

# JCECE Chemistry Sample Paper – 9

Duration: 60 Minutes

Maximum Marks: 50

## Instructions

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

**Q1.** The number of oxygen atoms present in 4.4 g of carbon dioxide  $\text{CO}_2$  (molar mass = 44 g/mol,  $N_A = 6.0 \times 10^{23}$ ) is:

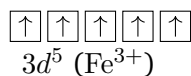
- (A)  $0.6 \times 10^{23}$
- (B)  $3.0 \times 10^{23}$
- (C)  $1.2 \times 10^{23}$
- (D)  $6.0 \times 10^{23}$

**Q2.** According to Bohr's model, the number of de Broglie waves made by an electron in the 4<sup>th</sup> orbit of a hydrogen atom (where the circumference equals  $n$  wavelengths) is:

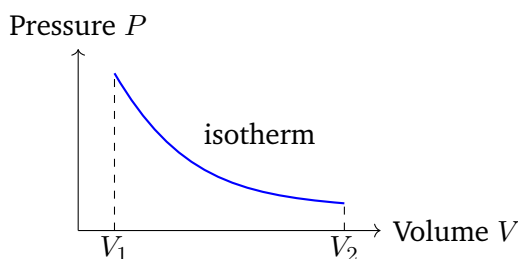
- (A) 2
- (B) 4
- (C) 8
- (D) 16



- Q3.** An  $\text{Fe}^{3+}$  ion has the  $3d$  configuration drawn below. Its spin-only magnetic moment  $\mu = \sqrt{n(n+2)}$  BM (where  $n$  is the number of unpaired electrons) is:



- (A)  $\sqrt{8}$  BM  
 (B)  $\sqrt{15}$  BM  
 (C)  $\sqrt{24}$  BM  
 (D)  $\sqrt{35}$  BM
- Q4.** For a sample of an ideal gas, the most probable speed is given by  $v_{mp} = \sqrt{\frac{2RT}{M}}$ . If the root-mean-square speed of the same sample is  $v_{rms} = \sqrt{\frac{3RT}{M}}$ , then the ratio  $v_{mp} : v_{rms}$  is:
- (A)  $\sqrt{2} : \sqrt{3}$   
 (B)  $\sqrt{3} : \sqrt{2}$   
 (C) 1 : 1  
 (D) 2 : 3
- Q5.** 2 mol of an ideal gas expands reversibly and isothermally at 300 K from 1 L to 10 L. From the indicator (work) diagram shown, the maximum work done by the gas,  $w = -nRT \ln \frac{V_2}{V_1}$  (take  $R = 8.314$ ,  $\ln 10 = 2.303$ ), is approximately:



- (A)  $-5.7$  kJ



- (B)  $-9.6 \text{ kJ}$
- (C)  $-11.5 \text{ kJ}$
- (D)  $-23.0 \text{ kJ}$

**Q6.** For the gaseous reaction  $\text{CH}_4(\text{g}) \rightarrow \text{C}(\text{g}) + 4\text{H}(\text{g})$  the enthalpy of atomization is  $1664 \text{ kJ/mol}$ . The average C–H bond dissociation energy in methane is:

- (A)  $416 \text{ kJ/mol}$
- (B)  $832 \text{ kJ/mol}$
- (C)  $1664 \text{ kJ/mol}$
- (D)  $208 \text{ kJ/mol}$

**Q7.** For the reaction  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$ , the relation between  $K_p$  and  $K_c$  is  $K_p = K_c(RT)^{\Delta n_g}$ . The value of  $\Delta n_g$  to be used is:

- (A)  $+1$
- (B)  $+2$
- (C)  $0$
- (D)  $-2$

**Q8.** A  $0.1 \text{ M}$  aqueous solution of sodium acetate ( $\text{CH}_3\text{COONa}$ ) is taken. Given  $K_a(\text{CH}_3\text{COOH}) = 1.0 \times 10^{-5}$  and  $K_w = 1.0 \times 10^{-14}$ , the pH of this salt solution is:

- (A)  $5$
- (B)  $7$
- (C)  $4$
- (D)  $9$

**Q9.** The solubility product of  $\text{Fe}(\text{OH})_3$  (an  $\text{AB}_3$ -type salt) is  $K_{sp} = 27 \times 10^{-16}$ . If its molar solubility is  $s$ , then  $K_{sp} = 27s^4$ , and the value of  $s$  is:

- (A)  $1 \times 10^{-4} \text{ mol/L}$

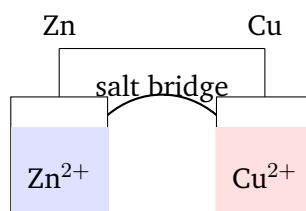


- (B)  $9 \times 10^{-4}$  mol/L  
 (C)  $3 \times 10^{-4}$  mol/L  
 (D)  $1 \times 10^{-8}$  mol/L

**Q10.** Two solutions are isotonic (equal osmotic pressure) at the same temperature. If solution X is 0.1 M glucose and solution Y is a  $c$  M solution of NaCl (assume complete dissociation,  $i = 2$ ), the concentration  $c$  of NaCl that makes Y isotonic with X is:

- (A) 0.20 M  
 (B) 0.10 M  
 (C) 0.05 M  
 (D) 0.025 M

**Q11.** For the spontaneous Daniell cell shown, where zinc is oxidised and copper(II) is reduced, the correct cell representation (cell notation) is:



- (A)  $\text{Zn} | \text{Zn}^{2+} || \text{Cu}^{2+} | \text{Cu}$   
 (B)  $\text{Cu} | \text{Cu}^{2+} || \text{Zn}^{2+} | \text{Zn}$   
 (C)  $\text{Zn}^{2+} | \text{Zn} || \text{Cu} | \text{Cu}^{2+}$   
 (D)  $\text{Cu}^{2+} | \text{Cu} || \text{Zn} | \text{Zn}^{2+}$

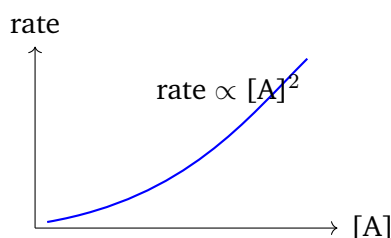
**Q12.** When a current is passed through molten  $\text{AlCl}_3$  and 0.3 mol of aluminium ( $\text{Al}^{3+} + 3e^- \rightarrow \text{Al}$ ) is deposited at the cathode, the number of gram-equivalents of aluminium deposited is:

- (A) 0.3  
 (B) 0.9

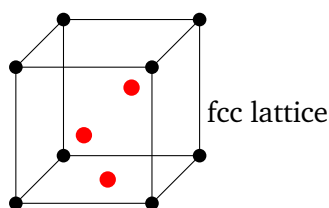


- (C) 0.1  
(D) 3.0

**Q13.** For the reaction with rate law  $\text{rate} = k[A]^2$ , the concentration of A is increased from 0.1 M to 0.3 M. From the rate-versus-[A] curve shown, the rate increases by a factor of:



- (A) 3  
(B) 6  
(C) 9  
(D) 27
- Q14.** For a first-order reaction with rate constant  $k = 2.303 \times 10^{-2} \text{ min}^{-1}$ , the time required for the reaction to be 99% complete (use  $t = \frac{2.303}{k} \log \frac{100}{100 - x}$ ) is:
- (A) 50 min  
(B) 100 min  
(C) 230 min  
(D) 200 min
- Q15.** In a face-centred cubic (ccp) lattice containing  $N$  atoms per unit cell as shown, the number of tetrahedral voids present is:



- (A) 4
- (B) 6
- (C) 2
- (D) 8

**Q16.** In the reaction  $\text{Zn(s)} + \text{CuSO}_4(\text{aq}) \rightarrow \text{ZnSO}_4(\text{aq}) + \text{Cu(s)}$ , the species that acts as the reducing agent is:

- (A)  $\text{Cu}^{2+}$
- (B)  $\text{SO}_4^{2-}$
- (C) Zn
- (D) Cu

**Q17.** A solution is prepared by dissolving 0.5 mol of NaOH (molar mass = 40 g/mol) in water to make 250 mL of solution. The strength of the solution in grams per litre (g/L) is:

- (A) 20 g/L
- (B) 80 g/L
- (C) 40 g/L
- (D) 160 g/L

**Q18.** The IUPAC name of the ester  $\text{CH}_3\text{-COO-CH}_2\text{CH}_3$  is:

- (A) methyl ethanoate
- (B) ethyl ethanoate
- (C) ethyl methanoate
- (D) methyl propanoate

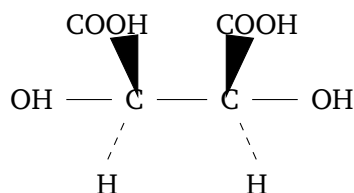
**Q19.** The total number of structural isomers (including alcohols and ethers) possible for the molecular formula  $\text{C}_3\text{H}_8\text{O}$  is:

- (A) 2



- (B) 3  
(C) 4  
(D) 5

**Q20.** For 2,3-dihydroxybutanedioic acid (tartaric acid),  $\text{HOOC}-\text{CH}(\text{OH})-\text{CH}(\text{OH})-\text{COOH}$  whose two equivalent chiral centres are drawn below, the total number of stereoisomers (counting the meso form) is:

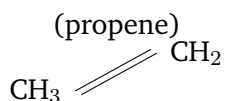


- (A) 4  
(B) 2  
(C) 3  
(D) 1

**Q21.** In aqueous solution, the correct order of basic strength of the following amines (most basic first) is:

- (A)  $(\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_3\text{N} > \text{NH}_3$   
 (B)  $\text{NH}_3 > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_2\text{NH} > (\text{CH}_3)_3\text{N}$   
 (C)  $(\text{CH}_3)_3\text{N} > (\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2 > \text{NH}_3$   
 (D)  $\text{CH}_3\text{NH}_2 > \text{NH}_3 > (\text{CH}_3)_2\text{NH} > (\text{CH}_3)_3\text{N}$

**Q22.** When propene (shown) undergoes acid-catalysed hydration (addition of water in presence of dilute  $\text{H}_2\text{SO}_4$ , Markovnikov addition), the major product is:

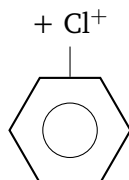


- (A) propan-1-ol



- (B) propan-2-ol
- (C) propane-1,2-diol
- (D) propanal

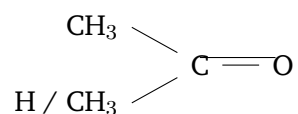
**Q23.** When benzene (shown) is treated with  $\text{Cl}_2$  in the presence of anhydrous  $\text{FeCl}_3$  (a Lewis acid catalyst), the electrophilic substitution product is:



- (A) benzene hexachloride
  - (B) chlorobenzene
  - (C) benzyl chloride
  - (D) dichlorobenzene
- Q24.** In the Finkelstein reaction, an alkyl chloride or bromide is converted into the corresponding alkyl iodide. The reagent used is:
- (A)  $\text{AgNO}_3$  in water
  - (B)  $\text{KOH}$  in alcohol
  - (C)  $\text{NaI}$  in dry acetone
  - (D)  $\text{Zn}$  dust
- Q25.** When phenol is treated with chloroform and aqueous  $\text{NaOH}$  (Reimer-Tiemann reaction) followed by acidification, the major product formed is:
- (A) benzoic acid
  - (B) picric acid
  - (C) anisole
  - (D) salicylaldehyde (2-hydroxybenzaldehyde)



- Q26.** Acetaldehyde and acetone both contain the carbonyl group (shown). The reagent that distinguishes the aldehyde (acetaldehyde) from the ketone (acetone) by giving a positive test only with the aldehyde is:



- (A) Tollens' reagent (ammoniacal  $\text{AgNO}_3$ )  
(B) 2,4-DNP reagent  
(C) sodium bisulphite  
(D) neutral  $\text{FeCl}_3$
- Q27.** Among ethanol, phenol and acetic acid, the one that liberates carbon dioxide (effervescence) on reaction with aqueous sodium bicarbonate ( $\text{NaHCO}_3$ ) is:
- (A) ethanol only  
(B) acetic acid only  
(C) phenol only  
(D) both phenol and acetic acid
- Q28.** Benzene diazonium chloride couples with phenol in mildly alkaline medium to give a coloured product. This azo-coupling reaction yields:
- (A) nitrobenzene  
(B) chlorobenzene  
(C) *p*-hydroxyazobenzene (an orange dye)  
(D) aniline
- Q29.** When egg-white protein is heated or treated with concentrated acid, it coagulates and loses its biological activity. This change is best described as:
- (A) hydrolysis of peptide bonds into amino acids



- (B) formation of a new primary structure
- (C) polymerisation of amino acids
- (D) denaturation (loss of secondary/tertiary structure)

**Q30.** Poly(vinyl chloride), PVC, is an addition polymer. The monomer from which PVC is made is:

- (A) vinyl chloride ( $\text{CH}_2=\text{CHCl}$ )
- (B) chloroethane ( $\text{CH}_3\text{CH}_2\text{Cl}$ )
- (C) vinyl alcohol ( $\text{CH}_2=\text{CHOH}$ )
- (D) tetrafluoroethene ( $\text{CF}_2=\text{CF}_2$ )

**Q31.** A neutral, highly reactive intermediate having a carbon atom with only six valence electrons (two bonds and a lone pair) is generated when chloroform reacts with a base. This species is:

- (A) a carbocation
- (B) a carbene (dichlorocarbene,  $:\text{CCl}_2$ )
- (C) a carbanion
- (D) a free radical

**Q32.** The reduction of the carbonyl group of a ketone to a  $-\text{CH}_2-$  group using zinc amalgam and concentrated HCl is known as:

- (A) Cannizzaro reaction
- (B) Wolff–Kishner reduction
- (C) Rosenmund reduction
- (D) Clemmensen reduction

**Q33.** A compound, on warming with Fehling's solution, gives a brick-red precipitate of cuprous oxide ( $\text{Cu}_2\text{O}$ ). The compound is most likely:

- (A) benzaldehyde (aromatic aldehyde)



- (B) acetaldehyde (an aliphatic aldehyde)
- (C) acetone (a ketone)
- (D) ethanol (an alcohol)

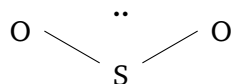
**Q34.** The reagent best suited to convert an alkyl halide ( $R-X$ ) into the corresponding alcohol ( $R-OH$ ) by nucleophilic substitution is:

- (A) alcoholic KOH
- (B) dry ether with Na
- (C) aqueous KOH (or moist  $Ag_2O$ )
- (D) concentrated  $H_2SO_4$

**Q35.** Across period 3 (Na to Cl), the non-metallic character generally increases. The correct order of non-metallic character among Na, Si, P and Cl (increasing order) is:

- (A)  $Na < Si < P < Cl$
- (B)  $Si < Na < P < Cl$
- (C)  $Cl < P < Si < Na$
- (D)  $Na < P < Si < Cl$

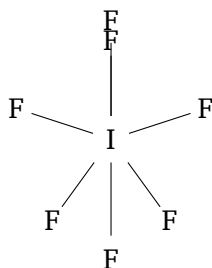
**Q36.** According to VSEPR theory, the molecule sulphur dioxide  $SO_2$  (shown, with one lone pair on S) has the shape:



- (A) bent (angular)
- (B) linear
- (C) trigonal planar
- (D) tetrahedral

**Q37.** The hybridization of the central iodine atom in iodine heptafluoride  $IF_7$  (pentagonal bipyramidal geometry shown) is:





- (A)  $sp^3d^3$
- (B)  $sp^3d^2$
- (C)  $sp^3d$
- (D)  $sp^3$

**Q38.** For the alkali metal halides (chlorides) of group 1, lattice enthalpy generally depends on ionic size. Among LiCl, NaCl, KCl and RbCl, the one with the highest (most negative) lattice enthalpy is:

- (A) RbCl
- (B) LiCl
- (C) KCl
- (D) NaCl

**Q39.** Boron trifluoride  $BF_3$  is a weaker Lewis acid than expected from boron's electron deficiency. This is explained by:

- (A) the inert pair effect of boron
- (B) a diagonal relationship with silicon
- (C) hydrogen bonding between molecules
- (D)  $p\pi-p\pi$  back-bonding from fluorine to boron

**Q40.** Down group 14, the relative stability of the +2 oxidation state with respect to +4 increases. Therefore, the most stable +2 state is shown by:

- (A) carbon
- (B) silicon



- (C) lead
- (D) germanium

**Q41.** Nitrogen shows very little tendency for catenation, whereas phosphorus catenates more readily. The main reason is:

- (A) the N–N single bond is weak (due to lone-pair repulsions on the small N atoms)
- (B) nitrogen has no lone pair
- (C) phosphorus is more electronegative than nitrogen
- (D) the P–P bond is much weaker than the N–N bond

**Q42.** The two common crystalline allotropic forms of sulphur, both built from puckered S<sub>8</sub> rings, are:

- (A) white and red sulphur
- (B) rhombic ( $\alpha$ ) and monoclinic ( $\beta$ ) sulphur
- (C) plastic and colloidal sulphur
- (D) graphitic and amorphous sulphur

**Q43.** The colour of the halogens deepens (becomes darker) on moving down group 17. The correct order of colour from lightest to darkest is:

- (A) I<sub>2</sub> < Br<sub>2</sub> < Cl<sub>2</sub> < F<sub>2</sub>
- (B) Br<sub>2</sub> < F<sub>2</sub> < Cl<sub>2</sub> < I<sub>2</sub>
- (C) F<sub>2</sub> < Cl<sub>2</sub> < Br<sub>2</sub> < I<sub>2</sub>
- (D) Cl<sub>2</sub> < F<sub>2</sub> < I<sub>2</sub> < Br<sub>2</sub>

**Q44.** Xenon hexafluoride XeF<sub>6</sub> has six bond pairs and one lone pair on xenon. According to VSEPR, its molecular shape is:

- (A) octahedral (regular)
- (B) planar hexagonal

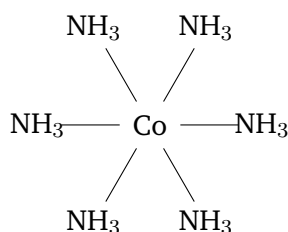


- (C) square pyramidal  
 (D) distorted octahedral (capped octahedral)

**Q45.** In acidic medium, potassium dichromate ( $K_2Cr_2O_7$ ) acts as a strong oxidising agent. The oxidation state of chromium changes from +6 in  $Cr_2O_7^{2-}$  to:

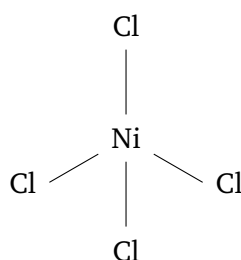
- (A) +3  
 (B) 0  
 (C) +2  
 (D) +7

**Q46.** In Werner's theory, for the octahedral complex  $[Co(NH_3)_6]Cl_3$  (the cation is shown), the secondary valence (coordination number) of cobalt is:



- (A) 3  
 (B) 6  
 (C) 9  
 (D) 2

**Q47.** For the tetrahedral complex  $[NiCl_4]^{2-}$  (shown), nickel is  $Ni^{2+}$  ( $d^8$ ) with two unpaired electrons (weak-field  $Cl^-$ ). Its spin-only magnetic moment  $\mu = \sqrt{n(n+2)}$  BM is:



- (A) 0 BM
- (B)  $\sqrt{3}$  BM
- (C)  $\sqrt{15}$  BM
- (D)  $\sqrt{8}$  BM

**Q48.** In the extraction of silver and gold from their ores, the metal is dissolved as a soluble cyano-complex by treatment with dilute sodium cyanide solution in the presence of air. This hydrometallurgical step is called:

- (A) roasting
- (B) calcination
- (C) froth flotation
- (D) cyanide leaching

**Q49.** Hydrogen has three isotopes. The isotope of hydrogen that contains one proton and two neutrons (mass number 3) and is radioactive is:

- (A) protium ( ${}^1_1\text{H}$ )
- (B) deuterium ( ${}^2_1\text{H}$ )
- (C) tritium ( ${}^3_1\text{H}$ )
- (D) ortho-hydrogen

**Q50.** In qualitative analysis, a white precipitate forms when  $\text{AgNO}_3$  is added to a solution; the precipitate is insoluble in dilute  $\text{HNO}_3$  but readily dissolves in dilute  $\text{NH}_4\text{OH}$ . This confirms the presence of the anion:

- (A) iodide ( $\text{I}^-$ )
- (B) sulphate ( $\text{SO}_4^{2-}$ )
- (C) bromide ( $\text{Br}^-$ )
- (D) chloride ( $\text{Cl}^-$ )



## Detailed Solutions

Q1.

## Solution

**Concept — Counting atoms from mass:** Find moles of the compound, multiply by Avogadro's number for molecules, then by the number of that atom per molecule.

**Step 1 — Find moles of  $\text{CO}_2$ :**  $n = \frac{4.4}{44} = 0.1 \text{ mol}$ .

**Step 2 — Find molecules of  $\text{CO}_2$ :**  $0.1 \times 6.0 \times 10^{23} = 0.6 \times 10^{23}$  molecules.

**Step 3 — Count O atoms per molecule:** each  $\text{CO}_2$  has 2 oxygen atoms.

**Step 4 — Total O atoms:**  $0.6 \times 10^{23} \times 2 = 1.2 \times 10^{23}$ .

**Why other options are wrong:**

- (A) counts molecules, not O atoms.
- (B) uses 0.5 mol of  $\text{CO}_2$ .
- (D) is the full  $N_A$  (uses 1 mol).

**Final Answer:**  $1.2 \times 10^{23}$  oxygen atoms  $\Rightarrow$

[Go Back to Q1](#)

Q2.

## Solution

**Concept — de Broglie waves in a Bohr orbit:** The quantum condition  $2\pi r = n\lambda$  means the number of complete waves equals the principal quantum number  $n$ .

**Step 1 — Write the standing-wave condition:**  $2\pi r_n = n\lambda$ .

**Step 2 — Interpret:** the circumference holds exactly  $n$  wavelengths.

**Step 3 — Substitute  $n = 4$ :** number of waves =  $n = 4$ .

**Why other options are wrong:**

- (A) uses  $n = 2$ .
- (C) uses  $2n$ .
- (D) uses  $n^2$ .

**Final Answer:** 4 waves  $\Rightarrow$



**Answer: (B)** [Go Back to Q2](#)

Q3.

### Solution

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

**Step 1 — Configuration of  $\text{Fe}^{3+}$ :** Fe is  $[\text{Ar}]3d^64s^2$ ; removing 3 electrons gives  $3d^5$ .

**Step 2 — Count unpaired electrons:**  $3d^5$  (half-filled) has all 5 electrons unpaired, so  $n = 5$ .

**Step 3 — Substitute into the formula:**  $\mu = \sqrt{5(5+2)} = \sqrt{5 \times 7}$ .

**Step 4 — Evaluate:**  $\mu = \sqrt{35}$  BM.

**Why other options are wrong:**

- (A) corresponds to  $n = 2$ .
- (B) corresponds to  $n = 3$ .
- (C) corresponds to  $n = 4$ .

**Final Answer:**  $\mu = \sqrt{35}$  BM  $\Rightarrow$  **D**

**Answer: (D)** [Go Back to Q3](#)

Q4.

### Solution

**Concept — Molecular speed ratios:** For the same gas at the same  $T$ ,  $v_{mp} = \sqrt{\frac{2RT}{M}}$  and  $v_{rms} = \sqrt{\frac{3RT}{M}}$ , so their ratio is fixed.

**Step 1 — Write both speeds:**  $v_{mp} = \sqrt{2RT/M}$ ,  $v_{rms} = \sqrt{3RT/M}$ .

**Step 2 — Take the ratio:**  $\frac{v_{mp}}{v_{rms}} = \sqrt{\frac{2RT/M}{3RT/M}}$ .

**Step 3 — Cancel common terms:**  $RT/M$  cancels, leaving  $\sqrt{\frac{2}{3}}$ .

**Step 4 — Express as a ratio:**  $v_{mp} : v_{rms} = \sqrt{2} : \sqrt{3}$ .

**Why other options are wrong:**

- (B) inverts the ratio.



- (C) ignores the difference in the constants.
- (D) uses the squares instead of the square roots.

**Final Answer:**  $\sqrt{2} : \sqrt{3} \Rightarrow$

**Answer: (A)** [Go Back to Q4](#)

Q5.

### Solution

**Concept — Reversible isothermal work:**  $w = -nRT \ln \frac{V_2}{V_1} = -2.303 nRT \log \frac{V_2}{V_1}$ .

**Step 1 — List data:**  $n = 2$  mol,  $R = 8.314$ ,  $T = 300$  K,  $V_2/V_1 = 10/1 = 10$ .

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

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

**Step 4 — Multiply:**  $w = -4988.4 \times 2.303 = -11488$  J.

**Step 5 — Convert to kJ:**  $w \approx -11.5$  kJ.

**Why other options are wrong:**

- (A) uses  $n = 1$ .
- (B) drops the factor of 2.303.
- (D) doubles the correct value.

**Final Answer:**  $w \approx -11.5$  kJ  $\Rightarrow$

**Answer: (C)** [Go Back to Q5](#)

Q6.

### Solution

**Concept — Average bond dissociation energy:** In methane the four C–H bonds are equivalent, so the average bond energy is the atomization enthalpy divided by 4.

**Step 1 — Identify the process:**  $\text{CH}_4 \rightarrow \text{C} + 4\text{H}$  breaks four C–H bonds.

**Step 2 — Total energy to break:**  $\Delta H_{atom} = 1664$  kJ/mol.

**Step 3 — Divide by number of bonds:** average C–H =  $\frac{1664}{4}$ .

**Step 4 — Evaluate:** = 416 kJ/mol.



Why other options are wrong:

- (B) divides by 2 instead of 4.
- (C) quotes the total atomization enthalpy.
- (D) divides by 8.

Final Answer: C–H bond energy = 416 kJ/mol  $\Rightarrow$  **A**

Answer: (A) [Go Back to Q6](#)

Q7.

### Solution

**Concept** —  $\Delta n_g$  for  $K_p = K_c(RT)^{\Delta n_g}$ :  $\Delta n_g = (\text{moles of gaseous products}) - (\text{moles of gaseous reactants})$ .

**Step 1 — Count product gas moles:** 2 mol  $\text{NH}_3$ .

**Step 2 — Count reactant gas moles:** 1 mol  $\text{N}_2 + 3$  mol  $\text{H}_2 = 4$ .

**Step 3 — Subtract:**  $\Delta n_g = 2 - 4 = -2$ .

Why other options are wrong:

- (A) and (B) have the wrong sign and value.
- (C) would require equal moles on both sides.

Final Answer:  $\Delta n_g = -2 \Rightarrow$  **D**

Answer: (D) [Go Back to Q7](#)

Q8.

### Solution

**Concept** — pH of a salt of weak acid and strong base: Such a salt hydrolyses to give a basic solution;  $\text{pH} = 7 + \frac{1}{2}(\text{p}K_a + \log C)$ .

**Step 1 — Find  $\text{p}K_a$ :**  $\text{p}K_a = -\log(1.0 \times 10^{-5}) = 5$ .

**Step 2 — Find  $\log C$ :**  $C = 0.1$ , so  $\log C = \log(10^{-1}) = -1$ .

**Step 3 — Substitute:**  $\text{pH} = 7 + \frac{1}{2}(5 + (-1)) = 7 + \frac{1}{2}(4)$ .

**Step 4 — Evaluate:**  $\text{pH} = 7 + 2 = 9$ .

Why other options are wrong:



- (A) and (C) give acidic values, but a weak-acid/strong-base salt is basic.
- (B) ignores hydrolysis.

**Final Answer:**  $\text{pH} = 9 \Rightarrow$  D

Answer: (D) [Go Back to Q8](#)

Q9.

### Solution

**Concept — Solubility of an  $\text{AB}_3$  salt:**  $\text{Fe}(\text{OH})_3 \rightleftharpoons \text{Fe}^{3+} + 3\text{OH}^-$  gives  $[\text{Fe}^{3+}] = s$  and  $[\text{OH}^-] = 3s$ , so  $K_{sp} = s(3s)^3 = 27s^4$ .

**Step 1 — Write  $K_{sp}$ :**  $K_{sp} = 27s^4 = 27 \times 10^{-16}$ .

**Step 2 — Cancel the 27:**  $s^4 = 10^{-16}$ .

**Step 3 — Take the fourth root:**  $s = (10^{-16})^{1/4} = 10^{-4}$ .

**Step 4 — State result:**  $s = 1 \times 10^{-4}$  mol/L.

**Why other options are wrong:**

- (B) wrongly multiplies the root by 9.
- (C) wrongly keeps the cube root of 27.
- (D) takes the eighth root.

**Final Answer:**  $s = 1 \times 10^{-4}$  mol/L  $\Rightarrow$  A

Answer: (A) [Go Back to Q9](#)

Q10.

### Solution

**Concept — Isotonic solutions:** Equal osmotic pressure means equal  $i \times C$ . For glucose  $i = 1$ ; for NaCl  $i = 2$ .

**Step 1 — Write the condition:**  $i_X C_X = i_Y C_Y$ .

**Step 2 — Substitute glucose side:**  $1 \times 0.1 = 0.1$ .

**Step 3 — Substitute NaCl side:**  $2 \times c = 0.1$ .

**Step 4 — Solve for  $c$ :**  $c = \frac{0.1}{2} = 0.05$  M.

**Why other options are wrong:**



- (A) multiplies instead of dividing by  $i$ .
- (B) ignores dissociation of NaCl.
- (D) uses  $i = 4$ .

**Final Answer:**  $c = 0.05 \text{ M NaCl} \Rightarrow \boxed{\text{C}}$

**Answer:** (C) [Go Back to Q10](#)

Q11.

### Solution

**Concept — Cell notation rules:** The anode (oxidation) is written on the left, the cathode (reduction) on the right; a single bar is a phase boundary and the double bar is the salt bridge.

**Step 1 — Identify the anode:** Zn is oxidised, so the Zn half-cell goes on the left.

**Step 2 — Identify the cathode:**  $\text{Cu}^{2+}$  is reduced, so the Cu half-cell goes on the right.

**Step 3 — Order within each electrode:** solid first then ion on the left; ion first then solid on the right.

**Step 4 — Assemble:**  $\text{Zn} | \text{Zn}^{2+} || \text{Cu}^{2+} | \text{Cu}$ .

**Why other options are wrong:**

- (B) reverses anode and cathode.
- (C) and (D) place the solids and ions in the wrong order.

**Final Answer:**  $\text{Zn} | \text{Zn}^{2+} || \text{Cu}^{2+} | \text{Cu} \Rightarrow \boxed{\text{A}}$

**Answer:** (A) [Go Back to Q11](#)

Q12.

### Solution

**Concept — Gram-equivalents:** gram-equivalents = moles  $\times$   $n$ -factor; for  $\text{Al}^{3+} + 3e^- \rightarrow \text{Al}$  the  $n$ -factor is 3.

**Step 1 — Identify the  $n$ -factor:** 3 electrons per Al atom, so  $n = 3$ .

**Step 2 — Use moles deposited:** 0.3 mol Al.

**Step 3 — Multiply:** equivalents =  $0.3 \times 3$ .



**Step 4 — Evaluate:** = 0.9 equivalents.

**Why other options are wrong:**

- (A) quotes moles, not equivalents.
- (C) divides by 3.
- (D) uses the wrong number of moles.

**Final Answer:** 0.9 gram-equivalents  $\Rightarrow$  **B**

**Answer: (B)** [Go Back to Q12](#)

**Q13.**

### Solution

**Concept — Effect of concentration on rate:** For rate =  $k[A]^2$ , multiplying  $[A]$  by a factor  $f$  multiplies the rate by  $f^2$ .

**Step 1 — Find the concentration factor:**  $\frac{0.3}{0.1} = 3$ .

**Step 2 — Apply the square (order 2):** rate factor =  $3^2$ .

**Step 3 — Evaluate:** = 9.

**Why other options are wrong:**

- (A) treats the reaction as first order.
- (B) multiplies the factor by the order.
- (D) cubes instead of squaring.

**Final Answer:** rate increases 9 times  $\Rightarrow$  **C**

**Answer: (C)** [Go Back to Q13](#)

**Q14.**

### Solution

**Concept — First-order completion time:**  $t = \frac{2.303}{k} \log \frac{[A]_0}{[A]}$ ; for 99% completion the ratio is 100/1.

**Step 1 — Set up the ratio:**  $\frac{100}{100 - 99} = \frac{100}{1} = 100$ .

**Step 2 — Evaluate the log:**  $\log 100 = 2$ .



**Step 3 — Substitute:**  $t = \frac{2.303}{2.303 \times 10^{-2}} \times 2$ .

**Step 4 — Simplify the fraction:**  $\frac{2.303}{2.303 \times 10^{-2}} = 100$ .

**Step 5 — Multiply:**  $t = 100 \times 2 = 200$  min.

**Why other options are wrong:**

- (A) uses  $\log 100 = 1$ .
- (B) is the time for 90% completion.
- (C) misplaces the factor of 2.303.

**Final Answer:**  $t = 200$  min  $\Rightarrow$   D

**Answer: (D)** [Go Back to Q14](#)

Q15.

### Solution

**Concept — Tetrahedral voids in ccp/fcc:** An fcc (ccp) unit cell has 4 atoms, and the number of tetrahedral voids is twice the number of atoms.

**Step 1 — Atoms per fcc cell:**  $N = 4$ .

**Step 2 — Rule for tetrahedral voids:** tetrahedral voids =  $2N$ .

**Step 3 — Substitute:**  $2 \times 4 = 8$ .

**Why other options are wrong:**

- (A) equals the number of octahedral voids ( $= N$ ), not tetrahedral.
- (B) and (C) miscount the void ratio.

**Final Answer:** 8 tetrahedral voids  $\Rightarrow$   D

**Answer: (D)** [Go Back to Q15](#)



Q16.

**Solution**

**Concept — Reducing agent:** The reducing agent is the species that is itself oxidised (loses electrons / increases its oxidation state).

**Step 1 — Track Zn:** Zn goes from 0 to +2 (loses  $2e^-$ ), so it is oxidised.

**Step 2 — Track Cu:**  $\text{Cu}^{2+}$  goes from +2 to 0 (gains electrons), so it is reduced.

**Step 3 — Identify the reducing agent:** the species that is oxidised, namely Zn.

**Why other options are wrong:**

- (A)  $\text{Cu}^{2+}$  is reduced, so it is the oxidising agent.
- (B) sulphate is a spectator ion.
- (D) Cu metal is the product, not a reactant reducing agent.

**Final Answer:** Zn is the reducing agent  $\Rightarrow$

[Go Back to Q16](#)

Q17.

**Solution**

**Concept — Strength in g/L:**  $\text{Strength} = \frac{\text{mass of solute (g)}}{\text{volume of solution (L)}}$ .

**Step 1 — Find mass of NaOH:** mass = moles  $\times$  molar mass =  $0.5 \times 40 = 20$  g.

**Step 2 — Convert volume:** 250 mL = 0.25 L.

**Step 3 — Apply the formula:** strength =  $\frac{20}{0.25}$ .

**Step 4 — Evaluate:** = 80 g/L.

**Why other options are wrong:**

- (A) quotes the mass dissolved, not per litre.
- (C) forgets the 0.25 L volume conversion.
- (D) doubles the correct value.

**Final Answer:** strength = 80 g/L  $\Rightarrow$

[Go Back to Q17](#)



Q18.

**Solution**

**Concept — IUPAC naming of esters:** An ester  $R-COO-R'$  is named “(alkyl from  $R'$ ) (acid-part)ate”; the acyl part  $CH_3COO$  comes from ethanoic (acetic) acid.

**Step 1 — Identify the acid part:**  $CH_3COO$  is the ethanoate group.

**Step 2 — Identify the alkyl part:**  $CH_2CH_3$  is the ethyl group.

**Step 3 — Combine:** ethyl ethanoate.

**Why other options are wrong:**

- (A) names a methyl ester (wrong alkyl group).
- (C) uses methanoate (formate) for the acid part.
- (D) names a propanoate ester.

**Final Answer:** ethyl ethanoate  $\Rightarrow$  **B**

**Answer: (B)** [Go Back to Q18](#)

Q19.

**Solution**

**Concept — Isomers of  $C_3H_8O$ :** Count alcohols and ethers with this formula (functional/position isomerism).

**Step 1 — Alcohols:** propan-1-ol ( $CH_3CH_2CH_2OH$ ) and propan-2-ol ( $CH_3CH(OH)CH_3$ ) = 2.

**Step 2 — Ethers:** methoxyethane ( $CH_3-O-CH_2CH_3$ ) = 1.

**Step 3 — Add them up:**  $2 + 1 = 3$  isomers.

**Why other options are wrong:**

- (A) misses the ether.
- (C) and (D) over-count non-existent structures.

**Final Answer:** 3 structural isomers  $\Rightarrow$  **B**

**Answer: (B)** [Go Back to Q19](#)



Q20.

**Solution**

**Concept — Stereoisomers with two similar chiral centres:** The naive count is  $2^n = 2^2 = 4$ , but when the two chiral centres carry identical sets of groups, one pair becomes a single meso compound, reducing the total.

**Step 1 — Count chiral centres:** tartaric acid has 2 chiral carbons ( $n = 2$ ).

**Step 2 — Naive maximum:**  $2^2 = 4$ .

**Step 3 — Apply the meso correction:** the two centres are equivalent, so the (+) and (−) enantiomers plus one meso form remain; the would-be fourth structure is identical to the meso form.

**Step 4 — Final count:** 3 stereoisomers (d, l and meso).

**Why other options are wrong:**

- (A) ignores the meso overlap.
- (B) counts only the enantiomeric pair.
- (D) counts only one form.

**Final Answer:** 3 stereoisomers ⇒  C

**Answer:**  (C) [Go Back to Q20](#)

Q21.

**Solution**

**Concept — Basicity of amines in water:** In aqueous solution the order is governed by a balance of inductive (+I), steric and solvation (H-bonding stabilisation of the cation) effects, giving the well-known order  $2^\circ > 1^\circ > 3^\circ$  for methyl amines.

**Step 1 — Recall the aqueous order for methylamines:**  
 $(\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_3\text{N} > \text{NH}_3$ .

**Step 2 — Reason:** dimethylamine balances electron donation and solvation best; trimethylamine is hindered and poorly solvated, so it falls below the primary amine but still above ammonia.

**Step 3 — Select the matching option:** option (A).

**Why other options are wrong:**

- (B) is the reverse order.



- (C) is the pure gas-phase (inductive-only) order, not the aqueous one.
- (D) places ammonia above secondary amines, which is incorrect.

**Final Answer:**  $(\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_3\text{N} > \text{NH}_3 \Rightarrow \boxed{\text{A}}$

**Answer: (A)** [Go Back to Q21](#)

**Q22.**

### Solution

**Concept — Acid-catalysed hydration (Markovnikov):** Water adds across the double bond with OH going to the more substituted carbon (via the more stable carbocation).

**Step 1 — Identify the alkene:** propene  $\text{CH}_3\text{-CH=CH}_2$ .

**Step 2 — Place H:** H adds to the terminal  $\text{CH}_2$  (more H atoms).

**Step 3 — Place OH:** OH adds to the internal carbon (secondary carbocation), giving  $\text{CH}_3\text{CH(OH)CH}_3$ .

**Step 4 — Name the product:** propan-2-ol.

**Why other options are wrong:**

- (A) is the anti-Markovnikov (hydroboration) product.
- (C) is a diol, not a single hydration product.
- (D) is an oxidation product, not from hydration.

**Final Answer:** propan-2-ol  $\Rightarrow \boxed{\text{B}}$

**Answer: (B)** [Go Back to Q22](#)

**Q23.**

### Solution

**Concept — Aromatic halogenation:** With a Lewis acid catalyst ( $\text{FeCl}_3$ ),  $\text{Cl}_2$  generates  $\text{Cl}^+$ , which substitutes a ring hydrogen (electrophilic aromatic substitution), giving the monohalide.

**Step 1 — Generate the electrophile:**  $\text{Cl}_2 + \text{FeCl}_3 \rightarrow \text{Cl}^+ + [\text{FeCl}_4]^-$ .

**Step 2 — Substitution on benzene:**  $\text{Cl}^+$  replaces one ring H.

**Step 3 — Product:**  $\text{C}_6\text{H}_5\text{Cl}$ , chlorobenzene.



**Why other options are wrong:**

- (A) benzene hexachloride forms by radical addition of  $\text{Cl}_2$  in UV light, not EAS.
- (C) benzyl chloride needs a methyl side chain (toluene), not benzene.
- (D) dichlorobenzene needs a second substitution step.

**Final Answer:** chlorobenzene  $\Rightarrow$

**Answer: (B)** [Go Back to Q23](#)

**Q24.**

### Solution

**Concept — Finkelstein reaction:**  $\text{R-Cl}$  (or  $\text{R-Br}$ ) +  $\text{NaI}$  in dry acetone  $\rightarrow$   $\text{R-I}$  +  $\text{NaCl}$ ;  $\text{NaCl}/\text{NaBr}$  is insoluble in acetone and precipitates, driving the equilibrium.

**Step 1 — Identify the goal:** replace  $\text{Cl}/\text{Br}$  by  $\text{I}$ .

**Step 2 — Choose the reagent:** sodium iodide in dry acetone.

**Step 3 — Why it works:**  $\text{NaCl}$  precipitates from acetone (Le Chatelier shift), giving high yield of  $\text{R-I}$ .

**Why other options are wrong:**

- (A)  $\text{AgNO}_3$  is used to test halides, not for Finkelstein.
- (B) alcoholic  $\text{KOH}$  causes elimination.
- (D)  $\text{Zn}$  dust is a reducing agent (Wurtz-type), not for halide exchange.

**Final Answer:**  $\text{NaI}$  in dry acetone  $\Rightarrow$

**Answer: (C)** [Go Back to Q24](#)

**Q25.**

### Solution

**Concept — Reimer-Tiemann reaction:** Phenol with  $\text{CHCl}_3$  and aqueous  $\text{NaOH}$  introduces a  $-\text{CHO}$  group ortho to the  $\text{OH}$ , giving salicylaldehyde after acidification (via the dichlorocarbene intermediate).

**Step 1 — Generate dichlorocarbene:**  $\text{CHCl}_3 + \text{NaOH} \rightarrow : \text{CCl}_2$ .

**Step 2 — Attack on the phenoxide ring:** the carbene attacks the ortho position.



**Step 3 — Hydrolysis/acidification:** gives an ortho  $-CHO$  group.

**Step 4 — Product:** salicylaldehyde (2-hydroxybenzaldehyde).

**Why other options are wrong:**

- (A) benzoic acid is not formed here.
- (B) picric acid needs nitration.
- (C) anisole is the methyl ether of phenol.

**Final Answer:** salicylaldehyde  $\Rightarrow$

[Go Back to Q25](#)

Q26.

### Solution

**Concept — Distinguishing aldehyde from ketone:** Tollens' reagent oxidises aldehydes (giving a silver mirror) but does not react with ketones; this is a clean aldehyde-only test.

**Step 1 — Acetaldehyde with Tollens':** the  $-CHO$  group reduces  $Ag^+$  to a silver mirror.

**Step 2 — Acetone with Tollens':** a ketone gives no reaction (no silver mirror).

**Step 3 — Conclude:** Tollens' distinguishes the two.

**Why other options are wrong:**

- (B) 2,4-DNP reacts with both aldehydes and ketones.
- (C) sodium bisulphite adds to both (and to methyl ketones).
- (D) neutral  $FeCl_3$  is a phenol test.

**Final Answer:** Tollens' reagent  $\Rightarrow$

[Go Back to Q26](#)



Q27.

**Solution**

**Concept —  $\text{NaHCO}_3$  test:** Only acids stronger than carbonic acid liberate  $\text{CO}_2$  from sodium bicarbonate. Carboxylic acids qualify; phenol and alcohols do not.

**Step 1 — Compare acid strengths:** acetic acid ( $\text{p}K_a \approx 4.8$ ) is stronger than carbonic acid ( $\text{p}K_a \approx 6.4$ ).

**Step 2 — Phenol:**  $\text{p}K_a \approx 10$ , weaker than carbonic acid, so no effervescence.

**Step 3 — Ethanol:** essentially neutral, no reaction.

**Step 4 — Conclude:** only acetic acid gives  $\text{CO}_2$ .

**Why other options are wrong:**

- (A) ethanol does not react.
- (C) phenol is too weak to release  $\text{CO}_2$ .
- (D) phenol does not react, so “both” is wrong.

**Final Answer:** acetic acid only  $\Rightarrow$

[Go Back to Q27](#)

Q28.

**Solution**

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

**Step 1 — Reagents:** benzene diazonium chloride + phenol in mild alkali.

**Step 2 — Site of attack:** para position of phenol.

**Step 3 — Product:** *p*-hydroxyazobenzene, an orange dye.

**Why other options are wrong:**

- (A) nitrobenzene needs nitration, not coupling.
- (B) chlorobenzene comes from a Sandmeyer-type reaction.
- (D) aniline is the reduction product of the diazonium salt, not the coupling product.

**Final Answer:** *p*-hydroxyazobenzene  $\Rightarrow$



Answer: (C) [Go Back to Q28](#)

Q29.

### Solution

**Concept — Denaturation:** Heat or acid disrupts the hydrogen bonds and other weak interactions that hold the secondary and tertiary structure, so the protein unfolds and loses function, while the primary (peptide) bonds remain intact.

**Step 1 — What is broken:** hydrogen bonds and salt bridges of the folded structure.

**Step 2 — What stays intact:** the peptide bonds of the primary structure are not hydrolysed.

**Step 3 — Name the process:** denaturation.

**Why other options are wrong:**

- (A) heat/acid coagulation does not cleave peptide bonds into free amino acids.
- (B) no new primary structure is formed.
- (C) no polymerisation occurs.

**Final Answer:** denaturation  $\Rightarrow$

Answer: (D) [Go Back to Q29](#)

Q30.

### Solution

**Concept — Monomer of PVC:** PVC is the addition polymer of vinyl chloride,  $\text{CH}_2=\text{CHCl}$ , which polymerises through its  $\text{C}=\text{C}$  double bond.

**Step 1 — Recall the repeat unit:**  $-(\text{CH}_2-\text{CHCl})-$ .

**Step 2 — Identify the monomer:** vinyl chloride  $\text{CH}_2=\text{CHCl}$ .

**Why other options are wrong:**

- (B) chloroethane is saturated and cannot add-polymerise.
- (C) vinyl alcohol gives PVA, not PVC.
- (D) tetrafluoroethene gives Teflon.

**Final Answer:** vinyl chloride  $\Rightarrow$



**Answer: (A)** [Go Back to Q30](#)

Q31.

### Solution

**Concept — Carbene:** A carbene is a neutral, divalent carbon species with only six valence electrons (two bonds and one lone pair). Dichlorocarbene forms when chloroform reacts with a strong base.

**Step 1 — Reaction:**  $\text{CHCl}_3 + \text{OH}^- \rightarrow \text{:CCl}_2 + \text{Cl}^- + \text{H}_2\text{O}$ .

**Step 2 — Electron count on C:** two C–Cl bonds ( $4e^-$ ) plus one lone pair ( $2e^-$ ) = 6 valence electrons.

**Step 3 — Classify:** this electron-deficient neutral species is a carbene.

**Why other options are wrong:**

- (A) a carbocation is positively charged.
- (C) a carbanion is negatively charged with a lone pair and three bonds.
- (D) a free radical has an odd, unpaired electron.

**Final Answer:** dichlorocarbene ( $\text{:CCl}_2$ )  $\Rightarrow$  **B**

**Answer: (B)** [Go Back to Q31](#)

Q32.

### Solution

**Concept — Clemmensen reduction:** A carbonyl group ( $>\text{C}=\text{O}$ ) of an aldehyde or ketone is reduced to a methylene group ( $-\text{CH}_2-$ ) using zinc amalgam [ $\text{Zn}(\text{Hg})$ ] and concentrated HCl.

**Step 1 — Identify the reagent:**  $\text{Zn}(\text{Hg})/\text{conc. HCl}$ .

**Step 2 — Identify the transformation:**  $>\text{C}=\text{O} \rightarrow -\text{CH}_2-$  (acidic-medium reduction).

**Step 3 — Name it:** Clemmensen reduction.

**Why other options are wrong:**

- (A) Cannizzaro is a disproportionation of aldehydes lacking  $\alpha$ -H.
- (B) Wolff–Kishner uses hydrazine/base (not  $\text{Zn}/\text{HCl}$ ).
- (C) Rosenmund reduces acid chlorides to aldehydes.



**Final Answer:** Clemmensen reduction  $\Rightarrow$

**Answer: (D)** [Go Back to Q32](#)

Q33.

### Solution

**Concept — Fehling's test:** Fehling's solution is reduced to red  $\text{Cu}_2\text{O}$  by aliphatic aldehydes; aromatic aldehydes, ketones and alcohols give a negative result.

**Step 1 — Recall what reacts:** only aliphatic aldehydes give the brick-red  $\text{Cu}_2\text{O}$ .

**Step 2 — Match the compound:** acetaldehyde ( $\text{CH}_3\text{CHO}$ ) is an aliphatic aldehyde.

**Step 3 — Conclude:** acetaldehyde gives the positive Fehling's test.

**Why other options are wrong:**

- (A) benzaldehyde (aromatic) does not respond to Fehling's.
- (C) acetone is a ketone, negative.
- (D) ethanol is an alcohol, negative.

**Final Answer:** acetaldehyde  $\Rightarrow$

**Answer: (B)** [Go Back to Q33](#)

Q34.

### Solution

**Concept — Halide to alcohol:** A hydroxide nucleophile in aqueous (or moist  $\text{Ag}_2\text{O}$ ) medium substitutes the halide to give an alcohol; aqueous conditions favour substitution over elimination.

**Step 1 — Goal:**  $\text{R-X} \rightarrow \text{R-OH}$ .

**Step 2 — Choose the nucleophile/medium:**  $\text{OH}^-$  from aqueous KOH (or moist silver oxide).

**Step 3 — Conclude:** aqueous KOH effects the substitution to the alcohol.

**Why other options are wrong:**

- (A) alcoholic KOH causes elimination to an alkene.
- (B) Na in dry ether is the Wurtz reaction (C-C coupling).



- (D) concentrated  $\text{H}_2\text{SO}_4$  does not give the alcohol.

**Final Answer:** aqueous KOH (or moist  $\text{Ag}_2\text{O}$ )  $\Rightarrow$

**Answer:** (C) [Go Back to Q34](#)

Q35.

### Solution

**Concept — Non-metallic character across a period:** Non-metallic character increases from left to right as electronegativity rises and atomic size falls.

**Step 1 — Order the elements left to right:** Na, Si, P, Cl across period 3.

**Step 2 — Relate to non-metallic character:** it increases in the same direction.

**Step 3 — Write increasing order:**  $\text{Na} < \text{Si} < \text{P} < \text{Cl}$ .

**Why other options are wrong:**

- (B) misplaces Na and Si.
- (C) reverses the trend.
- (D) swaps Si and P.

**Final Answer:**  $\text{Na} < \text{Si} < \text{P} < \text{Cl} \Rightarrow$

**Answer:** (A) [Go Back to Q35](#)

Q36.

### Solution

**Concept — VSEPR for  $\text{SO}_2$ :** S has two bond pairs (to the two O atoms) and one lone pair, i.e. three electron domains ( $\text{AX}_2\text{E}$ ), giving a bent shape.

**Step 1 — Count domains on S:** 2 bond pairs + 1 lone pair = 3 domains.

**Step 2 — Base geometry:** trigonal planar arrangement of the three domains.

**Step 3 — Effect of the lone pair:** the lone pair occupies one position, so the molecule is bent (angular), with the angle slightly less than  $120^\circ$ .

**Why other options are wrong:**

- (B) linear requires no lone pair ( $\text{AX}_2$ , e.g.  $\text{CO}_2$ ).
- (C) trigonal planar has no lone pair on the central atom.
- (D) tetrahedral needs four domains.



**Final Answer:** bent (angular)  $\Rightarrow$   A

**Answer:** (A) [Go Back to Q36](#)

Q37.

### Solution

**Concept — Hybridization from steric number:** For  $\text{IF}_7$  the central I has 7 bond pairs and 0 lone pairs; 7 electron domains correspond to  $sp^3d^3$  hybridization (pentagonal bipyramidal).

**Step 1 — Count sigma bonds on I:** 7 I-F bonds.

**Step 2 — Count lone pairs:** 0.

**Step 3 — Steric number:**  $7 + 0 = 7$  domains.

**Step 4 — Assign hybridization:** 7 domains  $\Rightarrow sp^3d^3$ .

**Why other options are wrong:**

- (B)  $sp^3d^2$  is for 6 domains.
- (C)  $sp^3d$  is for 5 domains.
- (D)  $sp^3$  is for 4 domains.

**Final Answer:**  $sp^3d^3 \Rightarrow$   A

**Answer:** (A) [Go Back to Q37](#)

Q38.

### Solution

**Concept — Lattice enthalpy and ionic size:** For the same anion, lattice enthalpy increases as the cation becomes smaller (stronger electrostatic attraction).  $\text{Li}^+$  is the smallest cation here.

**Step 1 — Order cation sizes:**  $\text{Li}^+ < \text{Na}^+ < \text{K}^+ < \text{Rb}^+$ .

**Step 2 — Relate to lattice enthalpy:** smaller cation  $\Rightarrow$  higher (more negative) lattice enthalpy.

**Step 3 — Select:** LiCl has the highest lattice enthalpy.

**Why other options are wrong:**

- (A) RbCl has the largest cation, so the lowest lattice enthalpy.



- (C) and (D) have larger cations than  $\text{Li}^+$ .

**Final Answer:**  $\text{LiCl} \Rightarrow \boxed{\text{B}}$

**Answer: (B)** [Go Back to Q38](#)

**Q39.**

### Solution

**Concept — Back-bonding in  $\text{BF}_3$ :** A filled  $2p$  orbital on fluorine donates electron density into the empty  $2p$  orbital on boron ( $p\pi-p\pi$ ), partially satisfying boron's electron deficiency and weakening its Lewis acidity.

**Step 1 — Boron is electron deficient:** only 6 electrons around B.

**Step 2 — Fluorine donates:** a lone pair on F overlaps with the empty B  $2p$  orbital.

**Step 3 — Effect:** this  $p\pi-p\pi$  back-bonding reduces the electron deficiency and makes  $\text{BF}_3$  a weaker Lewis acid than  $\text{BCl}_3$ .

**Why other options are wrong:**

- (A) the inert pair effect applies to heavier  $p$ -block elements, not boron's Lewis acidity.
- (B) the diagonal relationship does not explain this.
- (C)  $\text{BF}_3$  has no N-H/O-H for hydrogen bonding.

**Final Answer:**  $p\pi-p\pi$  back-bonding  $\Rightarrow \boxed{\text{D}}$

**Answer: (D)** [Go Back to Q39](#)

**Q40.**

### Solution

**Concept — Stability of +2 vs +4 in group 14:** Owing to the inert pair effect, the +2 state becomes more stable on going down the group; for lead, +2 is the more stable state.

**Step 1 — Trend down the group:** stability of +2 increases  $\text{C} < \text{Si} < \text{Ge} < \text{Sn} < \text{Pb}$ .

**Step 2 — Identify the most stable +2:** lead.

**Step 3 — Conclude:**  $\text{PbCl}_2$  is more stable than  $\text{PbCl}_4$ .



Why other options are wrong:

- (A) and (B) carbon and silicon strongly prefer +4.
- (D) germanium prefers +4 over +2.

Final Answer: lead  $\Rightarrow$

Answer: (C) [Go Back to Q40](#)

Q41.

### Solution

**Concept — Catenation in N vs P:** The N–N single bond is weak because the small N atoms place their lone pairs close together, causing strong lone-pair repulsion; the P–P single bond is stronger, so phosphorus catenates more.

**Step 1 — Compare single-bond strengths:** N–N is weaker than P–P.

**Step 2 — Reason for weak N–N:** lone-pair repulsion on the small, close N atoms.

**Step 3 — Consequence:** nitrogen shows poor catenation, phosphorus better.

Why other options are wrong:

- (B) nitrogen does have a lone pair.
- (C) nitrogen is more electronegative than phosphorus.
- (D) reverses the bond-strength comparison.

Final Answer: weak N–N bond (lone-pair repulsion)  $\Rightarrow$

Answer: (A) [Go Back to Q41](#)

Q42.

### Solution

**Concept — Crystalline allotropes of sulphur:** The two common crystalline forms are rhombic ( $\alpha$ ) sulphur and monoclinic ( $\beta$ ) sulphur, both made of  $S_8$  puckered rings.

**Step 1 — Recall the stable form:** rhombic ( $\alpha$ ) sulphur is stable below 369 K.

**Step 2 — Recall the high-temperature form:** monoclinic ( $\beta$ ) sulphur is stable above 369 K.

**Step 3 — Conclude:** the pair is rhombic and monoclinic.



Why other options are wrong:

- (A) “white/red sulphur” are not the standard crystalline forms.
- (C) plastic and colloidal sulphur are non-crystalline.
- (D) graphitic/amorphous are not sulphur allotropes.

**Final Answer:** rhombic ( $\alpha$ ) and monoclinic ( $\beta$ )  $\Rightarrow$  **B**

**Answer: (B)** [Go Back to Q42](#)

Q43.

### Solution

**Concept — Colour trend of halogens:** Down group 17 the colour deepens as the absorption shifts to longer wavelengths:  $F_2$  pale yellow,  $Cl_2$  greenish-yellow,  $Br_2$  reddish-brown,  $I_2$  violet-black.

**Step 1 — List the colours:** F (palest)  $\rightarrow$  I (darkest).

**Step 2 — Write increasing-darkness order:**  $F_2 < Cl_2 < Br_2 < I_2$ .

**Step 3 — Reason:** decreasing HOMO–LUMO gap down the group absorbs longer wavelengths, deepening the colour.

Why other options are wrong:

- (A) reverses the order.
- (B) and (D) scramble the sequence.

**Final Answer:**  $F_2 < Cl_2 < Br_2 < I_2 \Rightarrow$  **C**

**Answer: (C)** [Go Back to Q43](#)

Q44.

### Solution

**Concept — Shape of  $XeF_6$ :** Xe has 6 bond pairs and 1 lone pair (seven electron domains). The stereochemically active lone pair distorts the octahedron, so  $XeF_6$  is a distorted (capped) octahedron rather than a regular one.

**Step 1 — Count domains:** 6 bond pairs + 1 lone pair = 7.

**Step 2 — Base arrangement:** would be a pentagonal bipyramid / capped octahedron.



**Step 3 — Effect of the lone pair:** it makes the octahedron distorted, not regular.

**Why other options are wrong:**

- (A) a regular octahedron would require no lone pair.
- (B) planar hexagonal is not adopted.
- (C) square pyramidal corresponds to  $AX_5E$ .

**Final Answer:** distorted octahedral  $\Rightarrow$

[Go Back to Q44](#)

Q45.

### Solution

**Concept — Dichromate reduction:** In acidic solution  $Cr_2O_7^{2-}$  is reduced as it oxidises other species; chromium goes from +6 to +3 ( $Cr^{3+}$ , green).

**Step 1 — Oxidation state in dichromate:** Cr is +6 in  $Cr_2O_7^{2-}$ .

**Step 2 — Reduction half-reaction:**  $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$ .

**Step 3 — Final oxidation state:** +3.

**Why other options are wrong:**

- (B) 0 would be elemental Cr.
- (C) +2 is not the dichromate reduction product.
- (D) +7 exceeds the maximum for Cr and is wrong.

**Final Answer:** Cr goes to +3  $\Rightarrow$

[Go Back to Q45](#)

Q46.

### Solution

**Concept — Werner's valences:** The secondary valence equals the coordination number (number of ligands directly bonded), while the primary valence equals the oxidation state (satisfied by the counter-ions).

**Step 1 — Identify the ligands bonded to Co:** six  $NH_3$  molecules.

**Step 2 — Read off the secondary valence:** coordination number = 6.



**Step 3 — Conclude:** secondary valence of Co is 6.

**Why other options are wrong:**

- (A) 3 is the primary valence (oxidation state, balanced by the three  $\text{Cl}^-$ ).
- (C) 9 adds primary and secondary incorrectly.
- (D) 2 is unrelated.

**Final Answer:** secondary valence = 6  $\Rightarrow$  **B**

**Answer: (B)** [Go Back to Q46](#)

Q47.

### Solution

**Concept — Spin-only moment of a complex:**  $\mu = \sqrt{n(n+2)}$  BM with  $n$  the number of unpaired electrons.  $[\text{NiCl}_4]^{2-}$  is tetrahedral  $\text{Ni}^{2+}$  ( $d^8$ ) with  $\text{Cl}^-$  as a weak-field ligand.

**Step 1 — Configuration of  $\text{Ni}^{2+}$ :**  $d^8$ .

**Step 2 — Count unpaired electrons:** in the tetrahedral weak field,  $d^8$  has 2 unpaired electrons, so  $n = 2$ .

**Step 3 — Substitute:**  $\mu = \sqrt{2(2+2)} = \sqrt{2 \times 4}$ .

**Step 4 — Evaluate:**  $\mu = \sqrt{8}$  BM ( $\approx 2.83$  BM).

**Why other options are wrong:**

- (A) 0 would mean all electrons paired.
- (B) corresponds to  $n = 1$ .
- (C) corresponds to  $n = 3$ .

**Final Answer:**  $\mu = \sqrt{8}$  BM  $\Rightarrow$  **D**

**Answer: (D)** [Go Back to Q47](#)



Q48.

**Solution**

**Concept — Cyanide leaching:** Silver and gold are extracted by dissolving the metal as a soluble cyano-complex in aerated dilute NaCN, then displacing it with zinc (MacArthur–Forrest process).

**Step 1 — Dissolution:**  $4\text{Au} + 8\text{CN}^- + 2\text{H}_2\text{O} + \text{O}_2 \rightarrow 4[\text{Au}(\text{CN})_2]^- + 4\text{OH}^-$ .

**Step 2 — Recovery:** the metal is displaced from the complex by zinc.

**Step 3 — Name the step:** cyanide leaching (a hydrometallurgical method).

**Why other options are wrong:**

- (A) roasting heats a sulphide ore in air.
- (B) calcination heats a carbonate/hydroxide ore.
- (C) froth flotation concentrates sulphide ores physically.

**Final Answer:** cyanide leaching  $\Rightarrow$

**Answer: (D)** [Go Back to Q48](#)

Q49.

**Solution**

**Concept — Isotopes of hydrogen:** Protium ( $^1\text{H}$ , 0 neutrons), deuterium ( $^2\text{H}$ , 1 neutron) and tritium ( $^3\text{H}$ , 2 neutrons). Only tritium is radioactive.

**Step 1 — Match the description:** 1 proton and 2 neutrons  $\Rightarrow$  mass number 3.

**Step 2 — Identify:**  $^3_1\text{H}$  is tritium.

**Step 3 — Note radioactivity:** tritium is the radioactive isotope ( $\beta$  emitter).

**Why other options are wrong:**

- (A) protium has 0 neutrons.
- (B) deuterium has 1 neutron.
- (D) ortho-hydrogen is a spin form of  $\text{H}_2$ , not an isotope.

**Final Answer:** tritium ( $^3_1\text{H}$ )  $\Rightarrow$

**Answer: (C)** [Go Back to Q49](#)



Q50.

**Solution**

**Concept — Confirmatory test for chloride:**  $\text{Cl}^-$  gives a white  $\text{AgCl}$  precipitate with  $\text{AgNO}_3$  that is insoluble in dilute  $\text{HNO}_3$  but dissolves readily in dilute  $\text{NH}_4\text{OH}$  (forming  $[\text{Ag}(\text{NH}_3)_2]^+$ ).

**Step 1 — Note the white precipitate:**  $\text{AgCl}$  (white).

**Step 2 — Insoluble in dilute  $\text{HNO}_3$ :** rules out carbonate-type precipitates.

**Step 3 — Soluble in dilute  $\text{NH}_4\text{OH}$ :** characteristic of  $\text{AgCl}$  ( $\text{AgBr}$  is only sparingly soluble,  $\text{AgI}$  insoluble).

**Step 4 — Conclude:** the anion is chloride.

**Why other options are wrong:**

- (A)  $\text{AgI}$  is yellow and insoluble in  $\text{NH}_4\text{OH}$ .
- (B)  $\text{Ag}_2\text{SO}_4$  is only slightly precipitated and not this test.
- (C)  $\text{AgBr}$  is pale yellow and only sparingly soluble in dilute  $\text{NH}_4\text{OH}$ .

**Final Answer:** chloride ( $\text{Cl}^-$ )  $\Rightarrow$  **D**

**Answer: (D)** [Go Back to Q50](#)



## Answer Key

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

