SAAT Chemistry

Sample Paper – 4

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

(A) 1.505×10^{24}

(B) 3.011×10^{23}

(C) 6.022×10^{23}

(D) 3.011×10^{24}

Q2. The volume occupied by 0.25 mol of an ideal gas at STP (1 mol $= 22.4$ L) is

(A) 11.2 L

(B) 5.6 L

(C) 22.4 L

(D) 2.8 L

Q3. For the reaction $N_2 + 3H_2 \rightarrow 2NH_3$, the number of moles of ammonia formed from the complete reaction of 6 mol of hydrogen is

(A) 6 mol

(B) 2 mol

(C) 4 mol

(D) 3 mol

Q4. In the Bohr model of the hydrogen atom, the energy of an electron in the nth orbit is $E_n = -\dfrac{13.6}{n^2}$ eV. The energy of the electron in the second orbit ($n = 2$) is

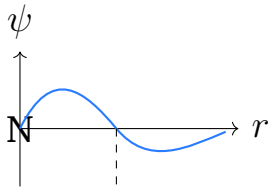
(A) -13.6 eV

(B) -6.8 eV

(C) -1.51 eV

(D) -3.4 eV

Q5. For a $3p$ orbital, whose radial node is indicated in the sketch, the total number of nodes (radial + angular) is



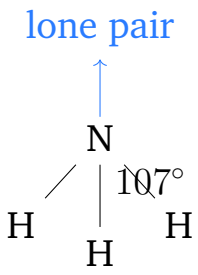
(A) 2

(B) 1

(C) 3

(D) 0

Q6. The shape of the ammonia molecule (NH_3), shown with its lone pair below, is



(A) trigonal planar

(B) trigonal pyramidal

(C) tetrahedral

(D) linear

Q7. According to molecular orbital theory, which of the following molecules is paramagnetic because it has two unpaired electrons in its antibonding π^* orbitals?

(A) N_2

(B) F_2

(C) H_2

(D) O_2

Q8. Which of the following molecules has the highest dipole moment?

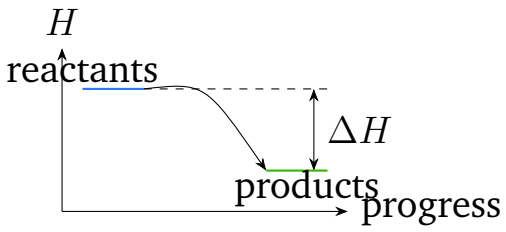
(A) CO_2

(B) BF_3

(C) H_2O

(D) CCl_4

Q9. For the reaction whose energy profile is shown, the products lie at a lower enthalpy than the reactants. The sign of ΔH for this reaction is



(A) negative (exothermic)

(B) positive (endothermic)

(C) zero

(D) undefined

Q10. For a chemical reaction that has just reached equilibrium at constant temperature and pressure, the value of the Gibbs free energy change (ΔG) is

(A) negative

(B) zero

(C) positive

(D) equal to ΔH

Q11. For the gaseous equilibrium $\mathrm{N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)}$, the relation between K_p and K_c is ($\Delta n_g =$ change in moles of gas)

(A) $K_p = K_c(RT)^{+2}$

(B) $K_p = K_c$

(C) $K_p = K_c(RT)^{-2}$

(D) $K_p = K_c(RT)^{+4}$

Q12. An aqueous solution of ammonium chloride ($\mathrm{NH_4Cl}$), the salt of a weak base and a strong acid, is

(A) strongly basic

(B) exactly neutral

(C) weakly basic

(D) acidic

Q13. The elevation in boiling point (ΔT_b) of a solution containing 0.5 mol of a non-volatile, non-electrolyte solute in 1 kg of water is ($K_b = 0.52\ \mathrm{K\,kg\,mol^{-1}}$)

(A) 0.52 K

(B) 0.26 K

(C) 1.04 K

(D) 0.13 K

Q14. Given the standard reduction potentials $E^{\circ}_{F_2/F^-} = +2.87$ V, $E^{\circ}_{Cl_2/Cl^-} = +1.36$ V, $E^{\circ}_{Br_2/Br^-} = +1.07$ V and $E^{\circ}_{I_2/I^-} = +0.54$ V, the strongest oxidising agent is

(A) F_2

(B) I_2

(C) Br_2

(D) Cl_2

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

(A) zero

(B) two

(C) half

(D) one

Q16. In the reaction $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$, the species that acts as the oxidising agent is

(A) Zn

(B) $ZnSO_4$

(C) $CuSO_4$ (i.e. Cu^{2+})

(D) Cu

Q17. Which of the following elements has the highest (most negative) electron gain enthalpy?

(A) Chlorine

(B) Fluorine

(C) Bromine

(D) Iodine

Q18. An element has the electronic configuration $[\mathrm{Ar}]3d^5 4s^1$. It belongs to the

(A) s-block

(B) d-block

(C) p-block

(D) f-block

Q19. Down group 2 of the periodic table, the solubility of the alkaline-earth-metal hydroxides $[\mathrm{M(OH)_2}]$ in water

(A) decreases

(B) remains constant

(C) increases

(D) first increases then decreases

Q20. Among the group-14 elements, the tendency to form long chains of identical atoms joined by covalent bonds (catenation), illustrated below, is maximum for

$$\mathrm{N \quad C - C - C - C - C \quad \cdots}$$

(A) silicon

(B) germanium

(C) tin

(D) carbon

Q21. Which of the following is the most reactive allotrope of phosphorus, which is stored under water because it ignites spontaneously in air?

(A) white phosphorus

(B) red phosphorus

(C) black phosphorus

(D) violet phosphorus

Q22. Which of the following is an interhalogen compound?

(A) HCl

(B) ICl

(C) $\mathrm{Cl_2O}$

(D) NaCl

Q23. The marked ability of transition metals and their compounds to act as catalysts is mainly because they

(A) have only one fixed oxidation state

(B) are radioactive

(C) show variable oxidation states and provide a surface for adsorption

(D) have completely filled d orbitals

Q24. The colour of many trivalent lanthanide ions ($\mathrm{Ln^{3+}}$) in their compounds is attributed to

(A) charge-transfer transitions only

(B) s–s transitions

(C) nuclear transitions

(D) f–f electronic transitions

Q25. The coordination number of the central cobalt atom in the complex $[Co(NH_3)_6]Cl_3$ is

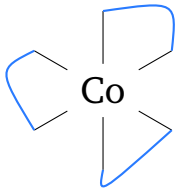
(A) 6

(B) 3

(C) 9

(D) 4

Q26. The octahedral complex $[Co(en)_3]^{3+}$ (en $=$ ethylenediamine), drawn below, exists as two non-superimposable mirror images. This type of isomerism is called



mirror-image pair

(A) linkage isomerism

(B) optical isomerism

(C) ionisation isomerism

(D) coordination isomerism

Q27. The IUPAC name of the compound $CH_3-CO-CH_2-CH_3$ is

(A) butanal

(B) butan-1-one

(C) butan-2-one

(D) butanoic acid

Q28. Which pair of compounds are functional-group isomers of each other (same molecular formula, different functional group)?

(A) n-butane and isobutane

(B) propan-1-ol and propan-2-ol

(C) but-1-ene and but-2-ene

(D) ethanol (C_2H_6O) and dimethyl ether (C_2H_6O)

Q29. The number of α-hydrogen atoms responsible for the hyperconjugative stabilisation of the *tert*-butyl cation $(CH_3)_3C^+$ is

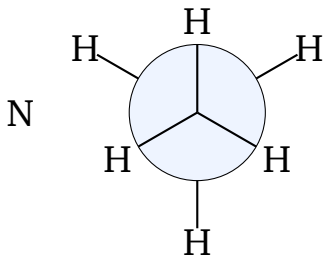
(A) 6

(B) 9

(C) 3

(D) 1

Q30. The most stable conformation of ethane, shown in the Newman projection below (dihedral angle 60°, minimum torsional strain), is the



(A) staggered conformation

(B) eclipsed conformation

(C) gauche-eclipsed conformation

(D) fully eclipsed only

Q31. The acid-catalysed hydration of propene ($CH_3CH{=}CH_2$) with water, following Markovnikov's rule, gives mainly

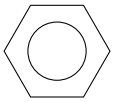
(A) propan-1-ol

(B) propane

(C) propan-2-ol

(D) propanal

Q32. Benzene, shown below, reacts with chlorine in the presence of anhydrous $FeCl_3$ to give chlorobenzene. The role of $FeCl_3$ is to act as a



(A) reducing agent

(B) nucleophile

(C) free radical

(D) Lewis-acid catalyst generating Cl^+

Q33. For a given alkyl group, the order of reactivity of the alkyl halides $R-X$ towards nucleophilic substitution generally is

(A) $R-F > R-Cl > R-Br > R-I$

(B) $R-I > R-Br > R-Cl > R-F$

(C) $R-Cl > R-Br > R-I > R-F$

(D) all react at the same rate

Q34. Vigorous oxidation of a primary alcohol such as ethanol with acidified $KMnO_4$ finally gives

(A) ethanoic (acetic) acid

(B) ethanal only

(C) ethane

(D) diethyl ether

Q35. The IUPAC name of the ether $CH_3-O-CH_2CH_3$ is

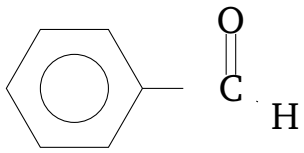
(A) ethoxyethane

(B) methanol

(C) methoxyethane

(D) propan-1-ol

Q36. Which aldehyde, having no α-hydrogen (structure shown), undergoes the Cannizzaro reaction with concentrated NaOH?



(A) acetaldehyde (CH_3CHO)

(B) propanal

(C) acetone

(D) benzaldehyde (C_6H_5CHO)

Q37. The reduction of acetic acid (CH_3COOH) with lithium aluminium hydride ($LiAlH_4$) gives

(A) acetaldehyde

(B) ethanol

(C) ethane

(D) ethyl acetate

Q38. The carbylamine reaction, in which a foul-smelling isocyanide is produced on heating with chloroform and alcoholic KOH, is a test for

(A) primary amines

(B) secondary amines

(C) tertiary amines

(D) quaternary ammonium salts

Q39. A nucleotide, the repeating unit of a nucleic acid (DNA/RNA), is made up of

(A) only a nitrogenous base

(B) a base and a sugar only

(C) a nitrogenous base, a pentose sugar and a phosphate group

(D) two amino acids joined by a peptide bond

Q40. Which of the following is a naturally occurring polymer?

(A) polythene

(B) nylon-6,6

(C) PVC

(D) cellulose

Detailed Solutions

Q1.

Solution

Concept — Atoms in a sample: First find moles, then molecules, then multiply by atoms per molecule.

Step 1 — Moles of CH_4: $n = \dfrac{8}{16} = 0.5$ mol.

Step 2 — Molecules: $0.5 \times N_A = 3.011 \times 10^{23}$ molecules. Each CH_4 has 5 atoms, so total atoms $= 5 \times 3.011 \times 10^{23} = 1.505 \times 10^{24}$.

Why other options are wrong: 3.011×10^{23} counts molecules; 6.022×10^{23} is 1 mol of molecules; 3.011×10^{24} uses the wrong atom count.

Final Answer: 1.505×10^{24} atoms $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept — Molar gas volume at STP: 1 mol of any ideal gas occupies 22.4 L at STP.

Step 1 — Substitute: $V = 0.25 \times 22.4$.

Step 2 — Compute: $V = 5.6$ L.

Why other options are wrong: 11.2 L is for 0.5 mol; 22.4 L is for 1 mol; 2.8 L is for 0.125 mol.

Final Answer: $V = 5.6$ L $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q2

Q3.

Solution

Concept — Stoichiometric ratio: Mole ratios from the balanced equation relate reactant and product amounts.

Step 1 — Ratio: $3\,H_2 : 2\,NH_3$, so $NH_3 = \dfrac{2}{3} \times (\text{mol } H_2)$.

Step 2 — Compute: $\dfrac{2}{3} \times 6 = 4$ mol NH_3.

Why other options are wrong: 6 ignores the ratio; 2 and 3 use wrong factors.

Final Answer: 4 mol of $NH_3 \Rightarrow$ C

Answer: (C) Go Back to Q3

Q4.

Solution

Concept — Bohr energy levels: $E_n = -\frac{13.6}{n^2}$ eV for hydrogen.

Step 1 — Put $n = 2$: $E_2 = -\frac{13.6}{4}$.

Step 2 — Compute: $E_2 = -3.4$ eV.

Why other options are wrong: -13.6 eV is $n = 1$; -6.8 eV halves wrongly; -1.51 eV is $n = 3$.

Final Answer: $E_2 = -3.4$ eV $\Rightarrow$ D

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Nodes of an orbital: Total nodes $= n - 1$; angular nodes $= l$; radial nodes $= n - l - 1$.

Step 1 — For $3p$: $n = 3$, $l = 1$. Total nodes $= n - 1 = 2$.

Step 2 — Check split: Angular $= l = 1$; radial $= 3 - 1 - 1 = 1$; sum $= 2$.

Why other options are wrong: 1 counts only radial (or only angular); 3 over-counts; 0 is for $1s$.

Final Answer: Total nodes $= 2 \Rightarrow$ A

Answer: (A) Go Back to Q5

Q6.

Solution

Concept — VSEPR shape: Three bond pairs and one lone pair around N give a trigonal pyramidal shape.

Step 1 — Count domains: N in NH_3 has 4 electron domains (3 bonds +1 lone

pair), so it is sp^3.

Step 2 — Shape: The lone pair occupies one position, leaving a pyramidal arrangement of the three N–H bonds (angle $\approx 107°$).

Why other options are wrong: Trigonal planar/linear ignore the lone pair; tetrahedral describes the electron-pair geometry, not the molecular shape.

Final Answer: NH_3 is trigonal pyramidal $\Rightarrow$ B

Answer: (B) Go Back to Q6

Q7.

Solution

Concept — Paramagnetism from MOT: A molecule is paramagnetic if it has unpaired electrons in its molecular orbitals.

Step 1 — O_2 configuration: The last two electrons occupy $\pi^*_{2p_x}$ and $\pi^*_{2p_y}$ singly (Hund's rule), giving two unpaired electrons.

Why other options are wrong: N_2, F_2 and H_2 have all electrons paired and are diamagnetic.

Final Answer: O_2 is paramagnetic $\Rightarrow$ D

Answer: (D) Go Back to Q7

Q8.

Solution

Concept — Dipole moment: A net dipole arises when bond dipoles do not cancel; bent geometry gives a large resultant.

Step 1 — Compare: H_2O is bent ($104.5°$) with a large net dipole (≈ 1.85 D).

Why other options are wrong: CO_2 (linear), BF_3 (trigonal planar) and CCl_4 (tetrahedral) are symmetric, so their bond dipoles cancel to zero.

Final Answer: H_2O has the highest dipole moment $\Rightarrow$ C

Answer: (C) Go Back to Q8

Q9.

Solution

Concept — Sign of enthalpy change: $\Delta H = H_{products} - H_{reactants}$.

Step 1 — Read the diagram: Products lie below reactants, so $H_{products} < H_{reactants}$.

Step 2 — Conclude: $\Delta H < 0$; heat is released (exothermic).

Why other options are wrong: Positive is endothermic (products higher); zero/undefined do not apply to a downhill profile.

Final Answer: ΔH is negative (exothermic) $\Rightarrow$ A

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Gibbs energy at equilibrium: At equilibrium the free energy is at a minimum, so $\Delta G = 0$.

Step 1 — Apply criterion: Spontaneous gives $\Delta G < 0$, non-spontaneous $\Delta G > 0$; at equilibrium $\Delta G = 0$.

Why other options are wrong: Negative/positive describe a reaction still proceeding; ΔG equals ΔH only when $T\Delta S = 0$, not in general.

Final Answer: $\Delta G = 0$ at equilibrium $\Rightarrow$ B

Answer: (B) Go Back to Q10

Q11.

Solution

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

Step 1 — Find Δn_g: Products $= 2$; reactants $= 1 + 3 = 4$; $\Delta n_g = 2 - 4 = -2$.

Step 2 — Substitute: $K_p = K_c(RT)^{-2}$.

Why other options are wrong: $(RT)^{+2}$ and $(RT)^{+4}$ have the wrong sign/value; $K_p = K_c$ requires $\Delta n_g = 0$.

Final Answer: $K_p = K_c(RT)^{-2} \Rightarrow$ C

Answer: (C) Go Back to Q11

Q12.

Solution

Concept — Salt hydrolysis: A salt of a weak base and strong acid hydrolyses to give an acidic solution.

Step 1 — Identify ions: NH_4^+ (from weak base NH_3) hydrolyses to release H^+; Cl^- (from strong acid HCl) does not hydrolyse.

Step 2 — Conclude: Excess H^+ makes the solution acidic ($pH < 7$).

Why other options are wrong: Basic/weakly basic would need a strong-base cation; it is not neutral because NH_4^+ hydrolyses.

Final Answer: The solution is acidic $\Rightarrow$ D

Answer: (D) Go Back to Q12

Q13.

Solution

Concept — Elevation in boiling point: $\Delta T_b = K_b\, m$ for a non-electrolyte ($i = 1$), where m is molality.

Step 1 — Molality: $m = \dfrac{0.5 \text{ mol}}{1 \text{ kg}} = 0.5 \text{ mol kg}^{-1}$.

Step 2 — Compute: $\Delta T_b = 0.52 \times 0.5 = 0.26$ K.

Why other options are wrong: 0.52 K uses $m = 1$; 1.04 K doubles; 0.13 K halves again.

Final Answer: $\Delta T_b = 0.26$ K $\Rightarrow$ B

Answer: (B) Go Back to Q13

Q14.

Solution

Concept — Oxidising power and E°: The species with the highest (most positive) standard reduction potential is the strongest oxidising agent.

Step 1 — Compare: E° values: F_2 2.87 > Cl_2 1.36 > Br_2 1.07 > I_2 0.54 V.

Step 2 — Pick the maximum: F_2 has the highest E°.

Why other options are wrong: I_2 is the weakest oxidiser; Br_2 and Cl_2 are intermediate.

Final Answer: F_2 is the strongest oxidising agent $\Rightarrow$ A

Answer: (A) Go Back to Q14

Q15.

Solution

Concept — Order from rate dependence: If rate $\propto [A]^n$, then doubling $[A]$ multiplies the rate by 2^n.

Step 1 — Set up: Rate doubles $\Rightarrow 2^n = 2 \Rightarrow n = 1$.

Step 2 — Conclude: The reaction is first order in A.

Why other options are wrong: Zero order would leave the rate unchanged; second order would quadruple it; half order would multiply by $\sqrt{2}$.

Final Answer: Order $= 1 \Rightarrow$ D

Answer: (D) Go Back to Q15

Q16.

Solution

Concept — Oxidising agent: The oxidising agent is itself reduced (gains electrons; its oxidation number decreases).

Step 1 — Track changes: Zn goes $0 \rightarrow +2$ (oxidised, reducing agent); Cu^{2+} goes $+2 \rightarrow 0$ (reduced).

Step 2 — Identify: Since Cu^{2+} (in $CuSO_4$) is reduced, it is the oxidising agent.

Why other options are wrong: Zn is the reducing agent; $ZnSO_4$ and Cu are products.

Final Answer: $CuSO_4$ (Cu^{2+}) is the oxidising agent $\Rightarrow$ C

Answer: (C) Go Back to Q16

Q17.

Solution

Concept — Electron gain enthalpy: Chlorine has the most negative electron gain enthalpy of all elements.

Step 1 — Reason: Fluorine's small size causes strong inter-electronic repulsion in its compact $2p$ subshell, making its electron gain enthalpy less negative than chlorine's.

Why other options are wrong: F is anomalously lower than Cl; Br and I are lower still down the group.

Final Answer: Chlorine has the highest electron gain enthalpy $\Rightarrow$ A

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Block from configuration: The block is named after the subshell that receives the last (differentiating) electron.

Step 1 — Read config: $[\mathrm{Ar}]3d^5 4s^1$ has its differentiating electrons in the $3d$ subshell (this is chromium, $Z = 24$).

Step 2 — Conclude: A partly filled d subshell places it in the d-block.

Why other options are wrong: s-block ends in ns^{1-2}; p-block fills np; f-block fills $4f/5f$.

Final Answer: It is a d-block element $\Rightarrow$ B

Answer: (B) Go Back to Q18

Q19.

Solution

Concept — Solubility of group-2 hydroxides: Solubility of $\mathrm{M(OH)_2}$ increases down group 2.

Step 1 — Reason: The lattice enthalpy falls faster than the hydration enthalpy down the group, so dissolution becomes more favourable.

Step 2 — Order: $\mathrm{Mg(OH)_2}$ (sparingly soluble) $< \mathrm{Ca(OH)_2} < \mathrm{Sr(OH)_2} < \mathrm{Ba(OH)_2}$.

Why other options are wrong: It does not decrease or stay constant; sulphate

solubility decreases, but hydroxide solubility increases.

Final Answer: Solubility increases down the group $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Catenation: The tendency to form chains of like atoms depends on the strength of the element–element bond.

Step 1 — Compare bond strength: The C–C bond is the strongest among group-14 E–E bonds, so carbon catenates the most.

Step 2 — Trend: Catenation decreases C $>$ Si $>$ Ge $\approx$ Sn down the group.

Why other options are wrong: Si, Ge and Sn form much weaker E–E bonds and catenate far less.

Final Answer: Carbon shows maximum catenation $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Allotropes of phosphorus: White phosphorus is the most reactive allotrope.

Step 1 — Structure: White phosphorus consists of strained, discrete $\mathrm{P_4}$ tetrahedra; the strained bonds make it very reactive.

Step 2 — Property: It glows in the dark and catches fire in air, so it is stored under water.

Why other options are wrong: Red, black and violet phosphorus are polymeric and far less reactive.

Final Answer: White phosphorus is the most reactive allotrope $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q21

Q22.

Solution

Concept — Interhalogen compounds: These contain two *different* halogen atoms only (type XX'_n).

Step 1 — Examine ICl**:** It contains iodine and chlorine, two different halogens, so it is an interhalogen.

Why other options are wrong: HCl is a hydrogen halide; Cl_2O is an oxide of chlorine; NaCl is an ionic salt.

Final Answer: ICl is an interhalogen $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q22

Q23.

Solution

Concept — Catalytic action of transition metals: Their variable oxidation states and large surface area let them form intermediates and adsorb reactants.

Step 1 — Mechanism: Variable oxidation states allow the metal to shuttle electrons; the metal surface adsorbs and activates reactant molecules.

Why other options are wrong: A single fixed oxidation state or completely filled d orbitals would hinder catalysis; radioactivity is irrelevant.

Final Answer: Variable oxidation states + surface adsorption $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q23

Q24.

Solution

Concept — Colour of lanthanide ions: Many Ln^{3+} ions are coloured due to transitions of electrons between $4f$ levels.

Step 1 — Identify the transition: The partially filled $4f$ subshell allows f–f transitions absorbing visible light.

Why other options are wrong: Colour here is not from s–s, charge-transfer alone or nuclear transitions.

Final Answer: Colour arises from f–f transitions $\Rightarrow$ $\boxed{D}$

Answer: (D) Go Back to Q24

Q25.

Solution

Concept — Coordination number: It is the number of ligand donor atoms directly bonded to the central metal.

Step 1 — Identify ligands in the sphere: In $[Co(NH_3)_6]^{3+}$ there are six NH_3 donors; the three Cl^- are outside the coordination sphere.

Step 2 — Count: Coordination number $= 6$.

Why other options are wrong: 3 counts the chlorides; 9 adds them wrongly; 4 is for a tetrahedral/square-planar complex.

Final Answer: Coordination number $= 6 \Rightarrow$ A

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — Optical isomerism: A complex with non-superimposable mirror images is chiral and shows optical isomerism.

Step 1 — Examine $[Co(en)_3]^{3+}$: The three bidentate en ligands give a propeller-like cation that exists as two enantiomers (Δ and Λ).

Why other options are wrong: Linkage needs an ambidentate ligand; ionisation and coordination isomerism involve interchange of ions/ligands, not mirror images.

Final Answer: It is optical isomerism $\Rightarrow$ B

Answer: (B) Go Back to Q26

Q27.

Solution

Concept — Naming ketones: The $>C{=}O$ ketone group takes the suffix "-one" with the lowest possible locant.

Step 1 — Count carbons: $CH_3{-}CO{-}CH_2{-}CH_3$ has 4 carbons (butan-).

Step 2 — Locate carbonyl: The C=O is on C-2, giving butan-2-one.

Why other options are wrong: Butanal is an aldehyde; "butan-1-one" is impossible (a terminal C=O would be an aldehyde); butanoic acid has $-COOH$.

Final Answer: The compound is butan-2-one $\Rightarrow$ C

Answer: (C) Go Back to Q27

Q28.

Solution

Concept — Functional-group isomerism: Same molecular formula but different functional groups.

Step 1 — Compare: Ethanol (C_2H_6O, an alcohol) and dimethyl ether (C_2H_6O, an ether) share the formula C_2H_6O but have different functional groups.

Why other options are wrong: n-butane/isobutane are chain isomers; the two propanols are position isomers; the butenes are position isomers, all keeping the same functional group.

Final Answer: Ethanol and dimethyl ether are functional-group isomers $\Rightarrow$ D

Answer: (D) Go Back to Q28

Q29.

Solution

Concept — Hyperconjugation: The cation is stabilised by overlap of adjacent C–H sigma bonds (α-C–H) with the empty p orbital.

Step 1 — Count α-H: $(CH_3)_3C^+$ has three CH_3 groups on the positive carbon, each with 3 H: $3 \times 3 = 9$ α-hydrogens.

Step 2 — Conclude: Nine hyperconjugative structures make it very stable.

Why other options are wrong: 6, 3 and 1 undercount the α-hydrogens.

Final Answer: 9 α-hydrogens $\Rightarrow$ B

Answer: (B) Go Back to Q29

Q30.

Solution

Concept — Conformations of ethane: Rotation about the C–C bond gives staggered and eclipsed forms.

Step 1 — Compare energies: In the staggered form the front and back C–H bonds are 60° apart, minimising torsional (eclipsing) strain.

Step 2 — Conclude: The staggered conformation is the most stable (lowest energy).

Why other options are wrong: The eclipsed forms have maximum torsional strain and are least stable.

Final Answer: The staggered conformation is most stable $\Rightarrow$ A

Answer: (A) Go Back to Q30

Q31.

Solution

Concept — Acid-catalysed hydration (Markovnikov): H^+ adds to give the more stable carbocation, and $-OH$ ends up on the more substituted carbon.

Step 1 — Apply to propene: H^+ adds to the terminal CH_2, giving the secondary cation on C-2; water then adds there.

Step 2 — Product: Propan-2-ol.

Why other options are wrong: Propan-1-ol is the anti-Markovnikov product; propane and propanal are not formed by simple hydration.

Final Answer: Propan-2-ol $\Rightarrow$ C

Answer: (C) Go Back to Q31

Q32.

Solution

Concept — Halogenation of benzene: Anhydrous $FeCl_3$ is a Lewis acid that polarises Cl_2 to generate the electrophile Cl^+.

Step 1 — Role: $FeCl_3 + Cl_2 \rightarrow Cl^+ + [FeCl_4]^-$; the Cl^+ attacks the benzene ring.

Why other options are wrong: It is not a reducing agent, a nucleophile or a free radical; the reaction is electrophilic substitution.

Final Answer: $FeCl_3$ is a Lewis-acid catalyst generating Cl^+ $\Rightarrow$ D

Answer: (D) Go Back to Q32

Q33.

Solution

Concept — Reactivity of alkyl halides: Reactivity follows the ease of C–X bond breaking, which increases as the C–X bond weakens.

Step 1 — Bond strength: C–F is strongest and C–I weakest, so C–I breaks most easily.

Step 2 — Order: $\mathrm{R{-}I} > \mathrm{R{-}Br} > \mathrm{R{-}Cl} > \mathrm{R{-}F}$.

Why other options are wrong: The first option reverses the trend; the third misorders; they do not react at the same rate.

Final Answer: $\mathrm{R{-}I} > \mathrm{R{-}Br} > \mathrm{R{-}Cl} > \mathrm{R{-}F} \Rightarrow \boxed{\mathrm{B}}$

Answer: (B) Go Back to Q33

Q34.

Solution

Concept — Oxidation of primary alcohols: A strong oxidant oxidises a 1° alcohol first to an aldehyde and then to a carboxylic acid.

Step 1 — Apply to ethanol: $\mathrm{CH_3CH_2OH} \xrightarrow{[\mathrm{O}]} \mathrm{CH_3CHO} \xrightarrow{[\mathrm{O}]} \mathrm{CH_3COOH}$.

Step 2 — Final product: With excess acidified $\mathrm{KMnO_4}$ the end product is ethanoic acid.

Why other options are wrong: Ethanal is only the intermediate; ethane (reduction) and diethyl ether are not oxidation products.

Final Answer: Ethanoic (acetic) acid $\Rightarrow \boxed{\mathrm{A}}$

Answer: (A) Go Back to Q34

Q35.

Solution

Concept — Naming ethers (IUPAC): The smaller alkoxy group ($\mathrm{R{-}O{-}}$) is named as a substituent on the larger parent chain.

Step 1 — Split the ether: $\mathrm{CH_3{-}O{-}CH_2CH_3}$ has a methoxy ($\mathrm{CH_3O{-}}$) group on an ethane chain.

Step 2 — Name: Methoxy + ethane = methoxyethane.

Why other options are wrong: Ethoxyethane is $\mathrm{C_2H_5OC_2H_5}$; methanol and

propan-1-ol are alcohols, not this ether.

Final Answer: The ether is methoxyethane $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q35

Q36.

Solution

Concept — Cannizzaro reaction: Aldehydes with *no* α-hydrogen undergo base-induced disproportionation to an alcohol and a carboxylate.

Step 1 — Test the choices: Benzaldehyde (C_6H_5CHO) has no α-H (the carbon next to CHO is part of the ring), so it gives Cannizzaro.

Step 2 — Products: $2C_6H_5CHO + NaOH \rightarrow C_6H_5CH_2OH + C_6H_5COONa$.

Why other options are wrong: Acetaldehyde and propanal have α-H (they undergo aldol instead); acetone is a ketone.

Final Answer: Benzaldehyde undergoes Cannizzaro $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q36

Q37.

Solution

Concept — Reduction of carboxylic acids: $LiAlH_4$ is a powerful reducing agent that reduces $-COOH$ all the way to a primary alcohol.

Step 1 — Apply: $CH_3COOH \xrightarrow{LiAlH_4} CH_3CH_2OH$ (ethanol).

Why other options are wrong: $LiAlH_4$ does not stop at the aldehyde; it does not give ethane or an ester.

Final Answer: Ethanol is formed $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q37

Q38.

Solution

Concept — Carbylamine (isocyanide) test: Only primary amines react with $CHCl_3$ and alcoholic KOH to give foul-smelling isocyanides.

Step 1 — Reaction: $R{-}NH_2 + CHCl_3 + 3KOH \rightarrow R{-}NC + 3KCl + 3H_2O$.

Why other options are wrong: Secondary, tertiary amines and quaternary salts do not give this offensive smell, so the test is specific to 1° amines.

Final Answer: The carbylamine test detects primary amines $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q38

Q39.

Solution

Concept — Structure of a nucleotide: A nucleotide is the monomer of nucleic acids.

Step 1 — Components: It consists of a nitrogenous base, a pentose sugar (ribose/deoxyribose) and a phosphate group.

Step 2 — Note: A base + sugar alone (without phosphate) is a nucleoside.

Why other options are wrong: A base alone or base + sugar is incomplete; two amino acids form a dipeptide, not a nucleotide.

Final Answer: Base + pentose sugar + phosphate $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q39

Q40.

Solution

Concept — Natural vs synthetic polymers: Natural polymers occur in nature; synthetic polymers are man-made.

Step 1 — Identify: Cellulose is a natural polymer of β-D-glucose found in plant cell walls.

Why other options are wrong: Polythene, nylon-6,6 and PVC are all synthetic (man-made) polymers.

Final Answer: Cellulose is a natural polymer $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q40

Answer Key

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