JCECE Chemistry Sample Paper – 8

Duration: 60 Minutes **Maximum Marks: 50**

Instructions

- This paper contains **50** Multiple Choice Questions (Single Correct Answer), modelled on the Chemistry portion of **JCECE** entrance.
- Each correct answer carries **+1 mark**. There is -0.25 **mark** for each incorrect answer; unattempted questions get 0.
- Only **one** option is correct. Choose carefully.
- Syllabus level: **Class 11 and Class 12 NCERT Chemistry (Jharkhand JAC / CBSE aligned) – Physical, Organic and Inorganic.**
- Use of mobile phones, calculators, or electronic gadgets is strictly prohibited.

Q1. The number of gram-equivalents present in 5.3 g of anhydrous sodium carbonate $\mathrm{Na_2CO_3}$ (molar mass $= 106$ g/mol, n-factor $= 2$) is:

(A) 0.025

(B) 0.05

(C) 0.10

(D) 0.20

Q2. In a hydrogen atom ($E_n = -13.6/n^2$ eV), the energy difference between the levels $n = 2$ and $n = 4$, i.e. $E_4 - E_2$, is:

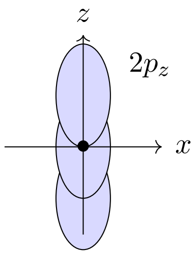
(A) $+0.85$ eV

(B) $+3.40$ eV

(C) -2.55 eV

(D) $+2.55$ eV

Q3. For the $2p$ orbital (whose dumb-bell shape is sketched), the azimuthal (angular momentum) quantum number l is:



(A) 0

(B) 1

(C) 2

(D) 3

Q4. The total translational kinetic energy of 2 mol of an ideal gas at 300 K ($R = 8.314$ J mol^{-1}K^{-1}), given $KE = \frac{3}{2}nRT$, is approximately:

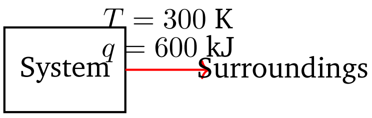
(A) 7483 J

(B) 3741 J

(C) 4988 J

(D) 2494 J

Q5. A process releases 600 kJ of heat to the surroundings at a constant temperature of 300 K (shown as heat flowing out of the system). The entropy change of the surroundings, $\Delta S_{surr} = q_{surr}/T$, is:



(A) -2.0 kJ K^{-1}

(B) $+1.0$ kJ K^{-1}

(C) $+2.0$ kJ K^{-1}

(D) -1.0 kJ K^{-1}

Q6. For $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$, the standard enthalpies of formation are $\Delta H_f^\circ(CH_4) = -75$, $\Delta H_f^\circ(CO_2) = -394$, $\Delta H_f^\circ(H_2O, l) = -286$ kJ/mol (and $O_2 = 0$). The enthalpy of reaction ΔH_{rxn}° is:

(A) -891 kJ

(B) -605 kJ

(C) $+891$ kJ

(D) -755 kJ

Q7. For $\mathrm{PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)}$, at equilibrium $[\mathrm{PCl_3}] = 0.4$ M, $[\mathrm{Cl_2}] = 0.5$ M and $K_c = 0.04$. The equilibrium concentration of $\mathrm{PCl_5}$ is:

(A) 0.20 M

(B) 5.0 M

(C) 0.08 M

(D) 2.5 M

Q8. A 0.1 M solution of a weak monobasic acid HA has a pH of 3. The acid dissociation constant K_a of HA is (assume $[\mathrm{H^+}] = \sqrt{K_a C}$):

(A) 1.0×10^{-3}

(B) 1.0×10^{-6}

(C) 1.0×10^{-4}

(D) 1.0×10^{-5}

Q9. The solubility product of $\mathrm{Mg(OH)_2}$ is 1.0×10^{-11}. In a solution where $[\mathrm{OH^-}] = 1.0 \times 10^{-3}$ M, the maximum $[\mathrm{Mg^{2+}}]$ that can remain in solution without precipitation is:

(A) 1.0×10^{-8} M

(B) 1.0×10^{-3} M

(C) 1.0×10^{-5} M

(D) 1.0×10^{-11} M

Q10. A solution containing 3.0 g of a non-electrolyte in 1 L of solution shows an osmotic pressure of 0.82 atm at 300 K ($R = 0.0821$ L atm $\mathrm{mol^{-1}K^{-1}}$). The molar mass of the solute is approximately:

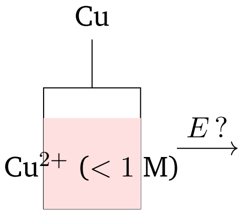
(A) 30 g/mol

(B) 90 g/mol

(C) 180 g/mol

(D) 45 g/mol

Q11. For the electrode $Cu^{2+} + 2e^- \rightarrow Cu$ ($E^\circ = +0.34$ V), the half-cell shown has its Cu^{2+} concentration decreased below 1 M. Using the Nernst equation, the electrode potential will:



(A) decrease (become less positive)

(B) increase (become more positive)

(C) remain exactly $+0.34$ V

(D) become exactly zero

Q12. A current of 5 A is passed through molten $AlCl_3$ to deposit 0.9 g of aluminium (atomic mass 27, $n = 3$; Faraday $= 96500$ C). The time of electrolysis required is approximately:

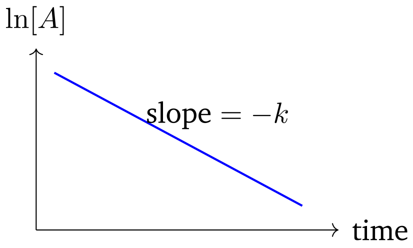
(A) 965 s

(B) 3860 s

(C) 9650 s

(D) 1930 s

Q13. For a first-order reaction the integrated rate law is $k = \dfrac{2.303}{t} \log \dfrac{[A]_0}{[A]}$. If 75% of the reactant decomposes in 40 min (so $[A]_0/[A] = 4$), the rate constant k is (take $\log 4 = 0.602$):



(A) 0.0173 min^{-1}

(B) 0.0347 min^{-1}

(C) 0.602 min^{-1}

(D) 0.0150 min^{-1}

Q14. For a first-order reaction with a half-life of 231 s, the rate constant $k = \dfrac{0.693}{t_{1/2}}$ is approximately:

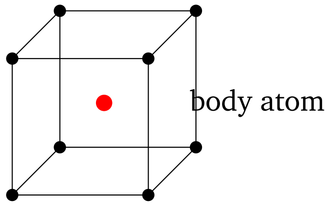
(A) 3.0×10^{-3} s^{-1}

(B) 3.0×10^{-2} s^{-1}

(C) 1.6×10^{2} s^{-1}

(D) 6.9×10^{-1} s^{-1}

Q15. In a body-centred cubic (bcc) lattice (shown), the relation between the edge length a and the atomic radius r is $\sqrt{3}\,a = 4r$. If $r = 1.24$ Å, the edge length a is approximately:



(A) 4.96 Å

(B) 2.48 Å

(C) 2.86 Å

(D) 3.51 Å

Q16. When potassium permanganate $\mathrm{KMnO_4}$ acts as an oxidant in acidic medium, Mn changes from $+7$ to $+2$. The n-factor (number of electrons gained per formula unit) of $\mathrm{KMnO_4}$ is:

(A) 3

(B) 5

(C) 2

(D) 7

Q17. A solution is prepared by dissolving 10 g of glucose in water to make a total volume of 250 mL. The percent mass/volume ($\%\, w/v$) of glucose is:

(A) 2.5%

(B) 10%

(C) 25%

(D) 4.0%

Q18. The IUPAC name of the compound $\mathrm{CH_3{-}CH_2{-}CO{-}CH_3}$ is:

(A) butanal

(B) propan-2-one

(C) butan-2-one

(D) butan-1-one

Q19. Cyclopropane and propene have the same molecular formula $\mathrm{C_3H_6}$ but differ in that one is cyclic and the other open-chain. This type of isomerism is called:

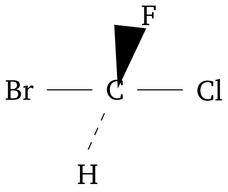
(A) ring–chain isomerism

(B) metamerism

(C) tautomerism

(D) position isomerism

Q20. A molecule is optically active when it is non-superimposable on its mirror image (chiral). Of the molecule drawn (a carbon bearing four different groups), the essential condition for optical activity is:



(A) presence of a plane of symmetry

(B) presence of a centre of symmetry

(C) all four groups being identical

(D) absence of any plane or centre of symmetry (chirality)

Q21. Among the substituted phenols below, the strongest acid (most acidic) is the one bearing the electron-withdrawing nitro group at the para position:

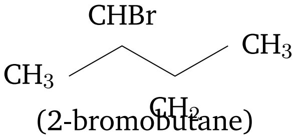
(A) p-cresol (p-methylphenol)

(B) p-nitrophenol

(C) p-aminophenol

(D) phenol (unsubstituted)

Q22. When 2-bromobutane (shown) is heated with alcoholic KOH, it undergoes dehydrohalogenation (β-elimination). Following Saytzeff's rule, the major alkene product is:



(2-bromobutane)

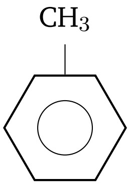
(A) but-1-ene

(B) buta-1,3-diene

(C) but-2-ene

(D) 2-methylprop-1-ene

Q23. When toluene ($C_6H_5CH_3$, shown) is treated with hot acidic $KMnO_4$, the $-CH_3$ side chain is oxidised to give:



(A) benzoic acid (C_6H_5COOH)

(B) benzaldehyde

(C) phenol

(D) benzyl alcohol

Q24. The correct order of reactivity of the haloalkanes CH_3I, CH_3Br and CH_3Cl towards nucleophilic substitution (most reactive first) is:

(A) $CH_3I > CH_3Br > CH_3Cl$

(B) $CH_3Cl > CH_3Br > CH_3I$

(C) $CH_3Br > CH_3I > CH_3Cl$

(D) all are equally reactive

Q25. When ethanol (C_2H_5OH) is heated with acetic acid (CH_3COOH) in the presence of a little concentrated H_2SO_4, the organic product (ester) formed is:

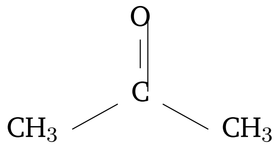
(A) ethyl alcohol

(B) acetic anhydride

(C) methyl acetate

(D) ethyl acetate ($CH_3COOC_2H_5$)

Q26. Acetone (whose carbonyl is shown) is treated with zinc amalgam and concentrated HCl (Clemmensen reduction). The product formed is:



(A) propan-2-ol

(B) propane

(C) propan-1-ol

(D) propene

Q27. The correct order of reactivity of carboxylic acid derivatives towards nucleophilic acyl substitution (most reactive first) is:

(A) amide $>$ ester $>$ anhydride $>$ acid chloride

(B) ester $>$ acid chloride $>$ amide $>$ anhydride

(C) acid chloride $>$ anhydride $>$ ester $>$ amide

(D) anhydride $>$ acid chloride $>$ amide $>$ ester

Q28. Benzene diazonium chloride couples with phenol in mildly alkaline medium to give an intensely coloured azo dye. The product of this azo coupling is:

(A) nitrobenzene

(B) p-hydroxyazobenzene (p-hydroxyphenylazobenzene)

(C) aniline

(D) chlorobenzene

Q29. α-D-glucose and β-D-glucose differ only in the configuration at the anomeric carbon (C-1). Such a pair of cyclic stereoisomers is called:

(A) epimers

(B) enantiomers

(C) geometrical isomers

(D) anomers

Q30. Which of the following is a biodegradable polymer obtained from 3-hydroxybutanoic acid and 3-hydroxypentanoic acid?

(A) PHBV (poly-β-hydroxybutyrate-co-β-hydroxyvalerate)

(B) polythene

(C) polystyrene

(D) PVC

Q31. In the homolytic fission of a covalent bond ($\mathrm{A{:}B} \rightarrow \mathrm{A}^\bullet + \mathrm{B}^\bullet$), each fragment retains one electron of the shared pair. The species produced by homolytic fission are:

(A) a carbocation and a carbanion

(B) two carbocations

(C) two free radicals

(D) a carbanion and an electrophile

Q32. When an amide ($\mathrm{R{-}CONH_2}$) is treated with bromine and aqueous (or alcoholic) KOH, it is converted to a primary amine with one fewer carbon atom. This reaction is known as:

(A) Cannizzaro reaction

(B) Wurtz reaction

(C) Sandmeyer reaction

(D) Hofmann bromamide degradation

Q33. An organic compound rapidly decolourises bromine water (orange to colourless) without evolving HBr gas. The compound most likely contains:

(A) a saturated alkane (C–C single bonds only)

(B) a carbon–carbon double bond (alkene/unsaturation)

(C) an ether linkage

(D) a fully substituted aromatic ring

Q34. To convert formaldehyde (HCHO) into a primary alcohol with an added carbon, the suitable reagent (followed by acidic hydrolysis) is:

(A) a Grignard reagent (R–MgX)

(B) Tollens' reagent

(C) concentrated H_2SO_4

(D) acidified $KMnO_4$

Q35. For which of the following elements is the second ionization energy (IE_2) abnormally high compared with its first, because removal of the second electron disturbs a stable noble-gas configuration?

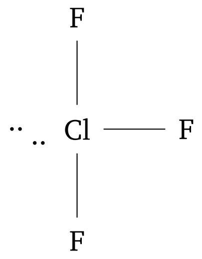
(A) magnesium (Mg)

(B) aluminium (Al)

(C) sodium (Na)

(D) calcium (Ca)

Q36. According to VSEPR theory, the molecular shape of chlorine trifluoride ClF_3 (central Cl with 3 bond pairs and 2 lone pairs, shown) is:



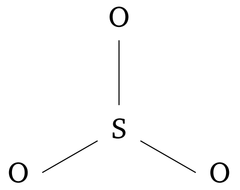
(A) trigonal planar

(B) T-shaped

(C) pyramidal

(D) tetrahedral

Q37. The hybridization of the central sulphur atom in sulphur trioxide SO_3 (trigonal planar, shown) is:



(A) sp^2

(B) sp^3

(C) sp

(D) sp^3d

Q38. Among the alkali-metal cations Li^+, Na^+, K^+ and Cs^+, the ion with the highest (most negative) hydration enthalpy is:

(A) Cs^+

(B) K^+

(C) Na^+

(D) Li^+

Q39. Potash alum is a double sulphate widely used as a coagulant. Its correct formula is:

(A) $Al_2(SO_4)_3$

(B) $K_2SO_4{\cdot}Al_2(SO_4)_3{\cdot}24H_2O$

(C) $KAlO_2$

(D) $Al(OH)_3$

Q40. Zeolites (hydrated aluminosilicates) are widely used in industry chiefly as:

(A) bleaching agents

(B) explosives

(C) shape-selective catalysts and ion-exchangers (water softening)

(D) refractory bricks

Q41. In the brown ring test for the nitrate ion, the brown coloured complex formed at the interface is:

(A) $[Fe(H_2O)_5NO]^{2+}$

(B) $Fe(OH)_3$

(C) $[Fe(CN)_6]^{4-}$

(D) $FeSO_4$

Q42. The H–O–H bond angle in water (104.5°) is larger than the H–S–H bond angle in hydrogen sulphide $(\approx 92^\circ)$. The best reason is:

(A) sulphur is more electronegative than oxygen

(B) water has no lone pairs

(C) oxygen is more electronegative and smaller, so its bond pairs are closer and repel more, widening the angle

(D) both have exactly sp hybridization

Q43. The electron gain enthalpy of fluorine is less negative than that of chlorine (i.e. $\mathrm{Cl} > \mathrm{F}$ in magnitude). The reason is:

(A) fluorine is larger than chlorine

(B) chlorine is more electronegative than fluorine

(C) fluorine has a higher nuclear charge

(D) the small size of F causes strong inter-electronic repulsion in its compact $2p$ subshell

Q44. Noble gases such as argon, krypton and xenon can be trapped in the cavities of a host lattice (e.g. β-quinol) without forming chemical bonds. Such trapping compounds are called:

(A) interstitial hydrides

(B) clathrates (cage compounds)

(C) amalgams

(D) zeolites

Q45. Among the first transition series, the element that exhibits the highest (maximum) oxidation state of $+7$ in its compounds (e.g. in $KMnO_4$) is:

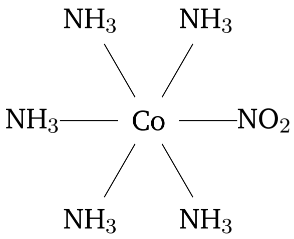
(A) chromium (Cr)

(B) manganese (Mn)

(C) iron (Fe)

(D) vanadium (V)

Q46. In the octahedral complex $[Co(NH_3)_5(NO_2)]^{2+}$ (shown), the ligand NO_2^- can bind through either N or O. Such a ligand is called:



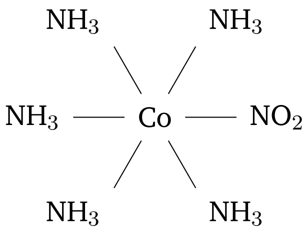
(A) an ambidentate ligand

(B) a bidentate ligand

(C) a chelating ligand

(D) a polydentate ligand

Q47. The complexes $[Co(NH_3)_5(NO_2)]^{2+}$ (nitro, M–N bonded, shown) and $[Co(NH_3)_5(O$ (nitrito, M–O bonded) are an example of:



(A) ionization isomerism

(B) geometrical isomerism

(C) linkage isomerism

(D) optical isomerism

Q48. The Ellingham diagram (a plot of ΔG° versus temperature for the formation of metal oxides) is most useful in metallurgy for:

(A) measuring the colour of an ore

(B) predicting whether a given reducing agent can reduce a metal oxide at a chosen temperature

(C) finding the melting point of the metal

(D) identifying the flame colour of a cation

Q49. Nascent hydrogen (hydrogen generated in situ, e.g. $\mathrm{Zn} + \mathrm{dil.\,H_2SO_4}$) is a more powerful reducing agent than ordinary molecular hydrogen mainly because:

(A) it is liberated in a more reactive, freshly-formed atomic/energetic state

(B) it is colder than H_2 gas

(C) it is heavier than H_2 gas

(D) it contains deuterium only

Q50. In Lassaigne's test, nitrogen in an organic compound is detected by fusing it with sodium and then treating the extract with $FeSO_4$ and Fe^{3+}. A positive test for nitrogen gives:

(A) a white precipitate

(B) a brown ring

(C) a deep red colouration

(D) a Prussian-blue (green) colouration due to ferric ferrocyanide

Detailed Solutions

Q1.

Solution

Concept — Gram-equivalents: gram-equivalents $= \dfrac{\text{mass}}{\text{equivalent mass}}$, where equivalent mass $= \dfrac{\text{molar mass}}{n\text{-factor}}$.

Step 1 — List data: mass $= 5.3$ g, molar mass $= 106$ g/mol, n-factor $= 2$.

Step 2 — Find equivalent mass: equivalent mass $= \dfrac{106}{2} = 53$ g/equiv.

Step 3 — Apply the formula: gram-equivalents $= \dfrac{5.3}{53}$.

Step 4 — Evaluate: gram-equivalents $= 0.10$.

Why other options are wrong:

- (A) divides by 212 (uses double the molar mass).
- (B) forgets the n-factor (gives the moles, 0.05).
- (D) doubles the correct value.

Final Answer: 0.10 gram-equivalents $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q1

Q2.

Solution

Concept — Energy difference of Bohr levels: $E_n = \dfrac{-13.6}{n^2}$ eV; the gap is $E_4 - E_2$.

Step 1 — Compute E_2: $E_2 = \dfrac{-13.6}{4} = -3.40$ eV.

Step 2 — Compute E_4: $E_4 = \dfrac{-13.6}{16} = -0.85$ eV.

Step 3 — Take the difference: $E_4 - E_2 = (-0.85) - (-3.40)$.

Step 4 — Evaluate: $E_4 - E_2 = -0.85 + 3.40 = +2.55$ eV.

Why other options are wrong:

- (A) is the magnitude of E_4 alone.
- (B) is the magnitude of E_2 alone.
- (C) has the wrong sign (absorption is positive going $2 \to 4$).

Final Answer: $E_4 - E_2 = +2.55 \text{ eV} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q2

Q3.

Solution

Concept — Azimuthal quantum number: The value of l fixes the orbital type: $s \Rightarrow l = 0$, $p \Rightarrow l = 1$, $d \Rightarrow l = 2$, $f \Rightarrow l = 3$.

Step 1 — Identify the orbital: the dumb-bell shape shown is a p orbital ($2p$).

Step 2 — Recall the code: for a p orbital, $l = 1$.

Step 3 — Conclude: the azimuthal quantum number is 1.

Why other options are wrong:

- (A) $l = 0$ is for a spherical s orbital.
- (C) $l = 2$ is for a d orbital.
- (D) $l = 3$ is for an f orbital.

Final Answer: $l = 1 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q3

Q4.

Solution

Concept — Translational kinetic energy: For an ideal gas, $KE = \dfrac{3}{2}nRT$.

Step 1 — List data: $n = 2$ mol, $R = 8.314$, $T = 300$ K.

Step 2 — Compute nRT: $nRT = 2 \times 8.314 \times 300 = 4988.4$ J.

Step 3 — Multiply by $\frac{3}{2}$: $KE = \dfrac{3}{2} \times 4988.4$.

Step 4 — Evaluate: $KE = 7482.6 \approx 7483$ J.

Why other options are wrong:

- (B) halves the correct answer.
- (C) is nRT without the $\frac{3}{2}$ factor.
- (D) uses $n = 1$ and drops the factor.

Final Answer: $KE \approx 7483 \text{ J} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q4

Q5.

Solution

Concept — Entropy of surroundings: $\Delta S_{surr} = \frac{q_{surr}}{T}$; heat released by the system is gained by the surroundings, so q_{surr} is positive.

Step 1 — Heat to surroundings: $q_{surr} = +600$ kJ (system releases it).

Step 2 — Temperature: $T = 300$ K.

Step 3 — Apply the formula: $\Delta S_{surr} = \frac{600}{300}$.

Step 4 — Evaluate: $\Delta S_{surr} = +2.0$ kJ K^{-1}.

Why other options are wrong:

- (A) has the wrong sign (that is ΔS of the system).
- (B) divides by 600.
- (D) both wrong sign and wrong magnitude.

Final Answer: $\Delta S_{surr} = +2.0$ kJ K$^{-1} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q5

Q6.

Solution

Concept — ΔH_{rxn} from formation enthalpies: $\Delta H^\circ_{rxn} = \sum \Delta H^\circ_f(\text{products}) - \sum \Delta H^\circ_f(\text{reactants})$.

Step 1 — Products sum: $\Delta H^\circ_f(\text{CO}_2) + 2\Delta H^\circ_f(\text{H}_2\text{O}) = (-394) + 2(-286) = -394 - 572 = -966$ kJ.

Step 2 — Reactants sum: $\Delta H^\circ_f(\text{CH}_4) + 2\Delta H^\circ_f(\text{O}_2) = (-75) + 0 = -75$ kJ.

Step 3 — Subtract: $\Delta H_{rxn} = -966 - (-75)$.

Step 4 — Evaluate: $\Delta H_{rxn} = -966 + 75 = -891$ kJ.

Why other options are wrong:

- (B) uses only one H_2O.
- (C) has the wrong sign.

- (D) forgets to subtract the CH_4 term correctly.

Final Answer: $\Delta H_{rxn} = -891 \text{ kJ} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q6

Q7.

Solution

Concept — Equilibrium concentration from K_c: $K_c = \dfrac{[\text{PCl}_3][\text{Cl}_2]}{[\text{PCl}_5]} \Rightarrow [\text{PCl}_5] = \dfrac{[\text{PCl}_3][\text{Cl}_2]}{K_c}$.

Step 1 — List data: $[\text{PCl}_3] = 0.4$, $[\text{Cl}_2] = 0.5$, $K_c = 0.04$.

Step 2 — Numerator: $[\text{PCl}_3][\text{Cl}_2] = 0.4 \times 0.5 = 0.20$.

Step 3 — Divide by K_c: $[\text{PCl}_5] = \dfrac{0.20}{0.04}$.

Step 4 — Evaluate: $[\text{PCl}_5] = 5.0$ M.

Why other options are wrong:

- (A) quotes the numerator only.
- (C) multiplies by K_c instead of dividing.
- (D) mis-divides.

Final Answer: $[\text{PCl}_5] = 5.0 \text{ M} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q7

Q8.

Solution

Concept — K_a from pH: For a weak acid, $[\text{H}^+] = \sqrt{K_a C}$, so $K_a = \dfrac{[\text{H}^+]^2}{C}$.

Step 1 — Find $[\text{H}^+]$ from pH: pH $= 3 \Rightarrow [\text{H}^+] = 10^{-3}$ M.

Step 2 — Square it: $[\text{H}^+]^2 = (10^{-3})^2 = 10^{-6}$.

Step 3 — Divide by C: $K_a = \dfrac{10^{-6}}{0.1}$.

Step 4 — Evaluate: $K_a = 10^{-6}/10^{-1} = 1.0 \times 10^{-5}$.

Why other options are wrong:

- (A) quotes $[H^+]$ itself.
- (B) forgets to divide by C.
- (C) mishandles the powers of ten.

Final Answer: $K_a = 1.0 \times 10^{-5} \Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q8**

Q9.

Solution

Concept — Maximum ion concentration: Precipitation begins when the ionic product equals K_{sp}. For Mg(OH)_2, $K_{sp} = [\text{Mg}^{2+}][\text{OH}^-]^2$, so $[\text{Mg}^{2+}]_{max} = \dfrac{K_{sp}}{[\text{OH}^-]^2}$.

Step 1 — List data: $K_{sp} = 1.0 \times 10^{-11}$, $[\text{OH}^-] = 1.0 \times 10^{-3}$ M.

Step 2 — Square $[\text{OH}^-]$: $(1.0 \times 10^{-3})^2 = 1.0 \times 10^{-6}$.

Step 3 — Divide: $[\text{Mg}^{2+}]_{max} = \dfrac{1.0 \times 10^{-11}}{1.0 \times 10^{-6}}$.

Step 4 — Evaluate: $[\text{Mg}^{2+}]_{max} = 1.0 \times 10^{-5}$ M.

Why other options are wrong:

- (A) divides by $[\text{OH}^-]^3$.
- (B) divides by $[\text{OH}^-]$ once only.
- (D) just quotes K_{sp}.

Final Answer: $[\text{Mg}^{2+}]_{max} = 1.0 \times 10^{-5}\text{ M} \Rightarrow \boxed{\text{C}}$

Answer: (C) **Go Back to Q9**

Q10.

Solution

Concept — Molar mass from osmotic pressure: $\pi = \dfrac{n}{V}RT = \dfrac{w}{MV}RT \Rightarrow M = \dfrac{wRT}{\pi V}$.

Step 1 — List data: $w = 3.0$ g, $R = 0.0821$, $T = 300$ K, $\pi = 0.82$ atm, $V = 1$ L.

Step 2 — Numerator: $wRT = 3.0 \times 0.0821 \times 300 = 73.89$.

Step 3 — Denominator: $\pi V = 0.82 \times 1 = 0.82$.

Step 4 — Divide: $M = \dfrac{73.89}{0.82} \approx 90$ g/mol.

Why other options are wrong:

- (A) and (D) result from dropping the RT factor.
- (C) doubles the value (uses 1.5 g basis error).

Final Answer: $M \approx 90$ g/mol $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Nernst equation effect: $E = E^\circ - \dfrac{0.059}{n}\log\dfrac{1}{[\text{Cu}^{2+}]}$. Lowering $[\text{Cu}^{2+}]$ raises the log term, which is subtracted, so E falls.

Step 1 — Write the Nernst form: for $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$, $E = E^\circ - \dfrac{0.059}{2}\log\dfrac{1}{[\text{Cu}^{2+}]}$.

Step 2 — Decrease $[\text{Cu}^{2+}]$: $\dfrac{1}{[\text{Cu}^{2+}]}$ becomes larger, so $\log\dfrac{1}{[\text{Cu}^{2+}]} > 0$.

Step 3 — Effect on E: a positive quantity is subtracted from E°, so E becomes less than $+0.34$ V.

Step 4 — Conclude: the electrode potential decreases.

Why other options are wrong:

- (B) would require increasing $[\text{Cu}^{2+}]$.
- (C) holds only at 1 M.
- (D) the potential does not collapse to zero.

Final Answer: E decreases $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q11

Q12.

Solution

Concept — Faraday's law (time): mass $m = \frac{M\,I\,t}{nF} \Rightarrow t = \frac{m\,n\,F}{M\,I}$.

Step 1 — List data: $m = 0.9$ g, $M = 27$, $n = 3$, $F = 96500$ C, $I = 5$ A.

Step 2 — Numerator: $m\,n\,F = 0.9 \times 3 \times 96500 = 260550$.

Step 3 — Denominator: $M\,I = 27 \times 5 = 135$.

Step 4 — Divide: $t = \frac{260550}{135} \approx 1930$ s.

Why other options are wrong:

- (A) uses $n = 1$.
- (B) doubles the answer.
- (C) uses $n = 15$ (error).

Final Answer: $t \approx 1930$ s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q12

Q13.

Solution

Concept — Integrated first-order rate law: $k = \frac{2.303}{t} \log \frac{[A]_0}{[A]}$.

Step 1 — Find the ratio: 75% decomposed leaves 25%, so $\frac{[A]_0}{[A]} = \frac{100}{25} = 4$.

Step 2 — Substitute: $k = \frac{2.303}{40} \log 4$.

Step 3 — Use $\log 4 = 0.602$: $k = \frac{2.303 \times 0.602}{40}$.

Step 4 — Evaluate: numerator $= 1.386$; $k = \frac{1.386}{40} = 0.0347$ min^{-1}.

Why other options are wrong:

- (A) uses $\log 2$ instead of $\log 4$.
- (C) forgets to divide by t.
- (D) wrong arithmetic.

Final Answer: $k = 0.0347$ min^{-1} $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q13

Q14.

Solution

Concept — Rate constant from half-life: For a first-order reaction, $k = \dfrac{0.693}{t_{1/2}}$.

Step 1 — List data: $t_{1/2} = 231$ s.

Step 2 — Substitute: $k = \dfrac{0.693}{231}$.

Step 3 — Evaluate: $k = 0.0030\ \text{s}^{-1} = 3.0 \times 10^{-3}\ \text{s}^{-1}$.

Why other options are wrong:

- (B) is off by a factor of 10.
- (C) inverts the relation.
- (D) just quotes 0.693.

Final Answer: $k = 3.0 \times 10^{-3}\ \text{s}^{-1} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q14

Q15.

Solution

Concept — bcc edge–radius relation: The body diagonal equals $4r$, so $\sqrt{3}\,a = 4r \Rightarrow a = \dfrac{4r}{\sqrt{3}}$.

Step 1 — List data: $r = 1.24$ Å.

Step 2 — Numerator: $4r = 4 \times 1.24 = 4.96$ Å.

Step 3 — Divide by $\sqrt{3}$: $a = \dfrac{4.96}{1.732}$.

Step 4 — Evaluate: $a \approx 2.86$ Å.

Why other options are wrong:

- (A) is $4r$ (forgets dividing by $\sqrt{3}$).
- (B) is $2r$.
- (D) uses $\sqrt{2}$ (the fcc relation) instead of $\sqrt{3}$.

Final Answer: $a \approx 2.86$ Å $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q15

Q16.

Solution

Concept — n-factor in redox: The n-factor equals the change in oxidation number per formula unit (electrons gained or lost).

Step 1 — Oxidation state before: Mn in $\mathrm{MnO_4^-}$ is $+7$.

Step 2 — Oxidation state after: in acidic medium Mn is reduced to $\mathrm{Mn^{2+}}$ $(+2)$.

Step 3 — Change: $\Delta = 7 - 2 = 5$ electrons gained.

Step 4 — Conclude: the n-factor is 5.

Why other options are wrong:

- (A) 3 applies to neutral/weakly basic medium $(\mathrm{Mn} \to \mathrm{MnO_2})$.
- (C) 2 is wrong here.
- (D) 7 is the oxidation number, not the change.

Final Answer: n-factor $= 5 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q16

Q17.

Solution

Concept — Percent mass/volume: $\%\,w/v = \dfrac{\text{mass of solute (g)}}{\text{volume of solution (mL)}} \times 100.$

Step 1 — List data: mass $= 10$ g, volume $= 250$ mL.

Step 2 — Form the ratio: $\dfrac{10}{250} = 0.04.$

Step 3 — Multiply by 100: $0.04 \times 100 = 4.0.$

Step 4 — Conclude: $\%\,w/v = 4.0\%.$

Why other options are wrong:

- (A) uses 1000 mL basis.
- (B) uses 100 mL basis.
- (C) uses 40 mL basis.

Final Answer: $\%\,w/v = 4.0\% \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q17

Q18.

Solution

Concept — IUPAC naming of ketones: Number the longest chain so the carbonyl carbon gets the lowest locant; the suffix is “-one”.

Step 1 — Count carbons: $CH_3–CH_2–CO–CH_3$ has 4 carbons in the chain (butan-).

Step 2 — Locate the carbonyl: the $C{=}O$ is on carbon 2.

Step 3 — Assemble the name: butan-2-one.

Why other options are wrong:

- (A) butanal is the aldehyde, not a ketone.
- (B) propan-2-one is acetone (3 carbons).
- (D) butan-1-one is impossible (a terminal C=O is an aldehyde).

Final Answer: butan-2-one $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q18

Q19.

Solution

Concept — Ring–chain isomerism: Isomers with the same molecular formula where one is an open chain and the other contains a ring.

Step 1 — Compare the two: cyclopropane is a 3-membered ring; propene is an open chain with a double bond.

Step 2 — Same formula: both are C_3H_6.

Step 3 — Classify: the difference (ring vs open chain) is ring–chain isomerism.

Why other options are wrong:

- (B) metamerism is unequal alkyl groups around a functional group.
- (C) tautomerism is keto–enol interconversion.
- (D) position isomerism shifts a substituent’s position.

Final Answer: ring–chain isomerism $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

Concept — Condition for optical activity: A molecule is optically active (chiral) when it lacks any plane of symmetry and any centre of symmetry, so it is non-superimposable on its mirror image.

Step 1 — Examine the carbon: it bears Br, Cl, F and H, all different.

Step 2 — Check symmetry: with four different groups there is no plane or centre of symmetry.

Step 3 — Conclude: absence of any such symmetry element is the essential condition for optical activity.

Why other options are wrong:

- (A) and (B) a plane or centre of symmetry makes the molecule achiral.
- (C) four identical groups give a symmetric, achiral molecule.

Final Answer: absence of plane/centre of symmetry $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Substituent effect on phenol acidity: Electron-withdrawing groups (like $-NO_2$) stabilise the phenoxide ion and increase acidity; electron-donating groups (like $-CH_3$, $-NH_2$) decrease it.

Step 1 — Classify substituents: $-NO_2$ is strongly electron-withdrawing; $-CH_3$ and $-NH_2$ are electron-donating.

Step 2 — Relate to acidity: p-nitrophenol forms the most stabilised phenoxide, so it is the most acidic.

Step 3 — Conclude: p-nitrophenol is the strongest acid here.

Why other options are wrong:

- (A) and (C) electron-donating groups lower acidity.
- (D) plain phenol is less acidic than the nitro derivative.

Final Answer: p-nitrophenol $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q21

Q22.

Solution

Concept — Saytzeff's rule: In dehydrohalogenation, the major product is the more substituted (more stable) alkene.

Step 1 — Identify possible products: from 2-bromobutane (CH_3–CHBr–CH_2–CH_3), elimination can give but-1-ene or but-2-ene.

Step 2 — Compare stability: but-2-ene (internal, disubstituted) is more stable than but-1-ene (terminal).

Step 3 — Apply Saytzeff: the more substituted but-2-ene is the major product.

Why other options are wrong:

- (A) but-1-ene is the minor (Hofmann) product.
- (B) a diene cannot form from a single elimination.
- (D) 2-methylprop-1-ene has the wrong carbon skeleton.

Final Answer: but-2-ene $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q22

Q23.

Solution

Concept — Side-chain oxidation of toluene: Hot acidic $\mathrm{KMnO_4}$ is a strong oxidant that attacks the benzylic carbon of an alkyl side chain. Regardless of the chain length, any side chain bearing a benzylic hydrogen is oxidised completely to a $-\mathrm{COOH}$ group, so toluene gives benzoic acid.

Step 1 — Identify the reactive site: the benzylic $-\mathrm{CH_3}$ carbon attached to the ring.

Step 2 — Oxidise fully: hot acidic $\mathrm{KMnO_4}$ oxidises $-\mathrm{CH_3}$ all the way to $-\mathrm{COOH}$.

Step 3 — Product: $\mathrm{C_6H_5COOH}$, benzoic acid.

Why other options are wrong:

- (B) benzaldehyde is a partial-oxidation product; hot $\mathrm{KMnO_4}$ goes further to the acid.

- (C) phenol would need replacement of the side chain, which does not happen here.
- (D) benzyl alcohol is also a milder partial-oxidation product, not the final one.

Final Answer: benzoic acid $\Rightarrow \boxed{\text{A}}$

$\boxed{\text{Answer: (A)}}$ **Go Back to Q23**

Q24.

Solution

Concept — Reactivity of haloalkanes: The C–X bond strength decreases from C–Cl to C–I, so the weakest bond (C–I) breaks most easily, making iodides the most reactive.

Step 1 — Compare bond strengths: C–Cl $>$ C–Br $>$ C–I.

Step 2 — Relate to reactivity: weaker bond $\Rightarrow$ easier substitution.

Step 3 — Order: $CH_3I > CH_3Br > CH_3Cl$.

Why other options are wrong:

- (B) reverses the trend.
- (C) misplaces CH_3Br and CH_3I.
- (D) they are not equally reactive.

Final Answer: $CH_3I > CH_3Br > CH_3Cl \Rightarrow \boxed{\text{A}}$

$\boxed{\text{Answer: (A)}}$ **Go Back to Q24**

Q25.

Solution

Concept — Fischer esterification: A carboxylic acid plus an alcohol, with a trace of H_2SO_4, gives an ester and water.

Step 1 — Identify the reactants: ethanol (C_2H_5OH) and acetic acid (CH_3COOH).

Step 2 — Form the ester: the $-OH$ of the acid combines with the $-H$ of the alcohol, releasing water.

Step 3 — Product: $CH_3COOC_2H_5$, ethyl acetate.

Why other options are wrong:

- (A) ethyl alcohol is a reactant, not the product.
- (B) anhydride needs two acid molecules, not esterification.
- (C) methyl acetate would need methanol.

Final Answer: ethyl acetate $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q25

Q26.

Solution

Concept — Clemmensen reduction: Zn(Hg) with concentrated HCl reduces a carbonyl group ($C{=}O$) all the way to a CH_2 group (carbonyl $\to$ methylene).

Step 1 — Identify the carbonyl: acetone is $CH_3–CO–CH_3$.

Step 2 — Reduce $C{=}O$ to CH_2: the central $C{=}O$ becomes CH_2.

Step 3 — Product: $CH_3–CH_2–CH_3$, propane.

Why other options are wrong:

- (A) propan-2-ol is the product of mild reduction (e.g. $NaBH_4$), not Clemmensen.
- (C) propan-1-ol has the wrong skeleton.
- (D) propene would require dehydration, not Clemmensen.

Final Answer: propane $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q26

Q27.

Solution

Concept — Reactivity of acid derivatives: Towards nucleophilic acyl substitution the order depends on how good the leaving group is and the electron density at the carbonyl: acid chloride > anhydride > ester > amide.

Step 1 — Best leaving group: Cl^- (acid chloride) leaves most easily.

Step 2 — Order down the list: anhydride next, then ester, then amide (poor leaving group, strong resonance donation by N).

Step 3 — Conclude: acid chloride $>$ anhydride $>$ ester $>$ amide.

Why other options are wrong:

- (A) reverses the trend.
- (B) and (D) jumble the middle members.

Final Answer: acid chloride $>$ anhydride $>$ ester $>$ amide $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q27

Q28.

Solution

Concept — Azo coupling: A diazonium salt acts as an electrophile and couples at the para position of an activated aromatic (phenol/aniline) to give a brightly coloured azo compound ($-\text{N}{=}\text{N}-$ link).

Step 1 — Identify the electrophile: benzene diazonium chloride, $\text{C}_6\text{H}_5\text{N}_2^+$.

Step 2 — Couple with phenol: attack occurs para to the $-\text{OH}$ group.

Step 3 — Product: p-hydroxyazobenzene (an azo dye).

Why other options are wrong:

- (A) nitrobenzene is unrelated.
- (C) aniline is a reagent, not the coupling product.
- (D) chlorobenzene comes from a Sandmeyer-type path, not coupling.

Final Answer: p-hydroxyazobenzene $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q28

Q29.

Solution

Concept — Anomers: Cyclic sugars differing only in configuration at the anomeric carbon (the new stereocentre formed on ring closure, C-1 in glucose) are called anomers.

Step 1 — Locate the difference: α- and β-D-glucose differ only at C-1.

Step 2 — Name the relationship: differing at the anomeric carbon $\Rightarrow$ anomers.

Step 3 — Conclude: they are anomers.

Why other options are wrong:

- (A) epimers differ at a carbon other than the anomeric one.
- (B) enantiomers are non-superimposable mirror images (differ at all centres).
- (C) geometrical isomerism applies to double bonds.

Final Answer: anomers $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q29

Q30.

Solution

Concept — Biodegradable polymers: PHBV is a copolymer of 3-hydroxybutanoic acid and 3-hydroxypentanoic acid; it is broken down by microorganisms.

Step 1 — Recall the monomers: 3-hydroxybutanoic acid + 3-hydroxypentanoic (valeric) acid.

Step 2 — Identify the polymer: this is PHBV.

Step 3 — Conclude: PHBV is the biodegradable polymer.

Why other options are wrong:

- (B), (C) and (D) polythene, polystyrene and PVC are non-biodegradable addition polymers.

Final Answer: PHBV $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q30

Q31.

Solution

Concept — Homolytic vs heterolytic fission: In homolytic fission the shared pair splits equally, one electron to each fragment, giving neutral free radicals. In heterolytic fission both electrons go to one fragment, giving ions.

Step 1 — Read the equation: $\text{A:B} \rightarrow \text{A}^{\bullet} + \text{B}^{\bullet}$ shows one electron on each fragment.

Step 2 — Identify the species: each fragment has an unpaired electron $\Rightarrow$ a free radical.

Step 3 — Conclude: homolysis produces two free radicals.

Why other options are wrong:

- (A) and (D) ions arise from heterolytic fission.
- (B) two carbocations would need loss of electrons, not homolysis.

Final Answer: two free radicals $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q31

Q32.

Solution

Concept — Hofmann bromamide degradation: An amide treated with $\mathrm{Br_2}$ and KOH loses the carbonyl carbon (as carbonate) and gives a primary amine with one fewer carbon.

Step 1 — Identify reactants: $\mathrm{R{-}CONH_2 + Br_2 + KOH}$.

Step 2 — Recognise the change: the amide becomes $\mathrm{R{-}NH_2}$ (one carbon shorter).

Step 3 — Name the reaction: Hofmann bromamide degradation.

Why other options are wrong:

- (A) Cannizzaro is disproportionation of aldehydes lacking α-H.
- (B) Wurtz couples alkyl halides.
- (C) Sandmeyer replaces a diazonium group.

Final Answer: Hofmann bromamide degradation $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q32

Q33.

Solution

Concept — Bromine water test: Alkenes (and alkynes) add bromine across the multiple bond, rapidly decolourising orange bromine water with no HBr evolved.

Step 1 — Observe the test: quick decolourisation without HBr gas indicates addition, not substitution.

Step 2 — Identify the group: addition across a C=C double bond.

Step 3 — Conclude: the compound contains a carbon–carbon double bond (unsaturation).

Why other options are wrong:

- (A) saturated alkanes do not react (no decolourisation without light).
- (C) ethers do not decolourise bromine water.
- (D) a fully substituted aromatic ring is unreactive here.

Final Answer: a C=C double bond (unsaturation) ⇒ $\boxed{\text{B}}$

Answer: (B) Go Back to Q33

Q34.

Solution

Concept — Grignard synthesis of alcohols: A Grignard reagent $\mathrm{R{-}MgX}$ adds to a carbonyl; with formaldehyde it gives, after hydrolysis, a primary alcohol with one extra carbon.

Step 1 — Choose the reagent: $\mathrm{R{-}MgX}$ attacks the carbonyl carbon of HCHO.

Step 2 — Hydrolyse: acidic work-up gives $\mathrm{R{-}CH_2{-}OH}$, a primary alcohol.

Step 3 — Conclude: a Grignard reagent is the correct choice.

Why other options are wrong:

- (B) Tollens' oxidises aldehydes, it does not add carbon.
- (C) $\mathrm{H_2SO_4}$ is a dehydrating/catalytic acid, not a carbon source.
- (D) $\mathrm{KMnO_4}$ oxidises rather than building the chain.

Final Answer: a Grignard reagent ⇒ $\boxed{\text{A}}$

Answer: (A) Go Back to Q34

Q35.

Solution

Concept — Abnormally high second ionization energy: If removing the second electron must break a stable noble-gas (or fully filled) configuration, IE_2 is exceptionally large. Sodium (Na^+ is $[\mathrm{Ne}]$) shows this.

Step 1 — Configuration of Na: $\mathrm{Na} = [\mathrm{Ne}]3s^1$; removing one electron gives $\mathrm{Na}^+ = [\mathrm{Ne}]$ (very stable).

Step 2 — Second removal: taking a second electron must pull it from the noble-gas $[\mathrm{Ne}]$ core, demanding huge energy.

Step 3 — Conclude: Na has an abnormally high IE_2.

Why other options are wrong:

- (A) Mg loses two electrons easily (IE_2 not abnormal).
- (B) Al easily loses up to three.
- (D) Ca readily forms Ca^{2+}, so its IE_2 is not abnormal.

Final Answer: sodium (Na) $\Rightarrow \boxed{\mathrm{C}}$

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

Q36.

Solution

Concept — VSEPR for $\mathrm{AB_3E_2}$: A central atom with 3 bond pairs and 2 lone pairs ($\mathrm{sp^3d}$) gives a T-shaped molecule (the two lone pairs occupy equatorial positions of a trigonal bipyramid).

Step 1 — Count domains for $\mathrm{ClF_3}$: Cl has 3 bond pairs + 2 lone pairs = 5 electron domains.

Step 2 — Place lone pairs: both lone pairs go equatorial to minimise repulsion.

Step 3 — Resulting shape: the three F atoms form a T shape.

Why other options are wrong:

- (A) trigonal planar needs 3 bond pairs and no lone pair.
- (C) pyramidal is for $\mathrm{AB_3E}$ (e.g. $\mathrm{NH_3}$).
- (D) tetrahedral is for 4 bond pairs.

Final Answer: T-shaped $\Rightarrow \boxed{\mathrm{B}}$

Answer: (B) Go Back to Q36

Q37.

Solution

Concept — Hybridization from geometry: A central atom with three sigma bonds and no lone pair (trigonal planar) is sp^2 hybridised.

Step 1 — Count sigma bonds on S: in $\mathrm{SO_3}$ there are 3 S–O sigma bonds.

Step 2 — Count lone pairs: 0 lone pairs on S.

Step 3 — Assign hybridization: 3 electron domains $\Rightarrow sp^2$ (trigonal planar).

Why other options are wrong:

- (B) sp^3 is for 4 domains.
- (C) sp is for 2 domains.
- (D) sp^3d is for 5 domains.

Final Answer: $sp^2 \Rightarrow \boxed{\mathrm{A}}$

Answer: (A) Go Back to Q37

Q38.

Solution

Concept — Hydration enthalpy trend: The smaller the cation, the higher its charge density and the more negative its hydration enthalpy. Down group 1, ionic size increases, so hydration enthalpy magnitude decreases.

Step 1 — Order the sizes: $\mathrm{Li^+} < \mathrm{Na^+} < \mathrm{K^+} < \mathrm{Cs^+}$.

Step 2 — Relate to hydration: smallest ion $\mathrm{Li^+}$ has the greatest charge density, so the most negative hydration enthalpy.

Step 3 — Conclude: $\mathrm{Li^+}$ has the highest hydration enthalpy.

Why other options are wrong:

- (A), (B) and (C) larger ions have lower (less negative) hydration enthalpies.

Final Answer: $\mathrm{Li^+} \Rightarrow \boxed{\mathrm{D}}$

Answer: (D) Go Back to Q38

Q39.

Solution

Concept — Potash alum: It is a double salt of potassium and aluminium sulphate with 24 water molecules of crystallisation.

Step 1 — Recall the formula: $K_2SO_4{\cdot}Al_2(SO_4)_3{\cdot}24H_2O$, often written $KAl(SO_4)_2{\cdot}12H_2O$.

Step 2 — Match the option: option (B) gives exactly this.

Step 3 — Conclude: (B) is correct.

Why other options are wrong:

- (A) is plain aluminium sulphate.
- (C) is potassium aluminate.
- (D) is aluminium hydroxide.

Final Answer: $K_2SO_4{\cdot}Al_2(SO_4)_3{\cdot}24H_2O \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q39

Q40.

Solution

Concept — Uses of zeolites: Their porous aluminosilicate framework makes them excellent shape-selective catalysts (e.g. ZSM-5 in petrochemistry) and ion-exchangers for softening water.

Step 1 — Recall the structure: zeolites have regular cavities of molecular dimensions.

Step 2 — Identify the use: they act as shape-selective catalysts and as ion-exchangers (water softening).

Step 3 — Conclude: option (C) is correct.

Why other options are wrong:

- (A) bleaching is done by other agents.
- (B) zeolites are not explosives.
- (D) refractory bricks use other oxides.

Final Answer: shape-selective catalysts / ion-exchangers $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q40

Q41.

Solution

Concept — Brown ring test: Nitrate is reduced by Fe^{2+} in the presence of concentrated H_2SO_4 to NO, which coordinates to Fe^{2+} forming the brown complex $[Fe(H_2O)_5NO]^{2+}$.

Step 1 — Recall the reagents: $FeSO_4$ and concentrated H_2SO_4 added to the nitrate solution.

Step 2 — Identify the brown species: the brown ring is $[Fe(H_2O)_5NO]^{2+}$ (nitrosyl iron complex).

Step 3 — Conclude: option (A) is correct.

Why other options are wrong:

- (B) $Fe(OH)_3$ is a hydroxide precipitate.
- (C) $[Fe(CN)_6]^{4-}$ is ferrocyanide.
- (D) $FeSO_4$ is the starting reagent.

Final Answer: $[Fe(H_2O)_5NO]^{2+} \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q41

Q42.

Solution

Concept — Bond angle and electronegativity: In H_2O the more electronegative, smaller oxygen draws the bond pairs closer to itself, increasing bond-pair–bond-pair repulsion and widening the angle, whereas in H_2S the larger, less electronegative sulphur lets the bond pairs lie further out, narrowing the angle toward $90°$.

Step 1 — Compare electronegativity: O $(3.5) >$ S (2.5).

Step 2 — Effect on bond pairs: on O the bond pairs are pulled in and repel more, so the angle opens to $104.5°$.

Step 3 — For S: the bond pairs are further from the nucleus, repulsion is less, and the angle is about $92°$ (nearly pure p orbitals).

Step 4 — Conclude: oxygen's higher electronegativity and smaller size explain the larger angle.

Why other options are wrong:

- (A) oxygen, not sulphur, is more electronegative.
- (B) water does have two lone pairs.
- (D) neither molecule is sp hybridised.

Final Answer: O more electronegative and smaller $\Rightarrow \boxed{\text{C}}$

Answer: (C) **Go Back to Q42**

Q43.

Solution

Concept — Electron gain enthalpy anomaly: Fluorine is so small that adding an electron into its compact $2p$ subshell brings strong inter-electronic repulsion, so its electron gain enthalpy is less negative than that of chlorine.

Step 1 — Compare sizes: F is smaller than Cl.

Step 2 — Effect of small size: the incoming electron faces high repulsion in F's small, electron-dense $2p$ shell.

Step 3 — Consequence: F releases less energy, so $\text{Cl} > \text{F}$ in electron gain enthalpy magnitude.

Why other options are wrong:

- (A) fluorine is smaller, not larger.
- (B) F is in fact more electronegative; that is not the reason here.
- (C) higher nuclear charge alone would make F more negative, contrary to fact.

Final Answer: small size $\Rightarrow$ strong repulsion in $2p \Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q43**

Q44.

Solution

Concept — Clathrates: When noble-gas atoms are physically trapped in the cavities of a host lattice without forming true chemical bonds, the product is a clathrate (cage) compound.

Step 1 — Describe the trapping: Ar, Kr, Xe fit into the cages of β-quinol or water ice.

Step 2 — Note the bonding: no chemical bonds form; trapping is purely physical (van der Waals).

Step 3 — Name the product: a clathrate.

Why other options are wrong:

- (A) interstitial hydrides involve hydrogen in metals.
- (C) amalgams are mercury alloys.
- (D) zeolites are aluminosilicate frameworks, not the trapping name here.

Final Answer: clathrates $\Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q44**

Q45.

Solution

Concept — Highest oxidation state in the 3d series: Manganese ($[\mathrm{Ar}]3d^5 4s^2$) can use all seven of its $3d$ and $4s$ electrons, reaching the $+7$ state, as in $\mathrm{KMnO_4}$.

Step 1 — Count valence electrons of Mn: $3d^5 4s^2$ gives $5+2=7$ usable electrons.

Step 2 — Identify the maximum state: all seven can be involved, giving $+7$.

Step 3 — Conclude: manganese shows the $+7$ state.

Why other options are wrong:

- (A) Cr reaches a maximum of $+6$ (as in $\mathrm{CrO_4^{2-}}$).
- (C) Fe usually maxes at $+3$ (rarely $+6$).
- (D) V maxes at $+5$.

Final Answer: manganese (Mn) $\Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q45**

Q46.

Solution

Concept — Ambidentate ligand: A monodentate ligand that can attach through either of two different donor atoms (e.g. NO_2^- via N or O) is called ambidentate.

Step 1 — Examine NO_2^-: it can bind through N (nitro) or through O (nitrito).

Step 2 — Classify: only one atom binds at a time, but two choices exist ⇒ ambidentate.

Step 3 — Conclude: NO_2^- is an ambidentate ligand.

Why other options are wrong:

- (B) bidentate ligands bind through two atoms at once.
- (C) chelating ligands form rings by binding through two or more atoms.
- (D) polydentate ligands bind through several atoms simultaneously.

Final Answer: an ambidentate ligand $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q46

Q47.

Solution

Concept — Linkage isomerism: It arises when an ambidentate ligand coordinates to the metal through different donor atoms, giving distinct compounds.

Step 1 — Compare the two complexes: one has NO_2 bonded through N (nitro), the other through O (nitrito, ONO).

Step 2 — Identify the cause: the same ambidentate ligand binds via different atoms.

Step 3 — Conclude: this is linkage isomerism.

Why other options are wrong:

- (A) ionization isomerism swaps ligand and counter-ion.
- (B) geometrical isomerism is a spatial arrangement difference.
- (D) optical isomerism involves non-superimposable mirror images.

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

Answer: (C) Go Back to Q47

Q48.

Solution

Concept — Ellingham diagram: A plot of ΔG° vs T for oxide formation; a metal whose line lies below another's can reduce the upper oxide at that temperature.

Step 1 — Read the diagram: compare the free-energy lines of the oxide to be reduced and of the reducing agent.

Step 2 — Apply the criterion: reduction is feasible if the overall ΔG° is negative at the chosen temperature.

Step 3 — Conclude: the Ellingham diagram predicts whether a reducing agent works at a given temperature.

Why other options are wrong:

- (A) it says nothing about colour.
- (C) it does not give melting points.
- (D) flame colour is unrelated.

Final Answer: predicts reducibility at a temperature $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q48

Q49.

Solution

Concept — Nascent hydrogen: Hydrogen produced in situ (e.g. $\text{Zn} + \text{dil. } H_2SO_4$) is freshly formed and energetic, so it reduces more powerfully than ordinary H_2 gas.

Step 1 — Origin: nascent hydrogen is generated at the moment of reaction within the mixture.

Step 2 — Reactivity: being freshly formed and in a more reactive (atomic/energetic) state, it reduces substances that molecular H_2 cannot.

Step 3 — Conclude: its reactive freshly-formed state explains the stronger reducing power.

Why other options are wrong:

- (B) temperature is not the reason.
- (C) it is not heavier than H_2.
- (D) it is ordinary hydrogen, not deuterium.

Final Answer: freshly-formed reactive state $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q49

Q50.

Solution

Concept — Lassaigne's test for nitrogen: Sodium fusion converts organic N to NaCN. Treatment with $\mathrm{FeSO_4}$ and then $\mathrm{Fe^{3+}}$ gives ferric ferrocyanide (Prussian blue), confirming nitrogen.

Step 1 — Sodium fusion: the compound's nitrogen becomes $\mathrm{CN^-}$ (NaCN).

Step 2 — Add $\mathrm{FeSO_4}$**:** $\mathrm{Fe^{2+} + CN^- \rightarrow [Fe(CN)_6]^{4-}}$ (ferrocyanide).

Step 3 — Add $\mathrm{Fe^{3+}}$**:** ferrocyanide reacts with $\mathrm{Fe^{3+}}$ to give Prussian blue, $\mathrm{Fe_4[Fe(CN)_6]_3}$.

Step 4 — Conclude: a Prussian-blue (blue-green) colour confirms nitrogen.

Why other options are wrong:

- (A) a white precipitate suggests halide/sulphate tests.
- (B) a brown ring is the nitrate test.
- (C) a deep red colour indicates sulphur (as thiocyanate), not nitrogen.

Final Answer: Prussian-blue colouration $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q50

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	D	3	B	4	A	5	C
6	A	7	B	8	D	9	C	10	B
11	A	12	D	13	B	14	A	15	C
16	B	17	D	18	C	19	A	20	D
21	B	22	C	23	A	24	A	25	D
26	B	27	C	28	B	29	D	30	A
31	C	32	D	33	B	34	A	35	C
36	B	37	A	38	D	39	B	40	C
41	A	42	C	43	D	44	B	45	B
46	A	47	C	48	B	49	A	50	D