AIIMS Paramedical Chemistry

Sample Paper – 9

Duration: 30 Minutes **Maximum Marks: 30**

Instructions

- This paper contains **30** Multiple Choice Questions (Single Correct Answer), modelled on the Chemistry portion of **AIIMS Paramedical** entrance.
- Each correct answer carries **+1 mark**. Each incorrect answer attracts **a penalty of $-\frac{1}{3}$ mark**. Unattempted questions score **0**.
- Only **one** option is correct. Choose carefully.
- Syllabus level: **Class 11 & 12 NCERT Chemistry**.
- Use of mobile phones, calculators, or electronic gadgets is strictly prohibited.

Q1. The number of oxygen atoms present in 1.6 g of methane (CH_4) is the same as the number of hydrogen atoms present in which of the following? (Atomic masses: C $=12$, H $=1$, O $=16$; methane contains no oxygen, so compare total atom counts.) How many hydrogen atoms are present in 1.6 g of methane?

(A) 6.022×10^{22}

(B) 2.4088×10^{23}

(C) 4.0×10^{22}

(D) 6.022×10^{23}

Q2. In the Bohr model of the hydrogen atom, the radius of an orbit is proportional to n^2 and the velocity of the electron is proportional to $1/n$. If the radius of the second orbit is r_2 and the velocity in the second orbit is v_2, what are the radius and velocity of the fourth orbit?

(A) radius $= 2r_2$, velocity $= 2v_2$

(B) radius $= 4r_2$, velocity $= v_2/4$

(C) radius $= 4r_2$, velocity $= v_2/2$

(D) radius $= 2r_2$, velocity $= v_2/2$

Q3. For a real gas, the compressibility factor is defined as $Z = \dfrac{PV}{nRT}$. At a certain temperature and pressure, 1 mole of a gas occupies 20% less volume than that predicted by the ideal gas equation. The value of Z for the gas under these conditions is:

(A) 0.8

(B) 1.2

(C) 1.0

(D) 0.2

Q4. The molar heat capacity at constant volume of an ideal monatomic gas is $C_V = \frac{3}{2}R$. The molar heat capacity at constant pressure C_P for the same gas, and the ratio $\gamma = C_P/C_V$, are respectively:

(A) $\frac{3}{2}R$ and 1.4

(B) $\frac{7}{2}R$ and 1.4

(C) $\frac{3}{2}R$ and 1.33

(D) $\frac{5}{2}R$ and 1.67

Q5. For the gaseous reaction $\mathrm{N_2}(g) + 3\mathrm{H_2}(g) \rightleftharpoons 2\mathrm{NH_3}(g)$, the relation between K_p and K_c is $K_p = K_c(RT)^{\Delta n}$. The value of Δn (change in number of moles of gas) for this reaction is:

(A) $+2$

(B) -2

(C) 0

(D) -1

Q6. An acetic acid / sodium acetate buffer has $\mathrm{p}K_a = 4.74$. To prepare a buffer of pH $= 5.74$, what ratio of [salt] to [acid] is required? (Use the Henderson–Hasselbalch equation.)

(A) $1 : 10$

(B) $1 : 1$

(C) $10 : 1$

(D) $100 : 1$

Q7. In the complex ion $[\mathrm{Cr(H_2O)_4Cl_2}]^{+}$, water is a neutral ligand and chloride carries a charge of -1. The oxidation state of chromium in this complex ion is:

(A) $+2$

(B) $+6$

(C) $+4$

(D) $+3$

Q8. On diluting an aqueous solution of a strong electrolyte, which of the following statements is correct?

(A) Specific conductance decreases while molar conductance increases.

(B) Both specific and molar conductance increase.

(C) Specific conductance increases while molar conductance decreases.

(D) Both specific and molar conductance decrease.

Q9. For a chemical reaction, the half-life $t_{1/2}$ is found to be independent of the initial concentration of the reactant. The order of the reaction is:

(A) Zero order

(B) First order

(C) Second order

(D) Third order

Q10. A solution that shows a *positive* deviation from Raoult's law is characterised by which of the following?

(A) $\Delta H_{\text{mix}} < 0$ and $\Delta V_{\text{mix}} < 0$

(B) $\Delta H_{\text{mix}} = 0$ and $\Delta V_{\text{mix}} = 0$

(C) $\Delta H_{\text{mix}} > 0$ and $\Delta V_{\text{mix}} > 0$

(D) $\Delta H_{\text{mix}} > 0$ and $\Delta V_{\text{mix}} < 0$

Q11. Moving across period 3 from sodium (Na) to chlorine (Cl), the valency of the elements with respect to oxygen (highest oxidation state) varies as:

(A) It remains constant at 1.

(B) It first decreases then increases.

(C) It increases from 1 to 8.

(D) It increases from 1 to 7.

Q12. An element has the ground-state electronic configuration $[\text{Ar}]\, 3d^6 4s^2$. To which block of the periodic table does this element belong?

(A) d-block

(B) s-block

(C) p-block

(D) f-block

Q13. Arrange the carbon–carbon bonds in ethane (C_2H_6), ethene (C_2H_4) and ethyne (C_2H_2) in order of *increasing* bond length.

(A) ethane $<$ ethene $<$ ethyne

(B) ethyne $<$ ethene $<$ ethane

(C) ethene $<$ ethyne $<$ ethane

(D) ethyne $<$ ethane $<$ ethene

Q14. In a water molecule (H_2O), the central oxygen atom is surrounded by a certain number of bond pairs and lone pairs. The number of lone pairs of electrons on the oxygen atom is:

(A) 0

(B) 1

(C) 2

(D) 3

Q15. The solubility of the sulphates of the alkaline earth metals (group 2) in water shows a definite trend down the group. The correct order of *decreasing* solubility is:

(A) $BaSO_4 > SrSO_4 > CaSO_4 > MgSO_4$

(B) $CaSO_4 > MgSO_4 > SrSO_4 > BaSO_4$

(C) $SrSO_4 > BaSO_4 > MgSO_4 > CaSO_4$

(D) $MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$

Q16. The hydrides of group 15 are NH_3, PH_3, AsH_3, SbH_3 and BiH_3. The correct order of their *decreasing* basicity is:

(A) $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

(B) $BiH_3 > SbH_3 > AsH_3 > PH_3 > NH_3$

(C) $PH_3 > NH_3 > AsH_3 > SbH_3 > BiH_3$

(D) $NH_3 > AsH_3 > PH_3 > SbH_3 > BiH_3$

Q17. Down group 16 (O, S, Se, Te, Po), which one of the following statements about the trends is *correct*?

(A) Atomic radius decreases down the group.

(B) Metallic character increases down the group.

(C) Electronegativity increases down the group.

(D) All members are non-metals.

Q18. Among the first-row transition metals, the unusually high (most positive) $E^{\circ}_{(M^{2+}/M)}$ value of copper, making it the only one that does not liberate hydrogen from dilute acids, is mainly attributed to:

(A) its very low ionisation enthalpy

(B) its large negative hydration enthalpy

(C) the high sum of its enthalpies of atomisation and ionisation not being balanced by hydration enthalpy

(D) its half-filled d-subshell

Q19. Which one of the following is an example of an *ambidentate* ligand?

(A) ethylenediamine (en)

(B) oxalate ($C_2O_4^{2-}$)

(C) ammonia (NH_3)

(D) nitrite (NO_2^-)

Q20. Ortho and para hydrogen differ in the relative orientation of the spins of their two nuclei. Which of the following statements about them is *correct*?

(A) In ortho-hydrogen the nuclear spins are parallel, while in para-hydrogen they are anti-parallel.

(B) In ortho-hydrogen the nuclear spins are anti-parallel, while in para-hydrogen they are parallel.

(C) Both forms have identical nuclear spin orientations.

(D) They differ only in the orientation of electron spins, not nuclear spins.

Q21. The homolytic fission of a covalent bond results in the formation of which of the following species?

(A) a carbocation and a carbanion

(B) two free radicals

(C) a carbocation and a free radical

(D) two carbanions

Q22. For but-2-ene (CH_3–CH=CH–CH_3), the isomer in which the two methyl groups lie on the *same* side of the double bond is correctly designated as:

(A) the E-isomer (and also the trans-isomer)

(B) the R-isomer

(C) the S-isomer

(D) the Z-isomer (and also the cis-isomer)

Q23. When 2-bromobutane (CH_3–CHBr–CH_2–CH_3) is treated with alcoholic KOH, elimination occurs. According to Saytzeff's rule, the *major* alkene product is:

(A) but-2-ene (the more substituted alkene)

(B) but-1-ene (the less substituted alkene)

(C) butane

(D) buta-1,3-diene

Q24. The addition polymerisation of ethene (CH_2=CH_2) under high pressure and temperature, in the presence of a trace of oxygen, gives which polymer?

(A) polyvinyl chloride (PVC)

(B) polystyrene

(C) polythene (polyethylene)

(D) polyacrylonitrile

Q25. Which of the following reagents is most suitable for converting ethanol (CH_3CH_2OH) into chloroethane (CH_3CH_2Cl) in good yield?

(A) dilute HCl alone at room temperature

(B) thionyl chloride, $SOCl_2$ (with pyridine)

(C) aqueous NaCl solution

(D) chlorine water

Q26. Which one of the following reagents gives a characteristic *violet* (or blue) colouration with phenol but *not* with ethanol, and is therefore used to distinguish a phenol from an alcohol?

(A) Fehling's solution

(B) Tollens' reagent

(C) bromine water (decolourisation)

(D) neutral ferric chloride ($FeCl_3$) solution

Q27. In the Gattermann–Koch reaction, benzene is treated with carbon monoxide and hydrogen chloride in the presence of anhydrous $AlCl_3$ (and CuCl). The organic product formed is:

(A) benzaldehyde

(B) benzoic acid

(C) acetophenone

(D) phenol

Q28. Which one of the following tests gives a positive result (silver mirror) with an aldehyde such as ethanal but a *negative* result with a ketone such as propanone, and is hence used to distinguish the two?

(A) the iodoform test

(B) the 2,4-DNP (Brady's) test

(C) Tollens' (ammoniacal silver nitrate) test

(D) the litmus test

Q29. When aniline ($C_6H_5NH_2$) is treated with acetic anhydride, the product formed by acylation of the amino group is:

(A) nitrobenzene

(B) acetanilide (N-phenylacetamide)

(C) benzanilide

(D) aniline hydrochloride

Q30. During the denaturation of a protein, which structural feature of the protein is primarily destroyed while the primary structure (sequence of amino acids) remains intact?

(A) the peptide (amide) bonds of the backbone

(B) the covalent C–C bonds of the side chains

(C) the sequence of the amino acid residues

(D) the secondary and tertiary (3-D) structure

Detailed Solutions

Q1.

Solution

Concept — Mole Concept: The number of particles equals (moles) $\times$ Avogadro's number $N_A = 6.022 \times 10^{23}$.

Step 1 — Moles of methane: Molar mass of $CH_4 = 12 + 4(1) = 16$ g/mol. Moles $= 1.6/16 = 0.1$ mol.

Step 2 — Atoms of hydrogen: Each CH_4 has 4 H atoms. Moles of H atoms $= 0.1 \times 4 = 0.4$ mol.

Step 3 — Count: Number of H atoms $= 0.4 \times 6.022 \times 10^{23} = 2.4088 \times 10^{23}$.

Why other options are wrong:

- 6.022×10^{22}: this is $0.1 \times N_A$, the count of C atoms, not H atoms.
- 4.0×10^{22} and 6.022×10^{23}: do not match $0.4\,N_A$.

Final Answer: 2.4088×10^{23} H atoms $\Rightarrow$ B

Answer: (B) Go Back to Q 1

Q2.

Solution

Concept — Bohr Orbits: Radius $r_n \propto n^2$ and velocity $v_n \propto 1/n$.

Step 1 — Radius ratio: $\dfrac{r_4}{r_2} = \dfrac{4^2}{2^2} = \dfrac{16}{4} = 4$, so $r_4 = 4r_2$.

Step 2 — Velocity ratio: $\dfrac{v_4}{v_2} = \dfrac{1/4}{1/2} = \dfrac{2}{4} = \dfrac{1}{2}$, so $v_4 = v_2/2$.

Why other options are wrong:

- radius $= 2r_2$: uses a linear n dependence; radius scales as n^2.
- velocity $= v_2/4$ or $= 2v_2$: do not follow the $1/n$ scaling between $n = 2$ and $n = 4$.

Final Answer: $r_4 = 4r_2$, $v_4 = v_2/2 \Rightarrow$ C

Answer: (C) Go Back to Q 2

Q3.

Solution

Concept — Compressibility Factor: $Z = \dfrac{PV_{\text{real}}}{nRT} = \dfrac{V_{\text{real}}}{V_{\text{ideal}}}$ at fixed P, T, n.

Step 1 — Express the real volume: "20% less than ideal" means $V_{\text{real}} = V_{\text{ideal}} - 0.20\,V_{\text{ideal}} = 0.80\,V_{\text{ideal}}$.

Step 2 — Compute Z: $Z = \dfrac{V_{\text{real}}}{V_{\text{ideal}}} = \dfrac{0.80\,V_{\text{ideal}}}{V_{\text{ideal}}} = 0.8$.

Why other options are wrong:

- 1.2: would mean the gas occupies more volume than ideal.
- 1.0: corresponds to ideal behaviour.
- 0.2: misreads "20% less" as $V_{\text{real}} = 0.2\,V_{\text{ideal}}$.

Final Answer: $Z = 0.8 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 3

Q4.

Solution

Concept — Heat Capacities: For an ideal gas, $C_P - C_V = R$ (Mayer's relation), and $\gamma = C_P/C_V$.

Step 1 — Find C_P: $C_P = C_V + R = \frac{3}{2}R + R = \frac{5}{2}R$.

Step 2 — Find γ: $\gamma = \dfrac{C_P}{C_V} = \dfrac{(5/2)R}{(3/2)R} = \dfrac{5}{3} \approx 1.67$.

Why other options are wrong:

- $\frac{3}{2}R$, 1.4: C_P cannot equal C_V; 1.4 is for a diatomic gas.
- $\frac{7}{2}R$, 1.4: values for a diatomic ($C_V = \frac{5}{2}R$) gas.
- $\frac{3}{2}R$, 1.33: wrong C_P.

Final Answer: $C_P = \frac{5}{2}R$, $\gamma = 1.67 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 4

Q5.

Solution

Concept — K_p vs K_c: $K_p = K_c(RT)^{\Delta n}$, where Δn = (moles of gaseous products) − (moles of gaseous reactants).

Step 1 — Count product moles: Right side: 2 moles $NH_3 \Rightarrow 2$.

Step 2 — Count reactant moles: Left side: 1 mole N_2 +3 moles $H_2 = 4$.

Step 3 — Compute Δn: $\Delta n = 2 - 4 = -2$.

Why other options are wrong:

- $+2$: reverses the sign of Δn.
- 0: would require equal gas moles on both sides.
- -1: an incorrect mole count.

Final Answer: $\Delta n = -2 \Rightarrow$ B

Answer: (B) Go Back to Q 5

Q6.

Solution

Concept — Henderson–Hasselbalch: $\text{pH} = \text{p}K_a + \log \dfrac{[\text{salt}]}{[\text{acid}]}$.

Step 1 — Substitute values: $5.74 = 4.74 + \log \dfrac{[\text{salt}]}{[\text{acid}]}$.

Step 2 — Solve the log term: $\log \dfrac{[\text{salt}]}{[\text{acid}]} = 5.74 - 4.74 = 1$.

Step 3 — Remove the log: $\dfrac{[\text{salt}]}{[\text{acid}]} = 10^1 = 10$, i.e. salt : acid $= 10 : 1$.

Why other options are wrong:

- $1 : 1$: gives $\text{pH} = \text{p}K_a = 4.74$.
- $1 : 10$: gives pH $= 3.74$ (below pK_a).
- $100 : 1$: gives pH $= 6.74$.

Final Answer: salt : acid $= 10 : 1 \Rightarrow$ C

Answer: (C) Go Back to Q 6

Q7.

Solution

Concept — Oxidation State in a Complex: The sum of the oxidation state of the metal and the charges of all ligands equals the overall charge on the complex ion.

Step 1 — Assign ligand charges: 4 H_2O are neutral (0 each); 2 Cl^- contribute $2(-1) = -2$.

Step 2 — Balance to the ion charge: Let Cr be x. Then $x + 0 + (-2) = +1$.

Step 3 — Solve: $x = +1 + 2 = +3$.

Why other options are wrong:

- $+2$, $+4$: arise from miscounting the chloride contribution.
- $+6$: not consistent with the $+1$ overall charge.

Final Answer: Cr is $+3 \Rightarrow$ D

Answer: (D) Go Back to Q 7

Q8.

Solution

Concept — Conductance on Dilution: Specific conductance (κ) measures conductance per unit volume; molar conductance (Λ_m) measures conductance of all ions from one mole.

Step 1 — Specific conductance: On dilution the number of ions per unit volume falls, so κ *decreases*.

Step 2 — Molar conductance: $\Lambda_m = \dfrac{\kappa \times 1000}{c}$. As c falls faster than κ and ions move more freely, Λ_m *increases*.

Why other options are wrong:

- Both increase / both decrease: each ignores that the two quantities change oppositely.
- Specific up, molar down: reverses the actual behaviour.

Final Answer: κ decreases, Λ_m increases $\Rightarrow$ A

Answer: (A) Go Back to Q 8

Q9.

Solution

Concept — Half-life and Order: For a first-order reaction $t_{1/2} = \dfrac{0.693}{k}$, which contains no concentration term.

Step 1 — Check the dependence: For zero order $t_{1/2} \propto [A]_0$; for first order $t_{1/2}$ is independent of $[A]_0$; for second order $t_{1/2} \propto 1/[A]_0$.

Step 2 — Match the data: "Independent of initial concentration" uniquely identifies a *first-order* reaction.

Why other options are wrong:

- Zero order: half-life rises with $[A]_0$.
- Second / third order: half-life falls as $[A]_0$ rises.

Final Answer: First order $\Rightarrow$ B

Answer: (B) Go Back to Q 9

Q10.

Solution

Concept — Deviations from Raoult's Law: Positive deviation occurs when A–B attractions are *weaker* than A–A and B–B attractions, so escaping tendency rises.

Step 1 — Sign of ΔH_{mix}: Weaker new interactions mean mixing absorbs heat, so $\Delta H_{\text{mix}} > 0$ (endothermic).

Step 2 — Sign of ΔV_{mix}: Looser packing makes the total volume expand, so $\Delta V_{\text{mix}} > 0$.

Why other options are wrong:

- $\Delta H < 0$, $\Delta V < 0$: this is *negative* deviation.
- $\Delta H = 0$, $\Delta V = 0$: this is an *ideal* solution.
- $\Delta H > 0$, $\Delta V < 0$: mixed signs, not a single deviation type.

Final Answer: $\Delta H_{\text{mix}} > 0$ and $\Delta V_{\text{mix}} > 0 \Rightarrow$ C

Answer: (C) Go Back to Q 10

Q11.

Solution

Concept — Valency Across a Period: The highest oxidation state with oxygen equals the group number (number of valence electrons available).

Step 1 — Trace the period: Na $(+1)$, Mg $(+2)$, Al $(+3)$, Si $(+4)$, P $(+5)$, S $(+6)$, Cl $(+7)$.

Step 2 — State the trend: The maximum valency with oxygen rises steadily from 1 (Na) to 7 (Cl across period 3).

Why other options are wrong:

- "1 to 8": period-3 maximum is 7 (Cl), not 8.
- "constant at 1" / "decreases then increases": contradict the steady rise.

Final Answer: Valency increases from 1 to $7 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 11

Q12.

Solution

Concept — Block Classification: The block is decided by the subshell that receives the last (differentiating) electron.

Step 1 — Read the configuration: $[\text{Ar}]\, 3d^6 4s^2$ has its last electrons entering the $3d$ subshell (this is iron, $Z = 26$).

Step 2 — Identify the block: Filling of a d-subshell places the element in the *d-block* (transition metals).

Why other options are wrong:

- s-block / p-block: require the last electron in s or p, not d.
- f-block: requires filling of an f-subshell.

Final Answer: d-block $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 12

Q13.

Solution

Concept — Bond Order and Bond Length: A higher bond order pulls the atoms closer, so bond length *decreases* as bond order rises.

Step 1 — Assign bond orders: Ethane C–C (single, order 1); ethene C=C (double, order 2); ethyne C≡C (triple, order 3).

Step 2 — Order of increasing length: Triple is shortest, single is longest: ethyne $<$ ethene $<$ ethane.

Why other options are wrong:

- ethane $<$ ethene $<$ ethyne: reverses the trend.
- the other orders place a higher-bond-order link as longer, which is wrong.

Final Answer: ethyne $<$ ethene $<$ ethane $\Rightarrow$ B

Answer: (B) Go Back to Q 13

Q14.

Solution

Concept — Lone Pairs on Central Atom: Oxygen has 6 valence electrons; in H_2O it forms two O–H bonds.

Step 1 — Account for bonding electrons: Two O–H single bonds use 2 of oxygen's electrons (one per bond), leaving $6 - 2 = 4$ non-bonding electrons.

Step 2 — Count lone pairs: 4 non-bonding electrons $= 2$ lone pairs. This bent shape (2 bond pairs + 2 lone pairs) gives the $\sim 104.5^\circ$ angle.

Why other options are wrong:

- 0, 1, 3: do not match the 4 leftover electrons on oxygen.

Final Answer: 2 lone pairs $\Rightarrow$ C

Answer: (C) Go Back to Q 14

Q15.

Solution

Concept — Solubility of Group-2 Sulphates: Down group 2, hydration enthalpy falls faster than lattice enthalpy, so solubility of the sulphates *decreases* from Mg to Ba.

Step 1 — Trend direction: $MgSO_4$ is the most soluble; $BaSO_4$ is virtually insoluble.

Step 2 — Write the decreasing order: $MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$.

Why other options are wrong:

- Any order placing $BaSO_4$ as most soluble is reversed.
- Mixed orders break the monotonic Mg $\rightarrow$ Ba decrease.

Final Answer: $MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4 \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q 15

Q16.

Solution

Concept — Basicity of Group-15 Hydrides: Basicity depends on the availability of the lone pair on the central atom. Down the group the lone pair becomes more diffuse and less available, so basicity falls.

Step 1 — Order down the group: N is smallest with the most concentrated lone pair, Bi is largest with the least available lone pair.

Step 2 — Decreasing basicity: $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$.

Why other options are wrong:

- $BiH_3 > \cdots > NH_3$: reverses the trend.
- Orders that swap NH_3 and PH_3 or AsH_3 and PH_3 break the monotonic decrease.

Final Answer: $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3 \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q 16

Q17.

Solution

Concept — Group-16 Trends: Down a group, atomic size increases, electronegativity decreases, and elements become more metallic.

Step 1 — Examine each claim: Oxygen and sulphur are non-metals, selenium and tellurium are metalloids, and polonium is a metal, so metallic character clearly *increases* down the group.

Step 2 — Reject the wrong claims: Atomic radius increases (not decreases); electronegativity decreases (not increases); not all members are non-metals.

Why other options are wrong:

- "radius decreases" and "electronegativity increases" reverse the real trends.
- "all non-metals" ignores Te (metalloid) and Po (metal).

Final Answer: Metallic character increases down group 16 $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q 17

Q18.

Solution

Concept — E° of Cu^{2+}/Cu: The standard electrode potential depends on atomisation enthalpy, ionisation enthalpies, and hydration enthalpy combined in a thermochemical cycle.

Step 1 — Identify the cause: For copper, the high sum of atomisation and ionisation enthalpies is *not* compensated by its hydration enthalpy, giving a positive (rather than negative) E°.

Step 2 — Consequence: Because $E^\circ_{(Cu^{2+}/Cu)}$ is positive, copper does not displace hydrogen from dilute acids.

Why other options are wrong:

- "very low ionisation enthalpy": copper's ionisation enthalpy is actually high.
- "large negative hydration enthalpy": would make E° more negative, not positive.
- "half-filled d-subshell": Cu does not have a half-filled d in this context.

Final Answer: High atomisation + ionisation not offset by hydration $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q 18

Q19.

Solution

Concept — Ambidentate Ligand: An ambidentate ligand can bind the metal through either of two different donor atoms (but only one at a time).

Step 1 — Examine the nitrite ion: NO_2^- can coordinate through N (nitro, $–NO_2$) or through O (nitrito, –ONO), making it ambidentate.

Step 2 — Classify the others: en and oxalate are bidentate chelating ligands; NH_3 is monodentate. None of these is ambidentate.

Why other options are wrong:

- en, oxalate: have two donor atoms that bind *simultaneously* (chelate), not alternatively.
- ammonia: a simple monodentate ligand.

Final Answer: Nitrite (NO_2^-) is ambidentate $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q 19

Q20.

Solution

Concept — Ortho / Para Hydrogen: The two forms differ in the relative orientation of the spins of the two protons (nuclei).

Step 1 — Ortho-hydrogen: The two nuclear spins are *parallel* (same direction).

Step 2 — Para-hydrogen: The two nuclear spins are *anti-parallel* (opposite directions).

Why other options are wrong:

- "ortho anti-parallel, para parallel": swaps the definitions.
- "identical orientations": then there would be no two forms.
- "electron spins": the distinction is in *nuclear* spins.

Final Answer: Ortho parallel, para anti-parallel $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q 20

Q21.

Solution

Concept — Homolytic Fission: In homolytic cleavage, the shared bonding pair splits *evenly*, one electron going to each fragment.

Step 1 — Resulting species: Each fragment keeps one unpaired electron, so two *free radicals* are produced.

Step 2 — Contrast with heterolysis: Heterolytic fission gives a cation and an anion (both electrons go to one atom), which is the opposite case.

Why other options are wrong:

- carbocation + carbanion: this is heterolytic fission.
- carbocation + radical / two carbanions: not the products of symmetrical homolysis.

Final Answer: Two free radicals $\Rightarrow$ B

Answer: (B) Go Back to Q 21

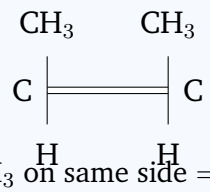
Q22.

Solution

Concept — E/Z and cis/trans: The higher-priority group on each doubly bonded carbon decides E/Z. When the higher-priority groups are on the *same* side, the alkene is Z.

Step 1 — Identify priorities: On each carbon of but-2-ene the choice is CH_3 versus H; CH_3 is higher priority.

Step 2 — Same-side isomer: Both CH_3 groups on the same side $\Rightarrow$ Z-isomer, which here is also the *cis*-isomer.



Both CH_3 on same side $\Rightarrow$ Z (cis)

Why other options are wrong:

- E (trans): groups on opposite sides.
- R / S: these label chiral centres, not double-bond geometry.

Final Answer: Z (cis)-isomer $\Rightarrow$ D

Answer: (D) Go Back to Q 22

Q23.

Solution

Concept — Saytzeff's Rule: In dehydrohalogenation, the major product is the *more substituted* (more stable) alkene, formed by removing the β-hydrogen from the more substituted carbon.

Step 1 — Identify β-hydrogens: 2-bromobutane can lose H from C1 (giving but-1-ene) or from C3 (giving but-2-ene).

Step 2 — Apply the rule: But-2-ene is the more substituted (disubstituted) alkene, hence the major product.

$$CH_3\text{–}CHBr\text{–}CH_2\text{–}CH_3 \xrightarrow[-HBr]{\text{alc. KOH}} CH_3\text{–}CH{=}CH\text{–}CH_3$$

but-2-ene (major, Saytzeff)

Why other options are wrong:

- but-1-ene: the less substituted (Hofmann) minor product.
- butane: would require reduction, not elimination.
- buta-1,3-diene: needs loss of two HBr; only one is present.

Final Answer: but-2-ene $\Rightarrow$ A

Answer: (A) Go Back to Q 23

Q24.

Solution

Concept — Addition Polymerisation: The free-radical addition polymerisation of ethene links many $CH_2{=}CH_2$ units into a long saturated chain.

Step 1 — Identify monomer and conditions: Ethene under high pressure/temperature with a trace of O_2 initiates the chain.

Step 2 — Name the product: The repeating $-(CH_2\text{–}CH_2)-$ chain is polythene (polyethylene).

Why other options are wrong:

- PVC: comes from vinyl chloride, not ethene.
- Polystyrene: comes from styrene.
- Polyacrylonitrile: comes from acrylonitrile.

Final Answer: Polythene $\Rightarrow$ C

Answer: (C) Go Back to Q 24

Q25.

Solution

Concept — Alcohol to Haloalkane: Thionyl chloride converts alcohols to chloroalkanes cleanly because the by-products (SO_2 and HCl) are gases and escape, giving a pure product.

Step 1 — Reaction: $CH_3CH_2OH + SOCl_2 \rightarrow CH_3CH_2Cl + SO_2\uparrow + HCl\uparrow$.

Step 2 — Why it is best: The gaseous by-products leave the high-purity chloroethane behind; pyridine mops up the HCl.

Why other options are wrong:

- dilute HCl alone: too slow / poor yield for a primary alcohol.
- aqueous NaCl / chlorine water: do not substitute the –OH group.

Final Answer: $SOCl_2$ (with pyridine) $\Rightarrow$ B

Answer: (B) Go Back to Q 25

Q26.

Solution

Concept — Phenol vs Alcohol Test: Phenols form coloured complexes with neutral ferric chloride; ordinary alcohols do not.

Step 1 — The test: Adding neutral $FeCl_3$ to phenol gives a violet (or blue) coloured complex.

Step 2 — Distinguish: Ethanol gives no such colour, so the violet colour confirms phenol.

Why other options are wrong:

- Fehling's / Tollens': detect aldehydes, not phenols.
- bromine water: phenol does decolourise it (white precipitate), but it is not

the violet-colour test asked for here, and the $FeCl_3$ colour test is the standard distinguishing reagent.

Final Answer: Neutral $FeCl_3 \Rightarrow$ D

Answer: (D) Go Back to Q 26

Q27.

Solution

Concept — Gattermann–Koch Reaction: Benzene reacts with CO and HCl in the presence of anhydrous $AlCl_3$ (and CuCl) to introduce a –CHO group directly onto the ring (formylation).

Step 1 — Product: The reaction yields benzaldehyde (C_6H_5CHO).

Step 2 — Note: It is a convenient way to make aromatic aldehydes from arenes.

Why other options are wrong:

- benzoic acid: would require oxidation of the aldehyde.
- acetophenone: a Friedel–Crafts acylation product (a ketone), not formylation.
- phenol: not formed in this reaction.

Final Answer: Benzaldehyde $\Rightarrow$ A

Answer: (A) Go Back to Q 27

Q28.

Solution

Concept — Aldehyde vs Ketone: Aldehydes are easily oxidised and reduce Tollens' reagent to give a silver mirror; ketones do not.

Step 1 — The test: Ethanal (an aldehyde) reduces ammoniacal $AgNO_3$, depositing metallic silver as a mirror.

Step 2 — The contrast: Propanone (a ketone) gives no silver mirror, so the positive Tollens' test distinguishes the two.

Why other options are wrong:

- iodoform test: positive for both ethanal and propanone (both have CH_3CO–), so it cannot distinguish them.

- 2,4-DNP: positive for both aldehydes and ketones.
- litmus: neither is appreciably acidic/basic.

Final Answer: Tollens' test $\Rightarrow$ C

Answer: (C) Go Back to Q 28

Q29.

Solution

Concept — Acylation of Amines: A primary aromatic amine reacts with acetic anhydride, replacing one N–H hydrogen with an acetyl group (–$COCH_3$).

Step 1 — Reaction: $C_6H_5NH_2 + (CH_3CO)_2O \rightarrow C_6H_5NHCOCH_3 + CH_3COOH$.

Step 2 — Name the product: $C_6H_5NHCOCH_3$ is acetanilide (N-phenylacetamide).

Why other options are wrong:

- nitrobenzene: a nitration product, not acylation.
- benzanilide: would need benzoylation (C_6H_5CO–), not acetylation.
- aniline hydrochloride: a salt, not an acylation product.

Final Answer: Acetanilide $\Rightarrow$ B

Answer: (B) Go Back to Q 29

Q30.

Solution

Concept — Denaturation of Proteins: Denaturation disrupts the weak interactions (hydrogen bonds, etc.) that maintain the secondary and tertiary structure, while the covalent backbone (primary structure) stays intact.

Step 1 — What is destroyed: The coiling/folding patterns, i.e. the secondary and tertiary (3-D) structures, unravel.

Step 2 — What survives: The sequence of amino acids (primary structure) is unchanged because peptide bonds are not broken.

Why other options are wrong:

- peptide bonds / C–C side-chain bonds: these covalent bonds are not broken in denaturation.
- amino-acid sequence: this is the primary structure, which is preserved.

Final Answer: Secondary and tertiary structure is destroyed $\Rightarrow$ D

Answer: (D) Go Back to Q 30

Answer Key

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