SRMJEEE Chemistry Sample Paper – 5

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. 2 mg of fluoride ion is present in 1 kg of drinking water. The concentration of fluoride in the water, expressed in parts per million (ppm) by mass, is:

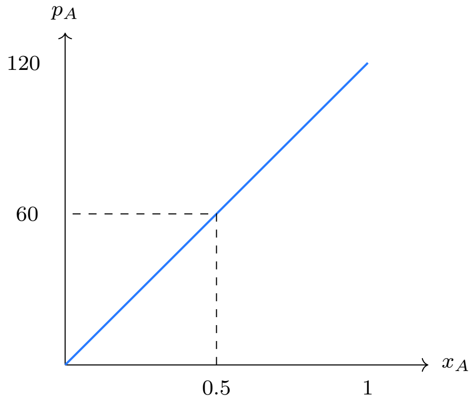
(A) 0.2 ppm

(B) 2 ppm

(C) 20 ppm

(D) 200 ppm

Q2. For an ideal binary solution of A and B, the partial pressures vary linearly with composition as shown. At a certain composition the partial pressure of A is $p_A = 60$ mmHg while the pure-component vapour pressure is $P_A^\circ = 120$ mmHg. The mole fraction of A in the solution is:



(A) 0.5

(B) 0.25

(C) 0.75

(D) 0.6

Q3. Two solutions are isotonic at the same temperature. A 0.1 M glucose solution is isotonic with an aqueous urea solution. The molar concentration of the urea solution must be:

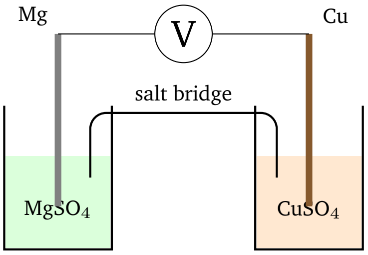
(A) 0.05 M

(B) 0.2 M

(C) 0.1 M

(D) 1.0 M

Q4. For the galvanic cell shown, the standard electrode potentials are $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = +0.34$ V and $E^\circ_{\text{Mg}^{2+}/\text{Mg}} = -2.37$ V. The standard EMF of the cell is:



(A) 2.03 V

(B) -2.71 V

(C) 2.37 V

(D) 2.71 V

Q5. For a weak electrolyte, the molar conductivity at concentration c is $\Lambda_m = 20$ S cm^2 mol^{-1} and at infinite dilution $\Lambda_m^\circ = 400$ S cm^2 mol^{-1}. The degree of dissociation α at this concentration is:

(A) 0.5

(B) 0.2

(C) 0.05

(D) 0.8

Q6. A current of 9.65 A is passed through a solution of silver nitrate. The time required to deposit 1.08 g of silver (atomic mass $= 108$, $1\ F = 96500$ C) is:

(A) 100 s

(B) 200 s

(C) 50 s

(D) 1000 s

Q7. Which of the following statements correctly distinguishes molecularity from order of a reaction?

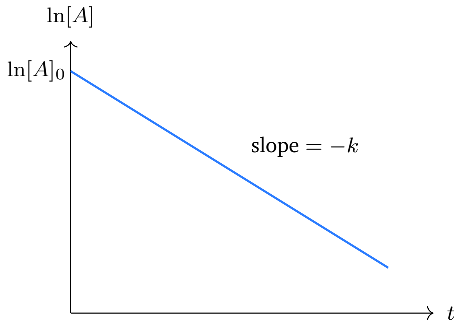
(A) Both molecularity and order are always equal

(B) Molecularity is a theoretical whole number for an elementary step, while order is determined experimentally and may be fractional

(C) Order is always a whole number, while molecularity can be fractional

(D) Molecularity can be zero, while order cannot

Q8. For a first-order reaction, a plot of $\ln[A]$ against time t is a straight line, as shown. The slope of this line is equal to:



(A) $+k$

(B) $k/2.303$

(C) $+2.303\,k$

(D) $-k$

Q9. For most ordinary reactions, the rate roughly doubles or triples for every 10 °C rise in temperature. This ratio of rate constants, $k_{(T+10)}/k_T$, is called the temperature coefficient and usually has a value of about:

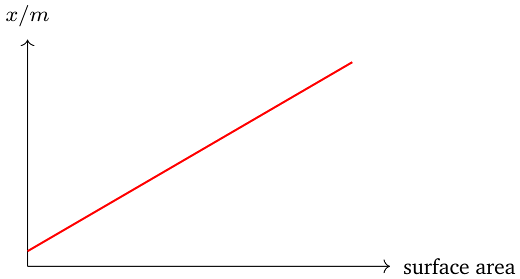
(A) 0.5

(B) 2 to 3

(C) 10

(D) 100

Q10. For a given mass of an adsorbent, the extent of adsorption increases as the available surface area increases. The graph shows how the amount adsorbed, x/m, rises with the surface area of the adsorbent. This is why a solid is most effective as an adsorbent when it is:



(A) finely powdered or porous

(B) a single large solid block

(C) melted to a liquid

(D) compressed into a dense pellet

Q11. Which of the following statements about lyophilic and lyophobic colloids is correct?

(A) Lyophobic sols are highly stable and reversible

(B) Lyophilic sols have little affinity for the dispersion medium

(C) Lyophilic sols are stable because the particles are strongly solvated by the medium, while lyophobic sols are easily coagulated

(D) Lyophobic sols are stabilised by strong solvation of their particles

Q12. In catalysis, a substance that increases the activity of a catalyst while a substance that destroys it are termed, respectively:

(A) poison and promoter

(B) inhibitor and activator

(C) adsorbate and absorbate

(D) promoter and catalytic poison

Q13. The correct order of acidic strength of the hydrohalic acids in aqueous solution is:

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

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

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

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

Q14. In xenon tetrafluoride, XeF_4, the central xenon atom is sp^3d^2 hybridised with two lone pairs. The shape of the molecule is:

(A) tetrahedral

(B) see-saw

(C) square planar

(D) octahedral

Q15. Unlike the other members of its group, nitrogen does *not* form pentahalides such as NX_5. The main reason for this anomalous behaviour is that nitrogen:

(A) is the most metallic element of the group

(B) has no available d-orbitals in its valence shell to expand its octet

(C) has a very large atomic size

(D) has the lowest electronegativity in the group

Q16. Which of the following transition-metal ions is *diamagnetic* (has no unpaired electrons)?

(A) Fe^{3+} (d^5)

(B) Mn^{2+} (d^5)

(C) Cu^{2+} (d^9)

(D) Zn^{2+} (d^{10})

Q17. The maximum oxidation state of $+7$ exhibited in the first transition ($3d$) series is shown by:

(A) iron (Fe)

(B) chromium (Cr)

(C) manganese (Mn)

(D) scandium (Sc)

Q18. Across the first transition series, the enthalpy of atomisation (and the melting point) generally reaches a *maximum* near the middle of the series. This is mainly because the number of unpaired d-electrons available for metallic bonding is:

(A) greatest near the middle of the series

(B) greatest at the very end of the series

(C) the same for every element

(D) zero throughout the series

Q19. In the complex ion $[\mathrm{Fe(CN)_6}]^{4-}$, in which CN is a -1 ligand, the oxidation number of iron is:

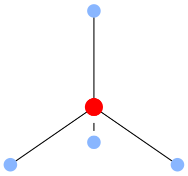
(A) $+3$

(B) $+2$

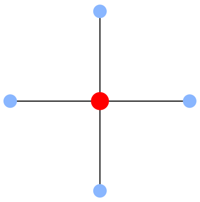
(C) $+4$

(D) 0

Q20. Both the geometries shown have coordination number 4. Geometry (II), in which the four ligands and the metal all lie in one plane at 90°, is described as:



(I) tetrahedral



(II) square planar

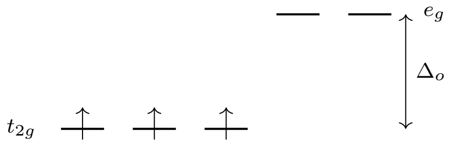
(A) tetrahedral

(B) octahedral

(C) square planar

(D) linear

Q21. An octahedral complex of a metal ion has the d-electron arrangement shown, with three unpaired electrons. Using the spin-only formula $\mu = \sqrt{n(n+2)}$ BM, its magnetic moment is:



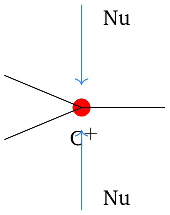
(A) $\sqrt{8}$ BM

(B) $\sqrt{24}$ BM

(C) 0 BM

(D) $\sqrt{15}$ BM

Q22. When an optically active alkyl halide reacts by an S_N1 path through the planar carbocation shown, the product is:



attack from both faces

(A) a racemic mixture (both configurations)

(B) a single product with complete inversion of configuration

(C) a single product with complete retention of configuration

(D) no substitution product at all

Q23. An alkyl halide reacts with *silver* nitrite ($AgNO_2$) to give predominantly:

(A) an alkyl nitrite (R–O–N=O)

(B) a nitroalkane ($R–NO_2$)

(C) an amine

(D) an ether

Q24. The dipole moment of chlorobenzene (1.69 D) is *lower* than that of cyclohexyl chloride (2.15 D). This is mainly because, in chlorobenzene:

(A) the C–Cl bond is purely ionic

(B) chlorine is less electronegative

(C) the molecule is non-planar

(D) the C atom bonded to Cl is sp^2 hybridised and partial double-bond character reduces the electron drift, giving a smaller dipole

Q25. When ethanol is treated with sodium metal, the gas evolved (which burns with a pop sound) is:

(A) oxygen

(B) carbon dioxide

(C) hydrogen

(D) ethane

Q26. When phenol is treated with an excess of bromine water at room temperature, the product obtained is:

(A) 2,4,6-tribromophenol (a white precipitate)

(B) only o-bromophenol

(C) bromobenzene

(D) only p-bromophenol

Q27. Ethers are chemically rather unreactive, yet on long standing in air and light they tend to form:

(A) alcohols

(B) explosive peroxides

(C) esters

(D) amines

Q28. When an aldehyde reacts with *one* molecule of an alcohol in the presence of dry HCl, the initial product formed is a:

(A) carboxylic acid

(B) ketone

(C) ester

(D) hemiacetal

Q29. Fehling's solution gives a brick-red precipitate of Cu_2O with aliphatic aldehydes but *not* with aromatic aldehydes such as benzaldehyde. Which of the following gives a *positive* Fehling's test?

(A) acetaldehyde (CH_3CHO)

(B) benzaldehyde (C_6H_5CHO)

(C) acetone (CH_3COCH_3)

(D) benzophenone

Q30. When a carboxylic acid is heated with an alcohol in the presence of a little concentrated H_2SO_4, the organic product formed is:

(A) an amide

(B) an acid anhydride

(C) an ester

(D) an acid chloride

Q31. The Gabriel phthalimide synthesis is used to prepare:

(A) only tertiary amines

(B) a mixture of all three classes of amines

(C) aromatic (aryl) amines only

(D) only primary (aliphatic) amines

Q32. A benzene diazonium salt is converted into benzene (the diazonium group is replaced by –H) when it is treated with:

(A) CuCl / HCl

(B) hypophosphorous acid, H_3PO_2

(C) dilute H_2SO_4 (warm)

(D) KI

Q33. Which of the following observations correctly distinguishes an amide (R–CONH$_2$) from a primary amine (R–NH$_2$)?

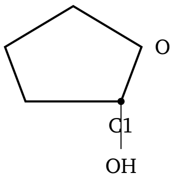
(A) An amide contains a C=O group attached to nitrogen and is at most weakly basic, whereas a primary amine has no carbonyl and is distinctly basic

(B) An amine contains a carbonyl group while an amide does not

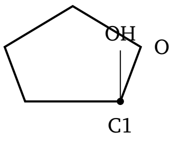
(C) Both are equally strong bases

(D) An amide turns red litmus blue more strongly than an amine

Q34. The two cyclic forms of glucose shown differ only in the orientation of the –OH group at C-1, the anomeric carbon. These two forms are called:



α (OH down)



β (OH up)

(A) geometrical isomers

(B) structural isomers

(C) anomers (α- and β-D-glucose)

(D) enantiomers of fructose

Q35. Which of the following correctly states a difference between DNA and RNA?

(A) DNA contains ribose sugar, RNA contains deoxyribose

(B) Both DNA and RNA contain the base uracil

(C) DNA contains uracil, RNA contains thymine

(D) DNA contains deoxyribose and the base thymine, while RNA contains ribose and the base uracil

Detailed Solutions

Q1.

Solution

Concept — Parts per million (ppm): for a dilute solution, ppm by mass $= \dfrac{\text{mass of solute}}{\text{mass of solution}} \times 10^6$.

Step 1 — Convert units: mass of solute $= 2$ mg $= 2 \times 10^{-3}$ g; mass of solution ≈ 1 kg $= 1000$ g.

Step 2 — Substitute:

$$\text{ppm} = \frac{2 \times 10^{-3}}{1000} \times 10^6 = 2 \text{ ppm}.$$

Why other options are wrong:

- (A) 0.2 misplaces a factor of ten.
- (C),(D) wrongly treat 2 mg as 20 mg or scale incorrectly.

Final Answer: 2 ppm $\Rightarrow \boxed{\text{B}}$

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

Q2.

Solution

Concept — Raoult's law: for an ideal solution the partial pressure of A is $p_A = x_A P_A^\circ$, a straight line from the origin up to P_A° at $x_A = 1$.

Step 1 — Rearrange for x_A:

$$x_A = \frac{p_A}{P_A^\circ} = \frac{60}{120} = 0.5.$$

Step 2 — Read the graph: the dashed construction at $p_A = 60$ meets the line at $x_A = 0.5$, confirming the value.

Why other options are wrong:

- (B),(C) use the wrong ratio of p_A to P_A°.
- (D) 0.6 has no basis in $60/120$.

Final Answer: $x_A = 0.5 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q2

Q3.

Solution

Concept — Isotonic solutions: two solutions are isotonic when they exert the same osmotic pressure, $\pi = cRT$. At the same temperature this requires equal molar concentrations of dissolved particles.

Step 1 — Both are non-electrolytes: glucose and urea do not dissociate ($i = 1$), so equal osmotic pressure means equal molarity.

Step 2 — Conclusion: the urea solution must also be 0.1 M.

Why other options are wrong:

- (A),(B),(D) would give a different osmotic pressure from the 0.1 M glucose.

Final Answer: 0.1 M urea $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q3

Q4.

Solution

Concept — Standard cell EMF: $E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$. The more negative electrode (Mg) is the anode; Cu is the cathode.

Step 1 — Substitute:

$$E^\circ_{\text{cell}} = E^\circ_{\text{Cu}^{2+}/\text{Cu}} - E^\circ_{\text{Mg}^{2+}/\text{Mg}} = 0.34 - (-2.37) = 2.71 \text{ V}.$$

Step 2 — Sign check: a positive EMF ($+2.71$ V) confirms the cell reaction is spontaneous as drawn.

Why other options are wrong:

- (A) 2.03 subtracts wrongly; (C) 2.37 ignores the Cu potential.
- (B) -2.71 reverses cathode and anode.

Final Answer: $E^\circ_{\text{cell}} = 2.71$ V $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Degree of dissociation: for a weak electrolyte, $\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$, the ratio of molar conductivity at the given concentration to that at infinite dilution.

Step 1 — Substitute:

$$\alpha = \frac{20}{400} = 0.05.$$

Step 2 — Interpret: only 5% of the electrolyte is dissociated at this concentration, typical of a weak electrolyte.

Why other options are wrong:

- (A),(B) use the wrong ratio $(0.5$ or $0.2)$.
- (D) 0.8 would imply strong dissociation, contradicting “weak”.

Final Answer: $\alpha = 0.05 \Rightarrow \boxed{\text{C}}$

Answer: (C) **Go Back to Q5**

Q6.

Solution

Concept — Faraday’s law: the charge needed is $Q = \frac{w}{M} \times n \times F$, and $Q = I \times t$, so $t = \frac{Q}{I}$. For Ag^+, $n = 1$.

Step 1 — Moles and charge: $n_{\text{Ag}} = \frac{1.08}{108} = 0.01$ mol, so $Q = 0.01 \times 96500 = 965$ C.

Step 2 — Time:

$$t = \frac{Q}{I} = \frac{965}{9.65} = 100 \text{ s}.$$

Why other options are wrong:

- (B),(D) over-count the charge or the moles.
- (C) 50 s halves the required charge.

Final Answer: $t = 100 \text{ s} \Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q6**

Q7.

Solution

Concept — Molecularity vs order: molecularity is the number of species that collide in a single elementary step; it is a theoretical whole number $(1, 2, 3)$. Order is the sum of the exponents in the experimentally determined rate law and may be zero, fractional or negative.

Step 1 — Key distinction: molecularity applies only to an elementary step and is always a small whole number, while order is found by experiment for the overall reaction.

Why other options are wrong:

- (A) the two are not always equal (they coincide only for elementary reactions).
- (C) order can be fractional, not molecularity.
- (D) order can be zero; molecularity cannot.

Final Answer: molecularity is a whole number for a step; order is experimental and may be fractional $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q7

Q8.

Solution

Concept — Integrated first-order law: $\ln[A] = \ln[A]_0 - kt$. Comparing with $y = mx + c$, the slope $m = -k$ and the intercept is $\ln[A]_0$.

Step 1 — Identify the slope: the straight-line plot of $\ln[A]$ vs t has slope $-k$ (negative, since $[A]$ falls with time).

Step 2 — Graph check: the line slopes downward from $\ln[A]_0$, consistent with slope $= -k$.

Why other options are wrong:

- (A) the slope is negative, not $+k$.
- (B),(C) the 2.303 factor appears only when using $\log_{10}$, not $\ln$.

Final Answer: slope $= -k \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept — Temperature coefficient: it is defined as the ratio of the rate constant at a temperature $10\ ^\circ\mathrm{C}$ higher to that at the lower temperature, $\dfrac{k_{(T+10)}}{k_T}$.

Step 1 — Typical value: for most ordinary reactions this ratio lies between 2 and 3, i.e. the rate roughly doubles or triples per $10\ ^\circ\mathrm{C}$ rise.

Why other options are wrong:

- (A) 0.5 would mean the rate halves on heating, which is wrong.
- (C),(D) 10 or 100 greatly overstate the typical increase.

Final Answer: about 2 to $3 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q9

Q10.

Solution

Concept — Surface area and adsorption: adsorption is a surface phenomenon, so for a fixed mass of adsorbent the extent of adsorption x/m rises as the exposed surface area increases (as the graph shows).

Step 1 — Maximise surface area: a solid that is finely powdered or porous (e.g. activated charcoal) exposes a far larger surface per gram than a single block, so it adsorbs much more.

Why other options are wrong:

- (B),(D) a large block or a dense pellet has a small surface area.
- (C) melting destroys the solid surface needed for adsorption.

Final Answer: finely powdered or porous $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q10

Q11.

Solution

Concept — Lyophilic vs lyophobic colloids: “lyophilic” (solvent-loving) particles are strongly attracted to and solvated by the dispersion medium, making the sol stable and reversible; “lyophobic” (solvent-hating) particles have little affinity for the medium and are easily coagulated.

Step 1 — Correct statement: lyophilic sols are stabilised by strong solvation of their particles, whereas lyophobic sols are unstable and readily coagulated by added electrolyte.

Why other options are wrong:

- (A) lyophobic sols are unstable and irreversible.
- (B) lyophilic sols have a *strong* affinity for the medium.
- (D) lyophobic particles are *not* solvated strongly.

Final Answer: lyophilic stable (solvated); lyophobic easily coagulated $\Rightarrow \boxed{\text{C}}$

$\boxed{\textbf{Answer: (C)}}$ **Go Back to Q11**

Q12.

Solution

Concept — Promoters and poisons: a *promoter* is a substance that itself has little catalytic action but enhances the activity of a catalyst (e.g. Mo in the Haber process). A *catalytic poison* is a substance that reduces or destroys the activity of a catalyst (e.g. As poisoning Pt).

Step 1 — Match the terms: activity-increasing substance = promoter; activity-destroying substance = catalytic poison.

Why other options are wrong:

- (A) reverses the two terms.
- (B),(C) inhibitor/activator and adsorbate/absorbate are not the correct catalysis terms here.

Final Answer: promoter and catalytic poison $\Rightarrow \boxed{\text{D}}$

$\boxed{\textbf{Answer: (D)}}$ **Go Back to Q12**

Q13.

Solution

Concept — Acidity of hydrohalic acids: acid strength is governed mainly by the H–X bond dissociation enthalpy, which decreases (bond becomes weaker) down the group as the atom gets larger. A weaker H–X bond releases H^+ more easily.

Step 1 — Order: since the H–X bond weakens from HF to HI, acidity increases: $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$. HF is the weakest (very strong H–F bond plus hydrogen bonding).

Why other options are wrong:

- (B) is the reverse (incorrect) order.
- (C),(D) place HF or HBr wrongly in the sequence.

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

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

Q14.

Solution

Concept — Shape from hybridisation and lone pairs: in XeF_4 the central Xe has 4 bond pairs $+2$ lone pairs $= 6$ electron domains, so it is sp^3d^2 hybridised (octahedral electron geometry).

Step 1 — Place the lone pairs: the two lone pairs occupy opposite (axial) positions to minimise repulsion, leaving the four F atoms in one plane.

Step 2 — Shape: four F atoms in a plane $\Rightarrow$ square planar.

Why other options are wrong:

- (A),(B) tetrahedral/see-saw correspond to different domain counts.
- (D) octahedral ignores the two lone pairs.

Final Answer: square planar $\Rightarrow \boxed{\text{C}}$

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

Q15.

Solution

Concept — Anomalous behaviour of the first element: the first member of a p-block group (N, O, F) differs from the rest because of its small size, high electronegativity and the *absence of d-orbitals* in its valence shell.

Step 1 — Apply to nitrogen: lacking valence d-orbitals, nitrogen cannot expand its octet, so it cannot form NX_5; heavier members (P, As) do form pentahalides using d-orbitals.

Why other options are wrong:

- (A) nitrogen is non-metallic, not the most metallic.
- (C) nitrogen has the *smallest* atomic size in the group.
- (D) nitrogen has the *highest*, not the lowest, electronegativity.

Final Answer: no available valence d-orbitals to expand the octet $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q15

Q16.

Solution

Concept — Para/diamagnetism: a species is paramagnetic if it has unpaired electrons and diamagnetic if all electrons are paired. Count the d-electrons.

Step 1 — Configurations: Fe^{3+} (d^5, 5 unpaired), Mn^{2+} (d^5, 5 unpaired), Cu^{2+} (d^9, 1 unpaired) are all paramagnetic; Zn^{2+} is d^{10} (all paired).

Step 2 — Conclusion: Zn^{2+} (d^{10}) has no unpaired electron, so it is diamagnetic.

Why other options are wrong:

- (A),(B),(C) all have one or more unpaired d-electrons and are paramagnetic.

Final Answer: Zn^{2+} (d^{10}, diamagnetic) $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — Highest oxidation state in the 3d series: the maximum oxidation state rises to the middle of the series, where the maximum number of $4s$ and $3d$ electrons can be used in bonding.

Step 1 — Find the $+7$ element: manganese ($3d^5\,4s^2$) has seven electrons available and reaches $+7$ (e.g. in $KMnO_4$), the highest in the series.

Why other options are wrong:

- (A) iron's common maximum is $+3$ (rarely $+6$).
- (B) chromium reaches $+6$ (e.g. in CrO_4^{2-}), not $+7$.
- (D) scandium shows only $+3$.

Final Answer: manganese, Mn ($+7$) $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q17

Q18.

Solution

Concept — Enthalpy of atomisation / melting point trend: the strength of metallic bonding in the transition metals depends on the number of unpaired d-electrons available for bonding.

Step 1 — Where bonding is strongest: the number of unpaired electrons is greatest near the middle of the series (around Cr/Mn region), giving the strongest metallic bonding and therefore the highest enthalpy of atomisation and melting points there.

Why other options are wrong:

- (B) at the end (Zn) the d-orbitals are full, so few/no unpaired electrons.
- (C),(D) the count of unpaired electrons clearly varies and is not zero throughout.

Final Answer: greatest number of unpaired electrons near the middle $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q18

Q19.

Solution

Concept — Oxidation number in a complex: the sum of the metal oxidation number and the ligand charges equals the overall charge of the complex ion.

Step 1 — Set up for $[\text{Fe(CN)}_6]^{4-}$: let the oxidation number of Fe be x; six CN$^-$ contribute $6 \times (-1) = -6$:

$$x + (-6) = -4.$$

Step 2 — Solve: $x = -4 + 6 = +2$.

Why other options are wrong:

- (A) $+3$ would give an overall charge of -3 (ferricyanide), not -4.
- (C),(D) $+4$ or 0 do not balance to -4.

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

$\boxed{\textbf{Answer: (B)}}$ **Go Back to Q19**

Q20.

Solution

Concept — Geometries for coordination number 4: four-coordinate complexes adopt either a tetrahedral arrangement (ligands at $109.5°$, non-planar) or a square-planar arrangement (all four ligands and the metal in one plane at $90°$).

Step 1 — Read geometry (II): the four ligands lie in a single plane around the metal at $90°$ to one another, which is the square-planar geometry (e.g. $[\text{Ni(CN)}_4]^{2-}$, $[\text{PtCl}_4]^{2-}$).

Why other options are wrong:

- (A) tetrahedral is geometry (I), which is non-planar.
- (B) octahedral is coordination number 6; (D) linear is coordination number 2.

Final Answer: square planar $\Rightarrow \boxed{\text{C}}$

$\boxed{\textbf{Answer: (C)}}$ **Go Back to Q20**

Q21.

Solution

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

Step 1 — Count unpaired electrons: the figure shows one electron in each of the three t_{2g} orbitals, so $n = 3$.

Step 2 — Substitute:

$$\mu = \sqrt{3(3+2)} = \sqrt{15}\text{ BM} \approx 3.87\text{ BM}.$$

Why other options are wrong:

- (A) $\sqrt{8}$ corresponds to $n = 2$; (B) $\sqrt{24}$ corresponds to $n = 4$.
- (C) 0 BM would require no unpaired electrons.

Final Answer: $\mu = \sqrt{15}$ BM $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q21

Q22.

Solution

Concept — Stereochemistry of S$_N$1: an S$_N$1 reaction passes through a planar (sp^2) carbocation. The nucleophile can attack this flat intermediate equally from *both* faces.

Step 1 — Consequence: attack from the two faces gives roughly equal amounts of the two enantiomers, i.e. a *racemic mixture*, so optical activity is largely lost (racemisation).

Step 2 — Contrast with S$_N$2: S$_N$2 is a one-step back-side attack giving complete *inversion* (Walden inversion) of configuration.

Why other options are wrong:

- (B) inversion is the S$_N$2 outcome, not S$_N$1.
- (C) retention is not the major S$_N$1 result; (D) substitution does occur.

Final Answer: a racemic mixture (racemisation) $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Ambident nitrite ion: the NO_2^- ion can bond through either N or O. The nature of the metal salt decides which atom attacks.

Step 1 — Silver nitrite: $AgNO_2$ is largely covalent, so the nitrogen attacks the carbon, giving mainly a *nitroalkane* (R–NO_2).

Step 2 — Contrast: sodium nitrite (ionic) reacts through oxygen to give chiefly an alkyl nitrite (R–O–N=O).

Why other options are wrong:

- (A) the alkyl nitrite is the product with *sodium* nitrite, not silver nitrite.
- (C),(D) amines/ethers need different reagents.

Final Answer: a nitroalkane (R–NO_2) $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q23

Q24.

Solution

Concept — Dipole moment of chlorobenzene vs cyclohexyl chloride: the magnitude of the dipole depends on how much electron density the C–Cl bond draws and the hybridisation of the carbon bonded to chlorine.

Step 1 — Effect in chlorobenzene: the C bonded to Cl is sp^2 (more electronegative than sp^3) and the chlorine lone pairs conjugate with the ring, giving the C–Cl bond partial double-bond character and reducing the electron drift toward Cl. Both effects lower the dipole moment.

Step 2 — Cyclohexyl chloride: here the carbon is sp^3 with no such resonance, so its dipole moment is larger (2.15 D > 1.69 D).

Why other options are wrong:

- (A) the C–Cl bond is covalent, not ionic.
- (B) chlorine's electronegativity is unchanged; (C) chlorobenzene is planar.

Final Answer: sp^2 C + partial double-bond character lower the dipole $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q24

Q25.

Solution

Concept — Alcohols as weak acids: the –OH hydrogen of an alcohol is weakly acidic. Active metals such as sodium displace it as hydrogen gas, forming a sodium alkoxide.

Step 1 — Reaction:

$$2\,C_2H_5OH + 2\,Na \rightarrow 2\,C_2H_5ONa + H_2\uparrow.$$

Step 2 — Identify the gas: the gas evolved is hydrogen, which burns with a characteristic pop.

Why other options are wrong:

- (A),(B) no O_2 or CO_2 is produced in this reaction.
- (D) ethane is not formed; the H comes off as H_2.

Final Answer: hydrogen gas (H_2) $\Rightarrow \boxed{C}$

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

Q26.

Solution

Concept — Bromination of phenol: the –OH group is a strong activating, ortho/para-directing group, so phenol is highly reactive towards electrophilic substitution. With *bromine water* (a polar medium) substitution occurs at all three activated positions.

Step 1 — Product: all the ortho and para positions are brominated, giving 2,4,6-tribromophenol, which separates as a white precipitate.

Why other options are wrong:

- (B),(D) mono-bromination occurs only in a non-polar solvent ($CS_2/CHCl_3$) at low temperature, not in bromine water.
- (C) the –OH group is not replaced, so bromobenzene is not formed.

Final Answer: 2,4,6-tribromophenol (white precipitate) $\Rightarrow \boxed{A}$

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

Q27.

Solution

Concept — Reactivity of ethers: the C–O–C linkage is strong and ethers lack a reactive functional centre, so they are generally inert to bases, oxidising agents and reducing agents.

Step 1 — Peroxide formation: on prolonged exposure to air and light, ethers slowly undergo autoxidation at the α-carbon to form *peroxides*, which can explode on heating or distillation.

Step 2 — Safety note: this is why old ether samples are tested for peroxides before distillation.

Why other options are wrong:

- (A),(C),(D) alcohols, esters or amines are not the autoxidation products of ethers in air.

Final Answer: explosive peroxides $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q27

Q28.

Solution

Concept — Acetal formation: an aldehyde adds an alcohol across its C=O group. One molecule of alcohol gives a *hemiacetal* (a carbon bearing both –OH and –OR); a second molecule, with loss of water, then gives the acetal.

Step 1 — First product: with *one* molecule of alcohol the immediate product is the hemiacetal, R–CH(OH)(OR′).

Step 2 — Further reaction: a second alcohol molecule converts the hemiacetal to the acetal, $\text{R–CH(OR}')_2$.

Why other options are wrong:

- (A),(B),(C) carboxylic acids, ketones or esters are not formed in this nucleophilic addition.

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

Answer: (D) Go Back to Q28

Q29.

Solution

Concept — Fehling's test: Fehling's solution (a Cu^{2+} tartrate complex) is reduced by *aliphatic* aldehydes to a brick-red precipitate of Cu_2O. Aromatic aldehydes such as benzaldehyde do not respond.

Step 1 — Pick the positive case: acetaldehyde (CH_3CHO) is an aliphatic aldehyde and gives a positive Fehling's test.

Step 2 — Why aromatic aldehydes fail: the aldehyde group attached directly to the ring is stabilised/deactivated by conjugation, so it is not oxidised by the mild Fehling's reagent.

Why other options are wrong:

- (B) benzaldehyde is aromatic and gives a negative test.
- (C),(D) ketones (acetone, benzophenone) are not oxidised by Fehling's solution.

Final Answer: acetaldehyde (CH_3CHO) $\Rightarrow \boxed{A}$

$\boxed{\text{Answer: (A)}}$ Go Back to Q29

Q30.

Solution

Concept — Fischer esterification: a carboxylic acid reacts with an alcohol in the presence of a strong acid catalyst (conc. H_2SO_4) to give an ester and water, in a reversible reaction.

Step 1 — Reaction:

$$\mathrm{RCOOH + R'OH \overset{H^+}{\rightleftharpoons} RCOOR' + H_2O.}$$

Step 2 — Role of H_2SO_4: it acts as catalyst and dehydrating agent, shifting the equilibrium toward the ester.

Why other options are wrong:

- (A) amides need ammonia/amine, not an alcohol.
- (B),(D) anhydrides/acid chlorides require different reagents (P_2O_5, $SOCl_2$).

Final Answer: an ester $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q30

Q31.

Solution

Concept — Gabriel phthalimide synthesis: potassium phthalimide is alkylated by an alkyl halide, and the resulting N-alkylphthalimide is then hydrolysed (or treated with hydrazine) to release the amine.

Step 1 — Product type: only *one* alkyl group can be introduced on nitrogen, so the method gives exclusively *primary* amines (aliphatic).

Step 2 — Limitation: aryl halides do not react (no S_N2), so aromatic primary amines cannot be made this way.

Why other options are wrong:

- (A),(B) secondary/tertiary amines or mixtures are not produced.
- (C) aryl amines cannot be prepared by this route.

Final Answer: only primary (aliphatic) amines $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q31

Q32.

Solution

Concept — Replacement of the diazonium group by –H: hypophosphorous acid (H_3PO_2) is a mild reducing agent that replaces the $-N_2^+$ group by a hydrogen atom.

Step 1 — Reaction:

$$C_6H_5N_2^+Cl^- + H_3PO_2 + H_2O \rightarrow C_6H_6 + N_2 + H_3PO_3 + HCl.$$

Step 2 — Use: this is a key step for removing an amino group from a ring after it has directed substitution.

Why other options are wrong:

- (A) CuCl/HCl (Sandmeyer) gives chlorobenzene.
- (C) warm dilute acid gives phenol; (D) KI gives iodobenzene.

Final Answer: hypophosphorous acid, $H_3PO_2 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q32

Q33.

Solution

Concept — Amide vs amine: an amide has the structure R–CO–NH_2 (a carbonyl directly bonded to nitrogen), whereas a primary amine R–NH_2 has no carbonyl. The carbonyl withdraws electron density from the N lone pair, so amides are essentially neutral (very weakly basic), while amines are clearly basic.

Step 1 — Distinguishing feature: the presence of the C=O attached to N, and the much lower basicity, identify an amide; a free, basic –NH_2 identifies the amine.

Why other options are wrong:

- (B) it is the amide, not the amine, that contains the carbonyl.
- (C) they are not equally basic; the amine is far more basic.
- (D) the amine, not the amide, turns red litmus blue.

Final Answer: amide has C=O on N and is barely basic; amine has no carbonyl and is basic $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — Anomers of glucose: when glucose cyclises, C-1 (the carbonyl carbon) becomes a new stereocentre, the *anomeric carbon*. The two cyclic forms differ only in the orientation of the –OH at C-1.

Step 1 — Name the forms: the form with the C-1 –OH *down* (trans to the CH_2OH) is α-D-glucose; the form with it *up* is β-D-glucose. These two are called *anomers*.

Step 2 — Interconversion: in solution they interconvert through the open-chain form (mutarotation).

Why other options are wrong:

- (A),(B) they are neither geometrical nor structural isomers.
- (D) they are forms of glucose, not enantiomers of fructose.

Final Answer: anomers (α- and β-D-glucose) $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q34

Q35.

Solution

Concept — DNA vs RNA: the two nucleic acids differ in their sugar and in one of their bases.

Step 1 — Sugar: DNA contains $2'$-deoxyribose, while RNA contains ribose (which has an extra –OH at C-2′).

Step 2 — Bases: both share adenine, guanine and cytosine; the fourth base is *thymine* in DNA but *uracil* in RNA.

Why other options are wrong:

- (A) the sugars are swapped (DNA has deoxyribose).
- (B) only RNA has uracil; (C) reverses thymine and uracil.

Final Answer: $\text{DNA} = \text{deoxyribose} + \text{thymine};\ \text{RNA} = \text{ribose} + \text{uracil} \Rightarrow \boxed{\text{D}}$

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

Answer Key

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