JCECE Chemistry Sample Paper – 10

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 volume occupied by 0.25 mol of carbon dioxide gas at STP (molar volume $= 22.4$ L mol^{-1}) is:

(A) 22.4 L

(B) 11.2 L

(C) 5.6 L

(D) 44.8 L

Q2. The velocity of the electron in the first Bohr orbit ($n = 1$) of a hydrogen atom is 2.18×10^6 m s^{-1}. According to Bohr's model ($v_n \propto 1/n$), the velocity of the electron in the second orbit ($n = 2$) is:

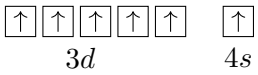
(A) 4.36×10^6 m s^{-1}

(B) 2.18×10^6 m s^{-1}

(C) 0.727×10^6 m s^{-1}

(D) 1.09×10^6 m s^{-1}

Q3. The ground-state electronic configuration of chromium (Cr, $Z = 24$) is anomalous. The $3d$ and $4s$ orbital boxes are shown. The correct outer configuration of Cr is:



(A) $3d^5 4s^1$

(B) $3d^4 4s^2$

(C) $3d^6 4s^0$

(D) $3d^3 4s^2$

Q4. In the van der Waals equation $\left(P + \dfrac{an^2}{V^2}\right)(V - nb) = nRT$, the term that corrects for the volume occupied by the gas molecules themselves is:

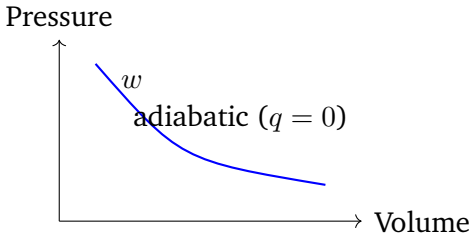
(A) $\dfrac{an^2}{V^2}$

(B) nb

(C) nRT

(D) $\dfrac{a}{V^2}$

Q5. For a gas undergoing an adiabatic change, the relation between heat q, work w and internal energy ΔU is shown on the first-law diagram. Since $q = 0$, the change in internal energy equals:



(A) q

(B) $q + w$

(C) w

(D) 0

Q6. The standard enthalpy of combustion of methane, $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H$ is given by $\Delta H_c = \Delta H_f(CO_2) + 2\Delta H_f(H_2O) - \Delta H_f(CH_4)$. Using $\Delta H_f(CO_2) = -393$, $\Delta H_f(H_2O) = -286$ and $\Delta H_f(CH_4) = -75$ kJ/mol, ΔH_c equals:

(A) -604 kJ/mol

(B) -754 kJ/mol

(C) -679 kJ/mol

(D) -890 kJ/mol

Q7. For the reaction $A(g) + B(g) \rightleftharpoons C(g)$, at a certain instant $[A] = 2$ M, $[B] = 2$ M and $[C] = 8$ M. The reaction quotient Q_c at this instant is:

(A) 2

(B) 4

(C) 8

(D) 0.5

Q8. To a 0.1 M solution of acetic acid (a weak acid) some solid sodium acetate is added. The effect on the solution is that:

(A) the degree of ionization of acetic acid increases and the pH falls

(B) the degree of ionization of acetic acid is suppressed and the pH rises

(C) the pH becomes exactly 7

(D) there is no change in pH

Q9. A basic buffer is prepared by mixing equal volumes of 0.2 M NH_4OH and 0.2 M NH_4Cl. Given $pK_b = 4.74$ for NH_4OH, the pOH and pH of the buffer (at 25°C) are:

(A) pOH $= 9.26$, pH $= 4.74$

(B) pOH $= 4.74$, pH $= 4.74$

(C) pOH $= 7.00$, pH $= 7.00$

(D) pOH $= 4.74$, pH $= 9.26$

Q10. When benzoic acid is dissolved in benzene, it dimerises. The van't Hoff factor i for complete dimerisation of benzoic acid in benzene tends towards:

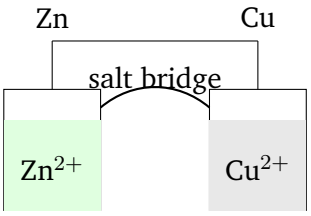
(A) 2

(B) 1

(C) 1.5

(D) 0.5

Q11. For the galvanic cell made of zinc and copper electrodes, $E^{\circ}_{Zn^{2+}/Zn} = -0.76$ V and $E^{\circ}_{Cu^{2+}/Cu} = +0.34$ V. The standard cell EMF (E°_{cell}) is:



(A) 1.10 V

(B) 0.42 V

(C) -1.10 V

(D) 0.76 V

Q12. The quantity of electric charge (in faradays) required to deposit 2 mol of aluminium from molten Al^{3+} ($Al^{3+} + 3e^- \rightarrow Al$) is:

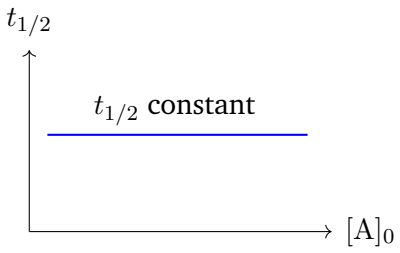
(A) 3 F

(B) 6 F

(C) 2 F

(D) 1 F

Q13. The graph shows how the half-life ($t_{1/2}$) of a reaction depends on the initial concentration $[A]_0$. Since $t_{1/2}$ is independent of $[A]_0$ (a horizontal line), the order of the reaction is:



(A) zero order

(B) second order

(C) first order

(D) third order

Q14. A catalyst increases the rate of a reaction because it:

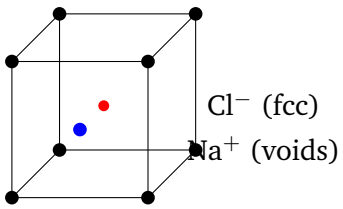
(A) increases the activation energy of the reaction

(B) changes the equilibrium constant in favour of products

(C) raises the temperature of the system

(D) provides an alternative path with a lower activation energy

Q15. Sodium chloride crystallises in the rock-salt (fcc) structure shown, with Cl^- at the fcc lattice points and Na^+ in all the octahedral voids. The number of NaCl formula units per unit cell is:



(A) 4

(B) 2

(C) 8

(D) 1

Q16. In the reaction $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$, the change in the oxidation state of manganese as it goes from $KMnO_4$ to MnO_2 is:

(A) $+7$ to $+6$ (decrease of 1)

(B) no change

(C) $+7$ to $+2$ (decrease of 5)

(D) $+7$ to $+4$ (decrease of 3)

Q17. The number of gram-equivalents of NaOH (molar mass 40 g/mol, n-factor $= 1$) present in 250 mL of a 0.2 N solution is:

(A) 0.05 equiv

(B) 0.20 equiv

(C) 0.50 equiv

(D) 0.025 equiv

Q18. The IUPAC name of the aromatic compound $\mathrm{C_6H_5}$–$\mathrm{NO_2}$ (a benzene ring bearing one $\mathrm{NO_2}$ group) is:

(A) nitrobenzol

(B) nitrobenzene

(C) phenyl nitrate

(D) benzene nitrite

Q19. The total number of ethers (open-chain) possible for the molecular formula $\mathrm{C_4H_{10}O}$ is:

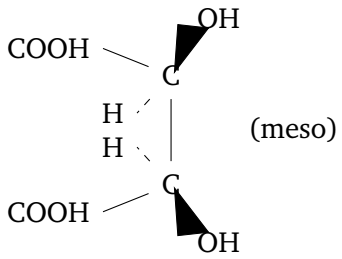
(A) 1

(B) 2

(C) 3

(D) 4

Q20. The molecule shown in wedge–dash form is meso-tartaric acid. Although it contains two stereocentres, it is optically inactive because it possesses:



(A) an internal plane of symmetry (it is a meso compound)

(B) three chiral centres

(C) no stereocentres at all

(D) an asymmetric carbon only

Q21. According to hyperconjugation, the most stable (most substituted) alkene among the following is the one with the greatest number of α-hydrogens. That alkene is:

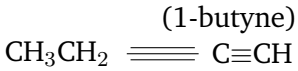
(A) ethene $\mathrm{CH_2{=}CH_2}$

(B) propene $\mathrm{CH_3CH{=}CH_2}$

(C) 2-methyl-2-butene $\mathrm{(CH_3)_2C{=}CHCH_3}$

(D) 1-butene $\mathrm{CH_3CH_2CH{=}CH_2}$

Q22. The terminal alkyne 1-butyne (shown) reacts with ammoniacal $\mathrm{AgNO_3}$ to give a white precipitate of silver acetylide. This is because the terminal $\equiv$C–H hydrogen is:



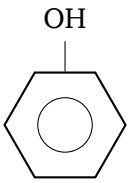
(A) basic, because of the lone pair

(B) non-acidic, like an alkane C–H

(C) weakly acidic, because the sp carbon holds the C–H electrons tightly

(D) replaced by a bromine atom

Q23. For the benzene derivative shown bearing an $-\mathrm{OH}$ group (phenol), the $-\mathrm{OH}$ substituent in electrophilic aromatic substitution behaves as:



(A) an activating, ortho/para-directing group

(B) a deactivating, ortho/para-directing group

(C) a group that has no directing effect

(D) a deactivating, meta-directing group

Q24. Towards the S_N2 reaction, the correct order of reactivity of the following bromides (most reactive first) is:

(A) $(CH_3)_3CBr > (CH_3)_2CHBr > CH_3CH_2Br > CH_3Br$

(B) $CH_3Br > CH_3CH_2Br > (CH_3)_2CHBr > (CH_3)_3CBr$

(C) $(CH_3)_2CHBr > CH_3Br > CH_3CH_2Br > (CH_3)_3CBr$

(D) all react at the same rate

Q25. Which reagent gives a violet (purple) colouration with phenol but no colour with ethanol, and is therefore used to distinguish a phenol from an alcohol?

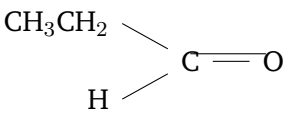
(A) Tollens' reagent

(B) Lucas reagent (anhydrous $ZnCl_2$/HCl)

(C) Fehling's solution

(D) neutral $FeCl_3$ solution

Q26. When the aldehyde propanal (carbonyl shown) is oxidised by acidified $KMnO_4$, the organic product formed is:



(A) propanoic acid (CH_3CH_2COOH)

(B) propan-1-ol

(C) propanone (acetone)

(D) ethanoic acid

Q27. Among the substituted acetic acids, the correct order of acid strength (strongest first) is:

(A) $\mathrm{F–CH_2COOH} > \mathrm{Cl–CH_2COOH} > \mathrm{Br–CH_2COOH} > \mathrm{CH_3COOH}$

(B) $\mathrm{CH_3COOH} > \mathrm{Br–CH_2COOH} > \mathrm{Cl–CH_2COOH} > \mathrm{F–CH_2COOH}$

(C) $\mathrm{Br–CH_2COOH} > \mathrm{Cl–CH_2COOH} > \mathrm{F–CH_2COOH} > \mathrm{CH_3COOH}$

(D) all are equally acidic

Q28. Nitrobenzene ($\mathrm{C_6H_5NO_2}$) is reduced to aniline ($\mathrm{C_6H_5NH_2}$) by:

(A) alkaline $\mathrm{KMnO_4}$

(B) Sn/HCl (or $\mathrm{H_2}$/Ni)

(C) Tollens' reagent

(D) dilute $\mathrm{H_2SO_4}$ alone

Q29. On acidic (or enzymatic) hydrolysis, one molecule of sucrose yields:

(A) two molecules of glucose

(B) two molecules of fructose

(C) one molecule of glucose and one of fructose

(D) one molecule of glucose and one of galactose

Q30. Buna–S, a synthetic rubber, is a copolymer formed from:

(A) 1,3-butadiene and styrene

(B) ethene and propene

(C) isoprene only

(D) vinyl chloride and acrylonitrile

Q31. The tert-butyl carbocation $(CH_3)_3C^+$ is stabilised by hyperconjugation. The number of α-C–H bonds (hyperconjugative structures) available to it is:

(A) 6

(B) 9

(C) 3

(D) 1

Q32. Benzene reacts with carbon monoxide and HCl in the presence of anhydrous $AlCl_3$/CuCl to give benzaldehyde. This synthesis of an aromatic aldehyde is the:

(A) Cannizzaro reaction

(B) Wurtz reaction

(C) Kolbe reaction

(D) Gattermann–Koch reaction

Q33. A substance gives a violet (Ruhemann's purple) colour on warming with ninhydrin solution. This test confirms the presence of:

(A) a ketone group

(B) a reducing sugar

(C) an α-amino acid (free $-NH_2$ and $-COOH$)

(D) a phenol group

Q34. To cleave a carbon–carbon double bond of an alkene into two carbonyl compounds, the reagent sequence used is:

(A) dilute alkaline $KMnO_4$ (cold)

(B) O_3 followed by Zn/H_2O (ozonolysis)

(C) concentrated H_2SO_4

(D) $LiAlH_4$

Q35. Lithium resembles magnesium in many properties (e.g. both form covalent nitrides and their carbonates decompose on heating). This similarity between elements of adjacent groups and periods is called the:

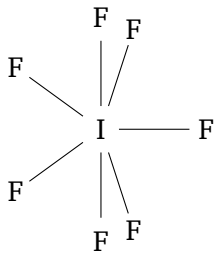
(A) inert pair effect

(B) lanthanide contraction

(C) screening effect

(D) diagonal relationship

Q36. According to VSEPR theory, iodine heptafluoride IF_7 (seven bond pairs, no lone pair, shown) has the molecular shape:



(A) octahedral

(B) square planar

(C) trigonal bipyramidal

(D) pentagonal bipyramidal

Q37. The bond angle in a molecule whose central atom is sp hybridised, such as the linear $BeCl_2$ (shown), is:

Cl — Be — Cl

(A) $109°28'$

(B) $120°$

(C) $180°$

(D) $90°$

Q38. Which of the following is an anomalous property of lithium that distinguishes it from the other alkali metals?

(A) Lithium forms mainly the normal oxide Li_2O (not peroxide/superoxide) and its salts are appreciably covalent

(B) Lithium is the most reactive alkali metal towards water

(C) Lithium hydroxide is the most soluble alkali hydroxide

(D) Lithium has the largest atomic radius in its group

Q39. Boron trichloride BCl_3 is described as an electron-deficient Lewis acid because the boron atom:

(A) has a lone pair to donate

(B) has only six electrons in its valence shell (an incomplete octet)

(C) carries a negative charge

(D) is in the $+1$ oxidation state

Q40. In carbon monoxide (CO) the carbon–oxygen bond order is 3, whereas in carbon dioxide (CO_2) each carbon–oxygen bond order is 2. This makes the C–O bond in CO:

(A) longer and weaker than in CO_2

(B) exactly the same length as in CO_2

(C) shorter and stronger than in CO_2

(D) a pure single bond

Q41. Among the oxoacids of nitrogen, the correct order of acid strength is governed by the oxidation state of nitrogen. The stronger acid of the pair HNO_3 and HNO_2 is:

(A) HNO_2, because N is in $+3$

(B) both are equally strong

(C) neither is acidic

(D) HNO_3, because N is in the higher $+5$ state

Q42. In the gas phase, the sulphur trioxide molecule SO_3 has the shape:

(A) trigonal planar (S is sp^2)

(B) bent (angular)

(C) linear

(D) pyramidal

Q43. When chlorine gas is passed into cold dilute NaOH, it disproportionates. The two chlorine-containing products are:

(A) $NaClO_3$ and $NaCl$

(B) $NaClO_4$ and $NaClO_2$

(C) $NaCl$ only

(D) $NaCl$ and $NaOCl$ (sodium hypochlorite)

Q44. Xenon hexafluoride XeF_6 has six bond pairs and one lone pair on Xe. Its shape is therefore:

(A) perfectly octahedral

(B) planar hexagonal

(C) distorted octahedral (capped, due to one lone pair)

(D) tetrahedral

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

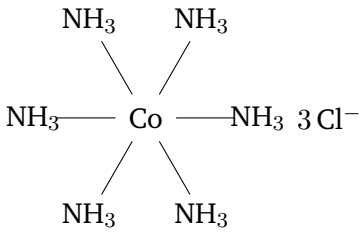
(A) 1.73 BM

(B) 3.87 BM

(C) 5.92 BM

(D) 2.83 BM

Q46. The octahedral complex $[Co(NH_3)_6]Cl_3$ (complex cation shown) dissociates in water. The total number of ions produced per formula unit is:



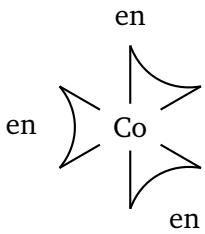
(A) 4

(B) 3

(C) 1

(D) 2

Q47. The octahedral complex $[Co(en)_3]^{3+}$ (en = ethylenediamine, a bidentate ligand, shown schematically) exhibits which kind of isomerism?



(A) no isomerism at all

(B) optical isomerism (it is chiral, existing as d and l forms)

(C) only geometrical (cis/trans) isomerism

(D) linkage isomerism

Q48. In the extraction of iron in the blast furnace, the principal reducing agent that reduces the iron oxide (Fe_2O_3) to iron in the hotter middle zone is:

(A) carbon monoxide (CO)

(B) molten silica

(C) calcium oxide (CaO)

(D) nitrogen gas

Q49. The permanent hardness of water, due to chlorides and sulphates of calcium and magnesium, is most effectively removed by:

(A) simply boiling the water

(B) treatment with washing soda (Na_2CO_3) or ion-exchange resins

(C) adding dilute HCl

(D) filtering through sand

Q50. In testing for a halide, a solution gives a curdy white precipitate with $AgNO_3$ that is readily soluble in dilute aqueous ammonia. The halide present is:

(A) iodide (I^-)

(B) chloride (Cl^-)

(C) bromide (Br^-)

(D) fluoride (F^-)

Detailed Solutions

Q1.

Solution

Concept — Molar volume at STP: One mole of any ideal gas occupies 22.4 L at STP, so volume $= n \times 22.4$ L.

Step 1 — List data: $n = 0.25$ mol, molar volume $= 22.4$ L/mol.

Step 2 — Write the relation: $V = n \times 22.4$.

Step 3 — Substitute: $V = 0.25 \times 22.4$.

Step 4 — Evaluate: $V = 5.6$ L.

Why other options are wrong:

- (A) is the volume of 1 mol.
- (B) is the volume of 0.5 mol.
- (D) is the volume of 2 mol.

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

Answer: (C) Go Back to Q1

Q2.

Solution

Concept — Velocity in Bohr orbit: The orbital speed is inversely proportional to n, i.e. $v_n = \dfrac{v_1}{n}$.

Step 1 — List data: $v_1 = 2.18 \times 10^6$ m/s, $n = 2$.

Step 2 — Write the relation: $v_2 = \dfrac{v_1}{2}$.

Step 3 — Substitute: $v_2 = \dfrac{2.18 \times 10^6}{2}$.

Step 4 — Evaluate: $v_2 = 1.09 \times 10^6$ m/s.

Why other options are wrong:

- (A) multiplies instead of dividing.
- (B) leaves the velocity unchanged.
- (C) divides by 3 instead of 2.

Final Answer: $v_2 = 1.09 \times 10^6$ m/s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q2

Q3.

Solution

Concept — Anomalous configuration of Cr: A half-filled $3d$ subshell ($3d^5$) gives extra stability, so one $4s$ electron shifts into $3d$.

Step 1 — Expected (Aufbau) config: $3d^4 4s^2$ for $Z = 24$.

Step 2 — Reason for the shift: the exactly half-filled $3d^5$ set and singly filled $4s^1$ are more stable (exchange energy).

Step 3 — Actual config: one $4s$ electron moves to $3d$, giving $3d^5 4s^1$.

Step 4 — Conclude: the outer configuration is $3d^5 4s^1$.

Why other options are wrong:

- (B) is the expected, not the actual, configuration.
- (C) wrongly empties $4s$.
- (D) has the wrong electron count for $Z = 24$.

Final Answer: $3d^5 4s^1 \Rightarrow$ A

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — van der Waals corrections: The term $\frac{an^2}{V^2}$ corrects pressure for intermolecular attraction, while nb corrects volume for the finite size of the molecules.

Step 1 — Identify the volume term: the correction subtracted from V is nb.

Step 2 — Meaning of b: b is the excluded volume per mole owing to molecular size.

Step 3 — Conclude: nb accounts for the volume of the molecules.

Why other options are wrong:

- (A) and (D) correct for intermolecular attractions (pressure term).
- (C) is just the ideal-gas right-hand side.

Final Answer: $nb \Rightarrow$ B

Answer: (B) Go Back to Q4

Q5.

Solution

Concept — First law for an adiabatic process: $\Delta U = q + w$; for an adiabatic change $q = 0$.

Step 1 — Write the first law: $\Delta U = q + w$.

Step 2 — Apply the adiabatic condition: $q = 0$.

Step 3 — Substitute: $\Delta U = 0 + w$.

Step 4 — Conclude: $\Delta U = w$, i.e. the change in internal energy equals the work done.

Why other options are wrong:

- (A) $q = 0$, so ΔU cannot equal q.
- (B) reduces to w once $q = 0$, but keeps a redundant q.
- (D) would require $w = 0$ as well, which is not the case.

Final Answer: $\Delta U = w \Rightarrow$ C

Answer: (C) Go Back to Q5

Q6.

Solution

Concept — Enthalpy of combustion from ΔH_f: $\Delta H_c = \sum \Delta H_f(\text{products}) - \sum \Delta H_f(\text{reactants})$; elemental O_2 has $\Delta H_f = 0$.

Step 1 — Products term: $\Delta H_f(CO_2) + 2\Delta H_f(H_2O) = -393 + 2(-286)$.

Step 2 — Evaluate products: $-393 - 572 = -965$ kJ.

Step 3 — Reactants term: $\Delta H_f(CH_4) + 2\Delta H_f(O_2) = -75 + 0 = -75$ kJ.

Step 4 — Subtract: $\Delta H_c = -965 - (-75) = -965 + 75$.

Step 5 — Evaluate: $\Delta H_c = -890$ kJ/mol.

Why other options are wrong:

- (A) uses only one H_2O.

- (B) forgets to add back $\Delta H_f(\mathrm{CH_4})$.
- (C) mishandles the sign of $\Delta H_f(\mathrm{CH_4})$.

Final Answer: $\Delta H_c = -890$ kJ/mol $\Rightarrow$ D

Answer: (D) Go Back to Q6

Q7.

Solution

Concept — Reaction quotient: $Q_c = \dfrac{[\mathrm{C}]}{[\mathrm{A}][\mathrm{B}]}$ for $\mathrm{A} + \mathrm{B} \rightleftharpoons \mathrm{C}$.

Step 1 — List concentrations: $[\mathrm{A}] = 2$, $[\mathrm{B}] = 2$, $[\mathrm{C}] = 8$.

Step 2 — Numerator: $[\mathrm{C}] = 8$.

Step 3 — Denominator: $[\mathrm{A}][\mathrm{B}] = 2 \times 2 = 4$.

Step 4 — Divide: $Q_c = \dfrac{8}{4} = 2$.

Why other options are wrong:

- (B) forgets one concentration in the denominator.
- (C) drops the denominator entirely.
- (D) inverts the ratio.

Final Answer: $Q_c = 2 \Rightarrow$ A

Answer: (A) Go Back to Q7

Q8.

Solution

Concept — Common-ion effect: Adding a salt that supplies a common ion ($\mathrm{CH_3COO^-}$) suppresses the ionisation of the weak acid, lowering $[\mathrm{H^+}]$ and raising the pH.

Step 1 — Identify the common ion: sodium acetate supplies $\mathrm{CH_3COO^-}$.

Step 2 — Shift the equilibrium: extra $\mathrm{CH_3COO^-}$ pushes $\mathrm{CH_3COOH} \rightleftharpoons \mathrm{CH_3COO^-} + \mathrm{H^+}$ to the left.

Step 3 — Effect on $[\mathrm{H^+}]$: ionisation is suppressed, so $[\mathrm{H^+}]$ falls.

Step 4 — Effect on pH: lower $[\mathrm{H^+}]$ means higher pH.

Why other options are wrong:

- (A) reverses both effects.
- (C) a weak-acid buffer is not exactly neutral.
- (D) there is a definite change.

Final Answer: ionisation suppressed, pH rises $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q8

Q9.

Solution

Concept — Basic buffer (Henderson): $\text{pOH} = pK_b + \log \dfrac{[\text{salt}]}{[\text{base}]}$, and $\text{pH} = 14 - \text{pOH}$.

Step 1 — Salt/base ratio: equal volumes of equal concentrations give $\dfrac{[\text{salt}]}{[\text{base}]} = 1$.

Step 2 — Log term: $\log 1 = 0$.

Step 3 — Find pOH: $\text{pOH} = 4.74 + 0 = 4.74$.

Step 4 — Find pH: $\text{pH} = 14 - 4.74 = 9.26$.

Why other options are wrong:

- (A) swaps pOH and pH.
- (B) gives pH = pOH, which is wrong for a basic buffer.
- (C) is the neutral value, not a basic buffer.

Final Answer: $\text{pOH} = 4.74$, $\text{pH} = 9.26 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q9

Q10.

Solution

Concept — van't Hoff factor for association: When solute molecules associate into n-mers, $i < 1$; for dimerisation ($n = 2$) complete association gives $i = \dfrac{1}{2}$.

Step 1 — Write the relation: $i = 1 + \left(\dfrac{1}{n} - 1\right)\alpha$, with $n = 2$.

Step 2 — Complete dimerisation: $\alpha = 1$.

Step 3 — Substitute: $i = 1 + \left(\frac{1}{2} - 1\right)(1) = 1 - \frac{1}{2}$.

Step 4 — Evaluate: $i = 0.5$.

Why other options are wrong:

- (A) $i = 2$ is for dissociation into two ions, not association.
- (B) $i = 1$ means no association.
- (C) is a partial value, not complete dimerisation.

Final Answer: $i = 0.5 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q10

Q11.

Solution

Concept — Standard cell EMF: $E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$; the electrode with the higher (more positive) reduction potential acts as the cathode.

Step 1 — Identify electrodes: $E^\circ_{Cu^{2+}/Cu} = +0.34$ V is higher, so Cu is the cathode; $E^\circ_{Zn^{2+}/Zn} = -0.76$ V, so Zn is the anode.

Step 2 — Write the formula: $E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$.

Step 3 — Substitute: $E^\circ_{cell} = 0.34 - (-0.76)$.

Step 4 — Evaluate: $E^\circ_{cell} = 0.34 + 0.76 = 1.10$ V.

Why other options are wrong:

- (B) 0.42 V wrongly subtracts the magnitudes $(0.76 - 0.34)$.
- (C) -1.10 V has the wrong sign (reverses cathode and anode).
- (D) 0.76 V uses only the zinc potential.

Final Answer: $E^\circ_{cell} = 1.10$ V $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q11

Q12.

Solution

Concept — Faraday and electrolysis: Depositing 1 mol of a metal needing z electrons requires z faradays; total $= z \times$ (moles).

Step 1 — Electrons per atom: $Al^{3+} + 3e^- \rightarrow Al$ needs 3 electrons.

Step 2 — Faradays per mole: 3 F per mole of Al.

Step 3 — Scale to 2 mol: $3 \times 2 = 6$ F.

Step 4 — Conclude: 6 faradays are required.

Why other options are wrong:

- (A) is for only 1 mol of Al.
- (C) ignores the 3-electron requirement.
- (D) ignores both factors.

Final Answer: 6 F $\Rightarrow$ B

Answer: (B) Go Back to Q12

Q13.

Solution

Concept — Half-life and order: For a first-order reaction $t_{1/2} = \dfrac{0.693}{k}$, which does not depend on the initial concentration.

Step 1 — Read the graph: $t_{1/2}$ is constant (horizontal line) as $[A]_0$ changes.

Step 2 — Match the order: only a first-order reaction has $t_{1/2}$ independent of $[A]_0$.

Step 3 — Conclude: the reaction is first order.

Why other options are wrong:

- (A) zero order: $t_{1/2} \propto [A]_0$ (rising line).
- (B) second order: $t_{1/2} \propto 1/[A]_0$ (falling curve).
- (D) third order: $t_{1/2} \propto 1/[A]_0^2$, also concentration-dependent.

Final Answer: first order $\Rightarrow$ C

Answer: (C) Go Back to Q13

Q14.

Solution

Concept — Action of a catalyst: A catalyst offers a new reaction pathway with a lower activation energy, so more molecules cross the barrier and the rate rises.

Step 1 — What a catalyst does: it lowers E_a by providing an alternative mechanism.

Step 2 — Effect on rate: a lower E_a means a larger rate constant, so the rate increases.

Step 3 — Note on equilibrium: a catalyst speeds both forward and backward reactions equally, leaving K unchanged.

Why other options are wrong:

- (A) it lowers, not raises, E_a.
- (B) it does not shift the equilibrium constant.
- (C) it does not change the temperature.

Final Answer: lower-E_a alternative path $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q14

Q15.

Solution

Concept — Formula units in rock salt: In NaCl, Cl^- form the fcc lattice (4 per cell) and Na^+ fill all octahedral voids (4 per cell), giving 4 NaCl units.

Step 1 — Count Cl^-: fcc gives $8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 1 + 3 = 4$.

Step 2 — Count Na^+: octahedral voids in fcc $= 4$ per cell.

Step 3 — Pair them: 4 Na^+ with 4 Cl^- give 4 NaCl formula units.

Why other options are wrong:

- (B) and (D) under-count the ions.
- (C) wrongly counts 8 units.

Final Answer: 4 formula units $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q15

Q16.

Solution

Concept — Oxidation-state change: Find the oxidation number of Mn in each species; the difference is the change.

Step 1 — Mn in $KMnO_4$: K is $+1$, O is -2; $+1 + x + 4(-2) = 0 \Rightarrow x = +7$.

Step 2 — Mn in MnO_2: $x + 2(-2) = 0 \Rightarrow x = +4$.

Step 3 — Find the change: from $+7$ to $+4$, a decrease of 3.

Step 4 — Conclude: Mn is reduced by 3 units.

Why other options are wrong:

- (A) is the change to manganate MnO_4^{2-} $(+6)$.
- (B) there is a definite change.
- (C) $+7$ to $+2$ is the acidic-medium reduction of permanganate, not to MnO_2.

Final Answer: $+7 \rightarrow +4$ (decrease of 3) $\Rightarrow$ D

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — Equivalents from normality: gram-equivalents $= N \times V(\text{L})$.

Step 1 — Convert volume: 250 mL $= 0.25$ L.

Step 2 — Write the relation: equivalents $= N \times V$.

Step 3 — Substitute: equivalents $= 0.2 \times 0.25$.

Step 4 — Evaluate: equivalents $= 0.05$.

Why other options are wrong:

- (B) uses $V = 1$ L.
- (C) uses $N = 2$.
- (D) halves the correct value.

Final Answer: 0.05 equiv $\Rightarrow$ A

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Naming a mono-substituted benzene: A benzene ring carrying one NO_2 group is named by prefixing "nitro" to benzene.

Step 1 — Identify the parent: benzene (C_6H_6).

Step 2 — Identify the substituent: $-NO_2$ is named "nitro".

Step 3 — Assemble the name: nitrobenzene.

Why other options are wrong:

- (A) "nitrobenzol" is an old trivial name, not IUPAC.
- (C) and (D) imply nitrate/nitrite esters, not a C–NO_2 bond.

Final Answer: nitrobenzene $\Rightarrow$ B

Answer: (B) Go Back to Q18

Q19.

Solution

Concept — Ethers of $C_4H_{10}O$: List all R–O–R′ combinations whose carbons total 4.

Step 1 — First ether: diethyl ether, CH_3CH_2–O–CH_2CH_3 $(2+2)$.

Step 2 — Second ether: methyl n-propyl ether, CH_3–O–$CH_2CH_2CH_3$ $(1+3)$.

Step 3 — Third ether: methyl isopropyl ether, CH_3–O–$CH(CH_3)_2$ $(1+3$, branched).

Step 4 — Count: total $= 3$ ethers.

Why other options are wrong:

- (A) and (B) miss one or more combinations.
- (D) counts a duplicate structure.

Final Answer: 3 ethers $\Rightarrow$ C

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Meso compounds: A molecule with stereocentres but an internal plane (or centre) of symmetry is superimposable on its mirror image and is therefore optically inactive (meso).

Step 1 — Note the two stereocentres: meso-tartaric acid has two carbons each bearing four different groups.

Step 2 — Look for symmetry: the two halves are mirror images of each other across an internal plane.

Step 3 — Consequence: the rotations cancel internally, so the molecule is achiral (meso).

Why other options are wrong:

- (D) it has two stereocentres, not just one asymmetric carbon.
- (B) there are two, not three.
- (C) it does contain stereocentres.

Final Answer: internal plane of symmetry (meso) $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q20

Q21.

Solution

Concept — Hyperconjugation and alkene stability: The more α-hydrogens on the carbons adjacent to the double bond, the more hyperconjugative structures and the greater the stability; this means more highly substituted alkenes are more stable.

Step 1 — Compare substitution: 2-methyl-2-butene is tetrasubstituted; the others are mono- or unsubstituted.

Step 2 — Count α-hydrogens: 2-methyl-2-butene has the most α-C–H bonds available.

Step 3 — Conclude: 2-methyl-2-butene is the most stable alkene.

Why other options are wrong:

- (A) ethene has no alkyl substituents.
- (B) propene is only monosubstituted.

- (D) 1-butene is a terminal, monosubstituted alkene.

Final Answer: 2-methyl-2-butene $\Rightarrow$ C

Answer: (C) Go Back to Q21

Q22.

Solution

Concept — Acidity of terminal alkynes: The $\equiv$C–H of a terminal alkyne sits on an sp carbon, which holds the bonding electrons close to the nucleus, making the H weakly acidic; it is removed by strong bases and by Ag^+/Cu^+.

Step 1 — Identify the carbon type: the terminal carbon is sp hybridised (high s-character).

Step 2 — Effect on the C–H: greater s-character means the bonding pair is held tightly, so the H is acidic.

Step 3 — Reaction: with ammoniacal $AgNO_3$ the acidic H is replaced, giving the white silver acetylide precipitate.

Why other options are wrong:

- (A) the terminal alkyne H is acidic, not basic.
- (B) an sp^3 alkane C–H is essentially non-acidic.
- (D) bromination is a different reaction, not the cause of acidity.

Final Answer: weakly acidic (sp C–H) $\Rightarrow$ C

Answer: (C) Go Back to Q22

Q23.

Solution

Concept — Directing effect of $-OH$: The phenolic $-OH$ donates its lone pair into the ring (+M), raising electron density at the ortho and para positions, so it is a strong activating, ortho/para-directing group.

Step 1 — Type of group: $-OH$ has lone pairs and is electron-releasing by resonance.

Step 2 — Effect on reactivity: it increases ring electron density (activating).

Step 3 — Directing positions: ortho and para become electron-rich, so substitu-

tion occurs there.

Why other options are wrong:

- (D) $-OH$ is activating, not deactivating, and not meta-directing.
- (B) deactivating o/p groups are the halogens, not $-OH$.
- (C) it does have a strong directing effect.

Final Answer: activating, ortho/para-directing $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to Q23

Q24.

Solution

Concept — S_N2 reactivity: S_N2 needs back-side attack, so less steric hindrance reacts faster; reactivity is methyl > primary > secondary > tertiary.

Step 1 — Rank by steric bulk: CH_3Br (least hindered) > CH_3CH_2Br > $(CH_3)_2CHBr$ > $(CH_3)_3CBr$ (most hindered).

Step 2 — Match to S_N2: the least hindered halide reacts fastest.

Step 3 — Conclude: order is $CH_3Br > CH_3CH_2Br > (CH_3)_2CHBr > (CH_3)_3CBr$.

Why other options are wrong:

- (A) reverses the order (that is the S_N1 trend).
- (C) misplaces the secondary halide.
- (D) they do not react at equal rates.

Final Answer: $CH_3Br > CH_3CH_2Br > (CH_3)_2CHBr > (CH_3)_3CBr \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q24

Q25.

Solution

Concept — $FeCl_3$ test for phenols: Phenols form coloured (violet/blue) complexes with neutral ferric chloride; alcohols do not react.

Step 1 — Recall the test: neutral $FeCl_3$ gives a violet colour with phenol.

Step 2 — Behaviour with ethanol: an alcohol gives no colour.

Step 3 — Conclude: neutral $FeCl_3$ distinguishes phenol from alcohol.

Why other options are wrong:

- (A) Tollens' tests for aldehydes.
- (B) Lucas distinguishes $1^\circ/2^\circ/3^\circ$ alcohols, not phenols.
- (C) Fehling's tests for aliphatic aldehydes.

Final Answer: neutral $FeCl_3 \Rightarrow$ D

Answer: (D) Go Back to Q25

Q26.

Solution

Concept — Oxidation of an aldehyde: A strong oxidant such as acidified $KMnO_4$ oxidises an aldehyde $RCHO$ to the carboxylic acid $RCOOH$ with the same number of carbons.

Step 1 — Identify the aldehyde: propanal is CH_3CH_2CHO.

Step 2 — Apply the oxidation: the $-CHO$ becomes $-COOH$ without losing a carbon.

Step 3 — Write the product: CH_3CH_2COOH, propanoic acid.

Why other options are wrong:

- (B) is the reduction product, not oxidation.
- (C) a ketone cannot form from a terminal aldehyde carbon.
- (D) ethanoic acid has one carbon too few.

Final Answer: propanoic acid $\Rightarrow$ A

Answer: (A) Go Back to Q26

Q27.

Solution

Concept — Halogen $-I$ effect on acidity: A more electronegative halogen withdraws electrons more strongly, stabilising the carboxylate and increasing acidity; so F $>$ Cl $>$ Br $>$ (no halogen).

Step 1 — Order the halogens by electronegativity: F $>$ Cl $>$ Br.

Step 2 — Relate to acid strength: stronger $-I$ means stronger acid.

Step 3 — Add the reference: acetic acid (CH_3COOH) has no electron-withdrawing halogen, so it is weakest.

Step 4 — Final order: $FCH_2COOH > ClCH_2COOH > BrCH_2COOH > CH_3COOH$.

Why other options are wrong:

- (B) reverses the entire trend.
- (C) misorders the halogens.
- (D) they are not equally acidic.

Final Answer: $F > Cl > Br > CH_3 \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q27

Q28.

Solution

Concept — Reduction of nitro to amine: A nitro group is reduced to a primary amine by active metal/acid (Sn/HCl, Fe/HCl) or catalytic hydrogenation (H_2/Ni).

Step 1 — Identify the goal: $-NO_2 \rightarrow -NH_2$.

Step 2 — Choose the reducing system: Sn/HCl (or H_2/Ni) supplies the electrons and hydrogen needed.

Step 3 — Conclude: nitrobenzene gives aniline.

Why other options are wrong:

- (A) alkaline $KMnO_4$ is an oxidant, not a reductant.
- (C) Tollens' is a mild oxidant.
- (D) dilute H_2SO_4 alone does not reduce the nitro group.

Final Answer: Sn/HCl (or H_2/Ni) $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q28

Q29.

Solution

Concept — Hydrolysis of sucrose: Sucrose is a disaccharide of glucose and fructose joined by a glycosidic bond; hydrolysis (inversion) breaks it into the two monosaccharides.

Step 1 — Identify the units: sucrose = glucose + fructose.

Step 2 — Break the bond: acid/enzyme cleaves the glycosidic linkage.

Step 3 — Conclude: one glucose and one fructose are released.

Why other options are wrong:

- (A) and (B) sucrose is not made of two identical sugars.
- (D) galactose comes from lactose, not sucrose.

Final Answer: glucose + fructose $\Rightarrow$ C

Answer: (C) Go Back to Q29

Q30.

Solution

Concept — Buna–S: Buna–S (SBR) is a copolymer of 1,3-butadiene and styrene ("Bu"=butadiene, "S"=styrene).

Step 1 — Decode the name: "Buna" refers to butadiene polymerised with Na catalyst; the "S" adds styrene.

Step 2 — Identify the monomers: 1,3-butadiene and styrene.

Step 3 — Conclude: Buna–S is their copolymer.

Why other options are wrong:

- (B) ethene/propene give other polyolefins.
- (C) isoprene alone gives natural rubber/polyisoprene.
- (D) vinyl chloride/acrylonitrile give different polymers.

Final Answer: 1,3-butadiene and styrene $\Rightarrow$ A

Answer: (A) Go Back to Q30

Q31.

Solution

Concept — Counting hyperconjugative structures: The number equals the number of α-C–H bonds (C–H bonds on carbons directly attached to the cationic carbon).

Step 1 — Identify α carbons: in $(CH_3)_3C^+$ there are three CH_3 groups attached to the positive carbon.

Step 2 — Count C–H per group: each CH_3 has 3 C–H bonds.

Step 3 — Total: $3 \times 3 = 9$ α-C–H bonds (nine hyperconjugative structures).

Why other options are wrong:

- (A) counts only two of the three methyls.
- (C) counts only one methyl.
- (D) is far too few.

Final Answer: 9 hyperconjugative structures $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q31

Q32.

Solution

Concept — Gattermann–Koch reaction: Benzene reacts with CO and HCl in the presence of anhydrous $AlCl_3$ (with CuCl) to introduce a $-CHO$ group, giving benzaldehyde.

Step 1 — Identify the reagents: CO + HCl with $AlCl_3$/CuCl.

Step 2 — Recognise the product: an aldehyde group is added to the ring, giving benzaldehyde.

Step 3 — Name it: this is the Gattermann–Koch formylation.

Why other options are wrong:

- (A) Cannizzaro is a disproportionation of aldehydes without α-H.
- (B) Wurtz couples alkyl halides.
- (C) Kolbe carboxylates phenoxide.

Final Answer: Gattermann–Koch reaction $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q32

Q33.

Solution

Concept — Ninhydrin test: Ninhydrin reacts with the free α-amino group of amino acids (and proteins) to give a violet colour (Ruhemann's purple).

Step 1 — Recall the reacting group: the free $-NH_2$ of an α-amino acid.

Step 2 — Observe the colour: a violet/purple colour develops on warming.

Step 3 — Conclude: the test confirms an α-amino acid.

Why other options are wrong:

- (A) ketones do not give this colour.
- (B) reducing sugars are detected by Fehling's/Tollens'.
- (D) phenols are detected by $FeCl_3$.

Final Answer: α-amino acid $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q33

Q34.

Solution

Concept — Ozonolysis: Treating an alkene with ozone forms an ozonide, which on reductive work-up with Zn/H_2O cleaves the C=C into two carbonyl compounds.

Step 1 — Identify the goal: split C=C into two C=O fragments.

Step 2 — Choose the reagent sequence: O_3 then Zn/H_2O (reductive ozonolysis).

Step 3 — Conclude: this gives aldehydes/ketones from the alkene.

Why other options are wrong:

- (A) cold dilute $KMnO_4$ gives a diol (Baeyer's test), not cleavage.
- (C) concentrated H_2SO_4 does not cleave the double bond this way.
- (D) $LiAlH_4$ is a reducing agent for carbonyls, not an alkene cleaver.

Final Answer: O_3 then Zn/H_2O $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q34

Q35.

Solution

Concept — Diagonal relationship: An element of period 2 resembles the element one place to its right in period 3 (Li–Mg, Be–Al, B–Si) because of similar charge-to-size ratio.

Step 1 — Identify the pair: Li (group 1) and Mg (group 2, next period).

Step 2 — Recognise the cause: similar polarising power links them diagonally.

Step 3 — Conclude: this is the diagonal relationship.

Why other options are wrong:

- (A) inert pair effect concerns ns^2 stability in heavier p-block.
- (B) lanthanide contraction is an f-block size effect.
- (C) screening affects effective nuclear charge, not this similarity.

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

Answer: (D) Go Back to Q35

Q36.

Solution

Concept — VSEPR for AB_7: Seven bond pairs and no lone pair on the central atom give a pentagonal bipyramidal shape.

Step 1 — Count domains: I in IF_7 has 7 bond pairs, 0 lone pairs.

Step 2 — Assign geometry: 7 domains $\Rightarrow$ pentagonal bipyramidal.

Step 3 — Conclude: IF_7 is pentagonal bipyramidal.

Why other options are wrong:

- (A) octahedral is for 6 domains.
- (B) square planar arises with 4 bonds and 2 lone pairs.
- (C) trigonal bipyramidal is for 5 domains.

Final Answer: pentagonal bipyramidal $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q36

Q37.

Solution

Concept — Bond angle and hybridization: An sp-hybridised central atom has two electron domains arranged linearly, giving a bond angle of $180°$.

Step 1 — Identify the hybridization: Be in $BeCl_2$ is sp (two bond pairs, no lone pair).

Step 2 — Geometry of sp: two domains point in opposite directions (linear).

Step 3 — State the angle: the Cl–Be–Cl angle is $180°$.

Why other options are wrong:

- (A) $109°28'$ is for sp^3.
- (B) $120°$ is for sp^2.
- (D) $90°$ is not the sp angle.

Final Answer: $180° \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q37

Q38.

Solution

Concept — Anomalous behaviour of lithium: Because of its very small size and high polarising power, Li differs from the other alkali metals: it forms mainly the normal oxide Li_2O and gives appreciably covalent salts.

Step 1 — Reaction with oxygen: Li forms Li_2O (normal oxide), whereas Na forms peroxide and K, Rb, Cs form superoxides.

Step 2 — Covalent character: the small Li^+ strongly polarises anions, so many Li salts have covalent character.

Step 3 — Conclude: statement (A) lists genuine anomalous properties of Li.

Why other options are wrong:

- (B) Li is actually the least reactive alkali metal towards water.
- (C) LiOH is the least, not most, soluble alkali hydroxide.
- (D) Li has the smallest, not largest, atomic radius in its group.

Final Answer: forms Li_2O and covalent salts $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q38

Q39.

Solution

Concept — Electron deficiency of BCl_3: Boron in BCl_3 has only three bond pairs and an empty $2p$ orbital, so it has just six valence electrons (an incomplete octet) and acts as a Lewis acid.

Step 1 — Count B's valence electrons: three B–Cl bonds give 6 electrons around B.

Step 2 — Recognise the deficiency: $6 < 8$, so the octet is incomplete.

Step 3 — Consequence: the empty orbital accepts a lone pair, making BCl_3 a Lewis acid.

Why other options are wrong:

- (A) B has no lone pair to donate.
- (C) B is not negatively charged.
- (D) B is in the $+3$ state, but that is not what defines electron deficiency here.

Final Answer: incomplete octet (six electrons) $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q39

Q40.

Solution

Concept — Bond order, length and strength: A higher bond order means a shorter and stronger bond. CO has bond order 3 while each C–O in CO_2 has bond order 2.

Step 1 — Compare bond orders: CO $(3) > CO_2$ (2).

Step 2 — Relate to length: higher bond order $\Rightarrow$ shorter bond.

Step 3 — Relate to strength: higher bond order $\Rightarrow$ stronger bond.

Step 4 — Conclude: the C–O bond in CO is shorter and stronger than in CO_2.

Why other options are wrong:

- (A) higher bond order makes it shorter and stronger, not longer/weaker.
- (B) the bond lengths are not equal.
- (D) CO's bond is a triple bond, not a single bond.

Final Answer: shorter and stronger than in CO_2 $\Rightarrow$ $\boxed{C}$

Answer: (C) Go Back to Q40

Q41.

Solution

Concept — Oxoacid strength and oxidation state: For oxoacids of the same element, acid strength increases with the oxidation state of the central atom (more terminal O atoms stabilise the conjugate base).

Step 1 — Find the oxidation state of N: in HNO_3 it is $+5$; in HNO_2 it is $+3$.

Step 2 — Apply the rule: higher oxidation state $\Rightarrow$ stronger acid.

Step 3 — Conclude: HNO_3 $(+5)$ is the stronger acid.

Why other options are wrong:

- (A) the lower $+3$ state makes HNO_2 weaker, not stronger.
- (B) they differ in strength.
- (C) both are acids.

Final Answer: HNO_3 $(+5)$ is stronger $\Rightarrow$ D

Answer: (D) Go Back to Q41

Q42.

Solution

Concept — Shape of SO_3: Sulphur in SO_3 has three bonding domains and no lone pair (sp^2), giving a trigonal planar molecule with 120° angles.

Step 1 — Count domains on S: three S–O bonds, no lone pair.

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

Step 3 — State the shape: trigonal planar.

Why other options are wrong:

- (D) pyramidal needs a lone pair (e.g. NH_3).
- (B) bent needs two lone pairs (e.g. SO_2 is bent, but SO_3 is planar).
- (C) linear is for sp with two domains.

Final Answer: trigonal planar (sp^2) $\Rightarrow$ A

Answer: (A) Go Back to Q42

Q43.

Solution

Concept — Disproportionation of Cl_2 in cold dilute base: $Cl_2 + 2NaOH \rightarrow NaCl + NaOCl + H_2O$; chlorine goes to -1 (in $NaCl$) and $+1$ (in $NaOCl$).

Step 1 — Recall the reaction: with cold dilute NaOH, Cl_2 disproportionates.

Step 2 — Identify the oxidation states: -1 in $NaCl$, $+1$ in $NaOCl$ (hypochlorite).

Step 3 — Conclude: the two products are $NaCl$ and $NaOCl$.

Why other options are wrong:

- (A) $NaClO_3$ forms only with hot concentrated NaOH.
- (B) perchlorate/chlorite are not the cold-dilute products.
- (C) $NaCl$ alone is not a disproportionation.

Final Answer: $NaCl$ and $NaOCl \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q43

Q44.

Solution

Concept — Shape of XeF_6: Xe has six bond pairs and one lone pair (7 domains), so the molecule is a distorted (capped) octahedron, not a regular one.

Step 1 — Count domains on Xe: 6 bond pairs $+1$ lone pair $= 7$ domains.

Step 2 — Effect of the lone pair: the extra lone pair distorts the regular octahedral arrangement.

Step 3 — Conclude: XeF_6 is a distorted octahedron.

Why other options are wrong:

- (A) it is distorted, not a perfect octahedron, because of the lone pair.
- (B) it is not planar hexagonal.
- (D) tetrahedral is for 4 domains.

Final Answer: distorted octahedral $\Rightarrow \boxed{C}$

Answer: (C) 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: $\mu = \sqrt{5(5+2)} = \sqrt{5 \times 7}$.

Step 3 — Evaluate inside the root: $5 \times 7 = 35$.

Step 4 — Take the square root: $\mu = \sqrt{35} \approx 5.92$ BM.

Why other options are wrong:

- (A) is for $n = 1$.
- (B) is for $n = 3$.
- (D) is for $n = 2$.

Final Answer: $\mu \approx 5.92$ BM $\Rightarrow$ C

Answer: (C) Go Back to Q45

Q46.

Solution

Concept — Ions on dissociation: Only ions outside the coordination sphere are released; the complex ion stays intact.

Step 1 — Identify the species: $[Co(NH_3)_6]Cl_3$ gives one $[Co(NH_3)_6]^{3+}$ and three Cl^-.

Step 2 — Count the ions: 1 complex cation $+$ 3 chloride ions.

Step 3 — Add: total $= 1 + 3 = 4$ ions.

Why other options are wrong:

- (D) and (B) under-count the free chlorides.
- (C) wrongly treats the salt as a non-electrolyte.

Final Answer: 4 ions $\Rightarrow$ A

Answer: (A) Go Back to Q46

Q47.

Solution

Concept — Optical isomerism in tris-chelate complexes: $[Co(en)_3]^{3+}$ has no plane or centre of symmetry, so it is chiral and exists as non-superimposable d and l mirror images.

Step 1 — Examine the geometry: three bidentate "en" ligands wrap around the octahedral Co.

Step 2 — Check for symmetry: the propeller-like arrangement lacks any improper symmetry element.

Step 3 — Conclude: the complex is chiral and shows optical isomerism (d and l).

Why other options are wrong:

- (A) it does show isomerism.
- (C) a homoleptic tris-chelate has no cis/trans geometrical isomers.
- (D) linkage isomerism needs an ambidentate ligand, which "en" is not.

Final Answer: optical isomerism (d/l) $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q47

Q48.

Solution

Concept — Reduction in the blast furnace: In the middle (hotter) zone, carbon monoxide reduces Fe_2O_3 to iron: $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$.

Step 1 — Identify the reductant: CO is generated from coke and CO_2.

Step 2 — Write the reduction: $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$.

Step 3 — Conclude: CO is the principal reducing agent.

Why other options are wrong:

- (B) silica forms slag with CaO, it is not the reductant.
- (C) CaO is the flux, not the reducing agent.
- (D) nitrogen is inert in the furnace.

Final Answer: carbon monoxide (CO) $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q48

Q49.

Solution

Concept — Removing permanent hardness: Permanent hardness (chlorides/sulphates of Ca, Mg) is not removed by boiling; it is removed by adding washing soda (Na_2CO_3) or by ion-exchange resins/zeolites.

Step 1 — Recall the cause: dissolved $CaCl_2$, $MgSO_4$, etc.

Step 2 — Choose the method: Na_2CO_3 precipitates Ca^{2+}/Mg^{2+} as carbonates; ion-exchange resins swap them for Na^+/H^+.

Step 3 — Conclude: washing soda or ion exchange removes permanent hardness.

Why other options are wrong:

- (A) boiling removes only temporary hardness.
- (C) dilute HCl does not soften water.
- (D) sand filtration removes suspended solids, not dissolved ions.

Final Answer: washing soda / ion-exchange $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q49

Q50.

Solution

Concept — Confirmatory test for chloride: Cl^- gives a curdy white $AgCl$ precipitate with $AgNO_3$ that dissolves readily in dilute ammonia (forming $[Ag(NH_3)_2]^+$).

Step 1 — Note the precipitate colour: curdy white indicates $AgCl$.

Step 2 — Test its solubility: $AgCl$ dissolves easily in dilute NH_3.

Step 3 — Conclude: the halide is chloride.

Why other options are wrong:

- (A) AgI is yellow and insoluble in ammonia.
- (C) $AgBr$ is pale yellow and only sparingly soluble in dilute ammonia.
- (D) F^- does not give a silver halide precipitate (AgF is soluble).

Final Answer: chloride (Cl^-) $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q50

Answer Key

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