JCECE Chemistry Sample Paper – 6

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 solution is prepared by dissolving 18 g of glucose ($C_6H_{12}O_6$, molar mass $= 180$ g/mol) in 90 g of water (molar mass $= 18$ g/mol). The mole fraction of glucose in the solution is:

(A) 0.50

(B) 0.10

(C) 0.02

(D) 0.20

Q2. For a hydrogen atom the radius of the first Bohr orbit ($n = 1$) is 0.529 Å. The radius of the orbit for $n = 3$ is:

(A) 1.587 Å

(B) 4.761 Å

(C) 0.176 Å

(D) 1.058 Å

Q3. An iron atom has atomic number 26. From the orbital box diagram of its $3d$ subshell shown below, the number of unpaired electrons in the ground-state Fe atom is:

$3d^6$ subshell

(A) 4

(B) 2

(C) 6

(D) 0

Q4. The density of carbon dioxide gas (CO_2, molar mass $= 44$ g/mol) at 300 K and 2.0 atm, taking $R = 0.0821$ L atm mol^{-1}K^{-1}, is approximately:

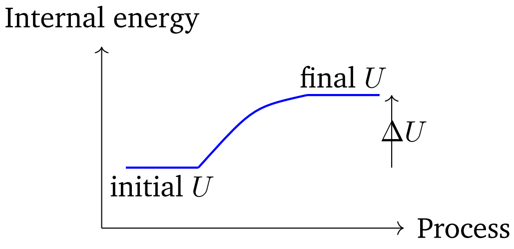
(A) 0.90 g/L

(B) 1.79 g/L

(C) 5.36 g/L

(D) 3.57 g/L

Q5. A gas absorbs 200 J of heat and, as shown in the energy diagram, does 80 J of work on the surroundings. Using the first law of thermodynamics, the change in internal energy ΔU of the gas is:



(A) $+280$ J

(B) -120 J

(C) $+80$ J

(D) $+120$ J

Q6. When 50 g of water is heated and its temperature rises from $25°$C to $45°$C, the heat absorbed (specific heat of water $= 4.2$ J g^{-1}K^{-1}) is:

(A) 4200 J

(B) 2100 J

(C) 9450 J

(D) 420 J

Q7. For the dissociation $\mathrm{PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)}$, 1 mol of $\mathrm{PCl_5}$ is taken in a vessel and at equilibrium 0.4 mol of $\mathrm{Cl_2}$ is formed. The degree of dissociation α of $\mathrm{PCl_5}$ is:

(A) 0.20

(B) 0.60

(C) 0.40

(D) 0.80

Q8. The pH of a 0.01 M aqueous solution of NaOH (a strong monoacidic base) at $25°$C is:

(A) 12

(B) 2

(C) 1

(D) 7

Q9. The solubility of $\mathrm{PbCl_2}$ (an $\mathrm{AB_2}$-type salt) in water at $25°$C is 1.0×10^{-2} mol/L. Its solubility product K_{sp} is:

(A) 1.0×10^{-4}

(B) 2.0×10^{-6}

(C) 4.0×10^{-6}

(D) 1.0×10^{-6}

Q10. Assuming complete dissociation, the van't Hoff factor (i) for an aqueous solution of aluminium sulphate, $\mathrm{Al_2(SO_4)_3}$, is:

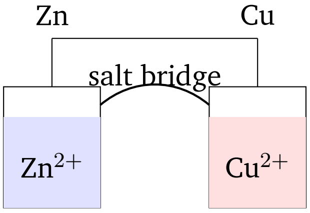
(A) 2

(B) 5

(C) 4

(D) 3

Q11. For the galvanic cell shown, the standard cell potential is $E^\circ_{cell} = +1.10$ V and 2 moles of electrons are transferred ($F = 96500$ C mol^{-1}). The standard Gibbs energy change ΔG° of the cell reaction is:



(A) -106 kJ

(B) $+212$ kJ

(C) $+106$ kJ

(D) -212 kJ

Q12. The quantity of electric charge required to deposit 1 mol of aluminium from molten Al^{3+} salt during electrolysis ($F = 96500$ C mol^{-1}) is:

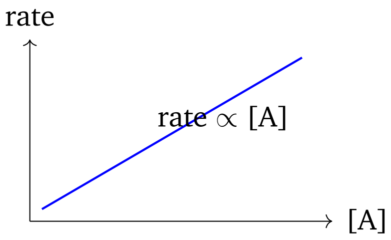
(A) 96500 C

(B) 48250 C

(C) 289500 C

(D) 193000 C

Q13. For a first-order reaction, the half-life is independent of the initial concentration of the reactant, as the rate-versus-concentration graph below indicates. The half-life $t_{1/2}$ of a first-order reaction depends on the rate constant k as:



(A) $t_{1/2} = k\,[\mathrm{A}]_0$

(B) $t_{1/2} = \dfrac{1}{k[\mathrm{A}]_0}$

(C) $t_{1/2} = \dfrac{[\mathrm{A}]_0}{2k}$

(D) $t_{1/2} = \dfrac{0.693}{k}$

Q14. For many reactions the rate becomes nearly double for every 10°C rise in temperature. If the rate of a reaction doubles for each 10°C rise, by what factor does the rate increase when the temperature is raised by 30°C?

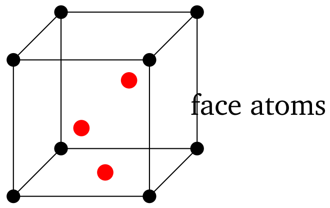
(A) 8

(B) 3

(C) 6

(D) 2

Q15. In a face-centred cubic (fcc) lattice, as illustrated by the cube shown, each atom is in contact with a fixed number of nearest neighbours. The coordination number of an atom in the fcc structure is:



(A) 8

(B) 4

(C) 6

(D) 12

Q16. In which of the following reactions does chlorine undergo disproportionation (simultaneous oxidation and reduction of the same element)?

(A) $H_2 + Cl_2 \rightarrow 2HCl$

(B) $2Na + Cl_2 \rightarrow 2NaCl$

(C) $Cl_2 + 2NaOH \rightarrow NaCl + NaOCl + H_2O$

(D) $Cl_2 + 2KBr \rightarrow 2KCl + Br_2$

Q17. A solution is made by mixing equal numbers of moles of two liquids; the mole fraction of each component in this binary mixture is:

(A) 0.5

(B) 1.0

(C) 0.25

(D) 2.0

Q18. The IUPAC name of the compound $CH_3–CH_2–CH_2–NH_2$ is:

(A) N-methylethanamine

(B) propan-2-amine

(C) propan-1-amine

(D) N, N-dimethylmethanamine

Q19. The total number of structural (chain) isomers of butane, C_4H_{10}, is:

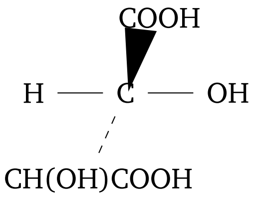
(A) 4

(B) 3

(C) 2

(D) 1

Q20. For the molecule 2,3-dihydroxybutanedioic acid (tartaric acid) shown, which contains two similar chiral carbons, the maximum number of optical isomers predicted by the 2^n rule (before considering meso forms) is:



(A) 2

(B) 3

(C) 1

(D) 4

Q21. The phenoxide ion ($C_6H_5O^-$) is more stable than an alkoxide ion mainly because:

(A) the negative charge is delocalised over the benzene ring by resonance

(B) it has a stronger inductive effect from hydrogen

(C) it has a larger number of sigma bonds

(D) oxygen in phenoxide is sp hybridised

Q22. Among the hydrocarbons shown, the one whose terminal hydrogen is most acidic (can be removed by sodamide, $NaNH_2$) is ethyne (acetylene):

(ethyne)
H ≡ C≡C–H

The product formed when ethyne reacts with sodamide is:

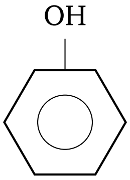
(A) ethene

(B) sodium acetylide ($HC \equiv C^-Na^+$)

(C) ethane

(D) ethanol

Q23. When phenol (shown) undergoes electrophilic substitution such as bromination, the $-\mathrm{OH}$ group directs the incoming group mainly to the:



(A) ortho and para positions

(B) meta position only

(C) ipso position only

(D) it does not undergo substitution

Q24. The correct order of reactivity of the following alkyl bromides towards the S_N2 reaction (fastest first) is:

(A) $\mathrm{CH_3{-}Br > CH_3CH_2{-}Br > (CH_3)_2CH{-}Br > (CH_3)_3C{-}Br}$

(B) $\mathrm{(CH_3)_3C{-}Br > (CH_3)_2CH{-}Br > CH_3CH_2{-}Br > CH_3{-}Br}$

(C) $\mathrm{(CH_3)_2CH{-}Br > CH_3{-}Br > CH_3CH_2{-}Br > (CH_3)_3C{-}Br}$

(D) all react at the same rate

Q25. In the Lucas test (anhydrous $\mathrm{ZnCl_2}$ + concentrated HCl), which alcohol produces turbidity (an insoluble alkyl chloride layer) immediately at room temperature?

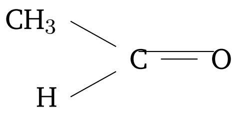
(A) a primary alcohol

(B) a tertiary alcohol

(C) methanol

(D) a secondary alcohol (only on warming)

Q26. Two molecules of acetaldehyde (whose carbonyl group is shown) undergo aldol condensation in the presence of dilute alkali. The immediate aldol product is:



(A) acetic acid

(B) 3-hydroxybutanal ($CH_3CH(OH)CH_2CHO$)

(C) ethanol

(D) but-2-ene

Q27. Among the acids chloroacetic acid ($ClCH_2COOH$), acetic acid (CH_3COOH) and fluoroacetic acid (FCH_2COOH), the correct order of acidic strength (strongest first) is:

(A) $CH_3COOH > ClCH_2COOH > FCH_2COOH$

(B) all three are equally acidic

(C) $FCH_2COOH > ClCH_2COOH > CH_3COOH$

(D) $ClCH_2COOH > FCH_2COOH > CH_3COOH$

Q28. In aqueous solution, aniline ($C_6H_5NH_2$) is a weaker base than methylamine (CH_3NH_2). The main reason is:

(A) aniline has more hydrogen atoms

(B) in aniline the lone pair on nitrogen is delocalised into the benzene ring, reducing its availability

(C) methylamine is a gas at room temperature

(D) aniline is insoluble in water

Q29. Which nitrogenous base is present in RNA but absent in DNA?

(A) adenine

(B) guanine

(C) thymine

(D) uracil

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

(A) ethylene glycol and terephthalic acid

(B) phenol and formaldehyde

(C) caprolactam only

(D) hexamethylenediamine and adipic acid

Q31. In the free-radical chlorination of methane, the step $\mathrm{Cl_2} \xrightarrow{\mathrm{h}\nu} 2\mathrm{Cl}^{\bullet}$ is best described as the:

(A) chain-termination step

(B) chain-propagation step

(C) chain-initiation step

(D) rearrangement step

Q32. Benzene reacts with acetyl chloride ($\mathrm{CH_3COCl}$) in the presence of anhydrous $\mathrm{AlCl_3}$ to give acetophenone. This reaction is known as:

(A) Cannizzaro reaction

(B) Wurtz reaction

(C) Sandmeyer reaction

(D) Friedel–Crafts acylation

Q33. The Lucas reagent (concentrated HCl with anhydrous $\mathrm{ZnCl_2}$) is used in the laboratory to:

(A) distinguish between primary, secondary and tertiary alcohols

(B) detect an aldehyde group

(C) detect unsaturation in alkenes

(D) test for a carboxylic acid

Q34. The product formed when ammonium acetate ($\mathrm{CH_3COONH_4}$) is heated strongly (with loss of water) is:

(A) acetic acid

(B) acetyl chloride

(C) ethylamine

(D) acetamide (CH_3CONH_2)

Q35. The correct order of electronegativity among the elements F, Cl, Br and I (decreasing order) is:

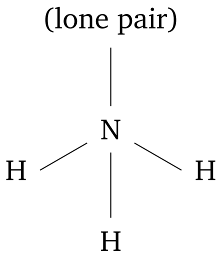
(A) $\mathrm{I > Br > Cl > F}$

(B) $\mathrm{Cl > F > Br > I}$

(C) $\mathrm{Br > Cl > F > I}$

(D) $\mathrm{F > Cl > Br > I}$

Q36. According to VSEPR theory, the molecular shape of the ammonia molecule NH_3 (shown, with one lone pair on nitrogen) is:



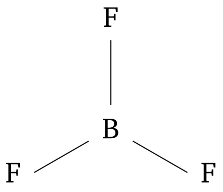
(A) trigonal pyramidal

(B) trigonal planar

(C) tetrahedral

(D) square planar

Q37. The hybridization of the central boron atom in boron trifluoride BF_3 (trigonal planar geometry shown) is:



(A) sp

(B) sp^2

(C) sp^3

(D) sp^3d

Q38. Lithium shows several properties similar to magnesium rather than to other alkali metals. This similarity is an example of:

(A) the inert pair effect

(B) the lanthanide contraction

(C) the diagonal relationship

(D) screening effect

Q39. Boron trichloride (BCl_3) acts as a Lewis acid. This behaviour is best explained by the fact that the boron atom:

(A) has an incomplete octet (only six electrons) and an empty p orbital

(B) carries a lone pair available for donation

(C) has a complete octet with no vacant orbital

(D) is more electronegative than chlorine

Q40. Which of the following is NOT a crystalline allotrope of carbon?

(A) diamond

(B) charcoal (amorphous carbon)

(C) graphite

(D) fullerene (C_{60})

Q41. The bond angle in NH_3 ($107°$) is greater than that in PH_3 ($\approx 93°$). The most acceptable reason is:

(A) phosphorus is more electronegative than nitrogen

(B) nitrogen has more lone pairs than phosphorus

(C) PH_3 has no lone pair

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

Q42. Among the oxides SO_2, SO_3 and Na_2O, the correct classification of their acid–base nature is:

(A) SO_2 and SO_3 are acidic while Na_2O is basic

(B) all three are basic oxides

(C) all three are acidic oxides

(D) SO_3 is basic while Na_2O is acidic

Q43. The correct order of chemical reactivity of the halogens (most reactive first) is:

(A) $I_2 > Br_2 > Cl_2 > F_2$

(B) $Cl_2 > F_2 > Br_2 > I_2$

(C) $F_2 > Cl_2 > Br_2 > I_2$

(D) $Br_2 > Cl_2 > F_2 > I_2$

Q44. According to VSEPR theory, the shape of the xenon difluoride molecule XeF_2 (which has three lone pairs on Xe) is:

(A) bent (angular)

(B) linear

(C) trigonal planar

(D) T-shaped

Q45. The steady decrease in atomic and ionic radii of the lanthanide elements with increasing atomic number is called:

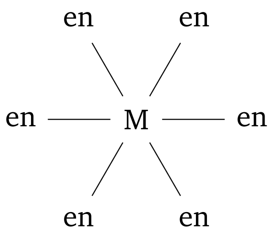
(A) the shielding effect

(B) lanthanide contraction

(C) the inert pair effect

(D) the diagonal relationship

Q46. Ethylenediamine (en) acts as a ligand in coordination complexes such as the octahedral one shown. Its denticity (number of donor atoms per ligand) is:



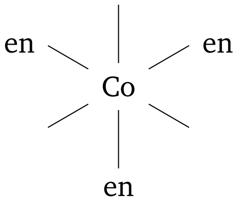
(A) 1

(B) 4

(C) 2

(D) 6

Q47. The octahedral complex $[\mathrm{Co(en)_3}]^{3+}$ (with three bidentate ethylenediamine ligands, shown schematically) exhibits which type of isomerism?



(A) optical isomerism (it is chiral, with non-superimposable mirror images)

(B) no isomerism at all

(C) only geometrical isomerism

(D) linkage isomerism

Q48. The process of heating a carbonate ore strongly in the absence (or limited supply) of air to convert it into its oxide is called:

(A) roasting

(B) calcination

(C) froth flotation

(D) smelting

Q49. "Heavy water" used in nuclear reactors as a moderator has the chemical formula:

(A) H_2O_2

(B) H_2O (purified)

(C) T_2O

(D) D_2O

Q50. Orange-red vapours of chromyl chloride (CrO_2Cl_2) form when a salt is heated with potassium dichromate and concentrated H_2SO_4. This test confirms the presence of the:

(A) sulphate ion

(B) chloride ion

(C) nitrate ion

(D) bromide ion

Detailed Solutions

Q1.

Solution

Concept — Mole fraction: The mole fraction of a component $= \dfrac{\text{moles of that component}}{\text{total moles of all components}}$.

Step 1 — Moles of glucose: $n_{glucose} = \dfrac{18}{180}$.

Step 2 — Evaluate: $n_{glucose} = 0.1$ mol.

Step 3 — Moles of water: $n_{water} = \dfrac{90}{18} = 5$ mol.

Step 4 — Total moles: $n_{total} = 0.1 + 5 = 5.1$ mol.

Step 5 — Mole fraction of glucose: $x_{glucose} = \dfrac{0.1}{5.1} \approx 0.02$.

Why other options are wrong:

- (A) ignores water moles entirely.
- (B) uses moles of glucose without dividing by total.
- (D) uses the wrong water mass.

Final Answer: $x_{glucose} \approx 0.02 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q1

Q2.

Solution

Concept — Bohr radius: For hydrogen, $r_n = r_1\, n^2$, where $r_1 = 0.529$ Å.

Step 1 — Identify n: Third orbit, $n = 3$.

Step 2 — Square n: $n^2 = 9$.

Step 3 — Substitute: $r_3 = 0.529 \times 9$.

Step 4 — Evaluate: $r_3 = 4.761$ Å.

Why other options are wrong:

- (A) multiplies by 3 instead of 9.
- (C) divides by 3.
- (D) multiplies by 2.

Final Answer: $r_3 = 4.761$ Å $\Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q2**

Q3.

Solution

Concept — Unpaired electrons: Fill the $3d$ subshell by Hund's rule (singly occupy each box before pairing); count the boxes with a single arrow.

Step 1 — Write configuration of Fe ($Z = 26$): $[\text{Ar}]\,3d^6\,4s^2$.

Step 2 — Distribute $3d^6$ over five orbitals: one orbital gets a pair, the other four get one electron each.

Step 3 — Count unpaired: four singly-occupied orbitals $\Rightarrow$ 4 unpaired electrons.

Step 4 — Conclude: the ground-state Fe atom has 4 unpaired electrons.

Why other options are wrong:

- (B) would correspond to $3d^8$ (like Ni).
- (C) is the maximum (half-filled $3d^5$ case, like Mn).
- (D) implies a fully paired subshell, which is not the case for $3d^6$.

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

Answer: (A) **Go Back to Q3**

Q4.

Solution

Concept — Density of an ideal gas: From $PV = nRT$ with $n = \dfrac{m}{M}$, the density $d = \dfrac{m}{V} = \dfrac{PM}{RT}$.

Step 1 — List data: $P = 2.0$ atm, $M = 44$ g/mol, $R = 0.0821$, $T = 300$ K.

Step 2 — Numerator: $PM = 2.0 \times 44 = 88$.

Step 3 — Denominator: $RT = 0.0821 \times 300 = 24.63$.

Step 4 — Divide: $d = \dfrac{88}{24.63} \approx 3.57$ g/L.

Why other options are wrong:

- (A) uses $P = 0.5$ atm.

- (B) uses $P = 1$ atm.
- (C) drops the temperature factor.

Final Answer: $d \approx 3.57$ g/L $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — First law of thermodynamics: $\Delta U = q + w$, where q is heat absorbed by the system and w is work done ON the system. Work done BY the system is $-w$.

Step 1 — Heat term: the gas absorbs heat, so $q = +200$ J.

Step 2 — Work term: the gas does 80 J of work ON the surroundings, so work done on the gas is $w = -80$ J.

Step 3 — Apply the first law: $\Delta U = q + w = 200 + (-80)$.

Step 4 — Evaluate: $\Delta U = +120$ J.

Why other options are wrong:

- (A) adds the work instead of subtracting it.
- (B) uses the wrong sign for q.
- (C) quotes only the work magnitude.

Final Answer: $\Delta U = +120$ J $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q5

Q6.

Solution

Concept — Calorimetry: Heat absorbed $q = m\,c\,\Delta T$.

Step 1 — List data: $m = 50$ g, $c = 4.2$ J g^{-1}K^{-1}, $\Delta T = 45 - 25 = 20$ K.

Step 2 — Multiply mass and specific heat: $m\,c = 50 \times 4.2 = 210$.

Step 3 — Multiply by ΔT: $q = 210 \times 20$.

Step 4 — Evaluate: $q = 4200$ J.

Why other options are wrong:

- (B) uses $\Delta T = 10$ K.
- (C) uses $\Delta T = 45$ K (forgot to subtract initial temperature).
- (D) drops a factor of 10.

Final Answer: $q = 4200$ J $\Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q6**

Q7.

Solution

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

Step 1 — Relate Cl_2 formed to PCl_5 dissociated: each mole of PCl_5 that dissociates gives one mole of Cl_2.

Step 2 — Moles dissociated: 0.4 mol of Cl_2 means 0.4 mol of PCl_5 dissociated.

Step 3 — Apply the formula: $\alpha = \dfrac{0.4}{1}$.

Step 4 — Evaluate: $\alpha = 0.40$.

Why other options are wrong:

- (A) halves the value.
- (B) uses 0.6 (the undissociated fraction).
- (D) doubles the value.

Final Answer: $\alpha = 0.40 \Rightarrow \boxed{\text{C}}$

Answer: (C) **Go Back to Q7**

Q8.

Solution

Concept — pH of a strong base: For NaOH, $[OH^-]$ = base concentration; $\text{pOH} = -\log[OH^-]$ and $\text{pH} = 14 - \text{pOH}$.

Step 1 — Find $[OH^-]$: $[OH^-] = 0.01 = 1 \times 10^{-2}$ M.

Step 2 — Compute pOH: $\text{pOH} = -\log(10^{-2}) = 2$.

Step 3 — Convert to pH: $\text{pH} = 14 - 2$.

Step 4 — Evaluate: $\mathrm{pH} = 12$.

Why other options are wrong:

- (B) is the pOH, not the pH.
- (C) uses 0.1 M.
- (D) is the neutral value.

Final Answer: $\mathrm{pH} = 12 \Rightarrow \boxed{\mathrm{A}}$

Answer: (A) Go Back to Q8

Q9.

Solution

Concept — K_{sp} of an $\mathrm{AB_2}$ salt: For $\mathrm{PbCl_2} \rightleftharpoons \mathrm{Pb^{2+}} + 2\mathrm{Cl^-}$, if solubility is s then $[\mathrm{Pb^{2+}}] = s$ and $[\mathrm{Cl^-}] = 2s$, so $K_{sp} = s(2s)^2 = 4s^3$.

Step 1 — Identify s: $s = 1.0 \times 10^{-2}$ mol/L.

Step 2 — Write K_{sp}: $K_{sp} = 4s^3$.

Step 3 — Cube s: $s^3 = (1.0 \times 10^{-2})^3 = 1.0 \times 10^{-6}$.

Step 4 — Multiply by 4: $K_{sp} = 4 \times 10^{-6}$.

Why other options are wrong:

- (A) squares s instead of cubing.
- (B) uses the factor 2 instead of 4.
- (D) omits the factor of 4.

Final Answer: $K_{sp} = 4.0 \times 10^{-6} \Rightarrow \boxed{\mathrm{C}}$

Answer: (C) Go Back to Q9

Q10.

Solution

Concept — van't Hoff factor: For a strong electrolyte that dissociates completely, $i =$ total number of ions produced per formula unit.

Step 1 — Write dissociation: $\mathrm{Al_2(SO_4)_3} \to 2\mathrm{Al}^{3+} + 3\mathrm{SO_4^{2-}}$.

Step 2 — Count cations: 2 aluminium ions.

Step 3 — Count anions: 3 sulphate ions.

Step 4 — Total ions: $i = 2 + 3 = 5$.

Why other options are wrong:

- (A) counts only the cations.
- (C) miscounts one ion short.
- (D) counts only the anions.

Final Answer: $i = 5 \Rightarrow \boxed{\mathrm{B}}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Gibbs energy and cell potential: $\Delta G^\circ = -nFE^\circ_{cell}$.

Step 1 — List data: $n = 2$, $F = 96500$ C/mol, $E^\circ_{cell} = +1.10$ V.

Step 2 — Substitute: $\Delta G^\circ = -(2)(96500)(1.10)$.

Step 3 — Multiply n and F: $2 \times 96500 = 193000$.

Step 4 — Multiply by E°: $193000 \times 1.10 = 212300\ \mathrm{J} \approx 212\ \mathrm{kJ}$.

Step 5 — Apply the sign: $\Delta G^\circ = -212$ kJ.

Why other options are wrong:

- (A) uses $n = 1$.
- (B) has the wrong (positive) sign.
- (C) has both a wrong sign and $n = 1$.

Final Answer: $\Delta G^\circ = -212\ \mathrm{kJ} \Rightarrow \boxed{\mathrm{D}}$

Answer: (D) Go Back to Q11

Q12.

Solution

Concept — Charge from Faraday's law: Charge $Q = n_e \times F$, where n_e is the number of moles of electrons required.

Step 1 — Electrons per Al: $\mathrm{Al^{3+}} + 3\mathrm{e^-} \rightarrow \mathrm{Al}$, so 3 mol of electrons per mol of Al.

Step 2 — Moles of electrons: for 1 mol of Al, $n_e = 3$ mol.

Step 3 — Substitute: $Q = 3 \times 96500$.

Step 4 — Evaluate: $Q = 289500$ C.

Why other options are wrong:

- (A) uses 1 electron.
- (B) uses half a Faraday.
- (D) uses 2 electrons.

Final Answer: $Q = 289500 \text{ C} \Rightarrow \boxed{\text{C}}$

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

Q13.

Solution

Concept — Half-life of a first-order reaction: For a first-order reaction $t_{1/2} = \dfrac{0.693}{k}$, which is independent of the initial concentration.

Step 1 — Recall the integrated first-order law: $k = \dfrac{2.303}{t} \log \dfrac{[\mathrm{A}]_0}{[\mathrm{A}]}$.

Step 2 — Set $[\mathrm{A}] = \frac{1}{2}[\mathrm{A}]_0$: $\dfrac{[\mathrm{A}]_0}{[\mathrm{A}]} = 2$.

Step 3 — Substitute: $k\, t_{1/2} = 2.303 \log 2 = 2.303 \times 0.301 = 0.693$.

Step 4 — Solve for $t_{1/2}$: $t_{1/2} = \dfrac{0.693}{k}$, independent of $[\mathrm{A}]_0$.

Why other options are wrong:

- (A) and (B) make $t_{1/2}$ depend on $[\mathrm{A}]_0$, which is wrong for first order.
- (C) is the zero-order half-life expression.

Final Answer: $t_{1/2} = \dfrac{0.693}{k} \Rightarrow \boxed{\text{D}}$

$\boxed{\text{Answer: (D)}}$ Go Back to Q13

Q14.

Solution

Concept — Temperature coefficient: If the rate doubles for every 10°C rise, then for a rise of ΔT the rate increases by a factor $2^{\Delta T/10}$.

Step 1 — Number of 10° steps: $\frac{30}{10} = 3$ steps.

Step 2 — Apply the doubling factor: factor $= 2^3$.

Step 3 — Evaluate: $2^3 = 8$.

Step 4 — Conclude: the rate increases 8-fold.

Why other options are wrong:

- (D) applies only one doubling.
- (B) adds the steps instead of raising to a power.
- (C) multiplies 2×3 instead of 2^3.

Final Answer: rate increases by $8 \Rightarrow \boxed{\text{A}}$

$\boxed{\text{Answer: (A)}}$ Go Back to Q14

Q15.

Solution

Concept — Coordination number (fcc): In a cubic close-packed (fcc) lattice, every atom touches 12 nearest neighbours.

Step 1 — Recall close packing: fcc is identical to cubic close packing (ccp).

Step 2 — Count nearest neighbours: 6 in the same close-packed layer, 3 above and 3 below.

Step 3 — Total: $6 + 3 + 3 = 12$.

Step 4 — Conclude: the coordination number is 12.

Why other options are wrong:

- (A) 8 is the coordination number of a bcc lattice.
- (B) 4 is for a diamond-type lattice.
- (C) 6 is for a simple cubic lattice.

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

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

Q16.

Solution

Concept — Disproportionation: A reaction in which the same element is simultaneously oxidised and reduced.

Step 1 — Examine option (C): in $\mathrm{Cl_2 + 2NaOH \rightarrow NaCl + NaOCl + H_2O}$, chlorine starts at oxidation state 0.

Step 2 — Track oxidation states: in NaCl, Cl is -1 (reduced); in NaOCl, Cl is $+1$ (oxidised).

Step 3 — Conclude: the same element (Cl) is both oxidised and reduced, so this is disproportionation.

Why other options are wrong:

- (A) and (B) chlorine is only reduced from 0 to -1.
- (D) chlorine is reduced and bromine is oxidised; different elements, so not disproportionation.

Final Answer: $\mathrm{Cl_2 + 2NaOH}$ reaction $\Rightarrow \boxed{\text{C}}$

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

Q17.

Solution

Concept — Mole fraction in a binary mixture: $x_1 = \dfrac{n_1}{n_1 + n_2}$ and the two mole fractions add to 1.

Step 1 — Equal moles: let each component have n moles, so $n_1 = n_2 = n$.

Step 2 — Total moles: $n_1 + n_2 = 2n$.

Step 3 — Mole fraction of each: $x = \dfrac{n}{2n} = 0.5$.

Step 4 — Check sum: $0.5 + 0.5 = 1$, as required.

Why other options are wrong:

- (B) a mole fraction cannot equal 1 when two components are present.

- (C) would require a $1{:}3$ ratio.
- (D) a mole fraction cannot exceed 1.

Final Answer: each mole fraction $= 0.5 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — IUPAC naming of amines: Name the longest carbon chain, then add the suffix "-amine" with the locant of the carbon bearing the $-NH_2$ group.

Step 1 — Identify the chain: three carbons $\Rightarrow$ "propan".

Step 2 — Locate the amino group: $-NH_2$ is on the terminal (C-1) carbon.

Step 3 — Combine: propan-1-amine.

Why other options are wrong:

- (A) describes a secondary amine with a different skeleton.
- (B) places the amino group on C-2.
- (D) is a tertiary amine, not a primary one.

Final Answer: propan-1-amine $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q18

Q19.

Solution

Concept — Chain isomerism: Count the distinct carbon-skeleton arrangements with the molecular formula C_4H_{10}.

Step 1 — Straight chain: n-butane, $CH_3CH_2CH_2CH_3$.

Step 2 — Branched chain: isobutane (2-methylpropane), $(CH_3)_3CH$.

Step 3 — Count distinct skeletons: only these two are possible.

Step 4 — Conclude: there are 2 structural isomers.

Why other options are wrong:

- (A) and (B) over-count; no third skeleton exists.

- (D) misses the branched isomer.

Final Answer: 2 isomers $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — 2^n rule: The maximum number of optical isomers is 2^n, where n is the number of chiral (asymmetric) carbon atoms.

Step 1 — Count chiral carbons in tartaric acid: there are 2 chiral carbons ($n = 2$).

Step 2 — Apply the rule: maximum isomers $= 2^2$.

Step 3 — Evaluate: $2^2 = 4$.

Step 4 — Conclude: the 2^n formula predicts 4 (in practice one pair is a meso form, but the formula gives 4).

Why other options are wrong:

- (A) uses $n = 1$.
- (B) is not a power of 2.
- (C) ignores chirality.

Final Answer: $2^2 = 4 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Resonance stabilisation: A conjugate base is more stable when its negative charge is delocalised.

Step 1 — Structure of phenoxide: the oxygen lone pair conjugates with the aromatic π system.

Step 2 — Charge delocalisation: the negative charge is spread onto the ortho and para carbons of the ring by resonance.

Step 3 — Compare with alkoxide: an alkoxide has no such conjugation, so its charge stays localised on oxygen.

Step 4 — Conclude: resonance delocalisation makes phenoxide more stable.

Why other options are wrong:

- (B) hydrogen has no significant electron-withdrawing inductive effect here.
- (C) the number of sigma bonds does not stabilise the charge.
- (D) phenoxide oxygen is sp^2/sp^3 in character, not sp.

Final Answer: resonance delocalisation $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q21

Q22.

Solution

Concept — Terminal alkyne acidity: The hydrogen on a terminal ≡C–H is weakly acidic because the carbanion formed is sp-hybridised and stable; a strong base such as $\mathrm{NaNH_2}$ removes it.

Step 1 — Identify the acidic hydrogen: the ≡C–H proton of ethyne.

Step 2 — Reaction with sodamide: $\mathrm{HC \equiv CH + NaNH_2 \rightarrow HC \equiv C^{-}Na^{+} + NH_3}$.

Step 3 — Identify the product: the monosodium salt, sodium acetylide.

Step 4 — Conclude: the product is $\mathrm{HC \equiv C^{-}Na^{+}}$.

Why other options are wrong:

- (A) and (C) would require addition/reduction, which sodamide does not do here.
- (D) no hydroxyl group is introduced.

Final Answer: sodium acetylide $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q22

Q23.

Solution

Concept — Directive effect of $-\mathrm{OH}$: The hydroxyl group is an activating, ortho/para-directing group because it donates electron density into the ring by resonance.

Step 1 — Classify the group: $-\mathrm{OH}$ is a $+M$ (electron-donating by resonance) group.

Step 2 — Locate the electron-rich positions: resonance places extra electron density at the ortho and para carbons.

Step 3 — Predict substitution sites: the electrophile attacks ortho and para positions.

Step 4 — Conclude: bromination of phenol gives mainly ortho and para products.

Why other options are wrong:

- (B) meta direction is characteristic of deactivating groups like $-\mathrm{NO_2}$.
- (C) the ipso carbon already bears the $-\mathrm{OH}$.
- (D) phenol is in fact highly reactive toward EAS.

Final Answer: ortho and para $\Rightarrow \boxed{\mathrm{A}}$

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

Q24.

Solution

Concept — S_N2 reactivity: The S_N2 rate is governed by steric hindrance at the carbon bearing the halogen; less crowding means a faster reaction. Hence methyl $>$ primary $>$ secondary $>$ tertiary.

Step 1 — Rank by crowding: $\mathrm{CH_3{-}Br}$ is least hindered.

Step 2 — Next: primary $\mathrm{CH_3CH_2{-}Br}$.

Step 3 — Then: secondary $\mathrm{(CH_3)_2CH{-}Br}$.

Step 4 — Slowest: tertiary $\mathrm{(CH_3)_3C{-}Br}$ (most hindered).

Why other options are wrong:

- (B) is the reverse order (that of S_N1).
- (C) misplaces the secondary halide.

- (D) ignores steric effects.

Final Answer: $CH_3–Br > CH_3CH_2–Br > (CH_3)_2CH–Br > (CH_3)_3C–Br \Rightarrow \boxed{A}$

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

Q25.

Solution

Concept — Lucas test: The rate of turbidity reflects carbocation stability. Tertiary alcohols form the most stable carbocation and react immediately; secondary react on warming; primary do not react appreciably at room temperature.

Step 1 — Rank carbocation stability: tertiary > secondary > primary.

Step 2 — Match to turbidity speed: tertiary gives turbidity at once.

Step 3 — Conclude: the tertiary alcohol produces immediate turbidity.

Why other options are wrong:

- (A) and (C) primary alcohols/methanol give no turbidity at room temperature.
- (D) secondary alcohols react only on warming, not immediately.

Final Answer: tertiary alcohol $\Rightarrow \boxed{B}$

Answer: (B) **Go Back to Q25**

Q26.

Solution

Concept — Aldol condensation: An aldehyde with α-hydrogens reacts under dilute base; the carbanion of one molecule adds to the carbonyl carbon of another, giving a β-hydroxy aldehyde (the aldol).

Step 1 — Generate the carbanion: dilute alkali removes an α-H from CH_3CHO to give $^{-}CH_2CHO$.

Step 2 — Nucleophilic addition: this carbanion attacks the carbonyl carbon of a second acetaldehyde.

Step 3 — Form the aldol: the product is $CH_3CH(OH)CH_2CHO$, i.e. 3-hydroxybutanal.

Step 4 — Conclude: the immediate aldol product is 3-hydroxybutanal.

Why other options are wrong:

- (A) and (C) result from oxidation/reduction, not aldol addition.
- (D) is the dehydrated (later) product, not the immediate aldol.

Final Answer: 3-hydroxybutanal $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q26

Q27.

Solution

Concept — Inductive effect on acidity: A more electronegative halogen withdraws electron density more strongly, stabilising the carboxylate ion and increasing acidity. Electronegativity: F $>$ Cl, and CH_3 (no halogen) is the weakest acid.

Step 1 — Rank electron withdrawal: F is most electron-withdrawing, then Cl, then none (acetic acid).

Step 2 — Translate to acidity: stronger withdrawal $\Rightarrow$ stronger acid.

Step 3 — Order: $FCH_2COOH > ClCH_2COOH > CH_3COOH$.

Step 4 — Conclude: fluoroacetic acid is the strongest.

Why other options are wrong:

- (A) reverses the trend.
- (B) ignores the inductive effect.
- (D) places Cl above F, contradicting electronegativity.

Final Answer: $FCH_2COOH > ClCH_2COOH > CH_3COOH \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q27

Q28.

Solution

Concept — Basicity of amines: Basicity depends on the availability of the nitrogen lone pair. If the lone pair is delocalised, the amine is a weaker base.

Step 1 — Examine aniline: the nitrogen lone pair is conjugated into the benzene ring.

Step 2 — Effect of delocalisation: the lone pair is less available to accept a proton.

Step 3 — Compare with methylamine: in methylamine the lone pair is fully available and even enhanced by the $+I$ effect of $\mathrm{CH_3}$.

Step 4 — Conclude: aniline is the weaker base because of lone-pair delocalisation.

Why other options are wrong:

- (A) the number of hydrogens does not set basicity.
- (C) physical state is irrelevant to basic strength.
- (D) solubility does not determine intrinsic basicity.

Final Answer: lone-pair delocalisation into the ring $\Rightarrow \boxed{\mathrm{B}}$

$\boxed{\textbf{Answer: (B)}}$ Go Back to Q28

Q29.

Solution

Concept — Bases of DNA and RNA: DNA contains adenine, guanine, cytosine and thymine; RNA contains adenine, guanine, cytosine and uracil. Thymine is replaced by uracil in RNA.

Step 1 — List shared bases: adenine, guanine and cytosine occur in both.

Step 2 — Identify the difference: DNA has thymine; RNA has uracil instead.

Step 3 — Conclude: uracil is present in RNA but not in DNA.

Why other options are wrong:

- (A) and (B) adenine and guanine occur in both DNA and RNA.
- (C) thymine is the one found in DNA, not RNA.

Final Answer: uracil $\Rightarrow \boxed{\mathrm{D}}$

$\boxed{\textbf{Answer: (D)}}$ Go Back to Q29

Q30.

Solution

Concept — Monomers of nylon-6,6: Nylon-6,6 is a polyamide made by condensation of a diamine with a dicarboxylic acid, each contributing six carbons (hence "6,6").

Step 1 — Diamine unit: hexamethylenediamine, $H_2N(CH_2)_6NH_2$.

Step 2 — Diacid unit: adipic acid, $HOOC(CH_2)_4COOH$.

Step 3 — Combine: amide (peptide-like) links form on condensation, releasing water.

Step 4 — Conclude: the monomers are hexamethylenediamine and adipic acid.

Why other options are wrong:

- (A) gives terylene (a polyester).
- (B) gives bakelite.
- (C) caprolactam gives nylon-6, not nylon-6,6.

Final Answer: hexamethylenediamine and adipic acid $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q30

Q31.

Solution

Concept — Free-radical chain mechanism: The chain has three stages: initiation (radicals are generated), propagation (radicals react to form new radicals) and termination (radicals combine).

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

Step 2 — Match to a stage: generating the first radicals is the initiation step.

Step 3 — Conclude: this is the chain-initiation step.

Why other options are wrong:

- (A) termination consumes radicals (e.g. $Cl^\bullet + Cl^\bullet \to Cl_2$).
- (B) propagation uses a radical to form another radical.
- (D) no skeletal rearrangement occurs here.

Final Answer: chain-initiation step $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q31

Q32.

Solution

Concept — Friedel–Crafts acylation: An aromatic ring reacts with an acyl halide in the presence of anhydrous $\mathrm{AlCl_3}$ to introduce an acyl ($-\mathrm{COR}$) group, giving an aryl ketone.

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

Step 2 — Electrophilic substitution: the acylium ion attacks benzene.

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

Step 4 — Name the reaction: this is Friedel–Crafts acylation.

Why other options are wrong:

- (A) Cannizzaro involves aldehydes without α-H disproportionating.
- (B) Wurtz couples alkyl halides with sodium.
- (C) Sandmeyer replaces a diazonium group with a halide.

Final Answer: Friedel–Crafts acylation $\Rightarrow \boxed{\mathrm{D}}$

Answer: (D) Go Back to Q32

Q33.

Solution

Concept — Lucas test: Lucas reagent (concentrated HCl + anhydrous $\mathrm{ZnCl_2}$) reacts with alcohols at different rates depending on whether they are primary, secondary or tertiary, allowing them to be distinguished.

Step 1 — Recall the reaction: the alcohol is converted to an alkyl chloride, which appears as turbidity.

Step 2 — Distinguish classes: tertiary reacts at once, secondary on warming, primary not at room temperature.

Step 3 — Conclude: the test distinguishes 1°, 2° and 3° alcohols.

Why other options are wrong:

- (B) aldehydes are detected by Tollens'/Fehling's, not Lucas.

- (C) unsaturation is tested by bromine water/Baeyer's reagent.
- (D) carboxylic acids are tested with $NaHCO_3$.

Final Answer: distinguishes $1°/2°/3°$ alcohols $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — Ammonium salt of an acid to amide: On strong heating, the ammonium salt of a carboxylic acid loses a molecule of water and is converted into the corresponding amide.

Step 1 — Identify the starting salt: ammonium acetate is CH_3COONH_4.

Step 2 — Apply the dehydration on heating: $CH_3COONH_4 \xrightarrow{\Delta} CH_3CONH_2 + H_2O$.

Step 3 — Name the product: the loss of water gives acetamide CH_3CONH_2.

Step 4 — Conclude: heating ammonium acetate yields acetamide.

Why other options are wrong:

- (A) acetic acid is the parent acid, not the dehydration product.
- (B) acetyl chloride needs $SOCl_2/PCl_5$, not simple heating.
- (C) ethylamine would require reduction, which is not happening here.

Final Answer: acetamide $CH_3CONH_2 \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q34

Q35.

Solution

Concept — Electronegativity trend in a group: Electronegativity decreases down a group as atomic size increases. So among the halogens it falls from F to I.

Step 1 — Recall the order down group 17: F is the most electronegative element.

Step 2 — Arrange descending: $F > Cl > Br > I$.

Step 3 — Conclude: fluorine is highest, iodine lowest.

Why other options are wrong:

- (A) reverses the trend.
- (B) and (C) misplace fluorine, which must be the most electronegative.

Final Answer: $\mathrm{F} > \mathrm{Cl} > \mathrm{Br} > \mathrm{I} \Rightarrow \boxed{\mathrm{D}}$

Answer: (D) Go Back to Q35

Q36.

Solution

Concept — VSEPR for NH_3: Nitrogen has three bond pairs and one lone pair (AB_3E). The four electron pairs are tetrahedrally arranged, but the molecular shape (atoms only) is trigonal pyramidal.

Step 1 — Count electron pairs: 3 bond pairs $+ 1$ lone pair $= 4$.

Step 2 — Electron geometry: tetrahedral.

Step 3 — Molecular shape (ignore lone pair position): trigonal pyramidal.

Step 4 — Conclude: NH_3 is trigonal pyramidal.

Why other options are wrong:

- (B) trigonal planar would need no lone pair (e.g. BF_3).
- (C) tetrahedral describes the electron geometry, not the molecular shape.
- (D) square planar requires six electron pairs with two lone pairs.

Final Answer: trigonal pyramidal $\Rightarrow \boxed{\mathrm{A}}$

Answer: (A) Go Back to Q36

Q37.

Solution

Concept — Hybridization from steric number: Steric number $=$ (sigma bonds $+$ lone pairs). For $\mathrm{BF_3}$, boron has three sigma bonds and no lone pair, giving steric number 3 and sp^2 hybridisation.

Step 1 — Count sigma bonds: three B–F bonds.

Step 2 — Count lone pairs on B: zero.

Step 3 — Steric number: $3 + 0 = 3$.

Step 4 — Assign hybridisation: steric number $3 \Rightarrow sp^2$ (trigonal planar).

Why other options are wrong:

- (A) sp corresponds to steric number 2.
- (C) sp^3 corresponds to steric number 4.
- (D) sp^3d corresponds to steric number 5.

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

$\boxed{\textbf{Answer: (B)}}$ Go Back to Q37

Q38.

Solution

Concept — Diagonal relationship: An element of the second period often resembles the element diagonally placed in the next period and group, owing to similar charge/size ratios. Li (period 2, group 1) resembles Mg (period 3, group 2).

Step 1 — Locate the pair: Li and Mg are diagonal neighbours.

Step 2 — Reason: similar charge density (charge-to-size ratio) causes similar chemistry.

Step 3 — Conclude: this is the diagonal relationship.

Why other options are wrong:

- (A) the inert pair effect concerns heavier p-block elements.
- (B) lanthanide contraction concerns the $4f$ series.
- (D) the screening effect alone does not explain the Li–Mg similarity.

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

$\boxed{\text{Answer: (C)}}$ Go Back to Q38

Q39.

Solution

Concept — Lewis acidity of BCl_3**:** Boron in BCl_3 has only six electrons in its valence shell (an incomplete octet) and a vacant $2p$ orbital, so it can accept an electron pair.

Step 1 — Count electrons around B: three B–Cl bonds give six shared electrons only.

Step 2 — Identify the vacant orbital: an empty $2p$ orbital remains on boron.

Step 3 — Lewis-acid behaviour: the empty orbital accepts a lone pair from a Lewis base.

Step 4 — Conclude: the incomplete octet/empty orbital makes BCl_3 a Lewis acid.

Why other options are wrong:

- (B) boron has no lone pair to donate.
- (C) the octet is not complete on boron.
- (D) boron is less electronegative than chlorine.

Final Answer: incomplete octet with an empty orbital $\Rightarrow \boxed{\text{A}}$

$\boxed{\text{Answer: (A)}}$ Go Back to Q39

Q40.

Solution

Concept — Allotropes of carbon: Crystalline allotropes have ordered lattices (diamond, graphite, fullerene). Charcoal is an amorphous (non-crystalline) form.

Step 1 — Classify diamond and graphite: both crystalline.

Step 2 — Classify fullerene: C_{60} is a crystalline molecular allotrope.

Step 3 — Classify charcoal: amorphous carbon, not crystalline.

Step 4 — Conclude: charcoal is NOT a crystalline allotrope.

Why other options are wrong:

- (A), (C) and (D) diamond, graphite and fullerene are all crystalline allotropes.

Final Answer: charcoal (amorphous) $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q40

Q41.

Solution

Concept — Bond angle in hydrides of group 15: A smaller, more electronegative central atom holds its bonding pairs closer, so bond-pair–bond-pair repulsion is greater, widening the bond angle.

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

Step 2 — Effect on bond pairs: in NH_3 the bond pairs are nearer the central atom and repel more.

Step 3 — Result: the angle in NH_3 ($107°$) is larger than in PH_3 ($\approx 93°$).

Step 4 — Conclude: the smaller, more electronegative N gives the larger angle.

Why other options are wrong:

- (A) P is in fact less electronegative than N.
- (B) both have exactly one lone pair.
- (C) PH_3 does have a lone pair.

Final Answer: N is smaller and more electronegative $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q41

Q42.

Solution

Concept — Acid–base nature of oxides: Non-metal oxides are usually acidic; metal oxides of s-block metals are basic.

Step 1 — Classify SO_2**:** non-metal oxide $\Rightarrow$ acidic (gives H_2SO_3 with water).

Step 2 — Classify SO_3**:** non-metal oxide $\Rightarrow$ acidic (gives H_2SO_4 with water).

Step 3 — Classify Na_2O**:** s-block metal oxide $\Rightarrow$ basic (gives NaOH with water).

Step 4 — Conclude: SO_2 and SO_3 are acidic, Na_2O is basic.

Why other options are wrong:

- (B) and (C) misclassify one or more oxides.
- (D) reverses the nature of SO_3 and Na_2O.

Final Answer: SO_2, SO_3 acidic; Na_2O basic $\Rightarrow \boxed{A}$

$\boxed{\text{Answer: (A)}}$ Go Back to Q42

Q43.

Solution

Concept — Reactivity of halogens: The chemical reactivity of the halogens depends on their oxidising power, which decreases down the group. Fluorine is the most reactive non-metal; reactivity then falls from Cl_2 to Br_2 to I_2.

Step 1 — Recall the trend: oxidising power and reactivity decrease as size increases down group 17.

Step 2 — Place fluorine first: F_2 has the highest reactivity (highest electrode potential, low bond dissociation energy).

Step 3 — Arrange the rest: $Cl_2 > Br_2 > I_2$ in decreasing reactivity.

Step 4 — Write the full order: $F_2 > Cl_2 > Br_2 > I_2$.

Why other options are wrong:

- (A) is the exact reverse of the correct trend.
- (B) wrongly places Cl_2 above F_2.
- (D) jumbles the order, putting Br_2 first.

Final Answer: $F_2 > Cl_2 > Br_2 > I_2 \Rightarrow \boxed{C}$

$\boxed{\text{Answer: (C)}}$ Go Back to Q43

Q44.

Solution

Concept — VSEPR for XeF_2**:** Xe has 2 bond pairs and 3 lone pairs (steric number 5, AB_2E_3). The lone pairs occupy the equatorial positions of a trigonal bipyramid, leaving the two F atoms axial, so the molecule is linear.

Step 1 — Count electron pairs: 2 bond pairs $+$ 3 lone pairs $= 5$.

Step 2 — Electron geometry: trigonal bipyramidal.

Step 3 — Place lone pairs equatorially: the three lone pairs take the equatorial sites.

Step 4 — Resulting shape: the two F atoms are axial, giving a linear molecule.

Why other options are wrong:

- (A) bent would need the lone pairs arranged differently.
- (C) trigonal planar does not match AB_2E_3.
- (D) T-shaped applies to AB_3E_2 (e.g. ClF_3).

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

Answer: (B) Go Back to Q44

Q45.

Solution

Concept — Lanthanide contraction: Across the lanthanide series, electrons enter the inner $4f$ subshell, which shields the nuclear charge poorly. The effective nuclear charge therefore rises steadily, pulling the electrons inward and causing a gradual decrease in atomic and ionic radii. This is the lanthanide contraction.

Step 1 — Identify the cause: added $4f$ electrons give weak, imperfect shielding.

Step 2 — Effect on effective nuclear charge: it increases with atomic number across the series.

Step 3 — Effect on size: radii decrease steadily from La to Lu.

Step 4 — Name the phenomenon: this regular size decrease is the lanthanide contraction.

Why other options are wrong:

- (A) the shielding effect is a contributing cause, not the name of this radius trend.

- (C) the inert pair effect concerns the stability of lower oxidation states, not size.
- (D) the diagonal relationship links pairs like Li–Mg, not the lanthanide radii trend.

Final Answer: lanthanide contraction $\Rightarrow \boxed{\text{B}}$

$\boxed{\text{Answer: (B)}}$ **Go Back to Q45**

Q46.

Solution

Concept — Denticity: Denticity is the number of donor atoms in a single ligand that bind to the central metal. A ligand binding through two donor atoms is bidentate.

Step 1 — Write the structure of en: ethylenediamine is $H_2N–CH_2–CH_2–NH_2$.

Step 2 — Find the donor atoms: each of the two nitrogen atoms carries a lone pair available for donation.

Step 3 — Count them: two nitrogen donor atoms bind the metal, forming a five-membered chelate ring.

Step 4 — Conclude: en is bidentate, so its denticity is 2.

Why other options are wrong:

- (A) 1 would make it monodentate (like NH_3).
- (B) 4 describes a tetradentate ligand.
- (D) 6 describes a hexadentate ligand (like EDTA).

Final Answer: denticity $= 2 \Rightarrow \boxed{\text{C}}$

$\boxed{\text{Answer: (C)}}$ **Go Back to Q46**

Q47.

Solution

Concept — Optical isomerism in tris-chelate complexes: An octahedral complex with three symmetrical bidentate ligands, $[\mathrm{M(AA)_3}]$, has no plane of symmetry; its mirror image is non-superimposable, so it is chiral and shows optical isomerism.

Step 1 — Identify the type: $[\mathrm{Co(en)_3}]^{3+}$ is a $\mathrm{M(AA)_3}$ tris-chelate.

Step 2 — Test for a symmetry plane: the propeller-like arrangement has none.

Step 3 — Mirror images: the two forms (often labelled Δ and Λ) are non-superimposable.

Step 4 — Conclude: the complex exhibits optical isomerism.

Why other options are wrong:

- (B) it clearly shows isomerism (it is chiral).
- (C) symmetrical $\mathrm{M(AA)_3}$ shows optical, not geometrical, isomerism.
- (D) linkage isomerism needs an ambidentate ligand, which en is not.

Final Answer: optical isomerism $\Rightarrow \boxed{\mathrm{A}}$

Answer: (A) Go Back to Q47

Q48.

Solution

Concept — Calcination: Heating an ore (especially a carbonate or hydroxide) strongly in the absence or limited supply of air to drive off volatile matter and form the oxide is called calcination.

Step 1 — Recognise the carbonate ore: e.g. $\mathrm{ZnCO_3} \xrightarrow{\Delta} \mathrm{ZnO} + \mathrm{CO_2}$.

Step 2 — Note the conditions: limited/absence of air.

Step 3 — Conclude: this process is calcination.

Why other options are wrong:

- (A) roasting heats (sulphide) ores in excess air.
- (C) froth flotation is a concentration step, not a heating step.
- (D) smelting reduces an oxide to the metal with a flux.

Final Answer: calcination $\Rightarrow \boxed{\mathrm{B}}$

Answer: (B) Go Back to Q48

Q49.

Solution

Concept — Heavy water: "Heavy water" is deuterium oxide, D_2O, in which ordinary hydrogen is replaced by its heavier isotope deuterium. It is used as a moderator in nuclear reactors.

Step 1 — Identify the isotope: deuterium (D, ^2H).

Step 2 — Write the formula: D_2O.

Step 3 — Conclude: heavy water is D_2O.

Why other options are wrong:

- (A) H_2O_2 is hydrogen peroxide.
- (B) ordinary purified water is still H_2O.
- (C) T_2O is "tritiated"/super-heavy water, not the usual moderator.

Final Answer: $D_2O \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q49

Q50.

Solution

Concept — Chromyl chloride test: When a chloride salt is heated with potassium dichromate and concentrated H_2SO_4, it gives orange-red vapours of chromyl chloride CrO_2Cl_2. This is a confirmatory test for the chloride ion.

Step 1 — Recall the reaction: $4Cl^- + Cr_2O_7^{2-} + 6H^+ \to 2CrO_2Cl_2 + 3H_2O$ (with conc. H_2SO_4).

Step 2 — Identify the orange-red vapour: the volatile species is chromyl chloride CrO_2Cl_2.

Step 3 — Link to the anion: only a chloride salt forms CrO_2Cl_2 under these conditions.

Step 4 — Conclude: the test confirms the presence of the chloride ion.

Why other options are wrong:

- (A) sulphate gives a white $BaSO_4$ precipitate test, not chromyl chloride.

- (C) nitrate is detected by the brown-ring test.
- (D) bromide and iodide do not give the chromyl chloride vapours (the test is specific to chloride).

Final Answer: chloride ion $\Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q50**

Answer Key

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