JCECE Chemistry Sample Paper – 3

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. A compound contains 40% carbon, 6.7% hydrogen and 53.3% oxygen by mass (atomic masses C $= 12$, H $= 1$, O $= 16$). Its empirical formula is:

(A) CHO

(B) $C_2H_4O_2$

(C) CH_2O

(D) CH_3O

Q2. The de Broglie wavelength of an electron (mass 9.1×10^{-31} kg) moving with a velocity of 7.3×10^6 m s^{-1}, taking $h = 6.63 \times 10^{-34}$ J s, is approximately:

(A) 1.0×10^{-10} m

(B) 1.0×10^{-12} m

(C) 3.3×10^{-10} m

(D) 6.6×10^{-9} m

Q3. For the orbital whose boundary surface (a $3d$ orbital with its angular lobes) is illustrated, the number of angular nodes (nodal planes) is:

a $3d$ subshell ($l = 2$)

(A) 1

(B) 2

(C) 0

(D) 3

Q4. A vessel contains 2 mol of N_2 and 3 mol of O_2. If the total pressure of the mixture is 5 atm, the partial pressure of O_2 is:

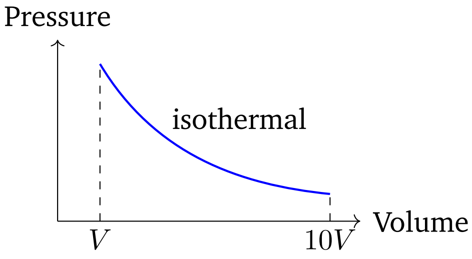
(A) 2 atm

(B) 3 atm

(C) 1 atm

(D) 5 atm

Q5. 2 mol of an ideal gas expands isothermally and reversibly at 300 K from a volume V to $10V$. Taking $R = 8.314\ \text{J K}^{-1}\text{mol}^{-1}$ and $\ln 10 = 2.303$, the work done *by* the gas (use $w_{by} = nRT \ln \frac{V_2}{V_1}$) is closest to:



(A) 5.74 kJ

(B) 2.87 kJ

(C) 1.15 kJ

(D) 11.5 kJ

Q6. For NaCl, the enthalpy of formation $\Delta H_f = -411$, sublimation of Na $= +108$, ionization of Na $= +496$, dissociation of $\frac{1}{2}\mathrm{Cl}_2 = +121$ and electron gain of Cl $= -349$ kJ/mol. Using the Born–Haber cycle, the lattice enthalpy of NaCl (i.e. $\mathrm{Na^+(g) + Cl^-(g) \rightarrow NaCl(s)}$) is:

(A) -411 kJ/mol

(B) -376 kJ/mol

(C) -787 kJ/mol

(D) -1135 kJ/mol

Q7. For $\mathrm{PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)}$, starting with 1 mol of $\mathrm{PCl_5}$, at equilibrium 0.6 mol of $\mathrm{PCl_5}$ remains. The degree of dissociation α is:

(A) 0.4

(B) 0.6

(C) 0.2

(D) 0.8

Q8. The pOH of a 0.001 M aqueous solution of NaOH (a strong base) at $25°\mathrm{C}$ is:

(A) 11

(B) 3

(C) 2

(D) 0.001

Q9. A buffer is made by mixing equal volumes of 0.2 M acetic acid and 0.2 M sodium acetate. For acetic acid $pK_a = 4.74$. The pH of this buffer is:

(A) 4.44

(B) 5.04

(C) 9.26

(D) 4.74

Q10. The osmotic pressure of a 0.1 M aqueous solution of a non-electrolyte at 300 K ($R = 0.0821$ L atm mol^{-1}K^{-1}) is:

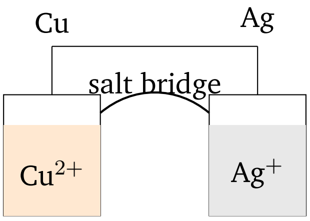
(A) 2.46 atm

(B) 24.6 atm

(C) 0.82 atm

(D) 1.23 atm

Q11. For the cell reaction shown, $E^\circ_{\mathrm{Cu^{2+}/Cu}} = +0.34$ V and $E^\circ_{\mathrm{Ag^{+}/Ag}} = +0.80$ V. Based on the standard EMF, the spontaneous (feasible) cell reaction and its E°_{cell} are:



(A) Ag is oxidised; $E^\circ_{cell} = -0.46$ V (feasible)

(B) no reaction occurs; $E^\circ_{cell} = 0$ V

(C) Cu is oxidised, Ag^{+} reduced; $E^\circ_{cell} = +0.46$ V (feasible)

(D) Cu is oxidised; $E^\circ_{cell} = +1.14$ V

Q12. When a current of 5 A is passed through molten $\mathrm{AlCl_3}$ for 965 s, the mass of aluminium (atomic mass 27, $F = 96500$ C mol^{-1}) deposited at the cathode is:

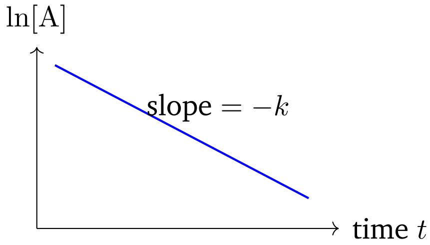
(A) 0.45 g

(B) 1.35 g

(C) 0.90 g

(D) 0.15 g

Q13. For a first-order reaction, a plot of $\ln[\mathrm{A}]$ against time t is a straight line of slope -0.02 min^{-1} (shown). The rate constant k of the reaction is:



(A) -0.02 min^{-1}

(B) 0.02 min^{-1}

(C) 0.04 min^{-1}

(D) 0.01 min^{-1}

Q14. A zero-order reaction has an initial concentration $[\mathrm{A}]_0 = 0.10$ M and a rate constant $k = 0.01$ mol L^{-1}min^{-1}. The half-life $t_{1/2} = \dfrac{[\mathrm{A}]_0}{2k}$ of this reaction is:

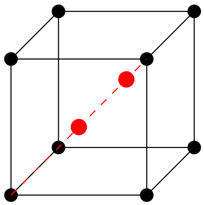
(A) 10 min

(B) 20 min

(C) 2.5 min

(D) 5 min

Q15. For the face-centred cubic (fcc / ccp) lattice shown, in which atoms touch along the face diagonal, the packing efficiency (percentage of space occupied) is:


face diagonal $= 4r$

(A) 52.4%

(B) 68%

(C) 32%

(D) 74%

Q16. In the reaction $\mathrm{Zn} + 2\mathrm{HCl} \to \mathrm{ZnCl_2} + \mathrm{H_2}$, the species that acts as the oxidising agent (the one that is reduced) is:

(A) Zn

(B) $\mathrm{Cl^-}$

(C) $\mathrm{ZnCl_2}$

(D) $\mathrm{H^+}$ (from HCl)

Q17. A sample of water contains 2×10^{-3} g of dissolved salt in 1000 g of water. The concentration of the salt expressed in parts per million (ppm) is:

(A) 0.2 ppm

(B) 2 ppm

(C) 20 ppm

(D) 200 ppm

Q18. The IUPAC name of the compound $\mathrm{CH_3{-}CH(OH){-}CH_2{-}CH_3}$ is:

(A) butan-1-ol

(B) 2-methylpropan-2-ol

(C) butan-2-ol

(D) butan-1,2-diol

Q19. Ethanol ($\mathrm{C_2H_5OH}$) and dimethyl ether ($\mathrm{CH_3{-}O{-}CH_3}$) have the same molecular formula $\mathrm{C_2H_6O}$ but different functional groups. This relationship is called:

(A) functional isomerism

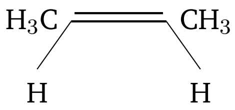
(B) chain isomerism

(C) position isomerism

(D) metamerism

Q20. For the alkene 2-butene, $CH_3–CH=CH–CH_3$ (the cis arrangement is drawn), the number of geometrical (cis/trans) isomers is:

(cis-2-butene)



(A) 1

(B) 3

(C) 0

(D) 2 (cis and trans)

Q21. Among the following alkenes, the most stable one (greatest number of α C–H bonds available for hyperconjugation with the double bond) is:

(A) ethene ($CH_2=CH_2$)

(B) 2,3-dimethyl-2-butene ($(CH_3)_2C=C(CH_3)_2$)

(C) propene ($CH_3CH=CH_2$)

(D) 1-butene ($CH_3CH_2CH=CH_2$)

Q22. Among the hydrocarbons shown, the one whose hydrogen is acidic enough to react with sodium metal (or ammoniacal $AgNO_3$) is:

$$H–C \equiv C–H \quad \text{(ethyne)}$$

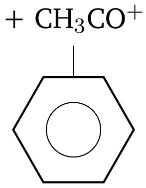
(A) ethyne ($HC\equiv CH$)

(B) ethene ($CH_2=CH_2$)

(C) ethane (CH_3-CH_3)

(D) but-2-yne ($CH_3C\equiv CCH_3$)

Q23. When benzene (shown) is treated with acetyl chloride (CH_3COCl) in the presence of anhydrous $AlCl_3$, the product of the electrophilic substitution is:



(A) toluene

(B) acetophenone ($C_6H_5COCH_3$)

(C) benzoic acid

(D) nitrobenzene

Q24. When CH_3CH_2Br (bromoethane) is treated with sodium metal in dry ether (Wurtz reaction), the principal hydrocarbon product is:

(A) ethane (CH_3CH_3)

(B) n-butane ($CH_3CH_2CH_2CH_3$)

(C) ethene ($CH_2{=}CH_2$)

(D) propane ($CH_3CH_2CH_3$)

Q25. When ethanol (CH_3CH_2OH) is heated with concentrated H_2SO_4 at 443 K ($170°$C), the major organic product is:

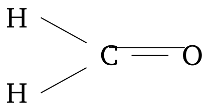
(A) diethyl ether

(B) ethanal

(C) ethene ($CH_2{=}CH_2$)

(D) ethanoic acid

Q26. When formaldehyde (HCHO, whose carbonyl is shown) is warmed with concentrated NaOH, it undergoes a Cannizzaro reaction. The two products formed are:



(A) two molecules of formic acid

(B) formic acid and acetaldehyde

(C) two molecules of methanol

(D) methanol and sodium formate ($HCOONa$)

Q27. When sodium acetate (CH_3COONa) is heated with soda lime (NaOH + CaO), it undergoes decarboxylation. The hydrocarbon product is:

(A) methane (CH_4)

(B) ethane (CH_3CH_3)

(C) ethene ($CH_2{=}CH_2$)

(D) acetone

Q28. When acetamide (CH_3CONH_2) is treated with Br_2 and aqueous KOH (Hofmann bromamide degradation), the amine produced is:

(A) ethylamine ($CH_3CH_2NH_2$)

(B) methylamine (CH_3NH_2)

(C) aniline

(D) dimethylamine

Q29. In proteins, the covalent linkage that joins two amino-acid residues together is formed between the $-COOH$ of one and the $-NH_2$ of the next. This linkage is a:

(A) glycosidic bond

(B) ester ($-COO-$) bond

(C) peptide ($-CONH-$) bond

(D) phosphodiester bond

Q30. Nylon-6,6 is a condensation polymer. The two monomers used to make it are:

(A) hexamethylenediamine and adipic acid

(B) ethylene glycol and terephthalic acid

(C) phenol and formaldehyde

(D) caprolactam alone

Q31. In the free-radical chlorination of methane, the step $Cl_2 \xrightarrow{h\nu} 2Cl^{\bullet}$ (homolysis of Cl_2 by light) represents which stage of the chain mechanism?

(A) propagation

(B) initiation

(C) termination

(D) substitution

Q32. Two molecules of an alkyl halide react with sodium metal in dry ether to give a higher symmetrical alkane. This reaction is known as the:

(A) Cannizzaro reaction

(B) Friedel–Crafts reaction

(C) Reimer–Tiemann reaction

(D) Wurtz reaction

Q33. An organic compound decolourises cold, dilute, alkaline $KMnO_4$ (Baeyer's reagent). This test indicates the presence of:

(A) an aldehyde group

(B) a phenolic $-OH$

(C) a carbon–carbon double or triple bond (unsaturation)

(D) a carboxylic acid group

Q34. The reagent set used to reduce nitrobenzene $(C_6H_5NO_2)$ to aniline $(C_6H_5NH_2)$ is:

(A) Sn / concentrated HCl (then make alkaline)

(B) PCC

(C) alkaline $\mathrm{KMnO_4}$

(D) $\mathrm{LiAlH_4}$ on the ring carbon

Q35. Which element of the second period has the most negative (most exothermic) electron gain enthalpy, reflecting the greatest tendency to accept an electron?

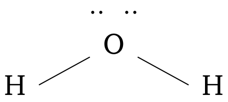
(A) nitrogen

(B) lithium

(C) carbon

(D) fluorine

Q36. According to VSEPR theory, the molecular shape of the water molecule $\mathrm{H_2O}$ (two bond pairs and two lone pairs on O, shown) is:



(angle $\approx 104.5°$)

(A) linear

(B) trigonal planar

(C) bent (angular)

(D) tetrahedral

Q37. The hybridization of the beryllium atom in beryllium chloride $\mathrm{BeCl_2}$ (a linear molecule, shown) is:

$$\mathrm{Cl} \text{ —— } \mathrm{Be} \text{ —— } \mathrm{Cl}$$

(linear, $180°$)

(A) sp^3

(B) sp^2

(C) sp

(D) sp^3d

Q38. Lithium resembles magnesium in many of its properties (e.g. both form normal oxides and nitrides). This similarity between Li and Mg is an example of:

(A) the diagonal relationship
(B) the inert pair effect
(C) the lanthanide contraction
(D) allotropy

Q39. In the borax bead test, the coloured bead obtained with metal ions is essentially a glass-like metal:

(A) carbonate
(B) metaborate (orthoborate of the metal)
(C) sulphide
(D) chloride

Q40. Regarding the bonding in carbon monoxide (CO) and carbon dioxide (CO_2), the correct statement is:

(A) CO has two C=O double bonds
(B) CO_2 contains a C≡O triple bond
(C) both are paramagnetic
(D) CO has a C≡O triple bond, while CO_2 has two C=O double bonds

Q41. The H–N–H bond angle in NH_3 ($107°$) is larger than the H–P–H angle in PH_3 ($\approx 93°$). The best reason is:

(A) N is larger than P
(B) PH_3 has no lone pair
(C) N is more electronegative and smaller, so its bond pairs are closer and repel more, widening the angle

(D) NH_3 is non-polar

Q42. Sulphur dioxide (SO_2) decolourises acidified $KMnO_4$ solution. This behaviour shows that SO_2 is acting as a:

(A) reducing agent

(B) oxidising agent

(C) dehydrating agent

(D) Lewis base only

Q43. The correct order of acidic strength of the hydrogen halides (strongest acid first) is:

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

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

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

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

Q44. In xenon tetrafluoride XeF_4 (square planar, four bond pairs and two lone pairs on Xe), the hybridization of the central xenon atom is:

(A) sp^3

(B) sp^3d^2

(C) sp^3d

(D) sp^2

Q45. The spin-only magnetic moment of the Fe^{3+} ion ($3d^5$ configuration, 5 unpaired electrons), using $\mu = \sqrt{n(n+2)}$ BM, is approximately:

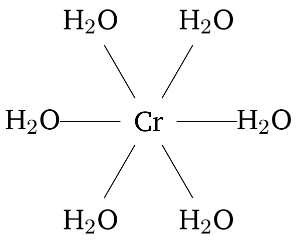
(A) 2.83 BM

(B) 4.90 BM

(C) 5.92 BM

(D) 3.87 BM

Q46. For the octahedral complex ion $[\mathrm{Cr(H_2O)_6}]^{3+}$ (shown), the coordination number of the chromium centre is:



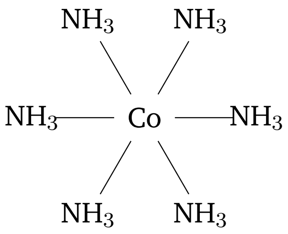
(A) 3

(B) 4

(C) 6

(D) 2

Q47. In the octahedral complex $[\mathrm{Co(NH_3)_6}]^{3+}$ (shown), $\mathrm{NH_3}$ is a strong-field ligand causing the $3d^6$ electrons to pair up. The complex is therefore:



(A) low-spin and diamagnetic (no unpaired electrons)

(B) high-spin with four unpaired electrons

(C) low-spin with two unpaired electrons

(D) high-spin and paramagnetic with six unpaired electrons

Q48. In the thermite (aluminothermy) process, the reducing agent used to extract metals such as Cr and Mn from their oxides is:

(A) coke (carbon)

(B) aluminium powder

(C) carbon monoxide

(D) hydrogen gas

Q49. Hydrogen peroxide (H_2O_2) oxidises black lead sulphide (PbS) to white lead sulphate ($PbSO_4$). In this reaction H_2O_2 is acting as:

(A) a reducing agent

(B) an acid

(C) an oxidising agent

(D) a dehydrating agent

Q50. A white precipitate, insoluble in dilute HCl, forms when $BaCl_2$ solution is added to an aqueous solution. This confirms the presence of the:

(A) chloride ion

(B) nitrate ion

(C) carbonate ion

(D) sulphate ion

Detailed Solutions

Q1.

Solution

Concept — Empirical formula: Convert mass percentages to moles by dividing by atomic mass, then take the simplest whole-number ratio.

Step 1 — Moles of C: $\frac{40}{12} = 3.33$.

Step 2 — Moles of H: $\frac{6.7}{1} = 6.7$.

Step 3 — Moles of O: $\frac{53.3}{16} = 3.33$.

Step 4 — Divide by the smallest (3.33): C $= 1$, H $= 2$, O $= 1$.

Step 5 — Write the formula: CH_2O.

Why other options are wrong:

- (A) CHO omits one H.
- (B) $C_2H_4O_2$ is a molecular multiple, not the simplest ratio.
- (D) CH_3O has the wrong H count.

Final Answer: $CH_2O \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q1

Q2.

Solution

Concept — de Broglie wavelength: $\lambda = \frac{h}{mv}$.

Step 1 — List data: $h = 6.63 \times 10^{-34}$, $m = 9.1 \times 10^{-31}$, $v = 7.3 \times 10^6$.

Step 2 — Denominator mv**:** $9.1 \times 10^{-31} \times 7.3 \times 10^6 = 66.4 \times 10^{-25} = 6.64 \times 10^{-24}$.

Step 3 — Divide: $\lambda = \frac{6.63 \times 10^{-34}}{6.64 \times 10^{-24}}$.

Step 4 — Evaluate: $\lambda \approx 1.0 \times 10^{-10}$ m.

Why other options are wrong:

- (B) is off by 10^2 (power-of-ten slip).
- (C) multiplies h by an extra factor.

- (D) misplaces the exponent.

Final Answer: $\lambda \approx 1.0 \times 10^{-10}$ m $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q2

Q3.

Solution

Concept — Angular nodes: The number of angular nodes (nodal planes) of an orbital equals its azimuthal quantum number l.

Step 1 — Identify the orbital: the subshell shown is $3d$, so $l = 2$.

Step 2 — Apply the rule: angular nodes $= l$.

Step 3 — Evaluate: angular nodes $= 2$.

Why other options are wrong:

- (A) 1 is for a p orbital ($l = 1$).
- (C) 0 is for an s orbital ($l = 0$).
- (D) 3 is for an f orbital ($l = 3$).

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

Answer: (B) Go Back to Q3

Q4.

Solution

Concept — Dalton's law (mole fraction): Partial pressure $=$ mole fraction $\times$ total pressure.

Step 1 — Total moles: $2 + 3 = 5$ mol.

Step 2 — Mole fraction of O_2: $x_{O_2} = \frac{3}{5} = 0.6$.

Step 3 — Apply Dalton's law: $p_{O_2} = 0.6 \times 5$.

Step 4 — Evaluate: $p_{O_2} = 3$ atm.

Why other options are wrong:

- (A) uses the N_2 mole fraction.
- (C) uses a wrong fraction.

- (D) is the total pressure, not the partial pressure.

Final Answer: $p_{O_2} = 3 \text{ atm} \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q4

Q5.

Solution

Concept — Isothermal reversible work: The work done by the gas is $w_{by} = nRT \ln \frac{V_2}{V_1}$.

Step 1 — List data: $n = 2$, $R = 8.314$, $T = 300$, $\frac{V_2}{V_1} = 10$.

Step 2 — Evaluate the log: $\ln 10 = 2.303$.

Step 3 — Multiply nRT: $2 \times 8.314 \times 300 = 4988.4$ J.

Step 4 — Multiply by $\ln 10$: $4988.4 \times 2.303 = 11489$ J.

Step 5 — Convert to kJ: $w_{by} \approx 11.5$ kJ.

Why other options are wrong:

- (A) uses $n = 1$.
- (B) uses $n = 1$ and drops a factor.
- (C) uses $\log_{10}$ without the $\ln$ conversion.

Final Answer: $w_{by} \approx 11.5 \text{ kJ} \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q5

Q6.

Solution

Concept — Born–Haber cycle: $\Delta H_f = \Delta H_{sub} + \Delta H_{IE} + \Delta H_{diss} + \Delta H_{EG} + U$, where U is the lattice enthalpy (formation of the solid from gaseous ions). Solve for U.

Step 1 — Sum the known steps (excluding U): $108 + 496 + 121 + (-349) = 376$ kJ.

Step 2 — Write the cycle: $-411 = 376 + U$.

Step 3 — Solve for U: $U = -411 - 376$.

Step 4 — Evaluate: $U = -787$ kJ/mol.

Why other options are wrong:

- (A) just quotes ΔH_f.
- (B) quotes the partial sum 376 with a sign change.
- (D) double-counts a term.

Final Answer: $U = -787$ kJ/mol $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — Degree of dissociation: $\alpha = \dfrac{\text{moles dissociated}}{\text{initial moles}}$.

Step 1 — Initial moles of $\mathrm{PCl_5}$: 1 mol.

Step 2 — Moles remaining: 0.6 mol.

Step 3 — Moles dissociated: $1 - 0.6 = 0.4$ mol.

Step 4 — Compute α: $\alpha = \dfrac{0.4}{1} = 0.4$.

Why other options are wrong:

- (B) quotes the un-dissociated fraction.
- (C) and (D) use wrong remaining amounts.

Final Answer: $\alpha = 0.4 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q7

Q8.

Solution

Concept — pOH of a strong base: NaOH is fully ionised, so $[\mathrm{OH^-}] =$ base concentration; $\mathrm{pOH} = -\log[\mathrm{OH^-}]$.

Step 1 — Find $[\mathrm{OH^-}]$: $[\mathrm{OH^-}] = 0.001 = 1 \times 10^{-3}$ M.

Step 2 — Apply the formula: $\mathrm{pOH} = -\log(1 \times 10^{-3})$.

Step 3 — Use log: $\log(10^{-3}) = -3$.

Step 4 — Evaluate: $\text{pOH} = 3$.

Why other options are wrong:

- (A) 11 is the pH, not the pOH.
- (C) uses 0.01 M.
- (D) quotes the concentration, not the pOH.

Final Answer: $\text{pOH} = 3 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q8

Q9.

Solution

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

Step 1 — Find the salt/acid ratio: equal volumes of equal 0.2 M solutions give $[\text{salt}] = [\text{acid}]$, so the ratio $= 1$.

Step 2 — Evaluate the log term: $\log 1 = 0$.

Step 3 — Apply the equation: $\text{pH} = 4.74 + 0$.

Step 4 — Result: $\text{pH} = 4.74$.

Why other options are wrong:

- (A) and (B) assume an unequal salt/acid ratio.
- (C) 9.26 is $14 - 4.74$ (the pOH-type slip).

Final Answer: $\text{pH} = 4.74 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q9

Q10.

Solution

Concept — Osmotic pressure: $\pi = CRT$, with C in mol/L.

Step 1 — List data: $C = 0.1$, $R = 0.0821$, $T = 300$.

Step 2 — Multiply RT: $0.0821 \times 300 = 24.63$.

Step 3 — Multiply by C: $\pi = 0.1 \times 24.63$.

Step 4 — Evaluate: $\pi = 2.46$ atm.

Why other options are wrong:

- (B) forgets to multiply by $C = 0.1$.
- (C) and (D) use wrong arithmetic.

Final Answer: $\pi = 2.46$ atm $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q10

Q11.

Solution

Concept — Feasibility from E°_{cell}: The electrode with the higher reduction potential is reduced (cathode); $E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$. A positive E°_{cell} means the reaction is spontaneous.

Step 1 — Compare potentials: $E^\circ_{\text{Ag}^+/\text{Ag}} = +0.80 \text{ V} > E^\circ_{\text{Cu}^{2+}/\text{Cu}} = +0.34 \text{ V}$.

Step 2 — Assign electrodes: Ag^+ is reduced (cathode); Cu is oxidised (anode).

Step 3 — Compute E°_{cell}: $E^\circ_{cell} = 0.80 - 0.34 = +0.46 \text{ V}$.

Step 4 — Judge feasibility: positive $E^\circ_{cell} \Rightarrow$ the reaction (Cu oxidised, Ag^+ reduced) is feasible.

Why other options are wrong:

- (A) reverses which species is oxidised, giving the wrong (negative) sign.
- (B) wrongly claims no reaction.
- (D) adds instead of subtracting the potentials.

Final Answer: Cu oxidised, Ag^+ reduced, $E^\circ_{cell} = +0.46 \text{ V} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q11

Q12.

Solution

Concept — Faraday's law: $m = \dfrac{M\,I\,t}{nF}$, where n is the number of electrons per ion.

Step 1 — List data: $M = 27$, $I = 5$, $t = 965$ s, $n = 3$ (for Al^{3+}), $F = 96500$.

Step 2 — Charge passed: $Q = It = 5 \times 965 = 4825$ C.

Step 3 — Moles of electrons: $\dfrac{4825}{96500} = 0.05$ mol e^-.

Step 4 — Moles of Al: $\dfrac{0.05}{3} = 0.0167$ mol.

Step 5 — Mass of Al: $0.0167 \times 27 = 0.45$ g.

Why other options are wrong:

- (B) forgets to divide by $n = 3$.
- (C) uses $n = 1.5$.
- (D) miscomputes the charge.

Final Answer: $m = 0.45$ g $\Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q12**

Q13.

Solution

Concept — First-order $\ln[\mathrm{A}]$ **vs** t **plot:** The integrated law $\ln[\mathrm{A}] = \ln[\mathrm{A}]_0 - kt$ gives a straight line of slope $-k$.

Step 1 — Read the slope: slope $= -0.02\ \text{min}^{-1}$.

Step 2 — Relate slope to k**:** slope $= -k$, so $k = -(\text{slope})$.

Step 3 — Solve: $k = -(-0.02) = 0.02\ \text{min}^{-1}$.

Why other options are wrong:

- (A) keeps the negative sign; k must be positive.
- (C) doubles the slope.
- (D) halves the slope.

Final Answer: $k = 0.02\ \text{min}^{-1} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q13

Q14.

Solution

Concept — Zero-order half-life: $t_{1/2} = \dfrac{[A]_0}{2k}$.

Step 1 — List data: $[A]_0 = 0.10$ M, $k = 0.01$ mol $L^{-1}min^{-1}$.

Step 2 — Denominator: $2k = 2 \times 0.01 = 0.02$.

Step 3 — Divide: $t_{1/2} = \dfrac{0.10}{0.02}$.

Step 4 — Evaluate: $t_{1/2} = 5$ min.

Why other options are wrong:

- (A) forgets the factor 2 in the denominator.
- (B) uses $4k$ or doubles wrongly.
- (C) halves the correct value.

Final Answer: $t_{1/2} = 5 \text{ min} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q14

Q15.

Solution

Concept — Packing efficiency of fcc: For ccp/fcc the atoms touch along the face diagonal ($\sqrt{2}\,a = 4r$), and there are 4 atoms per cell. The packing efficiency works out to 74%.

Step 1 — Relate radius and edge: $\sqrt{2}\,a = 4r \Rightarrow a = 2\sqrt{2}\,r$.

Step 2 — Volume of atoms: $4 \times \dfrac{4}{3}\pi r^3$.

Step 3 — Volume of cell: $a^3 = (2\sqrt{2}\,r)^3 = 16\sqrt{2}\,r^3$.

Step 4 — Efficiency: $\dfrac{\frac{16}{3}\pi r^3}{16\sqrt{2}\,r^3} = \dfrac{\pi}{3\sqrt{2}} \approx 0.74 = 74\%$.

Why other options are wrong:

- (A) 52.4% is simple cubic.
- (B) 68% is body-centred cubic.

- (C) 32% is not a standard packing value.

Final Answer: $74\% \Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q15**

Q16.

Solution

Concept — Oxidising agent: The oxidising agent is the species that is itself reduced (gains electrons / decreases in oxidation state).

Step 1 — Track Zn: Zn goes from 0 to $+2$, so it is oxidised (it is the reducing agent).

Step 2 — Track H: H^+ goes from $+1$ to 0 in H_2, so it is reduced.

Step 3 — Identify the oxidising agent: the species reduced is H^+ (from HCl).

Why other options are wrong:

- (A) Zn is oxidised, so it is the reducing agent.
- (B) Cl^- is a spectator (no change in oxidation state).
- (C) $ZnCl_2$ is a product, not the oxidant.

Final Answer: H^+ from HCl $\Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q16**

Q17.

Solution

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

Step 1 — List data: solute mass $= 2 \times 10^{-3}$ g, solution mass ≈ 1000 g.

Step 2 — Form the ratio: $\dfrac{2 \times 10^{-3}}{1000} = 2 \times 10^{-6}$.

Step 3 — Multiply by 10^6: $2 \times 10^{-6} \times 10^6 = 2$.

Step 4 — State the result: concentration $= 2$ ppm.

Why other options are wrong:

- (A) is off by a factor of 10.

- (C) and (D) misplace the power of ten.

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

Answer: (B) **Go Back to Q17**

Q18.

Solution

Concept — IUPAC naming of alcohols: Choose the longest chain containing the $-\mathrm{OH}$, number to give the $-\mathrm{OH}$ the lowest locant, and use the suffix *-ol*.

Step 1 — Count the chain: $\mathrm{CH_3{-}CH(OH){-}CH_2{-}CH_3}$ has 4 carbons (butane).

Step 2 — Locate the $-\mathrm{OH}$**:** on carbon 2 when numbered from the nearer end.

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

Why other options are wrong:

- (A) butan-1-ol has the $-\mathrm{OH}$ on C1.
- (B) is a tertiary alcohol with a branch, a different compound.
- (D) is a diol with two $-\mathrm{OH}$ groups.

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

Answer: (C) **Go Back to Q18**

Q19.

Solution

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

Step 1 — Compare formulae: ethanol and dimethyl ether are both $\mathrm{C_2H_6O}$.

Step 2 — Compare functional groups: ethanol is an alcohol ($-\mathrm{OH}$); dimethyl ether is an ether ($-\mathrm{O}-$).

Step 3 — Identify the type: different functional groups $\Rightarrow$ functional isomerism.

Why other options are wrong:

- (B) chain isomerism differs only in carbon skeleton.
- (C) position isomerism differs in the position of the same group.
- (D) metamerism is unequal alkyl groups about the same functional group.

Final Answer: functional isomerism $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

Concept — Geometrical isomerism: A double-bonded carbon must carry two *different* groups for cis/trans isomerism; 2-butene satisfies this on both carbons.

Step 1 — Examine each double-bond carbon: each $=\text{CH}$ carries one H and one CH_3 (two different groups).

Step 2 — Possible arrangements: the two CH_3 groups can be on the same side (cis) or on opposite sides (trans).

Step 3 — Count: 2 geometrical isomers (cis and trans).

Why other options are wrong:

- (A) 1 ignores the trans form.
- (B) 3 over-counts.
- (C) 0 would apply only if a carbon bore two identical groups.

Final Answer: 2 (cis and trans) $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Hyperconjugation and alkene stability: The more α C–H bonds (on carbons attached to the double bond) available for hyperconjugation, the more stable the alkene. More alkyl substitution at the double bond gives greater stability.

Step 1 — Count substitution: 2,3-dimethyl-2-butene is tetra-substituted (four methyl groups on the double bond).

Step 2 — Compare the others: propene and 1-butene are mono-substituted; ethene is un-substituted.

Step 3 — Conclude: the tetra-substituted alkene has the most α C–H bonds and is the most stable.

Why other options are wrong:

- (A) ethene has no alkyl group, least stable.
- (C) and (D) are only mono-substituted.

Final Answer: 2,3-dimethyl-2-butene $\Rightarrow \boxed{\text{B}}$

$\boxed{\textbf{Answer: (B)}}$ **Go Back to Q21**

Q22.

Solution

Concept — Acidity of terminal alkynes: A hydrogen on an sp-hybridised carbon (≡C–H) is acidic because the sp carbon holds the bonding electrons tightly; such terminal alkynes react with Na and with ammoniacal $\mathrm{AgNO_3}$.

Step 1 — Identify the acidic C–H: only a ≡C–H (terminal alkyne) is appreciably acidic.

Step 2 — Check ethyne: $\mathrm{HC{\equiv}CH}$ has terminal ≡C–H hydrogens, so it is acidic.

Step 3 — Conclude: ethyne reacts with Na / ammoniacal $\mathrm{AgNO_3}$.

Why other options are wrong:

- (B) ethene (sp^2 C–H) is not acidic enough.
- (C) ethane (sp^3 C–H) is essentially non-acidic.
- (D) but-2-yne has no *terminal* ≡C–H, so it gives no reaction.

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

$\boxed{\textbf{Answer: (A)}}$ **Go Back to Q22**

Q23.

Solution

Concept — Friedel–Crafts acylation: An acyl chloride with anhydrous $\mathrm{AlCl_3}$ generates the acylium ion $\mathrm{CH_3CO^+}$, which substitutes onto the ring to give an aryl ketone.

Step 1 — Identify the electrophile: $\mathrm{AlCl_3}$ generates $\mathrm{CH_3CO^+}$ from $\mathrm{CH_3COCl}$.

Step 2 — Substitution: $\mathrm{CH_3CO^+}$ replaces one ring H.

Step 3 — Product: $\mathrm{C_6H_5COCH_3}$, acetophenone.

Why other options are wrong:

- (A) toluene comes from Friedel–Crafts alkylation with CH_3Cl.
- (C) benzoic acid requires side-chain oxidation.
- (D) nitrobenzene needs nitration, not acylation.

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

Answer: (B) **Go Back to Q23**

Q24.

Solution

Concept — Wurtz reaction: Two molecules of an alkyl halide couple with sodium in dry ether to give an alkane with twice the carbon count.

Step 1 — Count carbons in the halide: bromoethane has 2 carbons.

Step 2 — Couple two units: $2 \times C_2H_5$ join to give a 4-carbon chain.

Step 3 — Name the product: $CH_3CH_2CH_2CH_3$, n-butane.

Why other options are wrong:

- (A) ethane would need coupling of methyl units.
- (C) ethene is an elimination product, not a Wurtz product.
- (D) propane has an odd carbon count, impossible from coupling two ethyl groups.

Final Answer: n-butane $\Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q24**

Q25.

Solution

Concept — Acid-catalysed dehydration of alcohols: At high temperature (443 K), concentrated H_2SO_4 removes water from ethanol to give an alkene (intramolecular dehydration).

Step 1 — Identify the conditions: concentrated H_2SO_4, 443 K favours elimination.

Step 2 — Remove water: ethanol loses H_2O across adjacent carbons.

Step 3 — Product: ethene, $CH_2{=}CH_2$.

Why other options are wrong:

- (A) diethyl ether forms at the lower temperature (413 K).
- (B) and (D) are oxidation products, not dehydration.

Final Answer: ethene $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q25

Q26.

Solution

Concept — Cannizzaro reaction: Aldehydes with no α-hydrogen (like HCHO) undergo a disproportionation with concentrated NaOH: one molecule is oxidised to the carboxylate salt and another is reduced to the alcohol.

Step 1 — Check α-H: formaldehyde has no α-hydrogen, so it undergoes Cannizzaro.

Step 2 — Oxidised product: one HCHO $\rightarrow$ $HCOONa$ (sodium formate).

Step 3 — Reduced product: the other HCHO $\rightarrow$ CH_3OH (methanol).

Step 4 — Conclude: products are methanol and sodium formate.

Why other options are wrong:

- (A) gives only the oxidised product.
- (B) introduces acetaldehyde, which is not formed.
- (C) gives only the reduced product.

Final Answer: methanol $+$ sodium formate $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q26

Q27.

Solution

Concept — Decarboxylation: Heating the sodium salt of a carboxylic acid with soda lime removes CO_2 and replaces $-COONa$ with $-H$, giving an alkane with one fewer carbon.

Step 1 — Identify the salt: CH_3COONa (sodium acetate).

Step 2 — Remove CO_2: $-COONa$ is replaced by $-H$.

Step 3 — Product: CH_4, methane.

Why other options are wrong:

- (B) ethane would need a 3-carbon precursor (propanoate).
- (C) ethene is not a decarboxylation product here.
- (D) acetone comes from dry distillation of calcium acetate, not soda-lime decarboxylation.

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

Answer: (A) **Go Back to Q27**

Q28.

Solution

Concept — Hofmann bromamide degradation: An amide $RCONH_2$ with Br_2/KOH loses one carbon as carbonate and gives a primary amine RNH_2 with one fewer carbon.

Step 1 — Identify R: in acetamide CH_3CONH_2, R $= CH_3$.

Step 2 — Lose one carbon: the carbonyl carbon leaves as carbonate.

Step 3 — Product: CH_3NH_2, methylamine.

Why other options are wrong:

- (A) ethylamine keeps the same carbon count (no degradation).
- (C) aniline would require benzamide.
- (D) dimethylamine is a secondary amine, not formed here.

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

Answer: (B) **Go Back to Q28**

Q29.

Solution

Concept — Peptide bond: The amide linkage $-\mathrm{CONH}-$ formed between the $-\mathrm{COOH}$ of one amino acid and the $-\mathrm{NH_2}$ of another (with loss of water) is called a peptide bond.

Step 1 — Identify the groups joined: $-\mathrm{COOH}$ and $-\mathrm{NH_2}$.

Step 2 — Name the linkage: the resulting $-\mathrm{CONH}-$ amide is a peptide bond.

Why other options are wrong:

- (A) glycosidic bonds join sugars.
- (B) ester bonds join acid and alcohol.
- (D) phosphodiester bonds join nucleotides in nucleic acids.

Final Answer: peptide ($-\mathrm{CONH}-$) bond $\Rightarrow \boxed{\mathrm{C}}$

Answer: (C) **Go Back to Q29**

Q30.

Solution

Concept — Nylon-6,6: A condensation polymer (polyamide) made from a diamine and a dicarboxylic acid, each contributing six carbons.

Step 1 — Diamine monomer: hexamethylenediamine $\mathrm{H_2N(CH_2)_6NH_2}$.

Step 2 — Diacid monomer: adipic acid $\mathrm{HOOC(CH_2)_4COOH}$.

Step 3 — Conclude: the two monomers are hexamethylenediamine and adipic acid.

Why other options are wrong:

- (B) those are the terylene (Dacron) monomers.
- (C) those make bakelite.
- (D) caprolactam alone gives nylon-6, not nylon-6,6.

Final Answer: hexamethylenediamine + adipic acid $\Rightarrow \boxed{\mathrm{A}}$

Answer: (A) **Go Back to Q30**

Q31.

Solution

Concept — Steps of a radical chain: Initiation creates radicals (often by homolysis under light/heat); propagation consumes and regenerates radicals; termination combines radicals.

Step 1 — Examine the step: $Cl_2 \xrightarrow{h\nu} 2Cl^\bullet$ produces radicals from a stable molecule using light.

Step 2 — Classify: generating the first radicals is the initiation step.

Step 3 — Conclude: this is initiation.

Why other options are wrong:

- (A) propagation steps involve a radical reacting to give a new radical.
- (C) termination combines two radicals.
- (D) substitution is the overall result, not a single chain step.

Final Answer: initiation $\Rightarrow \boxed{B}$

$\boxed{\text{Answer: (B)}}$ Go Back to Q31

Q32.

Solution

Concept — Wurtz reaction: Coupling of two alkyl halide molecules by sodium in dry ether to give a symmetrical higher alkane.

Step 1 — Identify the reagents: alkyl halide + Na + dry ether.

Step 2 — Recognise the outcome: two alkyl groups join to form a longer alkane.

Step 3 — Name it: this is the Wurtz reaction.

Why other options are wrong:

- (A) Cannizzaro is for aldehydes without α-H.
- (B) Friedel–Crafts needs an arene and $AlCl_3$.
- (C) Reimer–Tiemann is a phenol formylation.

Final Answer: Wurtz reaction $\Rightarrow \boxed{D}$

$\boxed{\text{Answer: (D)}}$ Go Back to Q32

Q33.

Solution

Concept — Baeyer's test: Cold dilute alkaline $KMnO_4$ (purple) is decolourised by carbon–carbon multiple bonds, which are oxidised to diols. It is a test for unsaturation.

Step 1 — Recall what reacts: alkenes/alkynes reduce (decolourise) $KMnO_4$.

Step 2 — Interpret the result: decolourisation ⇒ a C=C or C≡C bond is present.

Step 3 — Conclude: the compound is unsaturated.

Why other options are wrong:

- (A) the aldehyde test is Tollens'/Fehling's.
- (B) phenol is detected by neutral $FeCl_3$.
- (D) acids are detected by $NaHCO_3$ effervescence.

Final Answer: carbon–carbon unsaturation $\Rightarrow \boxed{C}$

$\boxed{\text{Answer: (C)}}$ Go Back to Q33

Q34.

Solution

Concept — Reduction of nitro to amine: Nitrobenzene is reduced to aniline by Sn (or Fe) with concentrated HCl; the salt is then basified to free the amine.

Step 1 — Goal: convert $-NO_2$ to $-NH_2$.

Step 2 — Choose reagent: Sn / concentrated HCl supplies the nascent hydrogen for reduction.

Step 3 — Conclude: Sn/HCl (then alkali) is correct.

Why other options are wrong:

- (B) PCC is an oxidant.
- (C) alkaline $KMnO_4$ oxidises, not reduces.
- (D) $LiAlH_4$ does not reduce an aromatic nitro group to the amine under these terms.

Final Answer: Sn / concentrated HCl $\Rightarrow \boxed{A}$

$\boxed{\text{Answer: (A)}}$ Go Back to Q34

Q35.

Solution

Concept — Electron gain enthalpy: The element that most readily accepts an electron (most negative ΔH_{eg}) in period 2 is fluorine, the most electronegative halogen of that period.

Step 1 — Compare the options: F is one electron short of a noble-gas configuration.

Step 2 — Relate to ΔH_{eg}: accepting an electron releases the most energy for F.

Step 3 — Conclude: fluorine has the most negative electron gain enthalpy among these.

Why other options are wrong:

- (A) nitrogen has a stable half-filled $2p^3$, so its ΔH_{eg} is nearly zero/positive.
- (B) lithium gains an electron weakly.
- (C) carbon is intermediate, far less than F.

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

Answer: (D) Go Back to Q35

Q36.

Solution

Concept — VSEPR for $\mathrm{AB_2E_2}$: A central atom with two bond pairs and two lone pairs (H_2O) has a bent (angular) shape.

Step 1 — Count domains on O: 2 bond pairs $+$ 2 lone pairs $= 4$ domains.

Step 2 — Base geometry: 4 domains $\Rightarrow$ tetrahedral electron geometry.

Step 3 — Molecular shape: with 2 lone pairs the shape is bent ($\approx 104.5^\circ$).

Why other options are wrong:

- (A) linear would need no lone pairs (e.g. $\mathrm{CO_2}$).
- (B) trigonal planar is for 3 bond pairs, no lone pair.
- (D) tetrahedral describes the electron geometry, not the molecular shape.

Final Answer: bent (angular) $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q36

Q37.

Solution

Concept — Hybridization from geometry: A central atom with two sigma bonds and no lone pair (linear) is sp hybridised.

Step 1 — Count sigma bonds on Be: two Be–Cl bonds in $\mathrm{BeCl_2}$.

Step 2 — Count lone pairs: 0 on Be.

Step 3 — Assign hybridization: 2 electron domains $\Rightarrow sp$ (linear, $180°$).

Why other options are wrong:

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

Final Answer: $sp \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q37

Q38.

Solution

Concept — Diagonal relationship: The first element of a group often resembles the second element of the next group (diagonally placed) because of similar charge/size ratios; Li resembles Mg.

Step 1 — Note the positions: Li (group 1, period 2) and Mg (group 2, period 3) are diagonal neighbours.

Step 2 — Explain the likeness: similar polarising power leads to similar chemistry (both form nitrides, both have covalent character).

Step 3 — Name it: the diagonal relationship.

Why other options are wrong:

- (B) inert pair effect concerns oxidation-state stability down a group.
- (C) lanthanide contraction is an f-block size effect.
- (D) allotropy is about different forms of an element.

Final Answer: diagonal relationship $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q38

Q39.

Solution

Concept — Borax bead test: On heating, borax gives boric anhydride and sodium metaborate; the B_2O_3 then combines with a metal oxide to form a coloured metal metaborate bead.

Step 1 — Recall the reaction: $Na_2B_4O_7 \to 2NaBO_2 + B_2O_3$, then $B_2O_3 + MO \to M(BO_2)_2$.

Step 2 — Identify the coloured species: the bead is a metal metaborate.

Step 3 — Conclude: the coloured bead is essentially a metal metaborate.

Why other options are wrong:

- (A), (C) and (D) carbonate, sulphide and chloride are not the species formed in the borax bead test.

Final Answer: metal metaborate $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q39

Q40.

Solution

Concept — Bonding in CO and CO_2: CO has a carbon–oxygen triple bond (one of the bonds being a coordinate/dative bond), while CO_2 is $O{=}C{=}O$ with two C=O double bonds.

Step 1 — Bonding in CO: C≡O triple bond (bond order 3).

Step 2 — Bonding in CO_2: two separate C=O double bonds.

Step 3 — Conclude: the correct statement is that CO has a triple bond and CO_2 has two double bonds.

Why other options are wrong:

- (A) wrongly assigns two double bonds to CO.
- (B) wrongly assigns a triple bond to CO_2.
- (C) both molecules are diamagnetic.

Final Answer: CO triple bond, CO_2 two double bonds $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q40

Q41.

Solution

Concept — Bond angle $NH_3 > PH_3$: On the smaller, more electronegative N the bonding electron pairs are held closer to the central atom, so bond pair–bond pair repulsions are greater, opening the angle; on the larger P the bond pairs are farther apart and the angle is smaller.

Step 1 — Compare central atoms: N is smaller and more electronegative than P.

Step 2 — Effect on bond pairs: closer, more concentrated bond pairs on N repel more strongly.

Step 3 — Conclude: this widens the H–N–H angle relative to H–P–H.

Why other options are wrong:

- (A) N is smaller, not larger, than P.
- (B) PH_3 does have a lone pair.
- (D) NH_3 is polar.

Final Answer: smaller, more electronegative N $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q41

Q42.

Solution

Concept — Reducing action of SO_2: When SO_2 decolourises acidified $KMnO_4$, the S is oxidised from $+4$ (in SO_2) to $+6$ (in sulphate), so SO_2 donates electrons and is a reducing agent.

Step 1 — Track sulphur: S goes from $+4$ to $+6$ (oxidised).

Step 2 — Track Mn: Mn is reduced from $+7$ to $+2$ (colour fades).

Step 3 — Conclude: SO_2 supplies the electrons, so it is the reducing agent.

Why other options are wrong:

- (B) oxidising agents gain electrons; here SO_2 loses them.
- (C) dehydration is not involved.
- (D) Lewis-base behaviour does not explain the redox decolourisation.

Final Answer: reducing agent $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q42

Q43.

Solution

Concept — Acid strength of HX: Acidity of the hydrogen halides increases down the group as the H–X bond becomes weaker and longer: $\mathrm{HI} > \mathrm{HBr} > \mathrm{HCl} > \mathrm{HF}$.

Step 1 — Recall the trend: bond strength HF > HCl > HBr > HI; weaker bonds ionise more easily.

Step 2 — Relate to acidity: the weakest H–X bond (HI) gives the strongest acid.

Step 3 — Order: $\mathrm{HI} > \mathrm{HBr} > \mathrm{HCl} > \mathrm{HF}$.

Why other options are wrong:

- (A) reverses the trend.
- (B) and (C) misplace HF and HI.

Final Answer: $\mathrm{HI} > \mathrm{HBr} > \mathrm{HCl} > \mathrm{HF} \Rightarrow \boxed{\mathrm{D}}$

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

Q44.

Solution

Concept — Hybridization of Xe in $\mathrm{XeF_4}$: Four bond pairs plus two lone pairs give six electron domains, so the hybridization is sp^3d^2 (square planar molecular shape).

Step 1 — Count domains: 4 bond pairs $+$ 2 lone pairs $=$ 6 domains.

Step 2 — Assign hybridization: 6 domains $\Rightarrow sp^3d^2$.

Step 3 — Note the shape: with two lone pairs in axial positions, the shape is square planar.

Why other options are wrong:

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

Final Answer: $sp^3d^2 \Rightarrow \boxed{\mathrm{B}}$

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

Q45.

Solution

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

Step 1 — Find n: Fe^{3+} is $3d^5$ with 5 unpaired electrons.

Step 2 — Substitute: $\mu = \sqrt{5(5+2)} = \sqrt{5 \times 7} = \sqrt{35}$.

Step 3 — Evaluate: $\sqrt{35} \approx 5.92$ BM.

Why other options are wrong:

- (A) 2.83 BM is for $n = 2$.
- (B) 4.90 BM is for $n = 4$.
- (D) 3.87 BM is for $n = 3$.

Final Answer: $\mu \approx 5.92 \text{ BM} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q45

Q46.

Solution

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

Step 1 — Count the ligands: $[Cr(H_2O)_6]^{3+}$ has six H_2O ligands.

Step 2 — Each is monodentate: each H_2O donates through one O atom.

Step 3 — Conclude: coordination number $= 6$.

Why other options are wrong:

- (A) 3 is the oxidation state, not the coordination number.
- (B) 4 and (D) 2 undercount the ligands.

Final Answer: coordination number $= 6 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q46

Q47.

Solution

Concept — Strong-field octahedral d^6: With a strong-field ligand the large Δ_o forces all six d electrons into the lower t_{2g} set, pairing them ($t_{2g}^6 e_g^0$); no unpaired electrons means low-spin and diamagnetic.

Step 1 — Find the d count: Co^{3+} is $3d^6$.

Step 2 — Apply strong field: $\mathrm{NH_3}$ gives a large Δ_o, so electrons pair in t_{2g}.

Step 3 — Configuration: $t_{2g}^6 e_g^0$, 0 unpaired electrons.

Step 4 — Conclude: the complex is low-spin and diamagnetic.

Why other options are wrong:

- (B) and (D) describe high-spin (weak-field) cases.
- (C) low-spin d^6 has zero, not two, unpaired electrons.

Final Answer: low-spin, diamagnetic $\Rightarrow \boxed{\mathrm{A}}$

Answer: (A) Go Back to Q47

Q48.

Solution

Concept — Thermite (aluminothermy): Highly reactive aluminium powder reduces metal oxides (e.g. $\mathrm{Cr_2O_3}$, $\mathrm{Mn_3O_4}$) to the free metal, releasing much heat.

Step 1 — Identify the reducing agent: aluminium powder.

Step 2 — Recall a reaction: $\mathrm{Cr_2O_3} + 2\mathrm{Al} \to 2\mathrm{Cr} + \mathrm{Al_2O_3}$.

Step 3 — Conclude: Al is the reducing agent in the thermite process.

Why other options are wrong:

- (A) carbon is used in blast-furnace/smelting reductions, not thermite.
- (C) CO reduces in the blast furnace.
- (D) $\mathrm{H_2}$ is used for a few oxides but is not the thermite reductant.

Final Answer: aluminium powder $\Rightarrow \boxed{\mathrm{B}}$

Answer: (B) Go Back to Q48

Q49.

Solution

Concept — Oxidising action of H_2O_2: In converting PbS (S in -2) to $PbSO_4$ (S in $+6$), sulphur is oxidised, so H_2O_2 gains electrons and acts as an oxidising agent.

Step 1 — Track sulphur: S goes from -2 in PbS to $+6$ in $PbSO_4$ (oxidised).

Step 2 — Track H_2O_2: the peroxide oxygen (-1) is reduced to -2 (water).

Step 3 — Conclude: H_2O_2 is the oxidising agent.

Why other options are wrong:

- (A) here H_2O_2 is reduced, so it is not the reducing agent.
- (B) and (D) acidic / dehydrating behaviour does not explain the oxidation of PbS.

Final Answer: oxidising agent $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q49

Q50.

Solution

Concept — Test for sulphate: Barium chloride reacts with sulphate ions to give a white precipitate of barium sulphate, $BaSO_4$, which is insoluble in dilute mineral acids such as HCl. This insolubility in acid distinguishes sulphate from carbonate.

Step 1 — Write the reaction: $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4 \downarrow$ (white).

Step 2 — Test with acid: $BaSO_4$ does not dissolve in dilute HCl.

Step 3 — Conclude: a white precipitate insoluble in HCl confirms the sulphate ion.

Why other options are wrong:

- (A) chloride is tested with $AgNO_3$, not $BaCl_2$.
- (B) nitrate gives no precipitate with $BaCl_2$.
- (C) barium carbonate is also white but dissolves in dilute HCl with effervescence, so it is not insoluble in acid.

Final Answer: sulphate ion ($BaSO_4$, insoluble in HCl) $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q50

Answer Key

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