

CBSE EXAMINATION PAPER-2025

CHEMISTRY

(Solved)

Time allowed : 3 hours

Maximum Marks : 53

General Instructions :

Read the following instructions carefully and follow them :

- i. This question paper contains **27 questions**. All questions are **compulsory**.
- ii. This question paper is divided into **5 sections**.
- iii. **Section A** – questions number **1 to 12** are multiple choice questions Each question carries **1 marks**.
- iv. **Section B** – questions number **13 to 16** are very short answer Each question carries **2 marks**.
- v. **Section C** – questions number **17 to 22** are short answer Each question carries **3 marks**.
- vi. **Section D** – questions number **23 to 24** are case based questions
- vii. **Section E** – questions number **25 to 27** are long answer Each question carries **5 marks**.
- viii. There is no overall choice given in the question paper. However, an internal choice has been provided in few questions.
- ix. Use of calculator is NOT allowed.

Section A

Question 1.

Which of the following transition metal ion is not coloured?

[1 Marks]

(A) Cu^+

(B) Ni^{2+}

(C) Co^{2+}

(D) V^{3+}

Explanation: The correct answer is Cu^+ . It is colorless in solution because it has a filled d-orbital ($3d^{10}$), which does not allow for d-d electronic transitions that are responsible for coloration in transition metal ions. The other ions listed (Ni^{2+} , Co^{2+} , and V^{3+}) have unpaired electrons and are thus colored.

Question 2.

Which of the following solutions will have the highest boiling point in water?

[1 Marks]

(A) 1% CaCl_2

(B) 1% KCl

(C) 1% urea

(D) 1% glucose

Explanation: The correct answer is 1% CaCl_2 . Calcium chloride (CaCl_2) dissociates into three ions (one Ca^{2+} and two Cl^-) when dissolved in water, resulting in a van't Hoff factor (i) of 3. Since the boiling point elevation is proportional to the number of particles in solution, 1% CaCl_2 will produce more particles compared to the other options (1% KCl produces 2 particles, 1% urea and 1% glucose produce 1 particle each). Therefore, the solution with the highest boiling point will be the one with the highest number of ions, which in this case is 1% CaCl_2 .

Question 3.

During electrolysis of dilute H_2SO_4 , using platinum electrodes, the gas evolved at the anode is:

[1 Marks]

(A) O_2 gas

(B) SO_3 gas

(C) SO_2 gas

(D) H₂ gas

Explanation: During the electrolysis of dilute H₂SO₄, water molecules are oxidized at the anode to produce oxygen gas (O₂) as per the equation $2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4\text{e}^-$. The other options provided (SO₂, SO₃, H₂) are not the products formed at the anode during this process.

Question 4.

The activation energy (E_a) of a reaction can be determined from the slope of which of the following plots?

[1 Marks]

(A) ln k vs. T

(B) ln k / t vs. T

(C) T / ln k vs. 1/T

(D) ln k vs. 1/T

Explanation: The correct option is 'ln k vs. 1/T'. According to the provided context, a plot of ln k versus 1/T generates a straight line, and the slope of this line is equal to $-E_a/R$. This confirms that the activation energy can be determined from this specific plot.

Question 5.

The number of moles of AgCl precipitated when excess AgNO₃ solution is mixed with one mole of [Co(NH₃)₃Cl₃] is:

[1 Marks]

(A) 0

(B) 3

(C) 1

(D) 2

Explanation:

According to the provided context, 1 mole of [Co(NH₃)₃Cl₃] will yield 3 moles of AgCl precipitated upon reaction with excess AgNO₃. Therefore, the correct answer is 3.

Question 6.

The reaction $R - OH + Na \rightarrow RO^-Na^+ + 1/2 H_2 (g)$ suggests that alcohols are:

[1 Marks]

(A) Amphoteric

(B) Basic

(C) Acidic

(D) Neutral

Explanation: The correct answer is 'Acidic.' This reaction indicates that alcohols can donate a proton to a stronger base, which is a characteristic of Brønsted acids. The context states that alcohols and phenols are indeed acidic in nature and react with metals to produce alkoxides, further confirming their acidic behavior.

Question 7.

At low temperature, phenol reacts with Br_2 in CS_2 to form:

[1 Marks]

(A) p-bromophenol

(B) 2,4,6-tribromophenol

(C) 2,4-dibromophenol

(D) o- and p-bromophenol

Explanation: At low temperature and in solvents of low polarity such as CS_2 , phenol reacts with bromine to form monobromophenols, primarily substituted at the ortho and para positions relative to the $-OH$ group. This results in o- and p-bromophenol rather than polybrominated products like 2,4,6-tribromophenol, which forms under different conditions such as in bromine water at room temperature.

Question 8.

When alkyl iodide is treated with large excess of ammonia, the major product obtained is:

[1 Marks]

(A) Secondary amine

(B) Primary amine

(C) Tertiary amine

(D) Quaternary ammonium salt

Explanation: The major product obtained is primary amine because when alkyl iodide reacts with a large excess of ammonia, it predominantly produces primary amine. This primary amine can act as a nucleophile and may further react with alkyl halides to form secondary and tertiary amines, and potentially quaternary ammonium salts. However, due to the excess of ammonia, the formation of primary amine is favored.

Question 9.

α -helix structure refers to:

[1 Marks]

(A) primary structure of protein

(B) quaternary structure of protein

(C) tertiary structure of protein

(D) secondary structure of protein

Explanation: The α -helix is a specific type of secondary structure in proteins, characterized by a helical shape formed by hydrogen bonds between the backbone atoms in a polypeptide chain. This is directly stated in the relevant context, which mentions that the secondary structure of proteins includes α -helix and β -pleated sheet structures.

Question 10.

Assertion (A) : Cooking time is reduced in pressure cooker.

Reason (R) : Boiling point of water inside the pressure cooker is elevated.

[1 Marks]

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true

Explanation: In a pressure cooker, the pressure inside increases, which raises the boiling point of water above 100°C. Since water boils at a higher temperature, food cooks faster, thus reducing the cooking time. Therefore, both Assertion (A) and Reason (R) are true, and the elevated boiling point is the correct explanation for reduced cooking time.

Question 11.

Assertion (A) : Actinoids show irregularities in their electronic configurations.

Reason (R) : Actinoids are radioactive in nature.

[1 Marks]

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(C) Assertion (A) is false, but Reason (R) is true

(D) Assertion (A) is true, but Reason (R) is false.

Explanation: Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). The irregularities in the electronic configurations of actinoids stem from the unique filling of the 5f orbitals, which is not directly caused by their radioactivity.

Question 12.

Assertion (A) : Vitamin K can be stored in our body.

Reason (R) : Vitamin K is a water soluble vitamin.

[1 Marks]

(A) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true

Explanation: Assertion (A) is true, but Reason (R) is false. Vitamin K is a fat-soluble vitamin, not water-soluble, meaning it can be stored in the body, particularly in the liver and fat

tissues. The provided context clearly distinguishes water-soluble vitamins from fat-soluble ones, indicating that fat-soluble vitamins, such as Vitamin K, are stored in the body.

Section B

Question 13.

What is meant by positive deviation from Raoult's law? Give an example. What type of azeotrope is formed by positive deviation?

[2 Marks]

Answer: (a) **Positive deviation** from Raoult's law means the total vapor pressure of a solution is higher than predicted by Raoult's law due to weaker intermolecular forces between different components. (b) An example is a mixture of ethanol and water which shows positive deviation. (c) Such solutions form **minimum boiling azeotropes** at a specific composition.

Question 14.

State a condition under which a bimolecular reaction is kinetically first order reaction. Give an example. For which type of reactions, do order and molecularity have the same value?

[2 Marks]

Answer: (a) A bimolecular reaction behaves as a first order reaction when one reactant is in large excess so its concentration remains almost constant during the reaction.

Example: The hydrolysis of methyl acetate in presence of large amount of water where water concentration is constant and reaction appears first order:



(b) Order and molecularity have the same value only for elementary reactions because molecularity is defined for elementary steps and corresponds to the number of reacting species involved, which equals the order of elementary reactions.

Question 15.

Why are haloarenes less reactive towards nucleophilic substitution reaction? How does the presence of nitro ($-\text{NO}_2$) group at ortho- and para-positions in haloarenes increase the reactivity towards nucleophilic substitution reaction?

[2 Marks]

Answer: (a) Haloarenes are less reactive towards nucleophilic substitution reactions because the C-Cl bond in them has a partial double bond character due to resonance with the aromatic ring, making bond cleavage difficult.

(b) The presence of an electron withdrawing nitro group ($-\text{NO}_2$) at ortho- and para-positions stabilizes the negative charge formed in the intermediate during nucleophilic

substitution, thereby increasing the reactivity of haloarenes towards nucleophilic substitution at those positions.

Question 16.

The two strands in DNA are not identical but complementary. Explain. What products would be formed when DNA is hydrolysed ?

[2 Marks]

Answer: (a) The two strands of DNA are complementary because the bases on one strand pair specifically with bases on the other strand: adenine (A) pairs with thymine (T), and cytosine (C) pairs with guanine (G). They are not identical because one strand has A where the other has T, and one has C where the other has G. This complementary base pairing allows the DNA to form a stable double helix.

(b) When DNA is hydrolyzed, it breaks down into three main products:

- Nitrogenous bases (A, T, G, C)
- Deoxyribose sugar
- Phosphate groups

Hydrolysis breaks the bonds between these components in the nucleotide, releasing them separately.

Section C

Question 17.

0.3 g of acetic acid (Molar mass = 60 g mol^{-1}) dissolved in 30 g of benzene shows a depression in freezing point equal to 0.45°C . Calculate the percentage association of acid if it forms a dimer in the solution.

(Given : K_f for benzene = $5.12 \text{ K kg mol}^{-1}$)

[3 Marks]

Answer: Step 1: Find the moles of acetic acid, $n = \text{mass} / \text{molar mass} = 0.3 / 60 = 0.005$ mol.

Step 2: Calculate the molality of the solution, molality = moles of solute / mass of solvent in kg = $0.005 / 0.03 = 0.1667 \text{ mol kg}^{-1}$.

Step 3: Calculate the expected freezing point depression if no association occurs: $\Delta T_f = K_f * \text{molality} = 5.12 * 0.1667 = 0.853^\circ\text{C}$.

Step 4: Actual depression given is 0.45°C , which is less due to association.

Step 5: Degree of association $\alpha = (\text{expected } \Delta T_f - \text{observed } \Delta T_f) / \text{expected } \Delta T_f = (0.853 - 0.45) / 0.853 = 0.472$.

Step 6: Percentage association = $\alpha * 100 = 47.2\%$.

Note: Since acetic acid forms dimers, the number of particles decreases, leading to a

lower freezing point depression.

Answer: The percentage association of acetic acid is 47.2%.

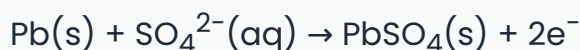
Question 18.

Write the name of the cell which is generally used in inverters. Write the reactions taking place at anode and cathode of this cell, when it is in use.

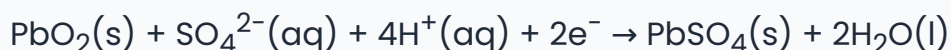
[3 Marks]

Answer: The cell generally used in inverters is the Lead Acid Battery.

Reactions at Anode (negative electrode):



Reactions at Cathode (positive electrode):



During discharge, the lead and lead dioxide electrodes react with sulfuric acid to form lead sulfate and water while producing electric energy. This process is reversible during charging.

Question 19.

Explain why electrolysis of an aqueous solution of NaCl gives H₂ gas at cathode and Cl₂ gas at anode? Write overall reaction.

(Given : $E^\circ_{\text{Na}^+/\text{Na}} = -2.71\text{ V}$, $E^\circ_{\text{H}_2\text{O}/\text{H}_2} = -0.83\text{ V}$,

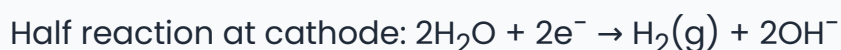
$E^\circ_{\text{Cl}_2/2\text{Cl}^-} = 1.36\text{ V}$, $E^\circ_{\text{H}^+/\text{O}_2/\text{H}_2\text{O}} = +1.23\text{ V}$)

[3 Marks]

Answer: Explanation:

During electrolysis of aqueous NaCl, both Na⁺ and H⁺ ions and Cl⁻ and OH⁻ ions are present due to water dissociation.

At cathode (reduction): Na⁺ has a very negative reduction potential (-2.71 V) compared to water (-0.83 V), so water is reduced preferentially producing H₂ gas and OH⁻ ions.



At anode (oxidation): Cl⁻ is oxidized to Cl₂ gas because chloride ions have lower oxidation potential (1.36 V) compared to water (1.23 V).



Overall reaction:



Thus, hydrogen gas is produced at cathode by water reduction, and chlorine gas is produced at anode by oxidation of chloride ions. Sodium ions remain in solution combining with OH⁻ to form NaOH.

Question 20.

A compound (A) with molecular formula C_4H_9I which is a primary alkyl halide, reacts with alcoholic KOH to give compound (B). Compound (B) reacts with HI to give (C) which is an isomer of (A). When (A) reacts with Na metal in the presence of dry ether, it gives a compound (D), C_8H_{18} , which is different from the compound formed when n-butyl iodide reacts with sodium. Write the structures of (A), (B), (C) and (D). Write the chemical equation when compound (A) is reacted with alcoholic KOH.

[3 Marks]

Answer: Compound (A) with molecular formula C_4H_9I is 1-iodobutane. When this alkyl halide reacts with alcoholic KOH, it undergoes elimination to form compound (B), which is butene (C_4H_8). The structure of compound (C), an isomer of (A), is 2-iodobutane. Upon reaction of compound (A) with sodium in dry ether, compound (D), which is octane (C_8H_{18}), is produced through a coupling reaction. The chemical equation for the reaction of (A) with alcoholic KOH is: $C_4H_9I + KOH(alc) \rightarrow C_4H_8 + KI + H_2O$.

Question 21.

Give reasons for the following :

- Benzoic acid does not undergo Friedel-Crafts reaction.
- HCHO is more reactive than CH_3CHO towards addition of HCN.
- Vinyl group directly attached with carboxylic acid should decrease the acidity of corresponding carboxylic acid due to resonance, but on the contrary it increases the acidity.

[3 Marks]

Answer: (a) Benzoic acid does not undergo Friedel-Crafts reaction because the $-COOH$ group is strongly deactivating and electron withdrawing. It reacts with the catalyst $AlCl_3$, forming a complex, which prevents the formation of the electrophile necessary for the reaction.

(b) HCHO (formaldehyde) is more reactive than CH_3CHO (acetaldehyde) towards addition of HCN because it has no alkyl group that donates electrons. Thus, the carbonyl carbon in HCHO is more electrophilic and easily attacked by nucleophiles like CN^- .

(c) Although a vinyl group is expected to decrease acidity due to resonance donation to the carboxyl group, it actually increases acidity because the vinyl group is sp^2 hybridised and more electronegative. This causes an electron withdrawing inductive effect, stabilising the carboxylate ion and increasing acidity.

Question 22.

Write the reaction of D-Glucose with the following :

(a) HCN (b) Br₂ water (c) (CH₃CO)₂O

[3 Marks]

Answer: (a) D-Glucose reacts with HCN to form a cyanohydrin by addition of HCN to the aldehyde group (-CHO) of glucose. This confirms the presence of an aldehyde group in glucose.

(b) When D-Glucose is treated with bromine water (Br₂ water), it gets oxidised to gluconic acid by converting the aldehyde group to a carboxylic acid group. This reaction shows glucose behaves as an aldose sugar.

(c) On reaction with acetic anhydride ((CH₃CO)₂O), glucose forms glucose pentaacetate by acetylation of all its hydroxyl (-OH) groups. In this reaction, no free aldehyde group is available as it forms a cyclic structure in glucose.

Section D

Question 23. The Crystal Field Theory (CFT) of coordination compounds is based on the effect of different crystal fields (provided by the ligands taken as point charges) on the degeneracy of d-orbital energies of the central metal atom/ion. The splitting of the d-orbitals provides different electronic arrangements in strong and weak crystal fields. In tetrahedral coordination entity formation, the d-orbital splitting is smaller as compared to the octahedral entity.

Question 24.

The Crystal Field Theory (CFT) of coordination compounds is based on the effect of different crystal fields (provided by the ligands taken as point charges) on the degeneracy of d-orbital energies of the central metal atom/ion. The splitting of the d-orbitals provides different electronic arrangements in strong and weak crystal fields. In tetrahedral coordination entity formation, the d-orbital splitting is smaller as compared to the octahedral entity.

Answer the following questions :

(1)

On the basis of CFT, explain why [Ti(H₂O)₆]Cl₃ complex is coloured ? What happens on heating the complex [Ti(H₂O)₆]Cl₃ ?

Give reason.[Atomic no. : Ti = 22]

[2 Marks]

Answer: $[\text{Ti}(\text{H}_2\text{O})_6]\text{Cl}_3$ is coloured due to the presence of unpaired electrons in the d-orbitals of titanium. According to Crystal Field Theory, the d-orbitals of a transition metal ion split into different energy levels in the presence of ligands. In this case, the water molecules act as ligands which induce a crystal field that causes the d-orbitals to split. The energy difference corresponds to specific wavelengths of light. When light hits the complex, certain wavelengths are absorbed to promote electrons from the lower energy d-orbital to the higher energy d-orbital, resulting in the absorption of light and giving the complex its colour. Typically, $[\text{Ti}(\text{H}_2\text{O})_6]\text{Cl}_3$ displays a blue-green color due to this electronic transition. \nWhen $[\text{Ti}(\text{H}_2\text{O})_6]\text{Cl}_3$ is heated, the gain of energy can lead to further excitation of the electrons. In some cases, this heating can cause the water ligands to be released and replaced with different ligands or even result in changes in the oxidation state of titanium, which may result in a different colour or a complex that is less stable.

Key Points: Titanium has partially filled d-orbitals-colour arises from electronic transitions-d-orbital splitting caused by ligands-water ligands can be released on heating

(2)

What is crystal field splitting energy ?

[1 Marks]

Answer: Crystal field splitting energy (Δ) is the energy difference between the split d-orbitals in a coordination complex. In the context of Crystal Field Theory, d-orbitals of the central metal atom/ion experience electrostatic interactions with the ligands, which leads to the splitting of their energies. Depending on whether the ligands are classified as strong field or weak field, the degree of splitting can vary significantly. In octahedral complexes, the splitting is larger due to stronger interactions by the surrounding ligands, while in tetrahedral complexes, the splitting is relatively smaller. The resulting energy difference plays a crucial role in determining the electronic arrangement and properties of the coordination compound.

Key Points: Crystal field splitting energy (Δ) distinguishes energy levels of d-orbitals-Influenced by ligand field strength-Splitting varies between octahedral and tetrahedral complexes

(3)

On the basis of Δ_o and P (pairing energy), how can you differentiate between a strong field ligand and a weak field ligand ?

[1 Marks]

Answer: In Crystal Field Theory, ligands are classified as strong field or weak field based on their ability to split the d-orbitals of a central metal ion. A strong field ligand leads to a large crystal field splitting energy (Δ_o) compared to the pairing energy (P), resulting in lower spin complexes where electrons prefer to pair up in the lower energy orbitals. In contrast, a weak field ligand has a smaller Δ_o , making the energy required for electron pairing greater than the energy difference between split orbitals, which results in higher spin complexes where electrons occupy the higher energy orbitals singly before pairing occurs. Therefore, if $\Delta_o > P$, the ligand is classified as a strong field ligand, whereas if $\Delta_o < P$, it is considered a weak field ligand.

Key Points: Definition of strong and weak field ligands–Comparison of Δ_o and P–Impact on electron configuration and spin state

(4)

Why are low spin tetrahedral complexes rarely observed ?

[1 Marks]

Answer: Low spin tetrahedral complexes are rarely observed primarily because of the nature of d-orbital splitting in tetrahedral coordination entities. In tetrahedral complexes, the crystal field splitting energy (Δ_t) is smaller compared to octahedral complexes, which leads to insufficient energy difference to favor the pairing of electrons in the lower energy orbitals. Additionally, tetrahedral complexes typically involve weak field ligands that do not stabilize low spin configurations effectively. As a result, most tetrahedral complexes tend to be high spin, where electrons occupy higher energy orbitals rather than pairing up in lower ones. Thus, the unique combination of smaller splitting energy and the predominance of weak field ligands makes low spin tetrahedral complexes quite uncommon.

Key Points: Tetrahedral complexes have smaller d-orbital splitting–energy (Δ_t)–Weak field ligands present in tetrahedral complexes do not favor low spin

Section E

Question 25.

Account for the following:

- (I) The $E^\circ \text{Mn}^{2+}/\text{Mn}$ value for manganese is highly negative, whereas $E^\circ \text{Mn}^{3+}/\text{Mn}^{2+}$ is highly positive.
- (II) Actinoids show wide range of oxidation states.
- (III) Transition metals have high melting points

Complete the following ionic equations:

- (I) $5\text{SO}_3^{2-} + 2\text{MnO}_4^- + 6\text{H}^+ \longrightarrow$
- (II) $2\text{MnO}_4^- + \text{H}_2\text{O} + \text{I}^- \longrightarrow$

[5 Marks]

Answer: (a) The $E^\circ \text{Mn}^{2+}/\text{Mn}$ value is highly negative because forming Mn^{2+} ion requires a lot of energy; manganese metal is very stable and not easily oxidized to Mn^{2+} . On the other hand, the $E^\circ \text{Mn}^{3+}/\text{Mn}^{2+}$ value is highly positive since Mn^{3+} is more easily formed from Mn^{2+} , especially in acidic medium, making the Mn^{3+} ion a strong oxidizing agent.

(b) Actinoids show a wide range of oxidation states because the 5f, 6d and 7s orbitals are close in energy, allowing variable electrons to participate in bonding. This results in oxidation states from +3 to +6 or more, reflecting their complex electron configurations.

(c) Transition metals have high melting points due to the presence of strong metallic bonding. This bonding arises from the delocalization of d-electrons which are more numerous and can form stronger bonds, requiring more energy to break, thus leading to high melting points.

Completion of ionic equations:

- (I) $5\text{SO}_3^{2+} + 2\text{MnO}_4^+ + 6\text{H}^+ \longrightarrow 5\text{SO}_4^{2+} + 2\text{Mn}^{2+} + 3\text{H}_2\text{O}$
- (II) $2\text{MnO}_4^+ + \text{H}_2\text{O} + \text{I}^+ \longrightarrow 2\text{MnO}_2 + 2\text{OH}^+ + \text{I}_2$

Explanation:

In (I) sulphite ions are oxidized to sulphate, and permanganate ions are reduced to Mn^{2+} in acidic medium.

In (II) permanganate ions are reduced to manganese dioxide (MnO_2) and iodide ions are oxidized to iodine (I_2) in alkaline medium.

Question 26.

(i) An organic compound (X) having molecular formula $C_5H_{10}O$ can show various properties depending on its structures. Draw each of the structures if it :

(I) shows Cannizzaro reaction.

(II) reduces Tollens' reagent and has a chiral carbon.

(III) gives positive iodoform test.

(ii) Write the reaction involved in the following :

(I) Clemmensen reduction

(II) Etard reaction

[5 Marks]

Answer: (i) Structures of compound X ($C_5H_{10}O$):

(I) Shows Cannizzaro reaction: Compound must be an aldehyde without alpha hydrogen.

Example: Pentanal ($CH_3-CH_2-CH_2-CH_2-CHO$).

Structure: $CH_3-CH_2-CH_2-CH_2-CHO$

Cannizzaro reaction occurs as pentanal has no alpha hydrogen.

(II) Reduces Tollens' reagent and has a chiral carbon: This implies it is an aldehyde with chiral center. Example: 2-Methylbutanal ($CH_3-CH(CH_3)-CH_2-CHO$). The chiral carbon is the second carbon.

Structure: $CH_3-CH(CH_3)-CH_2-CHO$

Tollens' test positive because it is an aldehyde.

(III) Gives positive iodoform test: Compound has CH_3-CO- group. Example: Methyl ethyl ketone ($CH_3-CO-CH_2-CH_3$).

Structure: $CH_3-CO-CH_2-CH_3$

Positive iodoform test due to methyl ketone group.

(ii) Reactions:

(I) Clemmensen reduction: Reduces aldehydes and ketones to alkanes using $Zn(Hg)$ and HCl .

General reaction: $R-CO-R/CHO + Zn(Hg)/HCl \rightarrow R-CH_2-R/CH_3$

(II) Etard reaction: Oxidation of methyl group attached to aromatic ring to aldehyde using CrO_3 in HCl .

General reaction: Toluene + Etard reagent (CrO_3/HCl) \rightarrow Benzaldehyde

Question 27.

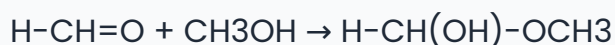
Answer the following questions :

- (i) Draw structure of the methyl hemiacetal of methanal.
- (ii) There are two – NH₂ groups in semicarbazide. However only one is involved in the formation of semicarbazones. Give reason.
- (iii) How will you convert ethanol to 3-hydroxybutanal ?
- (iv) Complete the following equation :
- (v) Write the final product formed when phthalic acid is treated with NH₃ followed by strong heating.

[5 Marks]

Answer: (i) Structure of methyl hemiacetal of methanal:

Methanal (HCHO) reacts with methanol (CH₃OH) to form methyl hemiacetal as follows:



Structure: H attached to C, C attached to OH and OCH₃ groups.

(ii) Reason why only one – NH₂ group in semicarbazide forms semicarbazones:

Semicarbazide has two – NH₂ groups; one is attached to the carbonyl carbon (part of the urea group) and is less reactive, while the other free amine group (terminal – NH₂) is more nucleophilic and involved in the formation of semicarbazones with aldehydes or ketones by condensation reaction.

(iii) Conversion of ethanol to 3-hydroxybutanal:

Step 1: Oxidize ethanol (CH₃CH₂OH) to ethanal (CH₃CHO) using PCC or any mild oxidizing agent.

Step 2: Perform aldol condensation of ethanal under base (NaOH) and water to produce 3-hydroxybutanal (CH₃CH(OH)CH₂CHO).

(iv) Complete the following equation:

As the equation is not provided in the question text, no answer can be given.

(v) Final product when phthalic acid is treated with NH₃ followed by strong heating:

Phthalic acid reacts with ammonia (NH₃) to form phthalamide, which upon strong heating undergoes cyclization to give phthalimide.

