl group, is more acidic than all of them.

Step 1 — Order: water $>$ 1° alcohol $>$ 2° alcohol $>$ 3° alcohol.

Why other options are wrong:

- (A) reverses the order and wrongly places tertiary as most acidic.
- (C) puts 3° above 1°, which is incorrect; (D) the four are *not* equally acidic.

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

$\boxed{\textbf{Answer: (B)}}$ **Go Back to Q25**

Q26.

Solution

Concept — Substituent effect on phenol acidity: an electron-withdrawing group (–NO_2) stabilises the phenoxide ion and *increases* acidity, whereas an electron-donating group (–CH_3) destabilises it and *decreases* acidity.

Step 1 — Rank: p-nitrophenol (most acidic, –NO_2 withdrawing) $>$ phenol (no substituent) $>$ p-cresol (least acidic, –CH_3 donating).

Why other options are wrong:

- (B),(D) wrongly place p-cresol as the most acidic.
- (C) wrongly places phenol above p-nitrophenol.

Final Answer: p-nitrophenol $>$ phenol $>$ p-cresol $\Rightarrow \boxed{\text{A}}$

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

Q27.

Solution

Concept — Boiling point and hydrogen bonding: alcohols have an O–H group and form strong intermolecular hydrogen bonds, which raise their boiling points. Ethers (C–O–C) have no O–H, so they cannot hydrogen-bond to one another.

Step 1 — Compare isomers: for the same molecular formula, the ether (no H-bonding) boils far lower than the isomeric alcohol (extensive H-bonding); e.g. dimethyl ether ($-24\ ^\circ$C) vs ethanol ($78\ ^\circ$C).

Why other options are wrong:

- (A) isomers have the *same* molar mass; (B) ethers are covalent, not ionic.
- (C) ethers are actually *less* associated, not “far more polar”.

Final Answer: ethers cannot form intermolecular H-bonds $\Rightarrow \boxed{\text{D}}$

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

Q28.

Solution

Concept — Oxidation of aldehydes: aldehydes carry an H on the carbonyl carbon and are very easily oxidised. Even mild oxidants (Tollens’ reagent, Fehling’s solution) convert RCHO into the corresponding carboxylic acid, RCOOH.

Step 1 — The change: RCHO $\xrightarrow{[O]}$ RCOOH; with Tollens’ reagent a silver mirror also forms, confirming the aldehyde.

Step 2 — Contrast with ketones: ketones lack the carbonyl H and are *not* oxidised by these mild reagents.

Why other options are wrong:

- (A) reduction (not oxidation) gives the alcohol; (B) oxidation does not form a ketone from an aldehyde.
- (D) a hydrocarbon is not produced.

Final Answer: carboxylic acid, RCOOH $\Rightarrow \boxed{\text{C}}$

$\boxed{\textbf{Answer: (C)}}$ **Go Back to Q28**

Q29.

Solution

Concept — Iodoform (haloform) test: a positive iodoform test is given by compounds containing a CH_3CO– group (a methyl ketone) or a $CH_3CH(OH)$– group (which is first oxidised to the methyl ketone). These give a yellow precipitate of CHI_3 with $I_2/NaOH$.

Step 1 — Test the options: acetone, CH_3COCH_3, has a CH_3CO– group, so it responds positively.

Why other options are wrong:

- (B) formaldehyde (HCHO) has no CH_3CO– group.
- (C) benzophenone has two aryl groups and no methyl ketone; (D) propanal lacks the CH_3CO– unit.

Final Answer: acetone, $CH_3COCH_3 \Rightarrow \boxed{A}$

Answer: (A) **Go Back to Q29**

Q30.

Solution

Concept — Inductive effect on acid strength: an electron-donating group near –COOH destabilises the carboxylate anion and weakens the acid. The CH_3 group of acetic acid is electron-donating ($+I$), whereas formic acid (H–COOH) has no such group.

Step 1 — Compare: with no electron-donating alkyl group, formic acid's carboxylate is less destabilised, so formic acid ($K_a \approx 1.8 \times 10^{-4}$) is stronger than acetic acid ($K_a \approx 1.8 \times 10^{-5}$).

Why other options are wrong:

- (A) the CH_3 group *donates* electrons (it weakens, not strengthens, acetic acid).
- (C) their strengths are not equal; (D) both are weak acids but still acidic.

Final Answer: formic acid is the stronger acid $\Rightarrow \boxed{B}$

Answer: (B) **Go Back to Q30**

Q31.

Solution

Concept — Reductive amination: a carbonyl compound is condensed with ammonia (or an amine) to form an imine, which is then reduced (H_2/Ni, or $NaBH_3CN$) to give an amine. The net result replaces the C=O by C–NH_2 (or C–NHR).

Step 1 — Overall change: $R_2C{=}O \xrightarrow{NH_3} R_2C{=}NH \xrightarrow{H_2/Ni} R_2CH{-}NH_2$, an amine.

Why other options are wrong:

- (A) a carboxylic acid would require oxidation, not amination.
- (B),(C) ethers and alkenes are not formed by reductive amination.

Final Answer: an amine $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q31

Q32.

Solution

Concept — Balz–Schiemann reaction: an aryl diazonium chloride is treated with fluoroboric acid (HBF_4) to precipitate the diazonium tetrafluoroborate, $ArN_2^+BF_4^-$. On heating, this decomposes to give the aryl fluoride, N_2 and BF_3.

Step 1 — Key step: $ArN_2^+BF_4^- \xrightarrow{\Delta} Ar{-}F + N_2 + BF_3$.

Why other options are wrong:

- (A) heating the chloride with Cu is a Sandmeyer-type route to Ar–Cl, not Ar–F.
- (B),(D) KBr or HF on the hydroxide do not give the Balz–Schiemann product.

Final Answer: heating the diazonium tetrafluoroborate $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q32

Q33.

Solution

Concept — Azo dye (coupling) test: a primary aromatic amine reacts with nitrous acid at 0–5 °C to form a stable diazonium salt, which then couples with β-naphthol in alkali to give a brightly coloured azo dye. This confirms a primary aromatic amine.

Step 1 — The result: the appearance of an orange-red dye (containing the –N=N– chromophore) is the positive test.

Why other options are wrong:

- (B) a colourless gas describes the behaviour of aliphatic amines (unstable diazonium, releasing N_2).
- (C) no white precipitate forms; (D) the isocyanide smell is the carbylamine test, a different reaction.

Final Answer: a brightly coloured azo dye $\Rightarrow \boxed{\text{A}}$

$\boxed{\text{Answer: (A)}}$ **Go Back to Q33**

Q34.

Solution

Concept — Functional groups in glucose: the open-chain structure of glucose (a hexose) has one terminal –CHO (aldehyde) group, one terminal –CH_2OH, and four secondary –CHOH groups along the chain.

Step 1 — Count the –OH groups: the four secondary –CHOH carbons plus the terminal –CH_2OH give a total of five –OH groups.

Step 2 — Carbonyl type: the group at the top of the Fischer projection is –CHO, an *aldehyde*, so glucose is an aldose (specifically an aldohexose).

Why other options are wrong:

- (A),(C) glucose has an aldehyde, not a ketone, and more than three/four –OH groups.
- (D) glucose has five –OH groups, not six, and a –CHO rather than a –COOH group.

Final Answer: five –OH groups and an aldehyde group $\Rightarrow \boxed{\text{B}}$

$\boxed{\text{Answer: (B)}}$ **Go Back to Q34**

Q35.

Solution

Concept — Nucleoside vs nucleotide: a *nucleoside* is a nitrogenous base joined to a pentose sugar (base + sugar). A *nucleotide* is a nucleoside that additionally carries a phosphate group (base + sugar + phosphate).

Step 1 — The extra component: the only difference is the phosphate group esterified to the sugar in a nucleotide.

Step 2 — Build-up: base + sugar $\rightarrow$ nucleoside; nucleoside + phosphate $\rightarrow$ nucleotide (the repeating unit of nucleic acids).

Why other options are wrong:

- (A),(B) both species contain one base and one sugar; these do not differ.
- (D) a peptide linkage belongs to proteins, not nucleic acids.

Final Answer: a phosphate group $\Rightarrow \boxed{\text{C}}$

Answer: (C) **Go Back to Q35**

Answer Key

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