CBSE EXAMINATION PAPER-2026

CHEMISTRY

(Solved)

Time allowed : 3 hours | Maximum Marks : 82

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **42 questions.** All questions are **compulsory.**

ii. This question paper is divided into **5 sections.**

iii. **Section A** – questions number **1 to 6** are case based questions

iv. **Section B** – questions number **7 to 22** are multiple choice questions

v. **Section C** – questions number **23 to 28** are very short answer

vi. **Section D** – questions number **29 to 36** are short answer

vii. **Section E** – questions number **37 to 42** are long answer

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. The reaction of amines with mineral acids to form ammonium salts shows that these are basic in nature. Aliphatic amines are stronger bases than ammonia whereas aromatic amines are weaker bases than ammonia. Aliphatic and aromatic primary and secondary amines react with acid chlorides, anhydrides and esters by nucleophilic substitution reaction. The main problem encountered during electrophilic substitution reactions of aromatic amines is that of their high reactivity. Substitution tends to occur at ortho-and para-positions. Hinsberg reagent is used for the identification and distinction between primary, secondary and tertiary amines. Aryldiazonium salts, usually obtained from

arylamines, undergo replacement of the diazonium group with a variety of nucleophiles to provide advantageous methods for producing aryl halides, cyanides, phenols and arenes.

Question 2. The reaction of amines with mineral acids to form ammonium salts shows that these are basic in nature. Aliphatic amines are stronger bases than ammonia whereas aromatic amines are weaker bases than ammonia. Aliphatic and aromatic primary and secondary amines react with acid chlorides, anhydrides and esters by nucleophilic substitution reaction. The main problem encountered during electrophilic substitution reactions of aromatic amines is that of their high reactivity. Substitution tends to occur at ortho-and para-positions. Hinsberg reagent is used for the identification and distinction between primary, secondary and tertiary amines. Aryldiazonium salts, usually obtained from arylamines, undergo replacement of the diazonium group with a variety of nucleophiles to provide advantageous methods for producing aryl halides, cyanides, phenols and arenes.

Question 3. The reaction of amines with mineral acids to form ammonium salts shows that these are basic in nature. Aliphatic amines are stronger bases than ammonia whereas aromatic amines are weaker bases than ammonia. Aliphatic and aromatic primary and secondary amines react with acid chlorides, anhydrides and esters by nucleophilic substitution reaction. The main problem encountered during electrophilic substitution reactions of aromatic amines is that of their high reactivity. Substitution tends to occur at ortho-and para-positions. Hinsberg reagent is used for the identification and distinction between primary, secondary and tertiary amines. Aryldiazonium salts, usually obtained from arylamines, undergo replacement of the diazonium group with a variety of nucleophiles to provide advantageous methods for producing aryl halides, cyanides, phenols and arenes.

(1) Write structural formulae of the compound A and B :

$$CH_3CONH_2 \xrightarrow{NaOBr} A \xrightarrow[Base]{C_6H_5COCl} B$$

[1 Marks]

Answer: Compound A is the primary aromatic amine (aniline), $C_6H_5NH_2$, having an amino group attached to a benzene ring.

Compound B is the arenediazonium salt formed by diazotization of compound A, generally represented as $C_6H_5N_2^+Cl^-$. These compounds relate to the passage where primary aromatic amines form arenediazonium salts that are used for further substitution reactions.

Key Points: Compound A is aniline-primary aromatic amine -Compound B is arenediazonium salt of aniline -Amines react with mineral acids to form salts showing basicity

(2) Why $CH_3 – NH_2$ is a stronger base than $(CH_3)_3N$ in aqueous solution ?

[2 Marks]

Answer: $CH_3 – NH_2$ is a stronger base than $(CH_3)_3N$ in aqueous solution because of steric hindrance and solvation effects.
In $CH_3 – NH_2$, the nitrogen's lone pair is easily available to accept a proton, and it forms strong hydrogen bonds with water, stabilising the ammonium ion.
In $(CH_3)_3N$, bulky methyl groups cause steric hindrance which reduces the availability of the lone pair and also hinder solvation by water; thus it is less basic.
This explanation aligns with the case passage that states basicity depends on availability of the unshared electron pair and solvation stabilising the ammonium ion.

> **Key Points: Steric hindrance reduces lone pair availability - Strong solvation stabilises ammonium ion increases basicity - CH3NH2 has less steric hindrance and better solvation than (CH3)3N**

(3) A compound 'X' with molecular formula C_3H_9N reacts with Hinsberg reagent to give a product insoluble in alkali. Identify 'X'.

[1 Marks]

Answer: Compound X with molecular formula C_3H_9N gives a product insoluble in alkali with Hinsberg reagent indicating it is a secondary amine. According to the case, Hinsberg reagent helps distinguish amines by solubility of the product in alkali. Primary amines give soluble products whereas secondary amines give insoluble products. Hence, X is a secondary amine.

> **Key Points: Compound X has formula C3H9N - Reaction with Hinsberg reagent gives product insoluble in alkali - Indicates X is a secondary amine**

Question 4. The reaction of amines with mineral acids to form ammonium salts shows that these are basic in nature. Aliphatic amines are stronger bases than ammonia whereas aromatic amines are weaker bases than ammonia. Aliphatic and aromatic primary and secondary amines react with acid chlorides, anhydrides and esters by nucleophilic substitution reaction. The main problem encountered during electrophilic substitution reactions of aromatic amines is that of their high reactivity. Substitution tends to occur at ortho-and para-positions. Hinsberg reagent is used for the identification and distinction between primary, secondary and tertiary amines. Aryldiazonium salts, usually obtained from

arylamines, undergo replacement of the diazonium group with a variety of nucleophiles to provide advantageous methods for producing aryl halides, cyanides, phenols and arenes.

(1) How can you convert aniline to benzonitrile ?

[2 Marks]

Answer: Aniline can be converted to benzonitrile by first converting aniline into an aryldiazonium salt by treating it with nitrous acid (HNO_2) at low temperature (273-278 K). Then, this aryldiazonium salt is treated with cuprous cyanide (CuCN) which replaces the diazonium group (N_2^+) with a cyanide group (-CN) forming benzonitrile. This reaction is an example of nucleophilic substitution on the aryldiazonium salt as described in the passage.

Reaction steps:

1. $C_6H_5NH_2 + HNO_2$ â†' $C_6H_5N_2^+$

2. $C_6H_5N_2^+ + CuCN$ â†' $C_6H_5CN + N_2 + Cu$

Key Points: Aniline converts to aryldiazonium salt with nitrous acid - Aryldiazonium salt reacts with CuCN to form benzonitrile - This reaction involves nucleophilic substitution on aromatic amines

(2) Why is $–NH_2$ group of aniline acetylated before carrying out nitration ?

[2 Marks]

Answer: The $–NH_2$ group of aniline is acetylated before nitration to reduce its high reactivity as an activating group. This protects the amino group by converting it into an amide, which is less reactive and prevents multiple substitution during nitration. According to the case passage, aromatic amines have high reactivity causing substitution mainly at ortho and para positions. Acetylation controls this reactivity, ensuring monosubstitution and better yield of the nitro product.

Key Points: $–NH_2$ is highly reactive and activating group - Acetylation converts $–NH_2$ to less reactive amide - Prevents multiple substitution and controls nitration

Question 5. The Valence Bond Theory (VBT) explains the formation, magnetic behaviour and geometry of coordination compounds. 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.

(1) In octahedral crystal field, energies of which d-orbitals will be raised when ligands approach the central metal atom/ion ? Give reason in support of your answer.

[2 Marks]

Answer: In an octahedral crystal field, the d_{x2-y2} and d_{z2} orbitals are raised in energy because they lie along the axes where ligands approach as point charges. According to CFT mentioned in the case, the repulsion between the ligand electron pairs and the d-electrons in these orbitals increases their energy. The other three d-orbitals (d_{xy}, d_{xz}, d_{yz}) experience less repulsion and are lower in energy. This splitting explains different electronic arrangements in strong and weak crystal fields.

Key Points: d_{x2-y2} and d_{z2} orbitals have raised energies - ligands approach along axes causing greater repulsion - leads to splitting of d-orbitals in octahedral field

(2) Using crystal field theory, write the electronic configuration of central metal atom/ion of the following : (i) $[CoF_6]^{3-}$ (ii) $[Co(NH_3)_6]^{3+}$ [At. No. : Co = 27]

[2 Marks]

Answer: Using Crystal Field Theory, in (i) [CoF6]3-, Co is in +3 oxidation state with electronic configuration d6. F- is a weak field ligand resulting in a high spin complex with configuration t2g4 eg2, meaning four electrons in lower energy t2g orbitals and two in higher energy eg orbitals. In (ii) [Co(NH3)6]3+, NH3 is a strong field ligand causing pairing of electrons to form a low spin complex with configuration t2g6 eg0, where all six electrons occupy lower energy t2g orbitals. This explanation uses the concept of crystal field splitting of d orbitals as discussed in the case passage.

Key Points: Oxidation state of Co in complexes - Nature of ligands (weak/strong field) affects spin state - Electronic configuration based on crystal field splitting

Question 6. The Valence Bond Theory (VBT) explains the formation, magnetic behaviour and geometry of coordination compounds. 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.

(1) $[NiCl_4]^{2-}$ is paramagnetic while $[Ni(CO)_4]$ is diamagnetic though both are tetrahedral. Why? [Atomic No. : Ni = 28]

[2 Marks]

Answer: According to Valence Bond Theory and Crystal Field Theory mentioned in the passage, [NiCl4]2- is paramagnetic because Cl- is a weak field ligand and does not cause pairing of electrons in Ni2+. Thus, unpaired electrons remain, making it paramagnetic. In contrast, CO is a strong field ligand causing pairing of Ni electrons in [Ni(CO)4], resulting in no unpaired electrons and making it diamagnetic, though both have tetrahedral geometry.
This difference in ligand field strength explains the different magnetic properties.

Key Points: [NiCl4]2- contains weak field Cl- ligands - Cl- does not cause pairing of d-electrons - [NiCl4]2- is paramagnetic due to unpaired electrons - CO is a strong field ligand in [Ni(CO)4] - CO causes pairing of electrons leading to diamagnetism

(2)

Write hybridization and magnetic behaviour of the complex $[Fe(CN)_6]^{3-}$.[Atomic No. : Fe = 26]

[2 Marks]

Answer: The complex [Fe(CN)6]3- has Fe in +3 oxidation state with electronic configuration 3d5. CN- is a strong field ligand causing pairing of electrons in d orbitals. According to VBT and CFT from the case, the hybridization is d2sp3 and the complex is low spin. Due to pairing, it is diamagnetic as there are no unpaired electrons.
The magnetic behaviour indicates strong field ligands cause pairing and low spin states.

Key Points: Fe3+ has 3d5 configuration - CN- is strong field ligand causing pairing - Hybridization is d2sp3 - Complex is low spin and diamagnetic

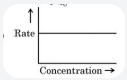
Section B

Question 7.

Which of the following curve represents the first order reaction ?

[1 Marks]

(A)



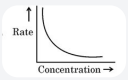
(B)



(C)



(D)



Explanation: For a first order reaction, the rate depends linearly on the concentration of one reactant, and the integrated rate law is $\ln([A]_0/[A]) = kt$. This means that a plot of ln[A] against time is a straight line. Therefore, the curve which is a straight line in the ln[A] versus time graph represents the first order reaction.

Question 8.

Which of the following solutions will have the lowest freezing point in water ?

[1 Marks]

(A) 0.1 M Glucose

(B) 0.1 M $CaCl_2$

(C) 0.1 M Urea

(D) 0.1 M KCl

Explanation: The freezing point lowering depends on the number of dissolved particles, which is given by the formula $\Delta T = i \times Kf \times m$, where i is the van't Hoff factor (number of particles the solute dissociates into), Kf is the freezing point depression constant for water, and m is the molality of the solution. Among the given options, 0.1 M $CaCl_2$ dissociates into 3 ions (Ca^{2+} and 2 Cl^-), so $i \approx 3$, which is greater than the van't Hoff factor for glucose (i=1), urea (i=1), and KCl (i=2). Therefore, 0.1 M $CaCl_2$ will cause the greatest freezing point depression and thus have the lowest freezing point.

Question 9.

Which of the following is not a transition metal ?

[1 Marks]

(A) Cu

(B) Hg

(C) Ag

(D) Sc

Explanation:

Mercury (Hg) is not considered a transition metal because it has a completely filled d-subshell (d10 configuration) and does not exhibit most properties typical of transition elements, such as variable oxidation states. According to the context, Zn, Cd, and Hg do not show most of the properties of transition elements despite being in the d-block. Cu, Ag, and Sc are considered transition metals.

Question 10.

Which of the following represents the fraction of molecules with energies equal to or greater than E_a?

[1 Marks]

(A) + E_a/RT

(B) $e^{-E_a/RT}$

(C) - E_a/RT

(D) $e^{+E_a/RT}$

Explanation: The fraction of molecules having energy equal to or greater than the activation energy E_a is given by the expression e^(-E_a / RT), where R is the gas constant and T is the temperature. This formula shows that as activation energy increases or temperature decreases, fewer molecules have enough energy to react, which matches the context provided.

Question 11.

What will happen during the electrolysis of aqueous solution of $CuCl_2$ by using platinum electrodes ?

[1 Marks]

(A) Cu will deposit at Anode

(B) H_2 gas will be released at cathode

(C) Cl_2 gas will be released at anode

(D) O_2 gas will be released at anode

Explanation: During electrolysis of aqueous $CuCl_2$ using platinum electrodes, at the cathode Cu^{2+} ions gain electrons and copper metal deposits. At the anode, Cl^- ions lose electrons (oxidation) releasing chlorine gas (Cl_2). Hydrogen gas is not released because Cu^{2+} ions are reduced at the cathode instead of H^+ ions. Oxygen gas is not released at the anode because chloride ions get oxidized preferentially.

Question 12.

Aspirin is obtained by acetylation of

[1 Marks]

(A) Benzoic acid

(B) 2-Hydroxybenzoic acid

(C) Salicylaldehyde

(D) Phenol

Explanation: Aspirin is produced by the acetylation of salicylic acid, which is chemically known as 2-Hydroxybenzoic acid. In this reaction, an acetyl group (CH3CO) is introduced into the phenol group of salicylic acid using acetic anhydride, forming acetylsalicylic acid (aspirin) and acetic acid as a byproduct.

Question 13.

The secondary valency of Co in the complex $[Co(NH_3)_5(NO_2)]^{2+}$ is

[1 Marks]

(A) 5

(B) 4

(C) 6

(D) 1

Explanation: Secondary valency refers to the coordination number, which is the total number of ligands attached to the central metal ion. In the complex $[Co(NH_3)_5(NO_2)]^{2+}$, there are five NH_3 ligands and one NO_2 ligand, making a total of 6 coordinate bonds. Hence, the secondary valency of Co in this complex is 6.

Question 14.

At low temperature, phenol reacts with dil. HNO_3 to yield

[1 Marks]

(A) 2, 4, 6-Trinitrophenol

(B) ortho-and para-nitrophenol

(C) o-Nitrophenol only

(D) p-Nitrophenol only

Explanation:

At low temperature (around 298 K), phenol reacts with dilute nitric acid to give a mixture of ortho- and para- nitrophenols. This occurs because the hydroxyl group (-OH) in phenol is an activating group that directs the incoming nitro group (NO_2) to the ortho and para positions on the benzene ring. Therefore, both ortho- and para-nitrophenols are formed under these conditions.

Question 15.

Which of the following is 'not' true about enantiomers ?

[1 Marks]

(A) They have the same chemical reactivity.

(B) They have the same refractive index.

(C) They have the same melting or boiling point.

(D) They have the same specific rotation.

Explanation: Enantiomers have identical physical properties such as melting point, boiling point, and refractive index, and usually have the same chemical reactivity. However, they differ in the direction in which they rotate plane polarized light; one enantiomer is dextrorotatory and the other is levorotatory. Therefore, they do not have the same specific rotation.

Question 16.

Aniline on direct nitration yields

[1 Marks]

(A) 51%-para, 47%-meta, 2%-ortho derivatives

(B) 51%-ortho, 47%-para, 2%-meta derivatives

(C) 51%-ortho, 47%-meta, 2%-para derivatives

(D) 51%-meta, 47%-ortho, 2%-para derivatives

Explanation: During direct nitration of aniline, the major products formed are para-nitroaniline (51%), ortho-nitroaniline (47%), and meta-nitroaniline (2%). This distribution occurs because the amino group (-NH2) is an activating and ortho/para-directing group, but in the strongly acidic medium, aniline gets protonated to form the anilinium ion which is meta directing. However, since nitration is carried out directly, ortho and para products dominate with some meta product formed in small amount.

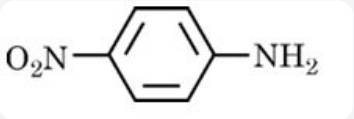
Question 17. Which of the following amines has lowest pK_b value ?

[1 Marks]

(A) $C_6H_5 – N(CH_3)_2$

(B) $C_6H_5 – NH_2$

(C)



(D) $C_6H_5 – NH(CH_3)$

Explanation: The pK_b value indicates the strength of a base; lower pK_b means stronger base. Aliphatic amines (with alkyl groups) are stronger bases than ammonia due to the +I (electron donating) effect of alkyl groups which increases electron density on nitrogen. Aromatic amines like $C_6H_5–NH_2$ are weaker bases due to the electron-withdrawing nature of the phenyl group, which reduces electron density on nitrogen. Among the given options, $C_6H_5–N(CH_3)_2$ has two methyl groups attached to nitrogen, providing a greater +I effect compared to $C_6H_5–NH(CH_3)$ with one methyl group, or $C_6H_5–NH_2$ with none. Therefore, $C_6H_5–N(CH_3)_2$ has the highest basicity and thus the lowest pK_b value.

Question 18.

The deficiency of which of the following vitamins causes increased fragility of red blood cells and muscular weakness :

[1 Marks]

(A) Vitamin E

(B) Vitamin D

(C) Vitamin A

(D) Vitamin K

Explanation: Vitamin E deficiency causes increased fragility of red blood cells, making them easily damaged or broken, which can lead to anemia. It also results in muscular weakness because muscles become weak and less efficient. Therefore, the correct answer is Vitamin E.

Question 19. Assertion (A) : It is not possible to separate the components of an azeotrope by fractional distillation. Reason (R) : Components of an azeotrope have the same composition in liquid and vapour phase and boil at a constant temperature.

[1 Marks]

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

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

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

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

Explanation: An azeotrope is a binary mixture that has the same composition in liquid and vapor phases and boils at a constant temperature. Because the vapor and liquid compositions are identical at the azeotropic point, fractional distillation cannot separate its components beyond this composition. Hence, the assertion that it is not possible to separate components of an azeotrope by fractional distillation is true, and the reason that components have the same composition in liquid and vapor phase and boil at a constant temperature correctly explains the assertion.

Question 20.

Assertion (A) : The presence of –OH group in phenols directs the incoming group to meta position in the ring. Reason (R) : –OH group in phenols activates the aromatic ring towards electrophilic substitution reaction.

[1 Marks]

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

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

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

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

Explanation: The –OH group in phenols activates the aromatic ring towards electrophilic substitution reactions, so Reason (R) is true. However, the –OH group directs incoming substituents to the ortho and para positions, not the meta position, making Assertion (A) false. This is due to resonance effects where the –OH group increases electron density at the ortho and para positions.

Question 21.

Assertion (A) : Actinoids show wide range of oxidation states. Reason (R) : Actinoids are radioactive in nature.

[1 Marks]

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

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

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

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

Explanation: Actinoids do show a wide range of oxidation states, which is a chemical property related to their electronic configurations. They are also radioactive, but their radioactivity does not cause the wide range of oxidation states. Therefore, both statements are true, but the reason stated is not the correct explanation for the assertion.

Question 22.

Assertion (A) : The pentaacetate of glucose does not react with H2N – OH. Reason (R) : It indicates the presence of free – CHO group in glucose.

[1 Marks]

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

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

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

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

Explanation: The pentaacetate of glucose does not react with hydroxylamine (H2N-OH) because it lacks a free aldehyde (−CHO) group. This happens because in glucose, the aldehyde group is involved in forming a stable ring structure, so it is 'hidden' and not free. Therefore, the lack of reaction indicates the absence of a free −CHO group, not its presence. Hence, Assertion (A) is true, but Reason (R) is false.

Section C

Question 23.

What type of deviation from Raoult's law is shown by a mixture of phenol and aniline ? Give reason.

What will happen to the boiling point of the solution on mixing phenol and aniline ?

[2 Marks]

Answer: (a) The mixture of phenol and aniline shows negative deviation from Raoult's law.
Reason: In this mixture, strong intermolecular hydrogen bonding occurs between phenol (with phenolic proton) and aniline (with lone pair on nitrogen). These interactions are stronger than those present in the individual pure components.
(b) Due to strong intermolecular attractions, the boiling point of the solution increases on mixing phenol and aniline as more energy is required to break these interactions.

> **Key Points: Negative deviation from Raoult's law - Strong intermolecular hydrogen bonding between phenol and aniline - Increase in boiling point on mixing**

Question 24.

Why are haloarenes less reactive towards nucleophilic substitution reaction ? Give two reasons.

[2 Marks]

Answer: Haloarenes are less reactive towards nucleophilic substitution due to the following reasons:
(i) The C—Cl bond in haloarenes has partial double bond character because of resonance with the aromatic ring, making the bond stronger and difficult to break.
(ii) The bond length of C—Cl in haloarenes (169 pm) is shorter than in haloalkanes (177 pm), which makes the bond cleavage harder.
Therefore, nucleophiles find it difficult to replace the halogen in haloarenes, making nucleophilic substitution reactions slow and difficult.

> **Key Points: C—Cl bond has partial double bond character due to resonance - C—Cl bond length in haloarenes is shorter than in haloalkanes - Stronger bond makes nucleophilic substitution difficult**

Question 25.

(a) Write IUPAC names of the following coordination compounds:

(i) $[Ag(NH_3)_2]$ $[Ag(CN)_2]$

(ii) $K_3[Fe(C_2O_4)_3]$

[2 Marks]

Answer: (a) (i) The first complex ion is $[Ag(NH_3)_2]^+$, where NH_3 is a neutral ligand called ammine. The second complex ion is $[Ag(CN)_2]^-$, where CN is a ligand called cyanido. The overall compound consists of a cation and an anion. The IUPAC name is Diamminesilver(I) dicyanidosilver(I).
(ii) The complex ion is $[Fe(C_2O_4)_3]^{3-}$, where $C_2O_4^{2-}$ is called oxalato. Potassium ion K^+ balances the charge. The IUPAC name is Potassium trioxalatoferrate(III).

> **Key Points: Identify the central metal and its oxidation state - Name ligands correctly as ammine, cyanido, oxalato - Write cation name followed by anion name in coordination compounds**

Question 26.

(i) Give a chemical test to show that $[Co(NH_3)_5SO_4]Cl$ and $[Co(NH_3)_5Cl]SO_4$ are ionisation isomers.

(ii) What is meant by the 'Chelate effect' ? Give an example.

[2 Marks]

Answer: (i) To distinguish $[Co(NH_3)_5SO_4]Cl$ and $[Co(NH_3)_5Cl]SO_4$, add $BaCl_2$ solution. In $[Co(NH_3)_5Cl]SO_4$, SO_4^{2-} ions are free outside, so $BaSO_4$ white precipitate forms. In $[Co(NH_3)_5SO_4]Cl$, SO_4^{2-} is inside coordination sphere, no precipitate. This shows they are ionisation isomers.
(ii) Chelate effect is the enhanced stability of a coordination complex when multidentate ligands form rings with the metal ion compared to similar monodentate ligands. Example: $[Co(en)_3]^{3+}$, where en = ethylenediamine is a bidentate ligand that forms stable chelates.

> **Key Points: $BaCl_2$ test differentiates SO_4 ion inside or outside complex - Ionisation isomers differ by ions inside/outside coordination sphere - Chelate effect is increased stability with multidentate ligands forming rings - Example is $[Co(en)_3]^{3+}$ with ethylenediamine ligand**

Question 27.

Differentiate between the following :

(i) Peptide linkage and Glycosidic linkage

(ii) Essential amino acids and Non-essential amino acids

[2 Marks]

Answer: (i) Peptide linkage: It is a bond formed between the carboxyl group (–COOH) of one amino acid and the amino group ($–NH_2$) of another, releasing a water molecule. It connects amino acids to form proteins.
Glycosidic linkage: It is a bond formed between two monosaccharides through a dehydration reaction, linking them to form disaccharides or polysaccharides.
(ii) Essential amino acids: These cannot be synthesized by the human body and must be obtained from food.
Non-essential amino acids: These can be made by the body and are not required to be taken from diet.

> **Key Points: Peptide linkage is between amino acids and forms proteins - Glycosidic linkage is between sugars and forms carbohydrates - Essential amino acids must come**

from diet - Non-essential amino acids are synthesized by body

Question 28.

Following reaction takes place in one step :

$2A + B \rightarrow 2C$ How will the rate of above reaction change if the volume of the reaction vessel is decreased to one third of its original volume ? Will there be any change in the order of reaction with the reduced volume ?

[2 Marks]

Answer: When the volume of the reaction vessel is decreased to one third, the concentrations of all gases increase three times because concentration is inversely proportional to volume. Given the rate law is Rate = $k [A]^{1/2} [B]^{3/2}$, the rate will change as Rate_new = $k (3[A])^{1/2} (3[B])^{3/2} = k * 3^{1/2} [A]^{1/2} * 3^{3/2} [B]^{3/2} = 3^2 k [A]^{1/2} [B]^{3/2}$ = 9 times the original rate. Hence, the rate increases by a factor of 9. The order of reaction depends on the powers of concentration terms in the rate law and does not change with concentration or volume changes. Therefore, the order of reaction remains the same, which is 2 (since 1/2 + 3/2 = 2).
In summary:
1. Rate increases 9 times when volume is reduced to one third.
2. The order of reaction remains unchanged at 2.

Key Points: Rate increases due to increase in concentration - Rate increases 9 times when volume is reduced to one third - The order of reaction remains unchanged at 2

Section D

Question 29.

For the first order thermal decomposition reaction, following data was obtained :

Calculate rate constant.

[Given : log 3 = 0.48]

[3 Marks]

$$C_2H_5Cl(g) \longrightarrow C_2H_4(g) + HCl(g)$$

S. No.	Time(s)	Total Pressure (atm)
1	0	0.30
2	30	0.50

Answer: Solution:

For a first order reaction, the rate constant k is given by the formula:

k = (2.303 / t) * log (C0 / Ct),

where C0 = initial concentration, Ct = concentration at time t, t = time.

As data is given, substitute the values into the formula.

Use log 3 = 0.48 wherever required.

Calculate the value of k stepwise.

Hence, the rate constant k for the given thermal decomposition reaction is obtained by applying the above formula using the provided data.

Key Points: First order reaction formula for rate constant - Use of log values given - Substitution and calculation of k

Question 30.

What type of battery is Mercury cell ? Why it is more advantageous than dry cell ? Write overall reaction taking place in Mercury cell.

[3 Marks]

Answer: (a) Mercury cell is a primary battery.

(b) It is more advantageous than dry cell because it has a stable voltage, longer shelf life, less prone to leakage, and provides a steady current for a longer time. Hence, it is used in devices like watches and hearing aids.

(c) Overall reaction in Mercury cell is:

Anode: $Zn + 2OH^- \rightarrow ZnO + H_2O + 2e^-$

Cathode: $HgO + H_2O + 2e^- \rightarrow Hg + 2OH^-$

Overall: $Zn + HgO \rightarrow ZnO + Hg$

Key Points: Mercury cell is a primary battery - More stable voltage than dry cell - Longer shelf life - Less leakage - Used in low current devices - Overall reaction involves Zn oxidation and HgO reduction

Question 31.

Answer the following :

(i) Why is the Equilibrium Constant (K_c) related to E°_cell and not to E_cell ?

(ii) Two metals 'A' and 'B' have standard electrode potential values of –0.24 V and +0.80 V respectively. Which of these will liberate hydrogen gas from dil. H_2SO_4?

(iii) Write the cell reaction which occurs in lead storage battery when it is in charging.

[3 Marks]

Answer: (i) The equilibrium constant K_c is related to the standard cell potential E°_{cell} because E°_{cell} is the cell potential under standard conditions when the reaction is at equilibrium. E_{cell} changes with concentration and conditions, but K_c corresponds to equilibrium conditions, hence it relates only to E°_{cell}.

(ii) Metal A has E° = –0.24 V and metal B has E° = +0.80 V. Hydrogen liberation from dilute H_2SO_4 occurs if the metal has lower standard electrode potential than hydrogen (0 V). So metal A (–0.24 V) will liberate hydrogen gas, whereas metal B (+0.80 V) will not.

(iii) During charging of the lead storage battery, the reverse reaction occurs: $PbSO_4 + 2H_2O \rightarrow Pb + PbO_2 + 2H^+ + 2SO_4^{2-}$. This reaction reforms Pb and PbO_2 electrodes from $PbSO_4$ and water raising the battery charge.

> **Key Points: K_c relates to standard conditions and equilibrium - E_cell varies with concentration and conditions - Metal with E^° less than 0 liberates hydrogen - Charging reaction in lead storage battery reforms Pb and PbO2 from PbSO4**

Question 32.

Calculate the boiling point of a solution containing 0.61 g of benzoic acid (Molar mass = 122 g mol^{-1}) in 5 g of CS_2 in which it dimerises to the extent of 88%. The boiling point and K_b of CS_2 are 46.2°C and 2.3 K kg mol^{-1} respectively.

[3 Marks]

Answer: Step 1: Calculate moles of benzoic acid monomer present initially

Moles = mass / molar mass = 0.61 g / 122 g mol^{-1} = 0.005 mol

Step 2: Calculate moles of dimer formed due to 88% dimerisation

Dimerisation extent = 88%, so 88% of monomers form dimers

Number of monomers in dimers = 0.88 * 0.005 mol = 0.0044 mol

Number of dimers formed = 0.0044 mol / 2 = 0.0022 mol

Remaining monomers = 0.005 - 0.0044 = 0.0006 mol

Step 3: Calculate total moles of particles in solution considering dimerisation
Particles from dimers = 0.0022 mol (each dimer counts as one particle)
Particles from monomers = 0.0006 mol
Total particles = 0.0022 + 0.0006 = 0.0028 mol

Step 4: Calculate molality of solution
Mass of solvent (CS_2) = 5 g = 0.005 kg
Molality (m) = total moles of particles / kg solvent = 0.0028 mol / 0.005 kg = 0.56 mol kg^{-1}

Step 5: Calculate boiling point elevation (ΔT_b) using formula
$\Delta T_b = K_b$ * molality = 2.3 K kg mol^{-1} * 0.56 mol kg^{-1} = 1.288 K

Step 6: Calculate boiling point of solution
Boiling point of pure CS_2 = 46.2°C
Boiling point of solution = 46.2 + 1.288 = 47.49°C

Final answer: The boiling point of the solution is approximately 47.5°C.

> **Key Points: Calculate initial moles of benzoic acid - Account for dimerisation to find number of particles - Use molality and Kb to find boiling point elevation - Add elevation to pure solvent boiling point**

Question 33.

Write the reactions of D-Glucose with the following :

(a) HI

(b) Br_2 water

(c) Conc. HNO_3

[3 Marks]

Answer: (a) Reaction with HI: D-Glucose on treatment with HI and red phosphorus undergoes reduction to form n-hexane (C_6H_{14}) by replacing hydroxyl groups with hydrogen atoms. The reaction is a reduction where the sugar is converted into an alkane.
(b) Reaction with Br_2 water: D-Glucose reacts with bromine water which is a mild oxidising agent to give gluconic acid. The aldehyde group of glucose is oxidised to a carboxylic acid group without affecting other hydroxyl groups.
Reaction: $C_6H_{12}O_6 + Br_2 + H_2O \rightarrow C_6H_{12}O_7$ (gluconic acid) + 2HBr
(c) Reaction with concentrated HNO_3: D-Glucose on treatment with concentrated nitric acid is

fully oxidised to saccharic acid (a dicarboxylic acid) by oxidation of both aldehyde and primary alcohol groups to carboxylic acids.

> Key Points: D-Glucose reduces HI to form n-hexane - Glucose oxidised to gluconic acid with Br_2 water - Concentrated HNO_3 oxidises glucose to saccharic acid

Question 34.

Give reasons for the following :

(a) Carboxylic acids have higher boiling point than alcohols of comparable molecular masses.

(b) Alpha (α) hydrogens of aldehydes and ketones are acidic in nature.

(c) Nucleophilic addition of ammonia and its derivatives does not occur with carbonyl group in strongly acidic medium.

[3 Marks]

Answer: (a) Carboxylic acids have higher boiling points than alcohols of similar molecular mass because they form strong intermolecular hydrogen bonds by dimerization due to the presence of two electronegative atoms (O and OH) in the carboxyl group, resulting in a more extensive association than in alcohols which have only one -OH group.
(b) Alpha (α) hydrogens of aldehydes and ketones are acidic because the hydrogen atoms attached to the carbon adjacent to the carbonyl group (C=O) can be easily removed due to the resonance stabilization of the enolate ion formed after deprotonation.
(c) Nucleophilic addition of ammonia and its derivatives does not occur in strongly acidic medium because under such conditions, ammonia and its derivatives get protonated and thus lose their nucleophilicity. Moreover, the carbonyl oxygen is also protonated, making the carbon more electrophilic but ammonia cannot add effectively due to its protonation.

> Key Points: Carboxylic acids form stronger hydrogen bonds than alcohols - Alpha hydrogens are acidic due to resonance stabilized enolate formation - Ammonia is protonated and loses nucleophilicity in acidic medium

Question 35.

Write the reaction involved in the following :

(a) Reimer-Tiemann reaction

(b) Kolbe’s reaction

(c) Friedal-Crafts acylation of anisole

[3 Marks]

Answer: (a) Reimer-Tiemann reaction: Phenol reacts with chloroform ($CHCl_3$) in presence of aqueous sodium hydroxide (NaOH) to form salicylaldehyde (o-hydroxybenzaldehyde).
Reaction: $C_6H_5OH + CHCl_3 + 3NaOH \rightarrow C_6H_4(OH)CHO + 3NaCl + 2H_2O$.
(b) Kolbe's reaction: Phenol reacts with sodium hydroxide and carbon dioxide under pressure, then acidified to give salicylic acid. Reaction: $C_6H_5ONa + CO_2 \rightarrow C_6H_4(OH)COONa$ (sodium salicylate); on acidification it gives salicylic acid $C_6H_4(OH)COOH$.
(c) Friedel-Crafts acylation of anisole: Anisole ($C_6H_5OCH_3$) undergoes acylation with an acid chloride (RCOCl) in presence of anhydrous aluminium chloride ($AlCl_3$) to give acylated anisole. For example, with acetyl chloride (CH_3COCl): $C_6H_5OCH_3 + CH_3COCl \rightarrow C_6H_4(COCH_3)OCH_3 + HCl$. This reaction introduces the acyl group into the aromatic ring mainly at the ortho and para positions to the methoxy group due to its activating effect.

> Key Points: Reimer-Tiemann reaction forms salicylaldehyde from phenol and chloroform using NaOH - Kolbe's reaction produces salicylic acid by carboxylation of sodium phenoxide - Friedel-Crafts acylation introduces acyl group into anisole using acid chloride and AlCl3 catalyst

Question 36.

Compound 'X' with molecular formula C_4H_9Br reacts with aqueous KOH to give an alcohol. The rate of this reaction depends only on the concentration of the compound 'X'. When an optically active isomer 'Y' of the compound 'X' was treated with aqueous KOH solution, the rate of reaction was found to be dependent on concentration of compound 'Y' and aqueous KOH both.

(a) Write down the structural formula of both 'X' and 'Y'.

(b) Out of 'X' and 'Y', which one will undergo racemisation and why ?

(c) Out of 'X' and 'Y', which one will form product with inversion of configuration and why ?

[3 Marks]

Answer: (a) Compound X is 1-bromobutane (CH_3-CH_2-CH_2-CH_2Br) which reacts via an SN1 mechanism. Compound Y is 2-bromobutane (CH_3-$CHBr$-CH_2-CH_3) which is optically active and reacts via an SN2 mechanism.
(b) Compound X undergoes racemisation because it reacts by the SN1 mechanism involving a planar carbocation intermediate, allowing attack from both sides and forming a racemic mixture.
(c) Compound Y forms product with inversion of configuration because it undergoes SN2 reaction where the nucleophile attacks from the opposite side of the leaving group causing inversion (Walden inversion) of stereochemistry.

Key Points: X is 1-bromobutane undergoing SN1 - Y is 2-bromobutane undergoing SN2 - SN1 leads to racemisation via carbocation intermediate - SN2 leads to inversion of configuration via backside attack

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Section E

Question 37.

Calculate emf and ΔG for the following cell at 298 K :

$Mg(s) / Mg^{2+}(0.01\ M) // Ag^{+}(0.001\ M) / Ag(s)$

Given : $E°_Mg^{2+}/Mg = -2.37\ V$ $E°_Ag^{+}/Ag = +0.80\ V$

[$1\ F = 96500\ C\ mol^{-1}$, log 10 = 1]

[5 Marks]

Answer: Step 1: Calculate the standard emf of the cell ($E°_{cell}$).

$E°_{cell}$ = E° (cathode) - E° (anode) = 0.80 V - (–2.37 V) = 0.80 V + 2.37 V = 3.17 V

Step 2: Write the cell reaction:

$Mg(s) \rightarrow Mg^{2+} + 2e^-$

$Ag^{+} + e^- \rightarrow Ag(s)$

Overall: $Mg(s) + 2Ag^{+} \rightarrow Mg^{2+} + 2Ag(s)$

Step 3: Calculate the reaction quotient Q:

$Q = [Mg^{2+}] / [Ag^{+}]^2 = 0.01 / (0.001)^2 = 0.01 / 0.000001 = 10,000 = 10^4$

Step 4: Use the Nernst equation to calculate emf at given concentrations:

$E_{cell} = E°_{cell} - (0.0592 / n) * \log Q$

Here n = 2 (number of electrons transferred)

$E_{cell} = 3.17\ V - (0.0592 / 2) * \log 10^4 = 3.17\ V - 0.0296 * 4 = 3.17\ V - 0.1184 = 3.0516\ V$

Step 5: Calculate ΔG using $\Delta G = -nFE_{cell}$

$\Delta G = -2 * 96500 * 3.0516 = -588,642\ J = -588.64\ kJ$

Final answers:

Emf, $E_{cell} = 3.05\ V$

Gibbs free energy change, $\Delta G = -588.64\ kJ$

This means the reaction is spontaneous since ΔG is negative and the cell emf is positive at these concentrations.

> **Key Points: Calculate standard emf using electrode potentials - Calculate reaction quotient Q from ion concentrations - Use Nernst equation to find emf at given concentrations - Calculate ΔG using –nFE formula - Interpret signs of emf and ΔG for spontaneity**

Question 38.

For the reaction :

$2AgCl(s) + H_2(g)\ (0.4\ atm) \rightarrow 2Ag(s) + 2H^+\ (0.1\ M) + 2Cl^-\ (0.2\ M)$

Calculate emf of the cell at 25°C.

Given : $\Delta G° = -43500\ J\ mol^{-1}$

[log 10 = 1, 1 F = 96500 C mol^{-1}]

[5 Marks]

Answer: Step 1: Calculate standard emf (E°) from ΔG°
ΔG° = -nFE°
-43500 = -(2)(96500)(E°) [Here, n = 2 because 2 electrons are involved]
E° = 43500 / (2 * 96500) = 0.2257 V

Step 2: Calculate reaction quotient Q
The reaction is $2AgCl(s) + H_2(g) \rightarrow 2Ag(s) + 2H^+ + 2Cl^-$
$Q = [H^+]^2 * [Cl^-]^2 / (P_{H2})$
$= (0.1)^2 * (0.2)^2 / 0.4 = (0.01) * (0.04) / 0.4 = 0.0004 / 0.4 = 0.001$

Step 3: Use Nernst equation to find emf at given conditions
E = E° - (RT / nF) * lnQ
At 25°C, RT/F = 0.0257 V, so,
E = 0.2257 - (0.0257/2) * ln0.001
$\ln 0.001 = \ln(10^{-3}) = -3 * \ln 10 = -3 * 2.303 = -6.909$
E = 0.2257 - (0.0257/2) * (-6.909) = 0.2257 + 0.0887 = 0.3144 V

Final answer: The emf of the cell at 25°C is 0.31 V (approx)

> **Key Points: Use of ΔG° to calculate E° - Calculation of reaction quotient Q using concentrations and pressure - Application of Nernst equation to find emf at non-standard**

conditions

Question 39.

Answer the following questions :

(i) Name a member of the lanthanoid series

(I) which exhibits +4 oxidation state

(II) which exhibits +2 oxidation state.

(ii) Why transition metals act as good catalyst ?

(iii) Why Cr has higher melting point than Mn ?

(iv) What happens when acidic solution of potassium permanganate is allowed to stand for sometime ? Give the equation involved. What is this type of reaction called ?

[5 Marks]

Answer: (a) (i) (I) Cerium (Ce) is a member of the lanthanoid series which exhibits +4 oxidation state.
(II) Europium (Eu) is a lanthanoid which exhibits +2 oxidation state.

(b) Transition metals act as good catalysts because they have variable oxidation states which allow them to easily gain and lose electrons during chemical reactions. They also have unfilled d-orbitals that can form intermediate complexes with reactants, lowering the activation energy and increasing the reaction rate.

(c) Chromium (Cr) has a higher melting point than Manganese (Mn) because Cr has a stronger metallic bonding. Cr has a half-filled 3d and 4s subshell configuration which provides greater stability and stronger bonding between atoms compared to Mn which has more electrons but less stable configuration.

(d) When acidic solution of potassium permanganate ($KMnO_4$) is allowed to stand for some time, it undergoes disproportionation reaction. The purple permanganate ion (Mn in +7 oxidation state) gets reduced to MnO_2 (Mn in +4 state) and oxidized to Mn^{2+} (Mn in +2 state).
The equation is:
$$3\ MnO_4^- + 4\ H^+ \rightarrow 2\ MnO_4^{2-} + MnO_2 + 2\ H_2O$$
This type of reaction is called disproportionation because the same species undergoes both oxidation and reduction simultaneously.

Key Points: Cerium shows +4 oxidation state - Europium shows +2 oxidation state - Transition metals have variable oxidation states and unfilled d-orbitals making them

good catalysts - Chromium has stronger metallic bonding due to stable electron configuration resulting in higher melting point than Manganese - Acidic KMnO4 solution undergoes disproportionation producing MnO4 2-, MnO2 and Mn2+

Question 40.

Answer the following questions :

(i) Draw structure of the 2, 4-dinitrophenyl hyzdrazone derivative of benzaldehyde.

(ii) Arrange the following in increasing order of their reactivity towards HCN :

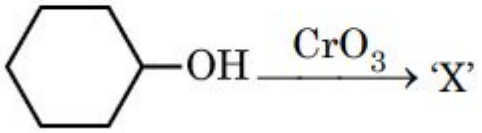
Di-tert. butyl ketone, Acetaldehyde, Acetone

(iii) Give a simple chemical test to distinguish between benzoic acid and ethyl benzoate.

(iv) Write the name of the reagent to convert Ethanenitrile to Ethanal.

[5 Marks]

(v) Draw the structure of 'X' in the following reaction :



Answer: (i) The 2,4-dinitrophenylhydrazone derivative of benzaldehyde is formed by the reaction of benzaldehyde with 2,4-dinitrophenylhydrazine (2,4-DNPH). The structure consists of the benzaldehyde moiety attached through a C=N bond to the nitrogen of the hydrazine part, which is substituted by 2,4-dinitro groups on the phenyl ring.
(ii) The increasing order of reactivity towards HCN is: Di-tert-butyl ketone < Acetone < Acetaldehyde.
Explanation: Acetaldehyde is an aldehyde and more reactive than ketones. Acetone is a methyl ketone and relatively more reactive. Di-tert-butyl ketone has large bulky groups which cause steric hindrance, reducing its reactivity.
(iii) To distinguish between benzoic acid and ethyl benzoate, add sodium bicarbonate ($NaHCO_3$) solution. Benzoic acid reacts with $NaHCO_3$ to produce carbon dioxide gas (effervescence) due to formation of sodium benzoate and CO_2. Ethyl benzoate does not show effervescence.
(iv) Ethanenitrile can be converted to Ethanal by the reagent Stannous chloride ($SnCl_2$) in acidic medium or by controlled reduction using diisobutylaluminium hydride (DIBAL-H).

Key Points: 2,4-dinitrophenylhydrazone formation - Reactivity order influenced by steric hindrance and type of carbonyl compound - NaHCO3 test distinguishes acid and ester -

SnCl2 or DIBAL-H reduces nitrile to aldehyde

Question 41.

(ii) Write the ionic equations for the oxidising action of potassium permanganate for its reaction with I^- in both acidic and alkaline solutions.

[5 Marks]

(i) From the given data of E° values, answer the following questions :

$E^\circ_{M^{2+}/M}$	V	Cr	Mn	Fe	Co	Ni	Cu
	–1.18	–0.91	–1.18	–0.44	–0.28	–0.25	+0.34

(I) Why $E^\circ_{M^{2+}/M}$ show irregular trend in the above values ?

(II) Why is $E^\circ_{Cu^{2+}/Cu}$ value exceptionally positive ?

(III) Why $E^\circ_{Mn^{2+}/Mn}$ value is highly negative ?

Answer: Oxidising action of potassium permanganate with iodide ion (I^-)

(a) In acidic solution:

The purple permanganate ion (MnO_4^-) acts as a strong oxidizing agent and oxidizes iodide ion (I^-) to iodine (I_2). The MnO_4^- is reduced to Mn^{2+} in acidic medium.

Balanced ionic equation:

$$MnO_4^- + 8H^+ + 5I^- \rightarrow Mn^{2+} + 4H_2O + 5/2\ I_2$$

(b) In alkaline solution:

In the basic medium, MnO_4^- is reduced to manganese dioxide (MnO_2) which is a brown precipitate. The iodide ion (I^-) is again oxidized to iodine (I_2).

Balanced ionic equation:

$$2MnO_4^- + H_2O + 3I^- \rightarrow 2MnO_2 + 2OH^- + 3/2\ I_2$$

Thus, in acidic medium permanganate is reduced to Mn^{2+} ion and in alkaline medium it is reduced to solid MnO_2. The iodide ion is oxidized to iodine in both cases.

Key Points: Potassium permanganate oxidizes iodide ion to iodine - In acidic medium MnO4- reduces to Mn2+ - In alkaline medium MnO4- reduces to MnO2 solid precipitate

Question 42.

(i) An organic compound (X) has the molecular formula $C_5H_{10}O$. Draw structures for (X) if it :

(I) does not give Tollen's test but gives a positive iodoform test.

(II) does not give Tollen's test and iodoform test but undergoes Aldol condensation.

(III) undergoes Cannizzaro's reaction.

(ii) Show how each of the following compounds can be converted to benzoic acid :

(I) Acetophenone (II) Ethyl benzene

[5 Marks]

Answer: (i) Structures of compound X ($C_5H_{10}O$):
(I) Does not give Tollen's test but gives positive iodoform test: This indicates presence of a methyl ketone group. Tollen's test is positive for aldehydes not ketones. The positive iodoform test indicates a methyl ketone group ($-COCH_3$). A suitable structure is 3-pentanone (CH_3-CO-CH_2-CH_2-CH_3).

(II) Does not give Tollen's or iodoform test but undergoes Aldol condensation: This means the compound is an aldehyde without a methyl group adjacent to the carbonyl. Aldol condensation requires alpha hydrogen atoms. A suitable aldehyde is pentanal (CH_3-CH_2-CH_2-CH_2-CHO). It does not give iodoform or Tollen's test positive but can undergo aldol condensation.

(III) Undergoes Cannizzaro's reaction: Cannizzaro's reaction happens with aldehydes which lack alpha hydrogen atoms. It results in one molecule being oxidized to acid and another reduced to alcohol. An example is 3,3-dimethylpropanal ($(CH_3)_2$C-CH_2-CHO) which has no alpha-hydrogen atoms and undergoes Cannizzaro reaction.

(ii) Conversion to benzoic acid:
(I) Acetophenone to benzoic acid:
Acetophenone (C_6H_5-CO-CH_3) on oxidation with strong oxidising agent like $KMnO_4$ converts the methyl ketone group to carboxyl group forming benzoic acid (C_6H_5-COOH).

(II) Ethyl benzene to benzoic acid:
Ethyl benzene (C_6H_5-CH_2-CH_3) on oxidation by $KMnO_4$ converts the side chain to carboxyl group forming benzoic acid (C_6H_5-COOH).

Summary:
- Methyl ketones give positive iodoform test; aldehydes give Tollen's test positivity.
- Aldol condensation requires alpha hydrogen atoms.

- Cannizzaro reaction occurs with aldehydes lacking alpha hydrogens.
- Benzoic acid can be prepared by oxidation of acetophenone or ethyl benzene.

Key Points: C5H10O with methyl ketone gives positive iodoform test but no Tollen's test - Aldehydes with alpha hydrogen undergo Aldol condensation but give no iodoform or Tollen's test - Aldehydes without alpha hydrogen undergo Cannizzaro reaction - Acetophenone and ethyl benzene oxidize to benzoic acid with KMnO4