

PGIMER BSc Nursing Chemistry

Sample Paper – 2

Duration: 23 Minutes

Maximum Marks: 25

Instructions

- This paper contains **25** Multiple Choice Questions (Single Correct Answer), modelled on the Chemistry portion of the **PGIMER BSc Nursing** entrance exam.
- Each correct answer carries **+1 mark**. **0.25 mark** is deducted for every incorrect answer. Unattempted questions carry **0 marks**.
- Only **one** option is correct. Choose carefully.
- Syllabus level: **Class 11 and 12 (NCERT) Chemistry**.
- The exam is conducted as a computer-based test. Personal calculators, mobile phones, log tables, and other electronic gadgets are strictly prohibited.

Q1. The number of molecules present in 8 g of oxygen gas (O_2 , molar mass = 32 g mol^{-1}) is (Avogadro's number = 6.022×10^{23}):

- (A) 1.505×10^{23}
(B) 6.022×10^{23}
(C) 3.011×10^{23}
(D) 0.75×10^{23}

Q2. The correct electronic configuration of the chloride ion Cl^- (atomic number of Cl = 17) is:

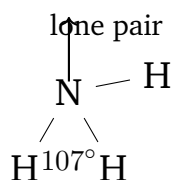
- (A) $1s^2 2s^2 2p^6 3s^2 3p^5$
(B) $1s^2 2s^2 2p^6 3s^2 3p^4$
(C) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^1$
(D) $1s^2 2s^2 2p^6 3s^2 3p^6$



Q3. The correct order of first ionization energy of the period-3 elements Na, Mg, Al and Si is:

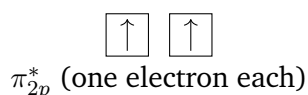
- (A) $\text{Na} < \text{Mg} < \text{Al} < \text{Si}$
- (B) $\text{Si} < \text{Mg} < \text{Al} < \text{Na}$
- (C) $\text{Na} < \text{Al} < \text{Mg} < \text{Si}$
- (D) $\text{Mg} < \text{Na} < \text{Al} < \text{Si}$

Q4. According to VSEPR theory, the molecular shape of ammonia (NH_3), drawn below with its lone pair, is:



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

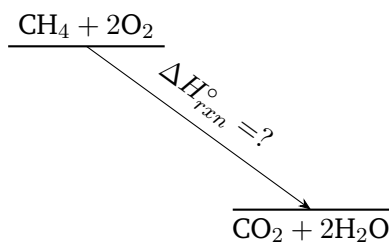
Q5. Using molecular orbital theory, which of the following molecules is **para-magnetic** because of two unpaired electrons in its antibonding π^* orbitals, as shown?



- (A) O_2
- (B) N_2
- (C) F_2
- (D) H_2

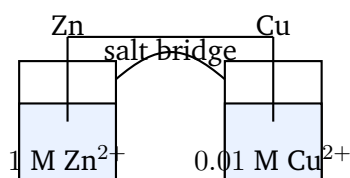


- Q6.** For the combustion $\text{CH}_4(g) + 2\text{O}_2(g) \rightarrow \text{CO}_2(g) + 2\text{H}_2\text{O}(l)$, the standard enthalpy of reaction, using $\Delta H_f^\circ(\text{CH}_4) = -75$, $\Delta H_f^\circ(\text{CO}_2) = -394$ and $\Delta H_f^\circ(\text{H}_2\text{O}) = -286 \text{ kJ mol}^{-1}$ (ΔH_f° of $\text{O}_2 = 0$), is:



- (A) -1041 kJ
 (B) -891 kJ
 (C) $+891 \text{ kJ}$
 (D) -394 kJ
- Q7.** For the equilibrium $\text{N}_2(g) + 3\text{H}_2(g) \rightleftharpoons 2\text{NH}_3(g)$, increasing the total pressure at constant temperature shifts the equilibrium:
- (A) no shift, since pressure has no effect
 (B) towards the reactants (backward)
 (C) towards the products (forward)
 (D) first forward, then backward
- Q8.** In the reaction $\text{Zn}(s) + \text{CuSO}_4(aq) \rightarrow \text{ZnSO}_4(aq) + \text{Cu}(s)$, the oxidising agent and the reducing agent are, respectively:
- (A) Zn and Cu^{2+}
 (B) Zn and SO_4^{2-}
 (C) Cu and Cu^{2+}
 (D) CuSO_4 (Cu^{2+}) and Zn
- Q9.** For the Daniell cell $\text{Zn} | \text{Zn}^{2+}(1 \text{ M}) || \text{Cu}^{2+}(0.01 \text{ M}) | \text{Cu}$ with $E_{\text{cell}}^\circ = 1.10 \text{ V}$, the cell potential at 298 K (take $\frac{0.059}{2} = 0.0295$) is:





- (A) 1.041 V
- (B) 1.159 V
- (C) 1.10 V
- (D) 0.541 V

Q10. The units of the rate constant k for a **first-order** reaction are:

- (A) $\text{mol L}^{-1} \text{s}^{-1}$
- (B) $\text{L mol}^{-1} \text{s}^{-1}$
- (C) $\text{L}^2 \text{mol}^{-2} \text{s}^{-1}$
- (D) s^{-1}

Q11. The molality of a solution prepared by dissolving 4 g of sodium hydroxide (NaOH, molar mass = 40 g mol^{-1}) in 250 g of water is:

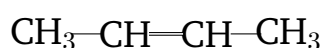
- (A) 0.1 m
- (B) 0.2 m
- (C) 0.4 m
- (D) 0.04 m

Q12. The oxidation state of iron in the hexacyanoferrate complex ion $[\text{Fe}(\text{CN})_6]^{3-}$ is:

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



- Q13.** The correct order of acidic strength of the oxoacids of chlorine is:
- (A) $\text{HClO}_4 < \text{HClO}_3 < \text{HClO}_2 < \text{HClO}$
(B) $\text{HClO} < \text{HClO}_2 < \text{HClO}_3 < \text{HClO}_4$
(C) $\text{HClO}_2 < \text{HClO} < \text{HClO}_4 < \text{HClO}_3$
(D) $\text{HClO}_3 < \text{HClO}_4 < \text{HClO} < \text{HClO}_2$
- Q14.** The characteristic colour of an aqueous solution containing the hydrated copper(II) ion $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$ (a $3d^9$ ion), arising from a $d-d$ transition, is:
- (A) green
(B) violet
(C) yellow
(D) blue
- Q15.** The correct order of solubility in water of the alkaline earth metal hydroxides is:
- (A) $\text{Mg}(\text{OH})_2 < \text{Ca}(\text{OH})_2 < \text{Sr}(\text{OH})_2 < \text{Ba}(\text{OH})_2$
(B) $\text{Ba}(\text{OH})_2 < \text{Sr}(\text{OH})_2 < \text{Ca}(\text{OH})_2 < \text{Mg}(\text{OH})_2$
(C) $\text{Ca}(\text{OH})_2 < \text{Mg}(\text{OH})_2 < \text{Ba}(\text{OH})_2 < \text{Sr}(\text{OH})_2$
(D) all four are equally soluble
- Q16.** The correct order of stability of the following carbocations is:
- (A) $\text{CH}_3^+ > 1^\circ > 2^\circ > 3^\circ$
(B) $3^\circ > 2^\circ > 1^\circ > \text{CH}_3^+$
(C) $2^\circ > 3^\circ > 1^\circ > \text{CH}_3^+$
(D) $1^\circ > 2^\circ > 3^\circ > \text{CH}_3^+$
- Q17.** The reductive ozonolysis (O_3 , then $\text{Zn}/\text{H}_2\text{O}$) of but-2-ene, shown below, gives:



- (A) two molecules of formaldehyde (HCHO)
- (B) two molecules of acetaldehyde (CH₃CHO)
- (C) one acetaldehyde and one formaldehyde
- (D) one acetone and one formaldehyde

Q18. The correct order of reactivity of alkyl halides towards bimolecular nucleophilic substitution (S_N2) is:

- (A) $3^\circ > 2^\circ > 1^\circ > \text{CH}_3\text{X}$
- (B) $2^\circ > 1^\circ > \text{CH}_3\text{X} > 3^\circ$
- (C) $1^\circ > \text{CH}_3\text{X} > 2^\circ > 3^\circ$
- (D) $\text{CH}_3\text{X} > 1^\circ > 2^\circ > 3^\circ$

Q19. The controlled oxidation of the secondary alcohol propan-2-ol (CH₃CHOHCH₃) gives:

- (A) a carboxylic acid
- (B) a ketone (propanone)
- (C) an aldehyde (propanal)
- (D) no reaction

Q20. Which of the following carbonyl compounds undergoes the aldol condensation?

- (A) acetaldehyde (CH₃CHO)
- (B) benzaldehyde (C₆H₅CHO)
- (C) formaldehyde (HCHO)
- (D) 2,2-dimethylpropanal ((CH₃)₃C-CHO)

Q21. Which of the following reactions yields a carboxylic acid?

- (A) reduction of an ester with LiAlH₄
- (B) oxidation of a ketone with mild oxidants

- (C) oxidation of a primary alcohol with acidified KMnO_4
- (D) acid-catalysed hydration of an alkene

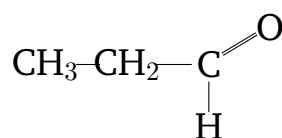
Q22. In the Hinsberg test (benzenesulphonyl chloride), a **tertiary** amine:

- (A) gives a product that is soluble in alkali
- (B) gives a product that is insoluble in alkali
- (C) does not react with the reagent
- (D) is converted into a primary amine

Q23. In proteins, the peptide (amide) bond is formed between:

- (A) two amino ($-\text{NH}_2$) groups of two amino acids
- (B) two carboxyl ($-\text{COOH}$) groups of two amino acids
- (C) an $-\text{OH}$ group and a $-\text{COOH}$ group (an ester linkage)
- (D) the $-\text{COOH}$ group of one amino acid and the $-\text{NH}_2$ group of another

Q24. The IUPAC name of the organic compound whose condensed structure is shown below is:



- (A) propan-1-ol
- (B) propanoic acid
- (C) propanal
- (D) propan-2-one

Q25. An organic compound rapidly decolourises bromine water and also Baeyer's reagent (cold dilute alkaline KMnO_4). This confirms the presence of:

- (A) an $-\text{OH}$ (hydroxyl) group
- (B) a carbon-carbon double or triple bond (unsaturation)



- (C) nitrogen in the molecule
- (D) an aromatic, fully saturated ring



Detailed Solutions

Q1.

Solution

Concept — Counting molecules: First find the number of moles, $n = \frac{m}{M}$, then multiply by Avogadro's number, $N = n \times N_A$.

Step 1 — Find the moles of O₂:

$$n = \frac{m}{M} = \frac{8}{32} = 0.25 \text{ mol.}$$

Step 2 — Multiply by Avogadro's number:

$$N = 0.25 \times 6.022 \times 10^{23}.$$

Step 3 — Evaluate:

$$N = 1.505 \times 10^{23} \text{ molecules.}$$

Why other options are wrong:

- Option B (6.022×10^{23}): this is one full mole, i.e. 32 g.
- Option C (3.011×10^{23}): this is 0.5 mol, i.e. 16 g.
- Option D (0.75×10^{23}): does not correspond to 0.25 mol.

Final Answer: Number of molecules = $1.505 \times 10^{23} \Rightarrow \boxed{A}$

Answer: (A) [Go Back to Q1](#)

Q2.

Solution

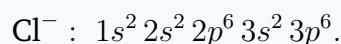
Concept — Electronic configuration of an ion: A negative ion has extra electrons; add the gained electrons to the neutral atom's configuration following the aufbau order.

Step 1 — Neutral chlorine: Cl ($Z = 17$) is $1s^2 2s^2 2p^6 3s^2 3p^5$.

Step 2 — Add one electron for Cl⁻: The gained electron enters the $3p$ subshell, completing it to $3p^6$.



Step 3 — Write the ion's configuration:



This is the same as the noble gas argon (18 electrons).

Why other options are wrong:

- Option A: this is neutral Cl (only 17 electrons), not the ion.
- Option B: only 16 electrons, which would be S or Cl^+ .
- Option C: places an electron in $3d$, which is wrong; $3p$ fills first.

Final Answer: Cl^- is $1s^2 2s^2 2p^6 3s^2 3p^6 \Rightarrow$ D

Answer: (D) [Go Back to Q2](#)

Q3.

Solution

Concept — Ionization energy trend: Across a period, ionization energy generally rises, but there are dips where a stable filled or half-filled subshell is broken.

Step 1 — Note the general rise: From Na to Si, increasing nuclear charge raises the ionization energy overall.

Step 2 — Spot the anomaly: Aluminium ($3s^2 3p^1$) loses its single $3p$ electron more easily than magnesium loses an electron from the stable filled $3s^2$. So Al has a *lower* ionization energy than Mg.

Step 3 — Write the order:



Why other options are wrong:

- Option A: places Al above Mg, ignoring the $3s^2$ stability.
- Option B: completely reversed.
- Option D: wrongly puts Mg below Na.

Final Answer: $\text{Na} < \text{Al} < \text{Mg} < \text{Si} \Rightarrow$ C

Answer: (C) [Go Back to Q3](#)



Q4.

Solution

Concept — VSEPR theory: Count bonding pairs and lone pairs on the central atom; lone pairs occupy positions but are not "seen" in the named shape.

Step 1 — Electron domains on nitrogen in NH_3 : Nitrogen has three N–H bonding pairs and one lone pair, giving four electron domains.

Step 2 — Predict the geometry: Four domains give a tetrahedral electron arrangement, but with one lone pair the *molecular* shape becomes trigonal pyramidal.

Step 3 — Bond angle: Lone-pair repulsion compresses the H–N–H angle to about 107° , as shown.

Why other options are wrong:

- Option A (tetrahedral): describes the electron domains, not the atoms' arrangement.
- Option B (trigonal planar): would need no lone pair (as in BF_3).
- Option D (bent): applies to two bonds and two lone pairs (as in H_2O).

Final Answer: NH_3 is trigonal pyramidal \Rightarrow C

Answer: (C) [Go Back to Q4](#)

Q5.

Solution

Concept — Magnetism from MO theory: A molecule is paramagnetic if it has one or more unpaired electrons in its molecular orbitals; it is diamagnetic if all electrons are paired.

Step 1 — Look at O_2 : O_2 has 16 electrons; the last two go singly into the two degenerate π_{2p}^* orbitals, one each, as shown.

Step 2 — Apply Hund's rule: These two unpaired electrons make O_2 paramagnetic.

Why other options are wrong:

- Option B (N_2): all electrons paired, diamagnetic.
- Option C (F_2): the π^* orbitals are completely filled (paired), so diamagnetic.
- Option D (H_2): two electrons in one bonding orbital, paired and diamagnetic.



Final Answer: O_2 is paramagnetic \Rightarrow

Answer: (A) [Go Back to Q5](#)

Q6.

Solution

Concept — Enthalpy from formation data: $\Delta H_{rxn}^\circ = \sum \Delta H_f^\circ(\text{products}) - \sum \Delta H_f^\circ(\text{reactants})$.

Step 1 — Sum for products: One CO_2 and two H_2O :

$$(-394) + 2(-286) = -394 - 572 = -966 \text{ kJ.}$$

Step 2 — Sum for reactants: One CH_4 and two O_2 (with $\Delta H_f^\circ(O_2) = 0$):

$$(-75) + 2(0) = -75 \text{ kJ.}$$

Step 3 — Subtract:

$$\Delta H_{rxn}^\circ = (-966) - (-75) = -966 + 75 = -891 \text{ kJ.}$$

Why other options are wrong:

- Option A (-1041 kJ): forgets to add back the methane term ($-966 - 75$).
- Option C ($+891 \text{ kJ}$): wrong sign; combustion is exothermic.
- Option D (-394 kJ): just copies the CO_2 value.

Final Answer: $\Delta H_{rxn}^\circ = -891 \text{ kJ} \Rightarrow$

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

Q7.

Solution

Concept — Le Chatelier's principle (pressure): Increasing pressure shifts a gaseous equilibrium towards the side with the smaller number of gas molecules.

Step 1 — Count moles of gas on each side: Left side: $1 + 3 = 4$ moles of gas.
Right side: 2 moles of gas.

Step 2 — Apply the rule: The product side has fewer gas molecules ($2 < 4$), so



raising the pressure shifts the equilibrium forward, towards NH_3 .

Why other options are wrong:

- Option A: pressure does affect equilibria where the mole numbers differ.
- Option B: backward shift would mean moving to the side with *more* gas moles, the opposite of what high pressure favours.
- Option D: the shift is in a single, definite direction, not oscillating.

Final Answer: The equilibrium shifts forward (towards products) \Rightarrow

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

Q8.

Solution

Concept — Oxidising and reducing agents: The reducing agent is the species that is oxidised (loses electrons); the oxidising agent is the species that is reduced (gains electrons).

Step 1 — Track the oxidation states: Zn goes from 0 to +2 (loses electrons, oxidised). Cu^{2+} goes from +2 to 0 (gains electrons, reduced).

Step 2 — Assign the roles: Since Zn is oxidised, it is the reducing agent. Since Cu^{2+} (in CuSO_4) is reduced, it is the oxidising agent.

Why other options are wrong:

- Option A: reverses the two roles.
- Option B: sulphate is a spectator ion, not the reducing agent.
- Option C: copper metal is the product, not a reactant agent.

Final Answer: Oxidising agent = Cu^{2+} (CuSO_4), reducing agent = Zn \Rightarrow

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



Q9.

Solution

Concept — Nernst equation: $E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{0.059}{n} \log Q$, where Q is the reaction quotient and n is the number of electrons transferred.

Step 1 — Write Q for the cell reaction: $\text{Zn} + \text{Cu}^{2+} \rightarrow \text{Zn}^{2+} + \text{Cu}$, so

$$Q = \frac{[\text{Zn}^{2+}]}{[\text{Cu}^{2+}]} = \frac{1}{0.01} = 100.$$

Step 2 — Substitute ($n = 2$):

$$E_{\text{cell}} = 1.10 - \frac{0.059}{2} \log(100).$$

Step 3 — Evaluate ($\log 100 = 2$):

$$E_{\text{cell}} = 1.10 - 0.0295 \times 2 = 1.10 - 0.059 = 1.041 \text{ V}.$$

Why other options are wrong:

- Option B (1.159 V): adds the correction instead of subtracting.
- Option C (1.10 V): ignores the concentration term.
- Option D (0.541 V): uses a wrong n or log value.

Final Answer: $E_{\text{cell}} = 1.041 \text{ V} \Rightarrow \boxed{\text{A}}$

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

Q10.

Solution

Concept — Units of the rate constant: For an n th-order reaction, k has units of $(\text{mol L}^{-1})^{1-n} \text{ s}^{-1}$.

Step 1 — Put $n = 1$ (first order):

$$(\text{mol L}^{-1})^{1-1} \text{ s}^{-1} = (\text{mol L}^{-1})^0 \text{ s}^{-1}.$$

Step 2 — Simplify: Anything to the power 0 is 1, so the units are just s^{-1} .

Why other options are wrong:



- Option A ($\text{mol L}^{-1} \text{s}^{-1}$): these are the units for a zero-order reaction.
- Option B ($\text{L mol}^{-1} \text{s}^{-1}$): these are the units for a second-order reaction.
- Option C ($\text{L}^2 \text{mol}^{-2} \text{s}^{-1}$): these are the units for a third-order reaction.

Final Answer: First-order k has units $\text{s}^{-1} \Rightarrow \boxed{\text{D}}$

Answer: (D) [Go Back to Q10](#)

Q11.

Solution

Concept — Molality: Molality is moles of solute per kilogram of solvent, $m = \frac{n_{\text{solute}}}{\text{mass of solvent (kg)}}$.

Step 1 — Find the moles of NaOH:

$$n = \frac{m}{M} = \frac{4}{40} = 0.1 \text{ mol.}$$

Step 2 — Convert the solvent mass to kg:

$$250 \text{ g} = 0.25 \text{ kg.}$$

Step 3 — Compute the molality:

$$m = \frac{0.1}{0.25} = 0.4 \text{ m.}$$

Why other options are wrong:

- Option A (0.1 m): forgets to divide by the solvent mass in kg.
- Option B (0.2 m): uses 0.5 kg instead of 0.25 kg.
- Option D (0.04 m): divides by 250 (g) rather than 0.25 (kg).

Final Answer: Molality = 0.4 m $\Rightarrow \boxed{\text{C}}$

Answer: (C) [Go Back to Q11](#)



Q12.

Solution

Concept — Oxidation state in a complex: The sum of the metal's oxidation state and the charges of all ligands equals the overall charge of the complex ion.

Step 1 — Note the ligand charge: Each cyanide (CN^-) carries a charge of -1 ; there are six of them, giving $6 \times (-1) = -6$.

Step 2 — Set up the equation: Let the oxidation state of Fe be x ; the overall charge is -3 :

$$x + (-6) = -3.$$

Step 3 — Solve:

$$x = -3 + 6 = +3.$$

Why other options are wrong:

- Option B (+2): this is iron in the ferrocyanide ion $[\text{Fe}(\text{CN})_6]^{4-}$.
- Option C (+4): would require an overall charge of -2 .
- Option D (+6): ignores the cyanide charges entirely.

Final Answer: Iron is in the $+3$ state \Rightarrow **A**

Answer: (A) [Go Back to Q12](#)

Q13.

Solution

Concept — Acidity of oxoacids: For oxoacids of the same central atom, acidic strength increases with the number of oxygen atoms (the higher oxidation state stabilises the conjugate base).

Step 1 — List the oxidation state of chlorine: HClO (+1), HClO_2 (+3), HClO_3 (+5), HClO_4 (+7).

Step 2 — Apply the trend: More oxygen atoms pull electron density away and stabilise the anion, so acidity rises from HClO to HClO_4 .

Step 3 — Write the order:



Why other options are wrong:



- Option A: exactly reversed (HClO_4 shown weakest).
- Option C and Option D: jumbled orders that ignore the oxidation-state trend.

Final Answer: $\text{HClO} < \text{HClO}_2 < \text{HClO}_3 < \text{HClO}_4 \Rightarrow \boxed{\text{B}}$

Answer: (B) [Go Back to Q13](#)

Q14.

Solution

Concept — Colour from $d-d$ transitions: A partially filled d subshell lets electrons jump between split d orbitals, absorbing part of visible light; the colour seen is the complement of the absorbed light.

Step 1 — Look at the ion: Cu^{2+} is $3d^9$, a partially filled d subshell, so $d-d$ transitions are possible.

Step 2 — Recall the observed colour: The hydrated $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$ ion absorbs in the red/orange region and appears blue.

Why other options are wrong:

- Option A (green): associated with hydrated Ni^{2+} or Fe^{2+} , not Cu^{2+} .
- Option B (violet): the typical colour of hydrated Ti^{3+} .
- Option C (yellow): not the colour of the hydrated copper(II) ion.

Final Answer: The hydrated Cu^{2+} ion is blue $\Rightarrow \boxed{\text{D}}$

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

Q15.

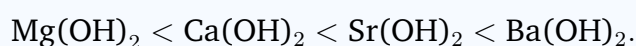
Solution

Concept — Solubility of group 2 hydroxides: The solubility of alkaline earth metal hydroxides increases down the group, because the lattice energy falls faster than the hydration energy.

Step 1 — Order the metals down the group: Mg, Ca, Sr, Ba from top to bottom.

Step 2 — Apply the trend: Solubility increases in the same direction, so $\text{Mg}(\text{OH})_2$ is the least soluble and $\text{Ba}(\text{OH})_2$ the most soluble.

Step 3 — Write the order:



Why other options are wrong:

- Option B: exactly reversed; this would be the sulphate trend, not the hydroxide trend.
- Option C: a jumbled order that breaks the down-group pattern.
- Option D: the solubilities clearly differ down the group.

Final Answer: $\text{Mg}(\text{OH})_2 < \text{Ca}(\text{OH})_2 < \text{Sr}(\text{OH})_2 < \text{Ba}(\text{OH})_2 \Rightarrow \boxed{\text{A}}$

Answer: (A) [Go Back to Q15](#)

Q16.

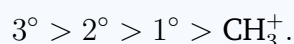
Solution

Concept — Carbocation stability: A carbocation is more stable when the positive charge is better dispersed by electron-donating alkyl groups (inductive effect and hyperconjugation).

Step 1 — Count the alkyl groups attached to the positive carbon: Tertiary (3°) has three, secondary (2°) has two, primary (1°) has one, and methyl (CH_3^+) has none.

Step 2 — Apply the trend: More alkyl groups give more hyperconjugation and stronger $+I$ donation, so stability rises in that order.

Step 3 — Write the order:

**Why other options are wrong:**

- Option A: completely reversed.
- Option C: wrongly places 2° above 3° .
- Option D: again puts the least stable cations first.

Final Answer: $3^\circ > 2^\circ > 1^\circ > \text{CH}_3^+ \Rightarrow \boxed{\text{B}}$

Answer: (B) [Go Back to Q16](#)



Q17.

Solution

Concept — Reductive ozonolysis: Ozone cleaves the C=C double bond, and the work-up with Zn/H₂O gives two carbonyl compounds; each doubly bonded carbon becomes a C=O.

Step 1 — Identify the alkene carbons: But-2-ene is CH₃-CH = CH-CH₃; each double-bond carbon bears one H and one CH₃.

Step 2 — Cleave the double bond: Each =CH-CH₃ fragment becomes CH₃-CHO (an aldehyde).

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

Why other options are wrong:

- Option A (two formaldehyde): would come from ethene, not but-2-ene.
- Option C (one acetaldehyde + one formaldehyde): this is the result for propene.
- Option D (acetone + formaldehyde): needs an isopropylidene group, not present here.

Final Answer: Two molecules of acetaldehyde ⇒ **B**

Answer: (B) [Go Back to Q17](#)

Q18.

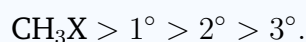
Solution

Concept — S_N2 reactivity: The S_N2 mechanism needs the nucleophile to attack the carbon from the back; less crowding (steric hindrance) means a faster reaction.

Step 1 — Compare the steric crowding: Methyl halide is the least hindered; bulk increases through primary and secondary to the very crowded tertiary halide.

Step 2 — Apply the trend: Less hindrance allows easier back-side attack, so the rate falls as crowding grows.

Step 3 — Write the order:



Why other options are wrong:



- Option A: this is the S_N1 order, the reverse of S_N2 .
- Option B and Option C: jumbled orders that misplace the methyl halide.

Final Answer: $\text{CH}_3\text{X} > 1^\circ > 2^\circ > 3^\circ \Rightarrow \boxed{\text{D}}$

Answer: (D) [Go Back to Q18](#)

Q19.

Solution

Concept — Oxidation of alcohols: A primary alcohol oxidises to an aldehyde then a carboxylic acid; a secondary alcohol oxidises to a ketone; a tertiary alcohol resists oxidation.

Step 1 — Classify the alcohol: Propan-2-ol has its $-\text{OH}$ on a carbon bonded to two other carbons, so it is a secondary alcohol.

Step 2 — Predict the product: Oxidation removes two hydrogens (one from the $-\text{OH}$, one from the $\text{C}-\text{H}$) to form a $\text{C}=\text{O}$, giving the ketone propanone (acetone).

Why other options are wrong:

- Option A (carboxylic acid): comes from a primary alcohol, not a secondary one.
- Option C (aldehyde): a secondary alcohol has no second H on the carbinol carbon to give an aldehyde.
- Option D (no reaction): only tertiary alcohols resist mild oxidation.

Final Answer: Propan-2-ol gives a ketone (propanone) $\Rightarrow \boxed{\text{B}}$

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

Q20.

Solution

Concept — Aldol condensation: A carbonyl compound undergoes the aldol reaction only if it has at least one α -hydrogen (a hydrogen on the carbon next to the $\text{C}=\text{O}$).

Step 1 — Check for α -hydrogens: Acetaldehyde, $\text{CH}_3\text{-CHO}$, has three α -hydrogens on its methyl group.

Step 2 — Conclude: With α -hydrogens available, a base can form the carbanion (enolate) needed for the aldol condensation, so acetaldehyde reacts.



Why other options are wrong:

- Option B (benzaldehyde): no α -hydrogen (the carbonyl is attached to the ring).
- Option C (formaldehyde): no α -hydrogen at all.
- Option D (2,2-dimethylpropanal): the α -carbon is fully substituted, so it has no α -hydrogen.

Final Answer: Acetaldehyde undergoes the aldol condensation \Rightarrow

[Go Back to Q20](#)

Q21.

Solution

Concept — Making carboxylic acids: Strong oxidation of a primary alcohol (or an aldehyde) gives a carboxylic acid; acidified KMnO_4 is a common strong oxidant for this.

Step 1 — Examine each route: Acidified KMnO_4 oxidises a primary alcohol all the way to the $-\text{COOH}$ group.

Step 2 — Confirm the product: For example, ethanol $\xrightarrow{\text{KMnO}_4/\text{H}^+}$ ethanoic acid (acetic acid).

Why other options are wrong:

- Option A: LiAlH_4 reduces an ester to alcohols, the opposite of forming an acid.
- Option B: ketones resist mild oxidation and do not simply give a carboxylic acid.
- Option D: hydration of an alkene gives an alcohol, not an acid.

Final Answer: Oxidation of a primary alcohol with acidified KMnO_4 gives a carboxylic acid \Rightarrow

[Go Back to Q21](#)



Q22.

Solution

Concept — Hinsberg test: Benzenesulphonyl chloride reacts with primary and secondary amines (which have N–H bonds) but not with tertiary amines (no N–H), so the three classes are distinguished.

Step 1 — Recall the requirement: The reagent attacks the N–H bond of the amine. A tertiary amine has no N–H hydrogen.

Step 2 — Predict the result for a tertiary amine: With no N–H to react, the tertiary amine does not react with the reagent (it stays unchanged, often as an insoluble oily layer that dissolves in acid).

Why other options are wrong:

- Option A: an alkali-soluble product is given by a *primary* amine.
- Option B: an alkali-insoluble sulphonamide is given by a *secondary* amine.
- Option D: the reagent does not convert a tertiary amine into a primary amine.

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

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Q23.

Solution

Concept — Peptide bond: A peptide bond is the amide linkage that joins amino acids in a protein, formed by a condensation reaction with loss of water.

Step 1 — Identify the reacting groups: The $-\text{COOH}$ group of one amino acid reacts with the $-\text{NH}_2$ group of the next amino acid.

Step 2 — Form the bond: A molecule of water is eliminated, leaving a $-\text{CO-NH-}$ (amide) linkage, the peptide bond.

Why other options are wrong:

- Option A: two amino groups cannot directly join into an amide.
- Option B: two carboxyl groups would give an anhydride, not a peptide bond.
- Option C: an $-\text{OH}$ with $-\text{COOH}$ gives an ester, not a peptide bond.

Final Answer: The peptide bond forms between the $-\text{COOH}$ of one amino acid and the $-\text{NH}_2$ of another \Rightarrow



Answer: (D) [Go Back to Q23](#)

Q24.

Solution

Concept — Naming a carbonyl compound: An aldehyde has the $-CHO$ group at the end of the chain; it is named by replacing the final “-e” of the alkane with “-al”.

Step 1 — Read the structure: The drawing is CH_3-CH_2-CHO : a three-carbon chain ending in a $-CHO$ group (a C double-bonded to O and also bonded to H).

Step 2 — Name the chain and group: Three carbons give a “prop” stem; the terminal $-CHO$ is an aldehyde, so the suffix is “-al”.

Step 3 — Assemble the name: The compound is propanal.

Why other options are wrong:

- Option A (propan-1-ol): would need an $-OH$ group, not a $C=O$.
- Option B (propanoic acid): would need a $-COOH$ group (an extra $O-H$).
- Option D (propan-2-one): would need the $C=O$ in the middle of the chain (a ketone), not at the end.

Final Answer: The compound is propanal \Rightarrow

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

Q25.

Solution

Concept — Test for unsaturation: Both bromine water and Baeyer’s reagent add across carbon–carbon multiple bonds; loss of their colour indicates an unsaturated compound.

Step 1 — Bromine water: A $C=C$ or $C\equiv C$ bond adds bromine, decolourising the orange bromine water.

Step 2 — Baeyer’s reagent: Cold dilute alkaline $KMnO_4$ oxidises the double bond to a diol, and its purple colour fades.

Step 3 — Conclude: Both positive tests together confirm a carbon–carbon double or triple bond (unsaturation).

Why other options are wrong:



- Option A ($-OH$ group): an alcohol does not decolourise bromine water in this way.
- Option C (nitrogen): nitrogen is detected by Lassaigne's test, not by these reagents.
- Option D (aromatic, saturated ring): a saturated ring with no multiple bond would not decolourise either reagent.

Final Answer: The tests confirm unsaturation (a $C=C$ or $C\equiv C$ bond) \Rightarrow

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Answer Key

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

