SAAT Chemistry

Sample Paper – 2

Duration: 40 Minutes **Maximum Marks: 40**

Instructions

- This paper contains **40** Multiple Choice Questions (Single Correct Answer), modelled on the Chemistry section of the **SAAT** (Siksha 'O' Anusandhan Admission Test).
- Each correct answer carries **+1 mark**. There is **no negative marking** for incorrect or unattempted answers.
- Only **one** option is correct. Attempt every question, since wrong answers are not penalised.
- Use of mobile phones, calculators, or other electronic gadgets is strictly prohibited.

Q1. The number of molecules present in 8 g of methane (CH_4, molar mass 16 g/mol) is $(N_A = 6.022 \times 10^{23})$

(A) 6.022×10^{23}

(B) 3.011×10^{23}

(C) 1.2×10^{24}

(D) 1.5×10^{23}

Q2. The number of moles present in 10.6 g of anhydrous sodium carbonate (Na_2CO_3, molar mass 106 g/mol) is

(A) 0.1 mol

(B) 1 mol

(C) 0.2 mol

(D) 0.5 mol

Q3. In the reaction $2H_2 + O_2 \rightarrow 2H_2O$, the mass of water formed when 4 g of hydrogen (H_2, molar mass 2 g/mol) burns completely in excess oxygen is

(A) 18 g

(B) 9 g

(C) 36 g

(D) 72 g

Q4. Which of the following sets of quantum numbers (n, l, m_l, m_s) is *not* permitted for an electron?

(A) $2,\ 1,\ 0,\ +\frac{1}{2}$

(B) $3,\ 2,\ -1,\ -\frac{1}{2}$

(C) $1,\ 0,\ 0,\ +\frac{1}{2}$

(D) $2,\ 2,\ 0,\ +\frac{1}{2}$

Q5. For the Cr^{3+} ion ($Z = 24$), the $3d$ sub-shell fills as shown. The number of unpaired electrons in Cr^{3+} is

$3d^3$

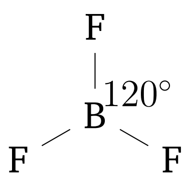
(A) 1

(B) 3

(C) 5

(D) 6

Q6. The hybridization of the boron atom in boron trifluoride (BF_3), whose trigonal planar shape is shown, is



(A) sp^2

(B) sp^3

(C) sp

(D) sp^3d

Q7. According to molecular orbital theory, the bond order of the dinitrogen molecule (N_2) is

(A) 1

(B) 2

(C) 3

(D) 2.5

Q8. Which of the following correctly orders the dipole moments of these molecules?

(A) $NH_3 > H_2O > HF$

(B) $HF > NH_3 > H_2O$

(C) $NH_3 > HF > H_2O$

(D) $H_2O > NH_3 > BF_3$

Q9. The standard enthalpy of formation of carbon dioxide from graphite and oxygen, $\mathrm{C(graphite)} + \mathrm{O_2(g)} \rightarrow \mathrm{CO_2(g)},\ \Delta H = -393.5$ kJ/mol, indicates that the reaction is

(A) exothermic (heat released)

(B) endothermic (heat absorbed)

(C) athermal (no heat change)

(D) spontaneous only above 1000 K

Q10. For a reaction $\Delta H = -40$ kJ/mol and $\Delta S = -100$ J/K/mol. The Gibbs free-energy change (ΔG) at 300 K is

(A) -70 kJ/mol

(B) -10 kJ/mol

(C) $+10$ kJ/mol

(D) -40 kJ/mol

Q11. For the gaseous equilibrium $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, the correct expression for the equilibrium constant K_c is

(A) $\frac{[N_2][H_2]^3}{[NH_3]^2}$

(B) $\frac{[NH_3]}{[N_2][H_2]}$

(C) $\frac{[NH_3]^2}{[N_2][H_2]^3}$

(D) $\frac{[NH_3]^2}{[N_2]^3[H_2]}$

Q12. The pH of a 0.01 M aqueous solution of sodium hydroxide (a strong base) at $25\,^\circ$C is

(A) 2

(B) 7

(C) 10

(D) 12

Q13. The molality of a solution containing 0.5 mol of glucose dissolved in 250 g of water is

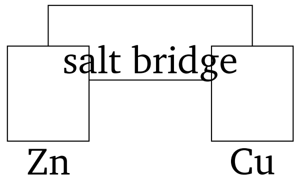
(A) 2 m

(B) 0.5 m

(C) 1 m

(D) 4 m

Q14. For the Daniell cell shown, $E^\circ_{cell} = 1.10$ V. Using the Nernst equation at 298 K, when $[Zn^{2+}] = [Cu^{2+}] = 1$ M, the cell potential E_{cell} is



(A) 0.00 V

(B) 1.10 V

(C) 2.20 V

(D) 0.55 V

Q15. For a reaction $\mathrm{A} \rightarrow \mathrm{products}$, doubling the concentration of A doubles the rate. The order of the reaction with respect to A is

(A) 0

(B) 2

(C) 3

(D) 1

Q16. The oxidation number of chromium in potassium dichromate $(K_2Cr_2O_7)$ is

(A) $+3$

(B) $+7$

(C) $+6$

(D) $+2$

Q17. On moving from left to right across a period in the modern periodic table, the first ionization enthalpy generally

(A) increases

(B) decreases

(C) remains constant

(D) first decreases then increases

Q18. Which of the following is the most electronegative element in the periodic table?

(A) Oxygen

(B) Fluorine

(C) Chlorine

(D) Nitrogen

Q19. Which alkali metal imparts a golden-yellow colour to a Bunsen flame?

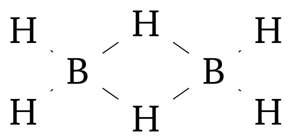
(A) Lithium

(B) Potassium

(C) Sodium

(D) Caesium

Q20. In the structure of diborane (B_2H_6), shown below with terminal and bridging hydrogens, the number of bridging (three-centre two-electron) hydrogen atoms is



(A) 4

(B) 6

(C) 0

(D) 2

Q21. Which of the following correctly represents the order of basicity of the group-15 hydrides?

(A) $PH_3 > NH_3 > AsH_3$

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

(C) $BiH_3 > AsH_3 > NH_3$

(D) $AsH_3 > PH_3 > NH_3$

Q22. Which of the following halogens is the strongest oxidising agent?

(A) F_2

(B) Cl_2

(C) Br_2

(D) I_2

Q23. Transition metals commonly show variable oxidation states. This is mainly because

(A) they have only s electrons available

(B) their nuclei are radioactive

(C) they are all diamagnetic

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

Q24. The most common and most stable oxidation state shown by the lanthanides is

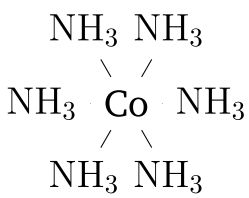
(A) $+2$

(B) $+4$

(C) $+3$

(D) $+1$

Q25. In the octahedral complex ion $[Co(NH_3)_6]^{3+}$, shown below, the oxidation number of cobalt is



(A) $+3$

(B) $+2$

(C) $+6$

(D) 0

Q26. The complex ion $[CoF_6]^{3-}$ (Co^{3+}, d^6) is a high-spin octahedral complex because F^- is a weak-field ligand. The number of unpaired electrons in it is

(A) 0

(B) 4

(C) 2

(D) 6

Q27. The IUPAC name of the compound $CH_3CH_2CH_2OH$ is

(A) propan-2-ol

(B) propanal

(C) propan-1-ol

(D) propanoic acid

Q28. The total number of structural (chain) isomers possible for the molecular formula C_5H_{12} is

(A) 2

(B) 5

(C) 4

(D) 3

Q29. Which of the following acids is the strongest, owing to the electron-withdrawing inductive effect of chlorine?

(A) $Cl_3C-COOH$ (trichloroacetic acid)

(B) CH_3-COOH (acetic acid)

(C) $ClCH_2-COOH$ (chloroacetic acid)

(D) $Cl_2CH-COOH$ (dichloroacetic acid)

Q30. The Wurtz reaction, in which two molecules of an alkyl halide react with sodium metal in dry ether, is used to prepare

(A) alkenes with one more carbon

(B) symmetrical alkanes with twice the carbons

(C) alcohols

(D) carboxylic acids

Q31. When hydrogen bromide (HBr) adds to propene, shown below, in the presence of organic peroxide (anti-Markovnikov / peroxide effect), the major product is

$$CH_3-CH=CH_2$$

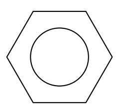
(A) 2-bromopropane

(B) propane

(C) 1-bromopropane

(D) 1,2-dibromopropane

Q32. In the Friedel–Crafts alkylation of benzene, shown below, with CH_3Cl, the catalyst (Lewis acid) used is



(A) dilute H_2SO_4

(B) aqueous NaOH

(C) H_2O

(D) anhydrous $AlCl_3$

Q33. Which of the following alkyl halides is the most reactive towards an S_N1 reaction?

(A) $(CH_3)_3CBr$ (tertiary)

(B) CH_3Br (methyl)

(C) CH_3CH_2Br (primary)

(D) $(CH_3)_2CHBr$ (secondary)

Q34. In the Lucas test (anhydrous $ZnCl_2$ + conc. HCl), which alcohol gives an immediate turbidity at room temperature?

(A) ethanol (primary)

(B) *tert*-butyl alcohol (tertiary)

(C) methanol (primary)

(D) propan-1-ol (primary)

Q35. When ethoxyethane (diethyl ether) is heated with excess concentrated HI, the products are

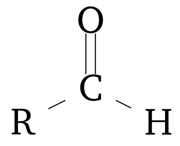
(A) ethanol and ethene

(B) ethanal and ethanol

(C) two molecules of ethyl iodide (C_2H_5I)

(D) ethane and iodine

Q36. Which reagent gives a brick-red precipitate of Cu_2O with an aliphatic aldehyde (carbonyl group shown) but not with a ketone?



(A) bromine water

(B) dilute HCl

(C) aqueous NaOH

(D) Fehling's solution

Q37. Among the following, which carboxylic acid is the strongest?

(A) CH_3COOH (acetic acid)

(B) FCH_2COOH (fluoroacetic acid)

(C) $BrCH_2COOH$ (bromoacetic acid)

(D) ICH_2COOH (iodoacetic acid)

Q38. Which of the following is the strongest base in the gas/aqueous phase among amines?

(A) aniline ($C_6H_5NH_2$)

(B) ammonia (NH_3)

(C) ethylamine ($C_2H_5NH_2$)

(D) diphenylamine ($(C_6H_5)_2NH$)

Q39. Glucose, the most common monosaccharide, is correctly classified as

(A) an aldohexose (a six-carbon sugar containing an aldehyde group)

(B) a ketopentose

(C) a disaccharide

(D) an amino acid

Q40. Nylon-6,6, prepared from hexamethylenediamine and adipic acid, is classified as a

(A) polyester

(B) natural addition polymer

(C) polythene-type polymer

(D) polyamide (condensation polymer)

Detailed Solutions

Q1.

Solution

Concept — Mole concept and Avogadro number: Number of molecules $= n \times N_A$, with $n = \dfrac{\text{mass}}{\text{molar mass}}$.

Step 1 — Moles of methane: $n = \dfrac{8}{16} = 0.5$ mol.

Step 2 — Molecules: $0.5 \times 6.022 \times 10^{23} = 3.011 \times 10^{23}$.

Why other options are wrong: 6.022×10^{23} is for 1 mol; 1.2×10^{24} is for 2 mol; 1.5×10^{23} uses a wrong mole value.

Final Answer: 3.011×10^{23} molecules $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Mole concept: $n = \dfrac{\text{given mass}}{\text{molar mass}}$.

Step 1 — Substitute: $n = \dfrac{10.6}{106}$.

Step 2 — Compute: $n = 0.1$ mol.

Why other options are wrong: 1 mol needs 106 g; 0.2 mol needs 21.2 g; 0.5 mol needs 53 g.

Final Answer: $n = 0.1$ mol $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q2

Q3.

Solution

Concept — Stoichiometry: Use the balanced equation $2H_2 + O_2 \rightarrow 2H_2O$; mole ratio $H_2 : H_2O = 2 : 2 = 1 : 1$.

Step 1 — Moles of H_2: $n = \dfrac{4}{2} = 2$ mol.

Step 2 — Moles and mass of water: 2 mol $H_2 \rightarrow$ 2 mol H_2O; mass $= 2 \times 18 = 36$ g.

Why other options are wrong: 18 g is for 1 mol water; 9 g and 72 g use wrong mole counts.

Final Answer: 36 g of water $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q3

Q4.

Solution

Concept — Allowed quantum numbers: For a given n, the azimuthal quantum number l can only take values $0, 1, \ldots, (n-1)$.

Step 1 — Test the set $2, 2, 0, +\frac{1}{2}$: Here $n = 2$, so l may be 0 or 1 only. $l = 2$ is impossible for $n = 2$.

Why other options are wrong: $2, 1, 0, +\frac{1}{2}$ $(2p)$, $3, 2, -1, -\frac{1}{2}$ $(3d)$ and $1, 0, 0, +\frac{1}{2}$ $(1s)$ all satisfy $l < n$ and valid m_l.

Final Answer: The set $2, 2, 0, +\frac{1}{2}$ is not allowed $\Rightarrow$ $\boxed{D}$

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Electronic configuration of ions: Remove electrons (first $4s$, then $3d$) to get the ion configuration; count singly-occupied d orbitals.

Step 1 — Cr ($Z = 24$): $[\mathrm{Ar}]3d^5 4s^1$. For Cr^{3+} remove the $4s^1$ and two $3d$ electrons: $[\mathrm{Ar}]3d^3$.

Step 2 — Count unpaired: $3d^3$ has 3 unpaired electrons (Hund's rule).

Why other options are wrong: 5 is Cr atom/Mn^{2+} (d^5); 1 and 6 miscount d^3.

Final Answer: 3 unpaired electrons $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q5

Q6.

Solution

Concept — Hybridization and shape: Three sigma bonds and no lone pair on the central atom give a trigonal planar shape.

Step 1 — Count domains on B: Boron in BF_3 has 3 bonding pairs and 0 lone pairs.

Step 2 — Assign hybridization: Three electron domains $\Rightarrow sp^2$, bond angle $120°$.

Why other options are wrong: sp^3 is tetrahedral; sp is linear; sp^3d is trigonal bipyramidal.

Final Answer: Boron is sp^2 hybridized $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q6

Q7.

Solution

Concept — Bond order (MOT): Bond order $= \frac{1}{2}(N_b - N_a)$.

Step 1 — N_2 has 14 electrons: $N_b = 10$, $N_a = 4$.

Step 2 — Compute: Bond order $= \frac{1}{2}(10 - 4) = 3$.

Why other options are wrong: 2 is O_2; 2.5 is NO/O_2^+; 1 is a single bond.

Final Answer: Bond order of $N_2 = 3 \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q7

Q8.

Solution

Concept — Dipole moment comparison: Dipole moment depends on bond polarity, molecular geometry and lone pairs.

Step 1 — Recall standard values: $\mu(H_2O) \approx 1.85$ D, $\mu(NH_3) \approx 1.47$ D, $\mu(BF_3) = 0$ D (symmetric, trigonal planar).

Step 2 — Order: $H_2O > NH_3 > BF_3$.

Why other options are wrong: The other orders contradict known values — NH_3 (1.47 D) is never greater than H_2O (1.85 D), so any order placing NH_3 above H_2O is wrong.

Final Answer: $H_2O > NH_3 > BF_3 \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept — Sign of ΔH: A negative enthalpy change means heat is released, i.e. the reaction is exothermic.

Step 1 — Read the sign: $\Delta H = -393.5$ kJ/mol < 0.

Step 2 — Conclude: Heat is given out, so the formation of CO_2 is exothermic.

Why other options are wrong: Endothermic needs $\Delta H > 0$; athermal needs $\Delta H = 0$; the sign alone does not set a temperature threshold.

Final Answer: The reaction is exothermic $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Gibbs free energy: $\Delta G = \Delta H - T\Delta S$ (use consistent units).

Step 1 — Convert ΔS: $\Delta S = -100$ J/K/mol $= -0.1$ kJ/K/mol.

Step 2 — Substitute: $\Delta G = -40 - (300)(-0.1) = -40 + 30 = -10$ kJ/mol.

Why other options are wrong: -70 adds the $T\Delta S$ term with the wrong sign; $+10$ flips ΔH; -40 ignores the entropy term.

Final Answer: $\Delta G = -10$ kJ/mol $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Equilibrium constant expression: $K_c = \dfrac{[\text{products}]^{\text{coeff}}}{[\text{reactants}]^{\text{coeff}}}$, each concentration raised to its stoichiometric coefficient.

Step 1 — Write for $N_2 + 3H_2 \rightleftharpoons 2NH_3$: $K_c = \dfrac{[NH_3]^2}{[N_2][H_2]^3}$.

Why other options are wrong: Option A inverts products and reactants; B and D use wrong exponents.

Final Answer: $K_c = \dfrac{[NH_3]^2}{[N_2][H_2]^3} \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q11

Q12.

Solution

Concept — pH of a strong base: Find $\text{pOH} = -\log[OH^-]$, then $\text{pH} = 14 - \text{pOH}$.

Step 1 — $[OH^-]$: NaOH is strong, so $[OH^-] = 0.01 = 10^{-2}$ M.

Step 2 — Compute: $\text{pOH} = 2$, hence $\text{pH} = 14 - 2 = 12$.

Why other options are wrong: 2 is the pOH; 7 is neutral; 10 uses a wrong concentration.

Final Answer: $\text{pH} = 12 \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q12

Q13.

Solution

Concept — Molality: $m = \dfrac{\text{moles of solute}}{\text{mass of solvent in kg}}$.

Step 1 — Mass of solvent: 250 g $= 0.25$ kg.

Step 2 — Compute: $m = \dfrac{0.5}{0.25} = 2$ m.

Why other options are wrong: 0.5 uses 1 kg; 1 uses 0.5 kg; 4 uses 125 g.

Final Answer: $m = 2$ m $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q13

Q14.

Solution

Concept — Nernst equation: $E_{cell} = E^\circ_{cell} - \dfrac{0.059}{n}\log Q$, where $Q = \dfrac{[Zn^{2+}]}{[Cu^{2+}]}$.

Step 1 — Evaluate Q: With both ions at 1 M, $Q = \dfrac{1}{1} = 1$, so $\log Q = 0$.

Step 2 — Substitute: $E_{cell} = 1.10 - 0 = 1.10$ V.

Why other options are wrong: At standard conditions the cell equals $E°$; 0.00, 2.20 and 0.55 V have no basis here.

Final Answer: $E_{cell} = 1.10$ V $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q14

Q15.

Solution

Concept — Order of reaction: For rate $= k[\text{A}]^x$, if doubling $[\text{A}]$ multiplies the rate by 2^x.

Step 1 — Apply the data: Rate doubles, so $2^x = 2 \Rightarrow x = 1$.

Why other options are wrong: Zero order would leave the rate unchanged; second order would quadruple it; third order would multiply by 8.

Final Answer: The reaction is first order in A $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q15

Q16.

Solution

Concept — Oxidation number: The sum of oxidation numbers in a neutral compound is zero.

Step 1 — Assign known values: K $= +1$ $(\times 2 = +2)$, O $= -2$ $(\times 7 = -14)$.

Step 2 — Solve for Cr: $+2 + 2x - 14 = 0 \Rightarrow 2x = 12 \Rightarrow x = +6$.

Why other options are wrong: $+3$ is Cr in Cr^{3+}/Cr_2O_3; $+2$ is in CrO; $+7$ is not a chromium state here.

Final Answer: Cr is $+6$ $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q16

Q17.

Solution

Concept — Ionization enthalpy trend: Across a period the effective nuclear charge rises and atomic size falls, so more energy is needed to remove an electron.

Step 1 — Apply: Left to right, first ionization enthalpy generally increases (with small dips at group 13 and 16).

Why other options are wrong: It decreases down a group, not across; it neither stays constant nor decreases first across the period.

Final Answer: Ionization enthalpy increases $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Electronegativity: Electronegativity increases across a period and decreases down a group, peaking at the top right (excluding noble gases).

Step 1 — Compare: On the Pauling scale, fluorine (≈ 4.0) is the highest of all elements.

Why other options are wrong: O (3.5), Cl (3.0) and N (3.0) are all below fluorine.

Final Answer: Fluorine is the most electronegative $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q18

Q19.

Solution

Concept — Flame colours of alkali metals: Each alkali metal gives a characteristic flame colour from electronic excitation.

Step 1 — Recall: Lithium = crimson red; sodium = golden yellow; potassium = lilac; caesium = blue-violet.

Step 2 — Pick: The golden-yellow flame is given by sodium.

Why other options are wrong: Li, K and Cs give crimson, lilac and blue-violet respectively.

Final Answer: Sodium gives a golden-yellow flame $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Structure of diborane: B_2H_6 has four terminal B–H bonds and two bridging B–H–B three-centre two-electron bonds.

Step 1 — Count bridging H: The two banana bonds account for 2 bridging hydrogen atoms.

Why other options are wrong: 4 is the number of terminal H; 6 is the total H; 0 ignores the bridges.

Final Answer: Number of bridging H $= 2 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Basicity of group-15 hydrides: Basicity decreases down the group as the central atom enlarges and the lone pair becomes more diffuse.

Step 1 — Order: $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$.

Step 2 — Pick: The option matching this trend is $NH_3 > PH_3 > AsH_3 > SbH_3$.

Why other options are wrong: The remaining orders reverse the correct trend.

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

Answer: (B) Go Back to Q21

Q22.

Solution

Concept — Oxidising power of halogens: Oxidising strength decreases down group 17; F_2 has the most positive (highest) standard reduction potential.

Step 1 — Compare $E°$: $F_2\,(+2.87\,\text{V}) > Cl_2\,(+1.36) > Br_2\,(+1.07) > I_2\,(+0.54)$.

Why other options are wrong: Cl_2, Br_2 and I_2 are progressively weaker oxidisers.

Final Answer: F_2 is the strongest oxidising agent $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Variable oxidation states: Transition metals use both ns and $(n-1)d$ electrons in bonding because these orbitals have comparable energies.

Step 1 — Reason: Small energy gaps let a variable number of d and s electrons participate, giving several stable oxidation states.

Why other options are wrong: They have d electrons too; they are not generally radioactive; many are paramagnetic, not all diamagnetic.

Final Answer: Close $(n-1)d$ and ns energies allow variable states $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q23

Q24.

Solution

Concept — Oxidation states of lanthanides: Although $+2$ and $+4$ occur for a few elements, the dominant state for almost all lanthanides is $+3$.

Step 1 — Reason: Loss of two $6s$ and one $5d/4f$ electron gives the stable Ln^{3+} ion.

Why other options are wrong: $+2$ and $+4$ are shown only by a few (e.g. Eu, Ce); $+1$ is not characteristic.

Final Answer: The common stable state is $+3 \Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q24

Q25.

Solution

Concept — Oxidation number in a complex: (metal oxidation number) $+$ (sum of ligand charges) $=$ overall charge of the complex ion.

Step 1 — Ligand charge: NH_3 is neutral, so six NH_3 contribute 0.

Step 2 — Solve: $x + 0 = +3 \Rightarrow x = +3$.

Why other options are wrong: $+2$, $+6$ and 0 do not satisfy the charge balance with neutral ammonia ligands.

Final Answer: Co is $+3 \Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — High-spin vs low-spin: With a weak-field ligand the small Δ_o keeps electrons unpaired (high spin), following Hund's rule.

Step 1 — Co^{3+} is d^6: In a weak octahedral field (F^-) the configuration is $t_{2g}^4 e_g^2$.

Step 2 — Count unpaired: $t_{2g}^4 e_g^2$ has 4 unpaired electrons.

Why other options are wrong: 0 is the low-spin d^6 case (strong field); 2 and 6 do not match high-spin d^6.

Final Answer: 4 unpaired electrons $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q26

Q27.

Solution

Concept — IUPAC nomenclature of alcohols: The $-OH$ group takes the suffix "-ol" with the lowest possible locant.

Step 1 — Count carbons: $CH_3CH_2CH_2OH$ has three carbons; OH is on carbon-1.

Step 2 — Name: propan-1-ol.

Why other options are wrong: propan-2-ol has OH on C-2; propanal is an aldehyde; propanoic acid is the $-COOH$ compound.

Final Answer: The compound is propan-1-ol $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q27

Q28.

Solution

Concept — Chain isomerism: Count the distinct carbon skeletons for the formula.

Step 1 — List C_5H_{12} isomers: n-pentane, isopentane (2-methylbutane), and neopentane (2,2-dimethylpropane).

Step 2 — Total: 3 structural isomers.

Why other options are wrong: C_4H_{10} has 2; 4 and 5 over-count C_5H_{12}.

Final Answer: 3 isomers $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q28

Q29.

Solution

Concept — Inductive effect on acidity: Electron-withdrawing groups stabilise the carboxylate ion, increasing acidity; more Cl atoms give a stronger acid.

Step 1 — Compare: $CH_3COOH < ClCH_2COOH < Cl_2CHCOOH < Cl_3CCOOH$.

Step 2 — Pick: Trichloroacetic acid (three Cl) is the strongest.

Why other options are wrong: Acetic acid has no Cl; mono- and dichloro acids are weaker than trichloro.

Final Answer: $Cl_3C{-}COOH$ is strongest $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to Q29

Q30.

Solution

Concept — Wurtz reaction: $2R{-}X + 2Na \xrightarrow{\text{dry ether}} R{-}R + 2NaX$, coupling two alkyl groups.

Step 1 — Product: Two alkyl halides join to give a symmetrical alkane with double the carbon count of the halide.

Why other options are wrong: It does not give alkenes, alcohols or carboxylic acids.

Final Answer: It gives symmetrical alkanes with twice the carbons $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q30

Q31.

Solution

Concept — Peroxide (anti-Markovnikov) effect: With peroxides, HBr adds by a free-radical mechanism so Br attaches to the carbon with more hydrogens (terminal carbon).

Step 1 — Apply to propene: Br goes to the terminal CH_2, H to the central carbon.

Step 2 — Product: 1-bromopropane.

Why other options are wrong: 2-bromopropane is the Markovnikov product (no peroxide); 1,2-dibromopropane needs Br_2; propane has no Br.

Final Answer: 1-bromopropane $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q31

Q32.

Solution

Concept — Friedel–Crafts alkylation: Benzene reacts with an alkyl halide in the presence of an anhydrous Lewis-acid catalyst that generates the carbocation electrophile.

Step 1 — Catalyst: Anhydrous $AlCl_3$ polarises CH_3Cl to give CH_3^+.

Why other options are wrong: Dilute H_2SO_4, NaOH and water do not generate the alkyl cation; water actually destroys $AlCl_3$.

Final Answer: Anhydrous $AlCl_3$ $\Rightarrow$ $\boxed{D}$

Answer: (D) Go Back to Q32

Q33.

Solution

Concept — S_N1 reactivity: The rate depends on carbocation stability: $3° > 2° > 1° >$ methyl.

Step 1 — Compare: $(CH_3)_3CBr$ forms the most stable (tertiary) carbocation.

Why other options are wrong: Methyl and primary cations are very unstable; the secondary one is less stable than tertiary, so they ionise more slowly.

Final Answer: $(CH_3)_3CBr$ is most reactive towards S_N1 $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — Lucas test: Lucas reagent reacts via S_N1; the rate of turbidity follows $3° > 2° > 1°$.

Step 1 — Apply: A tertiary alcohol (*tert*-butyl alcohol) gives immediate turbidity at room temperature.

Why other options are wrong: Primary alcohols (ethanol, methanol, propan-1-ol) show no turbidity at room temperature.

Final Answer: *tert*-butyl alcohol gives immediate turbidity $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q34

Q35.

Solution

Concept — Cleavage of ethers by HI: Concentrated HI cleaves the C–O bond; with a symmetrical ether and excess HI both alkyl groups end up as alkyl iodides.

Step 1 — Reaction: $C_2H_5{-}O{-}C_2H_5 + 2HI \rightarrow 2\,C_2H_5I + H_2O$.

Why other options are wrong: Ethers do not give ethene or ethanal here; with excess HI the alcohol first formed is further converted to ethyl iodide.

Final Answer: Two molecules of ethyl iodide $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q35

Q36.

Solution

Concept — Fehling's test: Fehling's solution (alkaline Cu^{2+} tartrate) is reduced by aliphatic aldehydes to a brick-red Cu_2O precipitate; ketones do not react.

Step 1 — Identify reagent: The brick-red Cu_2O test is given specifically by Fehling's solution.

Why other options are wrong: Bromine water, dilute HCl and NaOH do not give the Cu_2O precipitate distinction.

Final Answer: Fehling's solution $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q36

Q37.

Solution

Concept — Inductive effect and acidity: A more electronegative substituent withdraws electron density more strongly, stabilising the carboxylate and increasing acidity.

Step 1 — Compare the halogens: Electronegativity F $>$ Cl $>$ Br $>$ I, so $-I$ effect is strongest for F.

Step 2 — Pick: Fluoroacetic acid (FCH_2COOH) is the strongest among the listed acids.

Why other options are wrong: Acetic acid has no halogen; Br- and I-substituted acids are weaker than the F one.

Final Answer: FCH_2COOH is the strongest $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q37

Q38.

Solution

Concept — Basicity of amines: Alkyl groups push electron density onto nitrogen (+I effect), increasing basicity, while aryl groups delocalise the lone pair into the ring, decreasing it.

Step 1 — Compare: Ethylamine (alkyl, $+I$) is more basic than ammonia, which in turn is far more basic than aniline and diphenylamine (lone pair in resonance with the ring).

Why other options are wrong: Aniline and diphenylamine are weak bases due to resonance; ammonia is weaker than ethylamine.

Final Answer: Ethylamine is the strongest base $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q38

Q39.

Solution

Concept — Classification of glucose: Glucose has six carbons (hexose) and a terminal $-CHO$ aldehyde group, so it is an aldohexose.

Step 1 — Structure: $CHO-(CHOH)_4-CH_2OH$, a six-carbon aldose.

Why other options are wrong: A ketopentose has five carbons and a keto group; glucose is a monosaccharide, not a disaccharide; it is a sugar, not an amino acid.

Final Answer: Glucose is an aldohexose $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to Q39

Q40.

Solution

Concept — Condensation polymers: Nylon-6,6 forms by condensation (with loss of water) of a diamine and a dicarboxylic acid, linked by repeating amide $(-\mathrm{CONH}-)$ bonds.

Step 1 — Identify class: Amide linkages make it a polyamide; the step-growth condensation makes it a condensation polymer.

Why other options are wrong: A polyester has ester links; it is synthetic, not natural; it is not an addition (polythene-type) polymer.

Final Answer: Nylon-6,6 is a polyamide (condensation polymer) $\Rightarrow \boxed{\mathrm{D}}$

Answer: (D) Go Back to Q40

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	A	3	C	4	D	5	B
6	A	7	C	8	D	9	A	10	B
11	C	12	D	13	A	14	B	15	D
16	C	17	A	18	B	19	C	20	D
21	B	22	A	23	D	24	C	25	A
26	B	27	C	28	D	29	A	30	B
31	C	32	D	33	A	34	B	35	C
36	D	37	B	38	C	39	A	40	D