

AIIMS Paramedical Chemistry

Sample Paper – 2

Duration: 30 Minutes

Maximum Marks: 30

Instructions

- This paper contains **30** Multiple Choice Questions (Single Correct Answer), modelled on the Chemistry portion of **AIIMS Paramedical** entrance.
- Each correct answer carries **+1 mark**. A penalty of $-\frac{1}{3}$ mark is deducted for each incorrect answer; unattempted questions carry **0** marks.
- Only **one** option is correct. Choose carefully.
- Syllabus level: **Class 11 & 12 NCERT Chemistry**
- Use of mobile phones, calculators, or electronic gadgets is strictly prohibited.

Q1. The number of molecules present in 11 g of carbon dioxide (CO_2 , molar mass = 44 g mol^{-1}) is (Avogadro number $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$)

- (A) 6.022×10^{23}
(B) 3.011×10^{23}
(C) 1.5055×10^{23}
(D) 0.7527×10^{23}

Q2. An electron in an atom is described by the quantum numbers $n = 3$, $l = 2$, $m_l = 0$. The orbital in which this electron resides is

- (A) $3p$
(B) $3d$
(C) $3s$
(D) $4d$



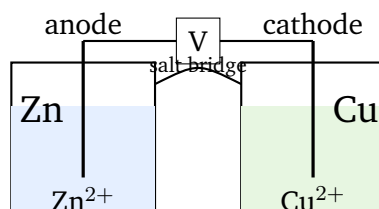
- Q3.** A fixed mass of an ideal gas occupies 2.0 L at 300 K and 1.0 atm. What volume will it occupy at 600 K and 2.0 atm?
- (A) 2.0 L
(B) 1.0 L
(C) 4.0 L
(D) 8.0 L
- Q4.** Given $\Delta H_1 = -393.5 \text{ kJ mol}^{-1}$ for $\text{C(s)} + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$ and $\Delta H_2 = -283.0 \text{ kJ mol}^{-1}$ for $\text{CO(g)} + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$. By Hess's law, ΔH for $\text{C(s)} + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{CO(g)}$ is
- (A) $-676.5 \text{ kJ mol}^{-1}$
(B) $+110.5 \text{ kJ mol}^{-1}$
(C) $+676.5 \text{ kJ mol}^{-1}$
(D) $-110.5 \text{ kJ mol}^{-1}$
- Q5.** 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 at temperature T is
- (A) $K_p = K_c(RT)^{+2}$
(B) $K_p = K_c(RT)^{-2}$
(C) $K_p = K_c(RT)^{+1}$
(D) $K_p = K_c$
- Q6.** A 0.10 M solution of a weak monobasic acid HA has $K_a = 1.0 \times 10^{-5}$. Assuming $\alpha \ll 1$, the pH of the solution is
- (A) 5.0
(B) 2.0
(C) 3.0
(D) 4.0



Q7. When the half-reaction $\text{MnO}_4^- \rightarrow \text{Mn}^{2+}$ is balanced in acidic medium, the number of H^+ ions and electrons required (respectively) on the reactant side is

- (A) 4H^+ and $3 e^-$
- (B) 8H^+ and $3 e^-$
- (C) 4H^+ and $5 e^-$
- (D) 8H^+ and $5 e^-$

Q8. For the cell below, the electrode potential of the Zn^{2+}/Zn half-cell ($E^\circ = -0.76 \text{ V}$) is measured when $[\text{Zn}^{2+}] = 0.01 \text{ M}$ at 298 K. Using the Nernst equation, the half-cell potential is



(Take $\frac{0.059}{2} = 0.0295$.)

- (A) -0.819 V
- (B) -0.701 V
- (C) -0.760 V
- (D) -0.731 V

Q9. A first-order reaction has a rate constant $k = 0.0693 \text{ min}^{-1}$. The half-life of the reaction is

- (A) 5 min
- (B) 10 min
- (C) 20 min
- (D) 100 min



- Q10.** When 1.8 g of glucose (molar mass = 180 g mol^{-1}) is dissolved in 100 g of water, the elevation in boiling point is (molal elevation constant $K_b = 0.52 \text{ K kg mol}^{-1}$)
- (A) 0.026 K
(B) 0.104 K
(C) 0.052 K
(D) 0.520 K
- Q11.** Among the isoelectronic species N^{3-} , O^{2-} , F^- and Na^+ , the ion with the largest ionic radius is
- (A) Na^+
(B) F^-
(C) O^{2-}
(D) N^{3-}
- Q12.** Which of the following arrangements correctly represents the order of decreasing electronegativity?
- (A) $\text{F} > \text{O} > \text{N} > \text{C}$
(B) $\text{C} > \text{N} > \text{O} > \text{F}$
(C) $\text{O} > \text{F} > \text{N} > \text{C}$
(D) $\text{N} > \text{O} > \text{F} > \text{C}$
- Q13.** The correct order of bond angles (smallest first) among the molecules H_2O , NH_3 and CH_4 is
- (A) $\text{CH}_4 < \text{NH}_3 < \text{H}_2\text{O}$
(B) $\text{NH}_3 < \text{H}_2\text{O} < \text{CH}_4$
(C) $\text{H}_2\text{O} < \text{NH}_3 < \text{CH}_4$
(D) $\text{H}_2\text{O} < \text{CH}_4 < \text{NH}_3$
- Q14.** Which of the following molecules has a net dipole moment equal to zero?



- (A) H_2O
- (B) CO_2
- (C) NH_3
- (D) SO_2

Q15. The thermal stability of the carbonates of group-2 (alkaline earth) metals follows the order

- (A) $\text{BeCO}_3 > \text{MgCO}_3 > \text{CaCO}_3 > \text{BaCO}_3$
- (B) $\text{MgCO}_3 > \text{BeCO}_3 > \text{BaCO}_3 > \text{CaCO}_3$
- (C) $\text{CaCO}_3 > \text{BaCO}_3 > \text{MgCO}_3 > \text{BeCO}_3$
- (D) $\text{BeCO}_3 < \text{MgCO}_3 < \text{CaCO}_3 < \text{BaCO}_3$

Q16. Aluminium is described as an amphoteric metal because it

- (A) dissolves in both dilute HCl and aqueous NaOH, evolving H_2 in each case
- (B) reacts only with acids and not with alkalis
- (C) reacts only with alkalis and not with acids
- (D) does not react with either acids or alkalis

Q17. Silicones are synthetic polymers whose backbone is built from a repeating unit of

- (A) alternating C–C bonds
- (B) alternating Si–Si bonds
- (C) alternating Si–O–Si linkages
- (D) alternating C–O–C linkages

Q18. The colour of transition-metal ions in aqueous solution is attributed to d – d electronic transitions. Which of the following ions is colourless because it has no unpaired d electrons?



- (A) Cu^{2+}
- (B) Zn^{2+}
- (C) Fe^{2+}
- (D) Ni^{2+}

Q19. In the complex $\text{K}_3[\text{Fe}(\text{CN})_6]$, the oxidation state of iron and its coordination number are, respectively

- (A) +2 and 4
- (B) +2 and 6
- (C) +3 and 4
- (D) +3 and 6

Q20. Regarding hydrogen peroxide (H_2O_2), which statement is correct?

- (A) Its molecule has a non-planar, open-book structure and the oxidation state of oxygen is -1
- (B) Its molecule is planar and the oxidation state of oxygen is -2
- (C) It is prepared industrially by burning hydrogen in excess oxygen
- (D) It acts only as an oxidising agent and never as a reducing agent

Q21. Which of the following carbocations is the most stable?

- (A) CH_3^+ (methyl cation)
- (B) $\text{C}_6\text{H}_5\text{CH}_2^+$ (benzyl cation)
- (C) CH_3CH_2^+ (ethyl cation)
- (D) $(\text{CH}_3)_2\text{CH}^+$ (isopropyl cation)

Q22. Which of the following compounds can exhibit geometrical (cis–trans) isomerism?

- (A) $\text{CH}_2=\text{CH}_2$ (ethene)
- (B) $\text{CH}_2=\text{CHCl}$ (chloroethene)



- (C) $\text{CHCl}=\text{CHCl}$ (1,2-dichloroethene)
(D) $\text{CH}_2=\text{C}(\text{CH}_3)_2$ (2-methylpropene)

Q23. Reductive ozonolysis of but-2-ene, $\text{CH}_3\text{CH}=\text{CHCH}_3$, gives

- (A) one molecule of butanal only
(B) formaldehyde and propanal
(C) one molecule of acetone only
(D) two molecules of acetaldehyde (ethanal)

Q24. The addition of HBr to propene ($\text{CH}_3\text{CH}=\text{CH}_2$) in the presence of organic peroxide gives mainly

- (A) 1-bromopropane ($\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$)
(B) 2-bromopropane ($\text{CH}_3\text{CHBrCH}_3$)
(C) 1,2-dibromopropane
(D) propan-2-ol

Q25. For the same alkyl group, the order of reactivity of alkyl halides in nucleophilic substitution ($\text{S}_{\text{N}}2$) is

- (A) $\text{R-F} > \text{R-Cl} > \text{R-Br} > \text{R-I}$
(B) $\text{R-Cl} > \text{R-F} > \text{R-Br} > \text{R-I}$
(C) $\text{R-I} > \text{R-Br} > \text{R-Cl} > \text{R-F}$
(D) $\text{R-Br} > \text{R-I} > \text{R-Cl} > \text{R-F}$

Q26. On mild oxidation with acidified $\text{K}_2\text{Cr}_2\text{O}_7$, a secondary alcohol is converted into

- (A) a carboxylic acid
(B) a ketone
(C) an aldehyde
(D) an ester



- Q27.** Which of the following carbonyl compounds can undergo the aldol condensation reaction?
- (A) HCHO (formaldehyde)
(B) C₆H₅CHO (benzaldehyde)
(C) (CH₃)₃C–CHO (2,2-dimethylpropanal)
(D) CH₃CHO (acetaldehyde)
- Q28.** Which of the following compounds gives a positive iodoform test (yellow precipitate with I₂/NaOH)?
- (A) CH₃COCH₃ (acetone)
(B) CH₃CH₂CH₂OH (propan-1-ol)
(C) C₆H₅CHO (benzaldehyde)
(D) HCHO (formaldehyde)
- Q29.** In the Hinsberg test, a tertiary amine
- (A) gives a sulphonamide soluble in alkali
(B) gives a sulphonamide insoluble in alkali
(C) does not react with benzenesulphonyl chloride
(D) is converted into a primary amine
- Q30.** Glucose does not give the 2,4-dinitrophenylhydrazine (Schiff's/2,4-DNP) test reliably and exists largely in a cyclic hemiacetal form. The number of hydroxyl (–OH) groups present in the open-chain structure of glucose is
- (A) 4
(B) 5
(C) 6
(D) 3



Detailed Solutions

Q1.

Solution

Concept — Mole concept: The number of molecules equals (number of moles) \times Avogadro number, where moles = given mass divided by molar mass.

Step 1 — Find the number of moles:

$$n = \frac{\text{mass}}{\text{molar mass}} = \frac{11 \text{ g}}{44 \text{ g mol}^{-1}}$$

Step 2 — Simplify:

$$n = 0.25 \text{ mol} = \frac{1}{4} \text{ mol.}$$

Step 3 — Convert moles to molecules:

$$N = n N_A = \frac{1}{4} \times 6.022 \times 10^{23}$$

$$N = 1.5055 \times 10^{23} \text{ molecules.}$$

Why other options are wrong:

- (A) 6.022×10^{23} is for 1 full mole (44 g), not 11 g.
- (B) 3.011×10^{23} corresponds to 22 g (half a mole).
- (D) 0.7527×10^{23} corresponds to 5.5 g (one-eighth mole).

Final Answer: $N = 1.5055 \times 10^{23}$ molecules \Rightarrow C

Answer: (C) [Go Back to Q 1](#)

Q2.

Solution

Concept — Quantum numbers: The principal quantum number n gives the shell, while the azimuthal quantum number l fixes the subshell: $l = 0$ is s , $l = 1$ is p , $l = 2$ is d , and $l = 3$ is f .

Step 1 — Identify the shell: $n = 3$ means the electron is in the third shell, so the orbital label starts with “3”.

Step 2 — Identify the subshell from l : $l = 2$ corresponds to a d subshell.

Step 3 — Combine: Shell 3 with subshell d gives a $3d$ orbital. The value $m_l = 0$



simply selects one of the five $3d$ orbitals and does not change the designation.

Why other options are wrong:

- (A) $3p$ would need $l = 1$.
- (C) $3s$ would need $l = 0$.
- (D) $4d$ would need $n = 4$, but here $n = 3$.

Final Answer: The orbital is $3d \Rightarrow$ B

Answer: (B) [Go Back to Q 2](#)

Q3.

Solution

Concept — Combined gas law: For a fixed mass of an ideal gas, $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$.

Step 1 — List the data: $P_1 = 1.0$ atm, $V_1 = 2.0$ L, $T_1 = 300$ K; $P_2 = 2.0$ atm, $T_2 = 600$ K, $V_2 = ?$

Step 2 — Rearrange for V_2 :

$$V_2 = V_1 \times \frac{P_1}{P_2} \times \frac{T_2}{T_1}$$

Step 3 — Substitute the values:

$$V_2 = 2.0 \times \frac{1.0}{2.0} \times \frac{600}{300}$$

Step 4 — Evaluate each factor:

$$V_2 = 2.0 \times 0.5 \times 2 = 2.0 \text{ L.}$$

The pressure doubling halves the volume, while the temperature doubling restores it, so $V_2 = V_1$.

Why other options are wrong:

- (B) 1.0 L ignores the temperature effect.
- (C) 4.0 L ignores the pressure effect.
- (D) 8.0 L multiplies both effects in the wrong direction.

Final Answer: $V_2 = 2.0$ L \Rightarrow A



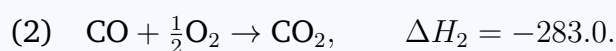
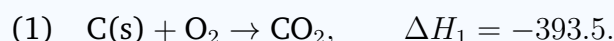
Answer: (A) [Go Back to Q 3](#)

Q4.

Solution

Concept — Hess's law: The enthalpy change of a reaction is the same whether it occurs in one step or several, so target equations can be obtained by adding or subtracting given equations.

Step 1 — Write the given equations:



Step 2 — Identify the target:



Step 3 — Combine (1) minus (2): Subtracting equation (2) from equation (1) cancels CO_2 and leaves the target equation:

$$\Delta H = \Delta H_1 - \Delta H_2.$$

Step 4 — Substitute the numbers:

$$\Delta H = (-393.5) - (-283.0).$$

$$\Delta H = -393.5 + 283.0 = -110.5 \text{ kJ mol}^{-1}.$$

Why other options are wrong:

- (A) -676.5 adds the two enthalpies instead of subtracting.
- (B) $+110.5$ has the wrong sign.
- (C) $+676.5$ both adds and reverses the sign.

Final Answer: $\Delta H = -110.5 \text{ kJ mol}^{-1} \Rightarrow$ D

Answer: (D) [Go Back to Q 4](#)



Q5.

Solution

Concept — Relation between K_p and K_c : For a gaseous equilibrium, $K_p = K_c(RT)^{\Delta n_g}$, where $\Delta n_g = (\text{moles of gaseous products}) - (\text{moles of gaseous reactants})$.

Step 1 — Count gaseous moles: Products: 2 mol NH_3 . Reactants: 1 mol $\text{N}_2 + 3$ mol $\text{H}_2 = 4$ mol.

Step 2 — Compute Δn_g :

$$\Delta n_g = 2 - 4 = -2.$$

Step 3 — Substitute into the formula:

$$K_p = K_c(RT)^{-2}.$$

Why other options are wrong:

- (A) $(RT)^{+2}$ uses the wrong sign of Δn_g .
- (C) $(RT)^{+1}$ uses $\Delta n_g = +1$.
- (D) $K_p = K_c$ would require $\Delta n_g = 0$.

Final Answer: $K_p = K_c(RT)^{-2} \Rightarrow$ **B**

Answer: (B) [Go Back to Q 5](#)

Q6.

Solution

Concept — pH of a weak acid: For a weak monobasic acid with $\alpha \ll 1$, the hydrogen-ion concentration is $[\text{H}^+] = \sqrt{K_a C}$, and $\text{pH} = -\log[\text{H}^+]$.

Step 1 — Substitute into $[\text{H}^+] = \sqrt{K_a C}$:

$$[\text{H}^+] = \sqrt{(1.0 \times 10^{-5})(0.10)}.$$

Step 2 — Multiply inside the root:

$$[\text{H}^+] = \sqrt{1.0 \times 10^{-6}}.$$



Step 3 — Take the square root:

$$[\text{H}^+] = 1.0 \times 10^{-3} \text{ mol L}^{-1}.$$

Step 4 — Compute pH:

$$\text{pH} = -\log(1.0 \times 10^{-3}) = 3.0.$$

Why other options are wrong:

- (A) 5.0 wrongly uses $\text{pH} = -\log K_a$.
- (B) 2.0 assumes the acid is fully ionised.
- (D) 4.0 comes from an arithmetic slip in the exponent.

Final Answer: $\text{pH} = 3.0 \Rightarrow$

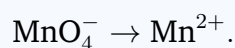
[Go Back to Q 6](#)

Q7.

Solution

Concept — Ion-electron method: In acidic medium we balance O atoms by adding H_2O , balance H atoms by adding H^+ , then balance charge by adding electrons.

Step 1 — Write the skeleton:



Manganese changes from +7 to +2.

Step 2 — Balance oxygen with water: There are 4 O atoms on the left, so add 4 H_2O on the right:



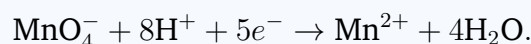
Step 3 — Balance hydrogen with H^+ : The right now has 8 H atoms, so add 8 H^+ on the left:



Step 4 — Balance charge with electrons: Left charge = $-1 + 8 = +7$; right



charge = +2. Add $5e^-$ to the left to bring it to +2:



Why other options are wrong:

- (A) and (B) give the wrong electron count (3 instead of 5).
- (C) gives the wrong number of H^+ (4 instead of 8).

Final Answer: 8H^+ and $5e^- \Rightarrow$ D

Answer: (D) [Go Back to Q 7](#)

Q8.

Solution

Concept — Nernst equation: For the half-cell $\text{Zn}^{2+} + 2e^- \rightarrow \text{Zn}$, the electrode potential is

$$E = E^\circ - \frac{0.059}{n} \log \frac{1}{[\text{Zn}^{2+}]}.$$

Step 1 — Insert $n = 2$ and the data:

$$E = -0.76 - \frac{0.059}{2} \log \frac{1}{0.01}.$$

Step 2 — Evaluate the log term:

$$\log \frac{1}{0.01} = \log(100) = 2.$$

Step 3 — Substitute $\frac{0.059}{2} = 0.0295$:

$$E = -0.76 - (0.0295)(2).$$

Step 4 — Simplify:

$$E = -0.76 - 0.059 = -0.819 \text{ V}.$$

Why other options are wrong:

- (B) -0.701 adds the correction with the wrong sign.
- (C) -0.760 ignores the correction term entirely.
- (D) -0.731 uses an incorrect log value.



Final Answer: $E = -0.819 \text{ V} \Rightarrow \boxed{\text{A}}$

Answer: (A) [Go Back to Q 8](#)

Q9.

Solution

Concept — First-order half-life: For a first-order reaction the half-life is independent of concentration and is given by $t_{1/2} = \frac{0.693}{k}$.

Step 1 — Substitute the rate constant:

$$t_{1/2} = \frac{0.693}{0.0693 \text{ min}^{-1}}$$

Step 2 — Divide:

$$t_{1/2} = 10 \text{ min.}$$

Why other options are wrong:

- (A) 5 min would correspond to $k = 0.1386 \text{ min}^{-1}$.
- (C) 20 min would correspond to $k = 0.03465 \text{ min}^{-1}$.
- (D) 100 min is off by a factor of ten in k .

Final Answer: $t_{1/2} = 10 \text{ min} \Rightarrow \boxed{\text{B}}$

Answer: (B) [Go Back to Q 9](#)

Q10.

Solution

Concept — Elevation of boiling point: $\Delta T_b = K_b m$, where m is the molality (moles of solute per kg of solvent).

Step 1 — Find moles of glucose:

$$n = \frac{1.8 \text{ g}}{180 \text{ g mol}^{-1}} = 0.01 \text{ mol.}$$

Step 2 — Find molality: Mass of water = 100 g = 0.100 kg.

$$m = \frac{0.01 \text{ mol}}{0.100 \text{ kg}} = 0.10 \text{ mol kg}^{-1}.$$



Step 3 — Apply the formula:

$$\Delta T_b = (0.52)(0.10).$$

Step 4 — Evaluate:

$$\Delta T_b = 0.052 \text{ K}.$$

Why other options are wrong:

- (A) 0.026 K halves the molality by mistake.
- (B) 0.104 K doubles the molality.
- (D) 0.520 K uses $m = 1$ instead of 0.1.

Final Answer: $\Delta T_b = 0.052 \text{ K} \Rightarrow$ C

Answer: (C) [Go Back to Q 10](#)

Q11.

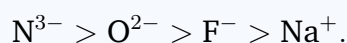
Solution

Concept — Isoelectronic species: All four ions have the same number of electrons (10). For isoelectronic ions, the species with the smallest nuclear charge (smallest Z) holds its electrons least tightly and is the largest.

Step 1 — List the nuclear charges: N^{3-} ($Z = 7$), O^{2-} ($Z = 8$), F^- ($Z = 9$), Na^+ ($Z = 11$).

Step 2 — Relate Z to size: As Z increases, the 10 electrons are pulled in more strongly, so the radius decreases. Hence radius increases as Z decreases.

Step 3 — Order by size:



The smallest Z is nitrogen ($Z = 7$), so N^{3-} is largest.

Why other options are wrong:

- (A) Na^+ has the highest Z and is the smallest.
- (B) F^- and (C) O^{2-} are intermediate, not largest.

Final Answer: N^{3-} has the largest ionic radius \Rightarrow D

Answer: (D) [Go Back to Q 11](#)



Q12.

Solution

Concept — Electronegativity trend: Across a period (left to right) electronegativity increases because nuclear charge rises while the shell stays the same. In period 2, the order is $C < N < O < F$, with fluorine the most electronegative element.

Step 1 — Arrange in increasing order: $C < N < O < F$.

Step 2 — Reverse for decreasing order:



Why other options are wrong:

- (B) is the increasing order, not decreasing.
- (C) and (D) wrongly place O or N above F.

Final Answer: $F > O > N > C \Rightarrow$

[Go Back to Q 12](#)

Q13.

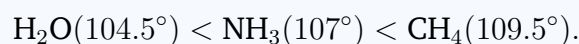
Solution

Concept — VSEPR and bond angle: All three central atoms are sp^3 hybridised. Lone pairs repel bonding pairs more strongly than bonding pairs repel each other, so more lone pairs squeeze the bond angle smaller.

Step 1 — Count lone pairs: CH_4 has 0 lone pairs, NH_3 has 1 lone pair, H_2O has 2 lone pairs.

Step 2 — Relate lone pairs to bond angle: More lone pairs give a smaller angle: $CH_4 = 109.5^\circ$, $NH_3 \approx 107^\circ$, $H_2O \approx 104.5^\circ$.

Step 3 — Arrange smallest first:



Why other options are wrong:

- (A) reverses the true order.
- (B) and (D) misplace H_2O or NH_3 .



Final Answer: $\text{H}_2\text{O} < \text{NH}_3 < \text{CH}_4 \Rightarrow \boxed{\text{C}}$

Answer: (C) [Go Back to Q 13](#)

Q14.

Solution

Concept — Molecular dipole moment: The net dipole moment is the vector sum of the individual bond dipoles. A symmetrical (linear or otherwise) arrangement can make these cancel to zero.

Step 1 — Examine CO_2 : CO_2 is linear ($\text{O}=\text{C}=\text{O}$). The two $\text{C}=\text{O}$ bond dipoles are equal and point in exactly opposite directions, so they cancel and the net dipole is zero.

Step 2 — Examine the others: H_2O and NH_3 are bent/pyramidal with lone pairs, and SO_2 is bent; in each the bond dipoles do not cancel, giving a net dipole moment.

Why other options are wrong:

- (A) H_2O is bent, $\mu \neq 0$.
- (C) NH_3 is pyramidal, $\mu \neq 0$.
- (D) SO_2 is bent, $\mu \neq 0$.

Final Answer: CO_2 has zero net dipole moment $\Rightarrow \boxed{\text{B}}$

Answer: (B) [Go Back to Q 14](#)

Q15.

Solution

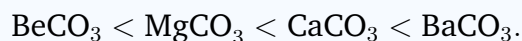
Concept — Thermal stability of group-2 carbonates: Stability increases down the group. Larger cations (lower charge density) polarise the carbonate ion less, so the carbonate resists decomposition more and needs a higher temperature to break down.

Step 1 — Order the cation sizes: $\text{Be}^{2+} < \text{Mg}^{2+} < \text{Ca}^{2+} < \text{Ba}^{2+}$.

Step 2 — Relate size to stability: Bigger cation \Rightarrow less polarising \Rightarrow more stable carbonate. So stability increases in the same order as size.



Step 3 — Write the order:



Why other options are wrong:

- (A) reverses the trend.
- (B) and (C) scramble the cation order.

Final Answer: $\text{BeCO}_3 < \text{MgCO}_3 < \text{CaCO}_3 < \text{BaCO}_3 \Rightarrow$ D

Answer: (D) [Go Back to Q 15](#)

Q16.

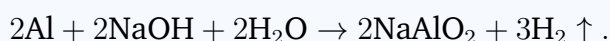
Solution

Concept — Amphoterism: An amphoteric metal (or oxide) reacts with both acids and bases. Aluminium shows this dual behaviour.

Step 1 — Reaction with acid:



Step 2 — Reaction with base:



Step 3 — Conclusion: Because Al liberates hydrogen with both dilute HCl and aqueous NaOH, it is amphoteric.

Why other options are wrong:

- (B) and (C) describe only one of the two behaviours.
- (D) is false; Al reacts with both.

Final Answer: It dissolves in both HCl and NaOH, evolving $\text{H}_2 \Rightarrow$ A

Answer: (A) [Go Back to Q 16](#)



Q17.

Solution

Concept — Silicones: Silicones are organosilicon polymers in which silicon and oxygen atoms alternate in the backbone, with organic groups (such as $-\text{CH}_3$) attached to silicon.

Step 1 — Identify the repeating unit: The chain is built from $\cdots \text{Si} - \text{O} - \text{Si} - \text{O} \cdots$ linkages.

Step 2 — Note the side groups: Each Si carries alkyl/aryl groups, but the structural backbone is the Si–O–Si chain.

Why other options are wrong:

- (A) and (B) describe carbon or pure silicon chains, not silicones.
- (D) describes an ether-type C–O–C chain, not the silicone backbone.

Final Answer: The backbone is alternating Si–O–Si linkages \Rightarrow **C**

Answer: (C) [Go Back to Q 17](#)

Q18.

Solution

Concept — Colour and d electrons: Colour in transition-metal ions arises from $d-d$ transitions, which require partly filled d orbitals. An ion with a completely filled (or empty) d subshell has no such transition and is colourless.

Step 1 — Write electron configurations: Zn^{2+} is $3d^{10}$ (filled), Cu^{2+} is $3d^9$, Fe^{2+} is $3d^6$, Ni^{2+} is $3d^8$.

Step 2 — Identify the one with no unpaired d electrons: Only Zn^{2+} ($3d^{10}$) has a completely filled d subshell, hence no $d-d$ transition and no colour.

Why other options are wrong:

- (A) Cu^{2+} ($3d^9$) is blue.
- (C) Fe^{2+} ($3d^6$) is pale green.
- (D) Ni^{2+} ($3d^8$) is green.

Final Answer: Zn^{2+} ($3d^{10}$) is colourless \Rightarrow **B**

Answer: (B) [Go Back to Q 18](#)



Q19.

Solution

Concept — Oxidation state and coordination number: In a complex, the oxidation state of the metal is found from the overall charge balance, and the coordination number equals the number of donor atoms (ligand attachments) around the metal.

Step 1 — Charge balance for $K_3[Fe(CN)_6]$: Three K^+ give +3, so the complex ion is $[Fe(CN)_6]^{3-}$. Each CN^- is -1 , six of them give -6 .

$$x + 6(-1) = -3 \Rightarrow x = +3.$$

Step 2 — Coordination number: There are six CN^- ligands, each bonded through one carbon, so the coordination number is 6.

Why other options are wrong:

- (A) and (B) give the wrong oxidation state (+2).
- (C) gives the wrong coordination number (4).

Final Answer: Fe is +3 with coordination number 6 \Rightarrow **D**

Answer: (D) [Go Back to Q 19](#)

Q20.

Solution

Concept — Structure of H_2O_2 : Hydrogen peroxide has a non-planar, “open-book” structure with the two O–H bonds lying in different planes. The oxidation state of oxygen in H_2O_2 is -1 .

Step 1 — Check the oxidation state: For H_2O_2 , $2(+1) + 2x = 0 \Rightarrow x = -1$ for each oxygen.

Step 2 — Check the geometry: The molecule is non-planar; the dihedral angle between the two O–H bonds gives the open-book shape.

Step 3 — Redox behaviour: With oxygen at the intermediate state -1 , H_2O_2 can act both as an oxidising agent and as a reducing agent.

Why other options are wrong:

- (B) H_2O_2 is not planar and oxygen is -1 , not -2 .



- (C) It is made by hydrolysis of peroxydisulphate (or the anthraquinone process), not by burning H_2 .
- (D) It can also act as a reducing agent.

Final Answer: Non-planar open-book structure, oxygen at $-1 \Rightarrow$

[Go Back to Q 20](#)

Q21.

Solution

Concept — Carbocation stability: Carbocations are stabilised by electron donation. Resonance (delocalisation into a π system) is a much stronger stabilising effect than the hyperconjugation/inductive effect of alkyl groups.

Step 1 — Classify each cation: CH_3^+ (no stabilisation), $CH_3CH_2^+$ (1°), $(CH_3)_2CH^+$ (2°), $C_6H_5CH_2^+$ (benzylic, resonance-stabilised).

Step 2 — Compare: The benzyl cation spreads its positive charge over the aromatic ring through resonance, making it far more stable than the simple alkyl cations.

Step 3 — Order of stability:



Why other options are wrong:

- (A) methyl cation is the least stable.
- (C) and (D) are alkyl cations less stable than benzyl.

Final Answer: The benzyl cation is the most stable \Rightarrow

[Go Back to Q 21](#)



Q22.

Solution

Concept — Geometrical isomerism: A C=C double bond shows cis–trans isomerism only when each doubly bonded carbon carries two *different* groups, so that the arrangement around the rigid double bond can differ.

Step 1 — Test each compound: In CHCl=CHCl, each carbon bears one H and one Cl (two different groups), so cis and trans forms exist.

Step 2 — Eliminate the rest: CH₂=CH₂, CH₂=CHCl and CH₂=C(CH₃)₂ each have at least one carbon carrying two identical groups (two H atoms or two CH₃), so no geometrical isomerism is possible.

Why other options are wrong:

- (A) ethene has two H on each carbon.
- (B) the CH₂ end has two identical H atoms.
- (D) the C(CH₃)₂ end has two identical CH₃ groups.

Final Answer: 1,2-dichloroethene shows cis–trans isomerism ⇒ C

Answer: (C) [Go Back to Q 22](#)

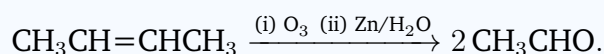
Q23.

Solution

Concept — Reductive ozonolysis: Ozone cleaves the C=C double bond, and on reductive work-up (Zn/H₂O) each doubly bonded carbon becomes a carbonyl carbon, giving aldehydes/ketones.

Step 1 — Locate the double bond: In but-2-ene, CH₃CH=CHCH₃, the double bond is between C-2 and C-3, each carrying one H and one CH₃.

Step 2 — Cleave the double bond: Each =CH–CH₃ fragment becomes CH₃CHO (acetaldehyde):



Step 3 — State the products: Two molecules of acetaldehyde (ethanal) are formed.

Why other options are wrong:

- (A) butanal is not a cleavage product.



- (B) formaldehyde would require a terminal =CH₂.
- (C) acetone would require a =C(CH₃)₂ carbon.

Final Answer: Two molecules of acetaldehyde ⇒ D

Answer: (D) [Go Back to Q 23](#)

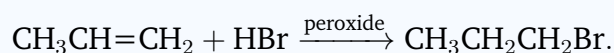
Q24.

Solution

Concept — Peroxide (Kharasch) effect: HBr adds to an unsymmetrical alkene by an anti-Markovnikov (free-radical) pathway in the presence of peroxide, so Br adds to the carbon bearing more hydrogens.

Step 1 — Without peroxide (Markovnikov): Br would go to C-2 (the more substituted carbon), giving 2-bromopropane.

Step 2 — With peroxide (anti-Markovnikov): The free-radical mechanism places Br on the terminal CH₂ (C-1, the carbon with more H):



Step 3 — Name the product: The major product is 1-bromopropane.

Why other options are wrong:

- (B) 2-bromopropane is the Markovnikov (no-peroxide) product.
- (C) 1,2-dibromopropane needs Br₂, not HBr.
- (D) propan-2-ol requires water addition.

Final Answer: 1-bromopropane ⇒ A

Answer: (A) [Go Back to Q 24](#)

Q25.

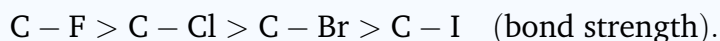
Solution

Concept — Reactivity of alkyl halides: In nucleophilic substitution, the carbon–halogen bond must break. The weaker (longer) the C–X bond, the more easily X[−] leaves, so reactivity follows the bond strength order.

Step 1 — Compare C–X bond strengths: C–I is the weakest and C–F is the



strongest:



Step 2 — Translate to reactivity: Weaker bond means a better leaving group, so reactivity is the reverse of bond strength:



Why other options are wrong:

- (A) is the bond-strength order, i.e. the reverse of reactivity.
- (B) and (D) scramble the halogen order.

Final Answer: $\text{R}-\text{I} > \text{R}-\text{Br} > \text{R}-\text{Cl} > \text{R}-\text{F} \Rightarrow \boxed{\text{C}}$

Answer: (C) [Go Back to Q 25](#)

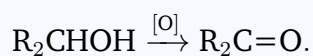
Q26.

Solution

Concept — Oxidation of alcohols: Primary alcohols oxidise to aldehydes and then carboxylic acids; secondary alcohols oxidise to ketones; tertiary alcohols resist ordinary oxidation.

Step 1 — Identify the substrate: A secondary alcohol has the $-\text{OH}$ on a carbon bonded to two other carbons.

Step 2 — Oxidation product: Removing two hydrogens (one from $-\text{OH}$, one from the $\text{C}-\text{H}$) gives a $\text{C}=\text{O}$ between two carbon groups, i.e. a ketone:



Why other options are wrong:

- (A) carboxylic acids come from primary alcohols.
- (C) aldehydes come from primary alcohols.
- (D) esters require an acid plus an alcohol, not oxidation.

Final Answer: A secondary alcohol is oxidised to a ketone $\Rightarrow \boxed{\text{B}}$

Answer: (B) [Go Back to Q 26](#)



Q27.

Solution

Concept — Aldol condensation: An aldol reaction requires a carbonyl compound that has at least one α -hydrogen (a hydrogen on the carbon next to the C=O), since enolate formation at that carbon drives the reaction.

Step 1 — Check for α -hydrogens: CH_3CHO has three α -hydrogens on its methyl group, so it can form an enolate.

Step 2 — Eliminate the others: HCHO , $\text{C}_6\text{H}_5\text{CHO}$ and $(\text{CH}_3)_3\text{C}-\text{CHO}$ have no α -hydrogen, so they cannot undergo self-aldol condensation.

Why other options are wrong:

- (A) formaldehyde has no α -carbon at all.
- (B) benzaldehyde has no α -hydrogen.
- (C) the α -carbon in 2,2-dimethylpropanal bears no hydrogen.

Final Answer: Acetaldehyde (has α -H) undergoes aldol condensation \Rightarrow **D**

Answer: (D) [Go Back to Q 27](#)

Q28.

Solution

Concept — Iodoform test: A positive iodoform test (yellow CHI_3 precipitate) is given by compounds containing a $\text{CH}_3\text{CO}-$ group (a methyl ketone) or a $\text{CH}_3\text{CH}(\text{OH})-$ group that can be oxidised to it.

Step 1 — Examine acetone: CH_3COCH_3 contains the $\text{CH}_3\text{CO}-$ (methyl ketone) group, so it gives the iodoform test.

Step 2 — Eliminate the others: Propan-1-ol, benzaldehyde and formaldehyde lack a $\text{CH}_3\text{CO}-$ or $\text{CH}_3\text{CH}(\text{OH})-$ unit.

Why other options are wrong:

- (B) propan-1-ol has no $\text{CH}_3\text{CH}(\text{OH})-$ group.
- (C) benzaldehyde has no methyl-carbonyl group.
- (D) formaldehyde has no methyl group attached to the carbonyl.

Final Answer: Acetone gives a positive iodoform test \Rightarrow **A**

Answer: (A) [Go Back to Q 28](#)



Q29.

Solution

Concept — Hinsberg test: Benzenesulphonyl chloride (Hinsberg's reagent) distinguishes 1°, 2° and 3° amines. The reaction needs an N–H bond to form a sulphonamide.

Step 1 — Behaviour of each amine: Primary amines give an alkali-soluble sulphonamide; secondary amines give an alkali-insoluble sulphonamide.

Step 2 — Tertiary amine: A tertiary amine has no N–H bond, so it cannot form a sulphonamide and does not react with benzenesulphonyl chloride.

Why other options are wrong:

- (A) alkali-soluble sulphonamide is the primary-amine result.
- (B) alkali-insoluble sulphonamide is the secondary-amine result.
- (D) the amine is not converted into a primary amine.

Final Answer: A tertiary amine does not react with the reagent \Rightarrow

[Go Back to Q 29](#)

Q30.

Solution

Concept — Structure of glucose: The open-chain form of glucose is an aldohexose ($\text{CHO}-(\text{CHOH})_4-\text{CH}_2\text{OH}$) carrying one aldehyde group and several hydroxyl groups.

Step 1 — Write the open-chain skeleton: CHO at C-1, then four CHOH carbons (C-2 to C-5), and a CH_2OH at C-6.

Step 2 — Count the –OH groups: C-2, C-3, C-4 and C-5 each bear one –OH (four groups), and C-6 (CH_2OH) bears one more, giving a total of five –OH groups.

Step 3 — State the answer: The open-chain glucose has five hydroxyl groups (plus one aldehyde group).

Why other options are wrong:

- (A) 4 omits the primary CH_2OH .
- (C) 6 wrongly counts the aldehyde oxygen as an –OH.
- (D) 3 undercounts the secondary –OH groups.



Final Answer: Open-chain glucose has five $-OH$ groups \Rightarrow

Answer: (B) [Go Back to Q 30](#)



Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	B	3	A	4	D	5	B
6	C	7	D	8	A	9	B	10	C
11	D	12	A	13	C	14	B	15	D
16	A	17	C	18	B	19	D	20	A
21	B	22	C	23	D	24	A	25	C
26	B	27	D	28	A	29	C	30	B

