

NCERT Solutions for Class 12 Chemistry

Chapter 8 – Aldehydes, Ketones and Carboxylic Acids

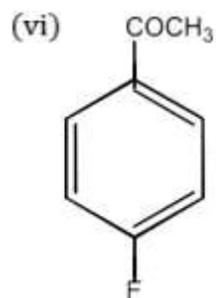
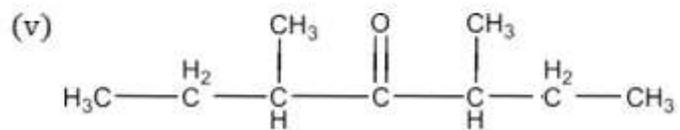
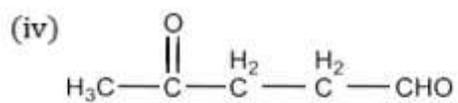
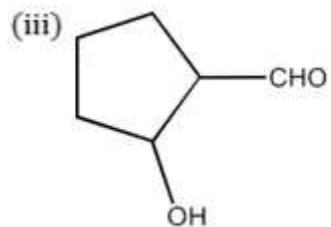
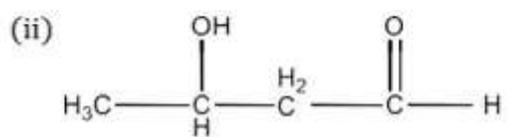
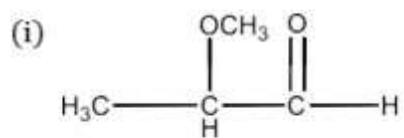
Intext Questions – Class 12 Chemistry Chapter 8 – Aldehydes, Ketones and Carboxylic Acids

8.1

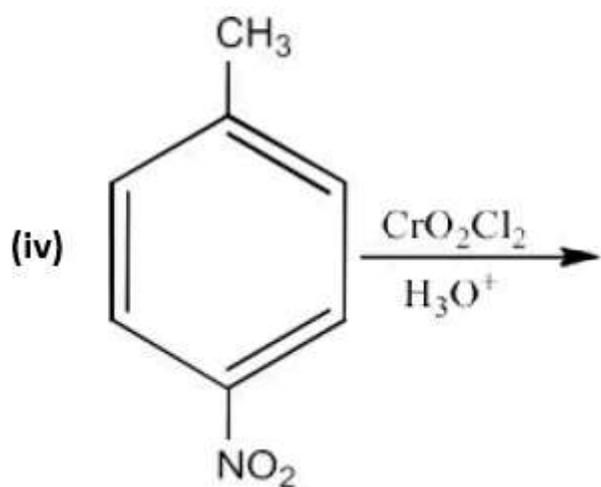
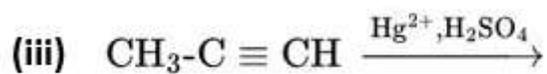
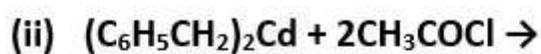
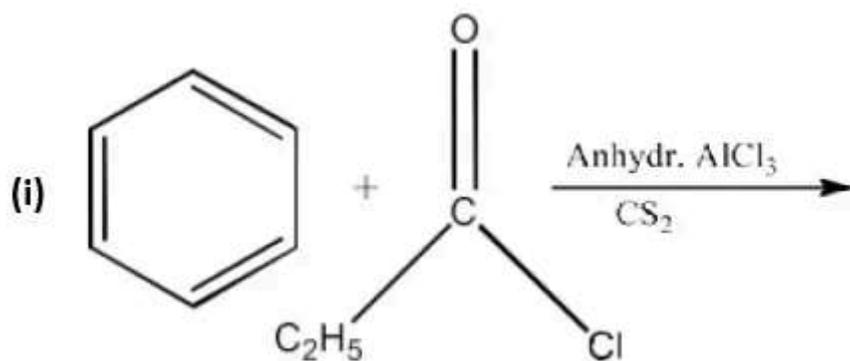
Write the structures of the following compounds.

- (i) α -Methoxypropionaldehyde
- (ii) 3-Hydroxybutanal
- (iii) 2-Hydroxycyclopentane carbaldehyde
- (iv) 4-Oxopentanal
- (v) Di-sec. butyl ketone
- (vi) 4-Fluoroacetophenone

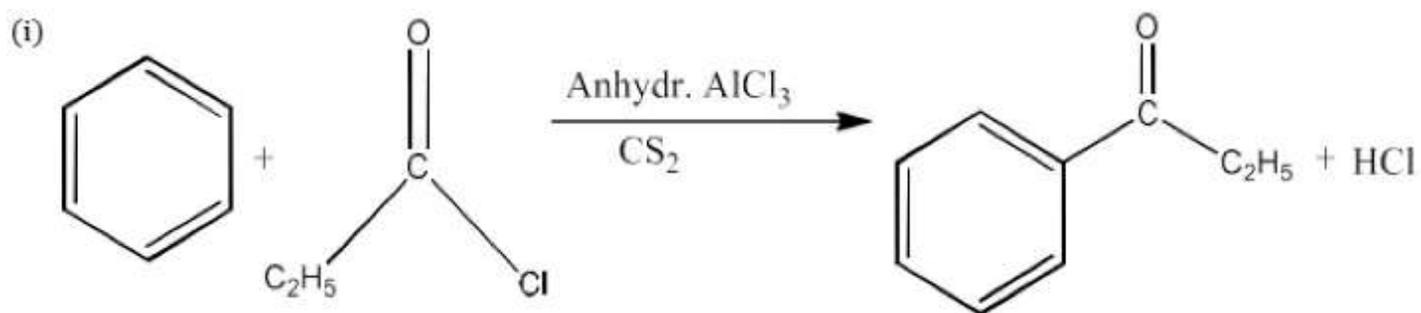
Ans –

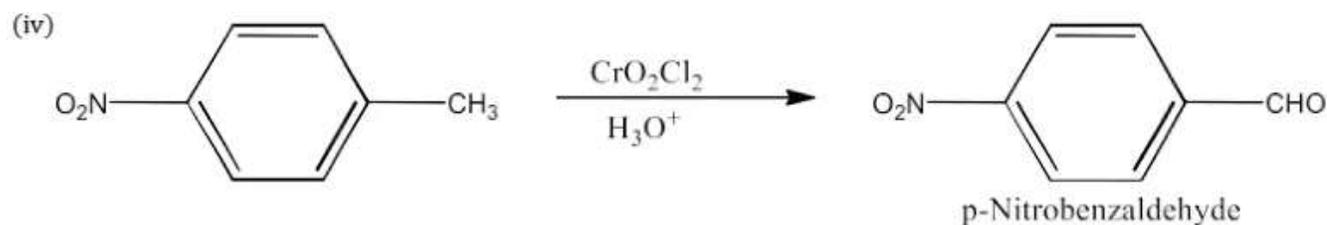
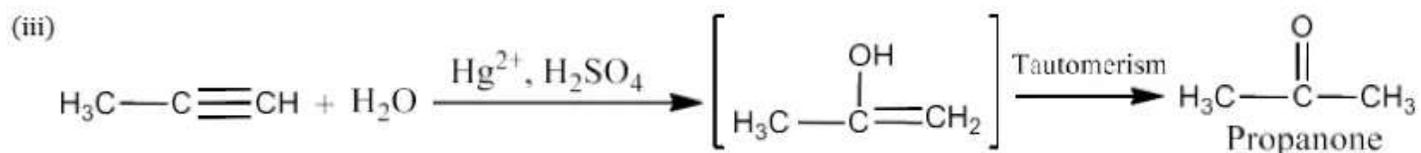


8.2



Ans –





8.3

Arrange the following compounds in increasing order of their boiling points.

CH_3CHO , $\text{CH}_3\text{CH}_2\text{OH}$, CH_3OCH_3 , $\text{CH}_3\text{CH}_2\text{CH}_3$

◆ Key Points to Note from Question

Key Concept:

- **Intermolecular Forces:** Boiling point depends on hydrogen bonding, dipole interactions, and van der Waals forces.
- **Hydrogen Bonding:** Strongest in alcohols, increasing boiling point.
- **Dipole-Dipole Interactions:** Present in aldehydes and ethers, giving moderate boiling points.
- **Van der Waals Forces:** Weakest in alkanes, leading to the lowest boiling point.

Ans – The sequence of the elements based on their boiling levels will be represented as:
 $\text{CH}_3\text{CH}_2\text{CH}_3 < \text{CH}_3\text{OCH}_3 < \text{CH}_3\text{CHO} < \text{CH}_3\text{CH}_2\text{OH}$

The molecular masses of each of these substances are similar. The greatest boiling point is exhibited by $\text{CH}_3\text{CH}_2\text{OH}$, which experiences significant intermolecular H-bonding. Dipole-dipole relations are powerful in CH_3CHO compared to CH_3OCH_3 because CH_3CHO is considerably more polarized than CH_3OCH_3 . Consequently, CH_3CHO 's boiling level $>$ CH_3OCH_3 . $\text{CH}_3\text{CH}_2\text{CH}_3$ exhibits the lowest boiling point & only fragile Van Der Waals interactions occur amongst its molecular compounds.

8.4

Arrange the following compounds in increasing order of their reactivity in nucleophilic addition reactions.

- (i) Ethanal, Propanal, Propanone, Butanone.
(ii) Benzaldehyde, p-Tolualdehyde, p-Nitrobenzaldehyde, Acetophenone.

Hint: Consider steric effect and electronic effect.

✦ **Key Points to Note from Question**

Key Concept:

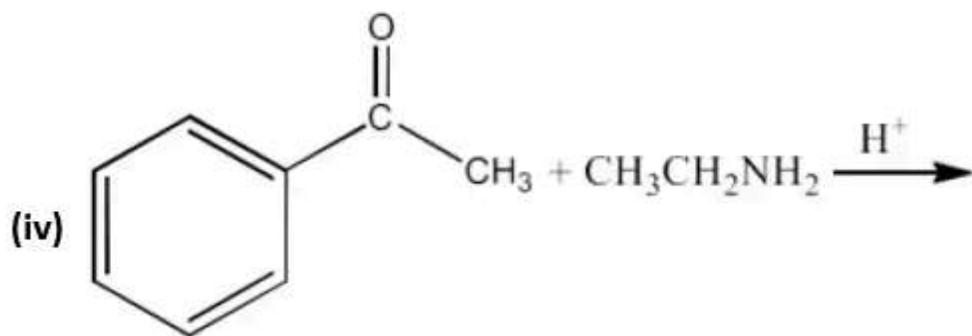
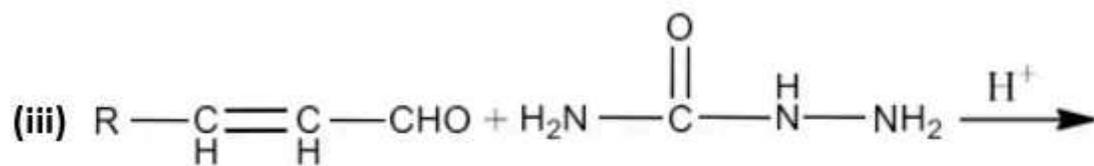
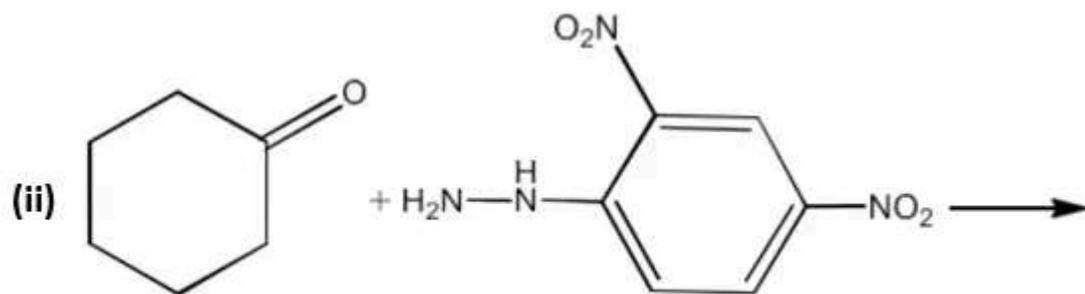
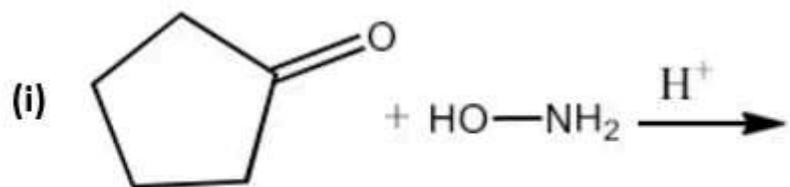
- **Electronic Effects:** Electron-donating groups ($-\text{CH}_3$, $-\text{OH}$) reduce reactivity, while electron-withdrawing groups ($-\text{NO}_2$) increase reactivity.
- **Steric Hindrance:** More alkyl groups around the carbonyl carbon hinder nucleophilic attack.
- **Aldehydes vs. Ketones:** Aldehydes are generally more reactive than ketones due to less steric hindrance and stronger partial positive charge on the carbonyl carbon.

Ans – (i) Butanone < propanone < propanal < ethanal represents the ascending sequence of responsiveness among carbonyl groups over nucleophilic addition processes. Two elements determine the sensitivity such as electronic & steric variables.

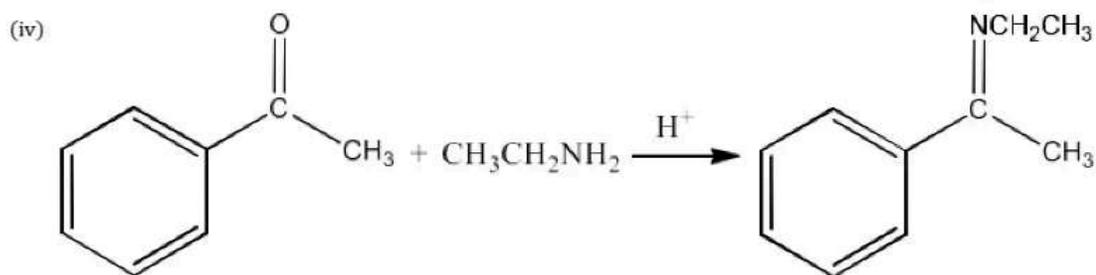
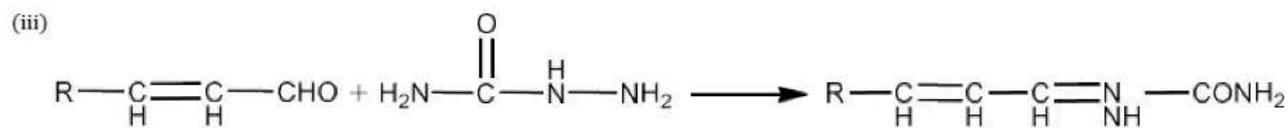
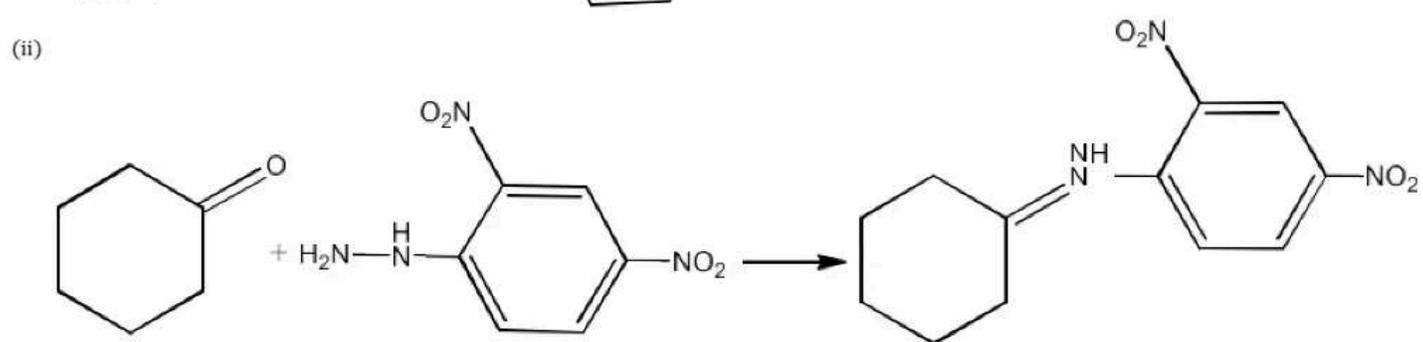
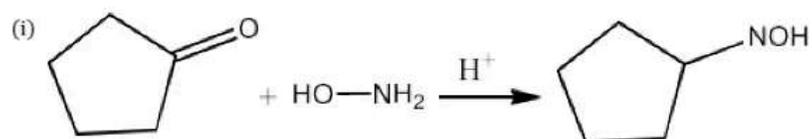
(ii) Acetophenone < p-tolualdehyde < benzaldehyde < p-nitrobenzaldehyde is the ascending pattern of reactive elements.

Justification: Acetophenone is the most poorly reactive ketone when it comes to nucleophilic interaction. Every other substance is an aldehyde. Considering the group composed of CH_3 near the para position concerning the $-\text{CHO}$ group is going to boost the electron density over the carbonyl carbon atom resulting in the hyperconjugation impact, p-tolualdehyde remains less reactive compared to benzaldehyde. That's why in comparison to benzaldehyde; the nucleophile assault is a bit less severe.

The nitro compound in p-nitrobenzaldehyde consists of the opposite consequence. Because of the $-\text{I}$ and $-\text{R}$ effects, this is an electron-withdrawing substance. The nucleophile assault is favoured when the electron density is present around the atom of carbonyl carbon drops.

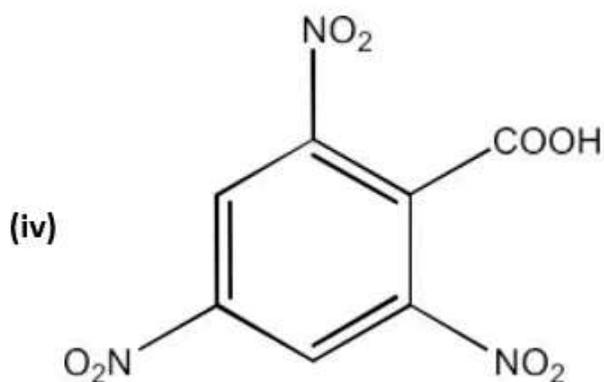
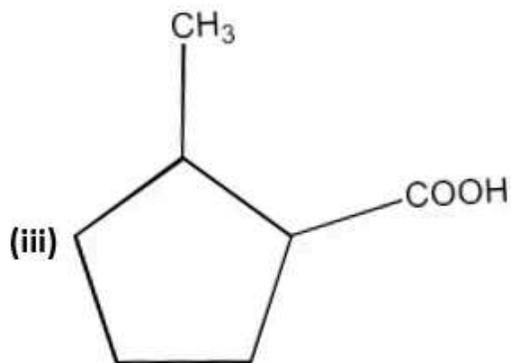
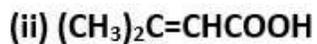


Ans -



8.6

Give the IUPAC names of the following compounds:



Ans – (i) 3 – Phenylpropanoic acid

(ii) 3 – Methylbut-2-enoic acid

(iii) 2-Methylcyclohexanecarboxylic acid

(iv) 2,4,6 – Trinitrobenzoic acid

8.7

Show how each of the following compounds can be converted to benzoic acid.

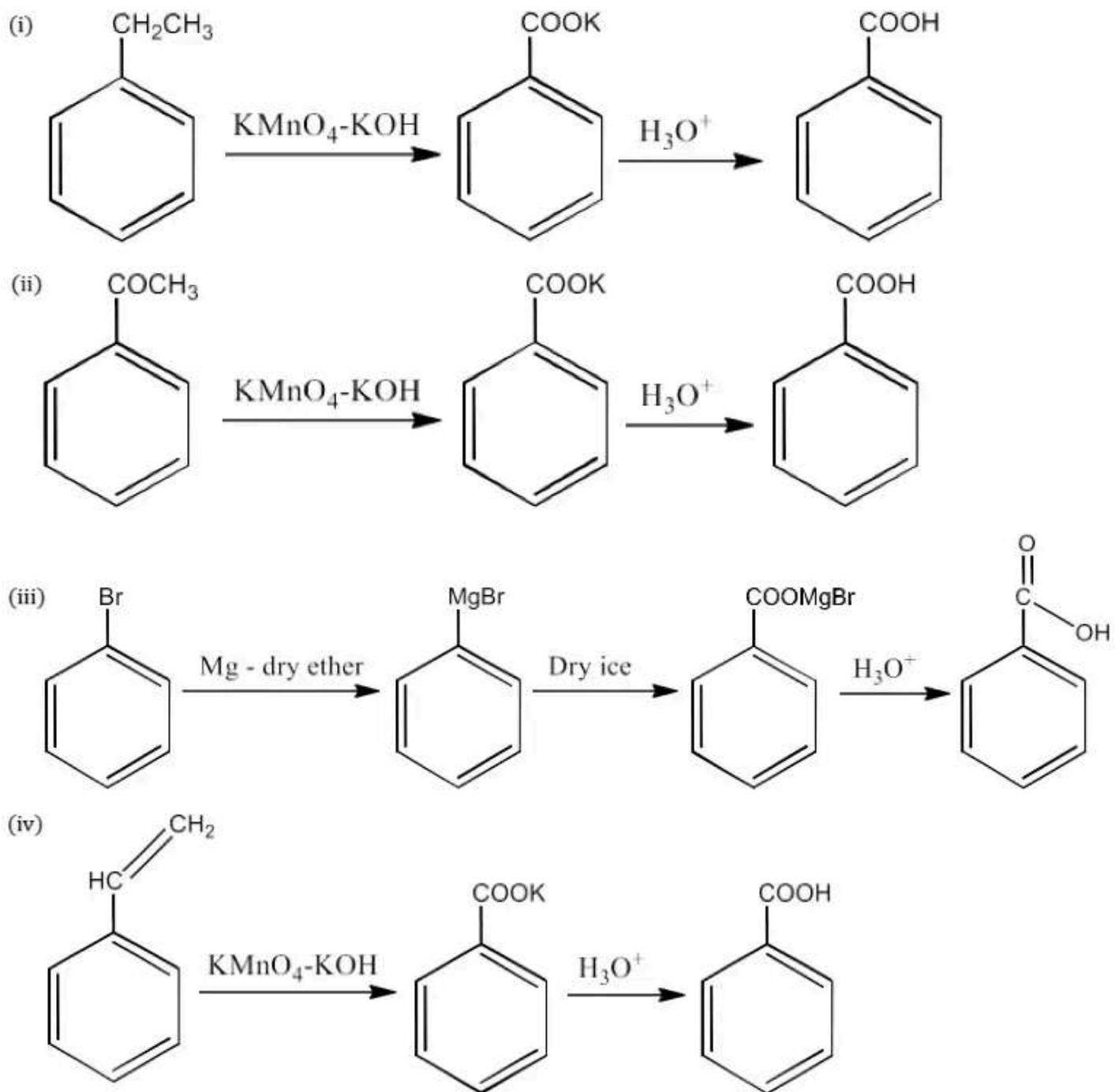
(i) Ethylbenzene

(ii) Acetophenone

(iii) Bromobenzene

(iv) Phenylethene (Styrene)

Ans –

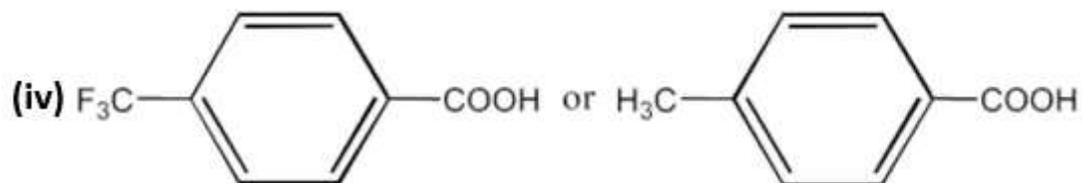


Which acid of each pair shown here would you expect to be stronger?

(i) $\text{CH}_3\text{CO}_2\text{H}$ or $\text{CH}_2\text{FCO}_2\text{H}$

(ii) $\text{CH}_2\text{FCO}_2\text{H}$ or $\text{CH}_2\text{ClCO}_2\text{H}$

(iii) $\text{CH}_2\text{FCH}_2\text{CH}_2\text{CO}_2\text{H}$ or $\text{CH}_3\text{CHFCH}_2\text{CO}_2\text{H}$



Ans – Justification: The reason for this is that the CH_3 category's +I action elevates the electron density around the oxygen atom that is commonly found in the carboxyl category's O-H bond, making bond breakage even more challenging. As a result, the acidic strength is significantly reduced. The -I power, or the overall impact of electron-withdrawing atoms is extremely strong for the existing atomic particles that go by the name F.

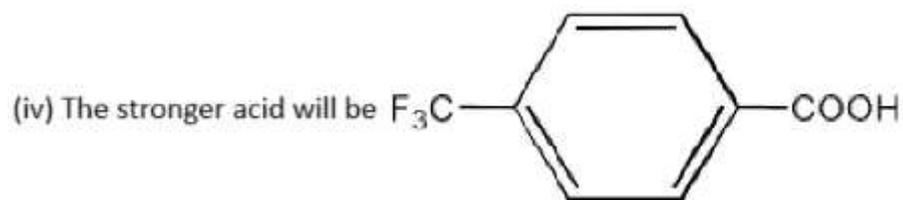
This robust atomic structure will transform the connected bond breakage process much more efficiently thereby reducing the oxygen atom's combined electron density. As a result, the acidic nature gets highly solidified.

We must also consider the fact that how many F atoms are readily available within a specific molecule. Consequently, the F atom's approximate location inside the carbon atom ring. Based on the earlier conversation,

(i) The stronger acid will be CH_2FCOOH .

(ii) The stronger acid will be CH_2FCOOH .

(iii) The stronger acid will be $\text{CH}_3\text{CHFCH}_2\text{COOH}$.



Exercise Questions – Class 12 Chemistry Chapter 8 – Aldehydes, Ketones and Carboxylic Acids

What is meant by the following terms ? Give an example of the reaction in each case.

(i) Cyanohydrin

(ii) Acetal

(iii) Semicarbazone

(iv) Aldol

(v) Hemiacetal

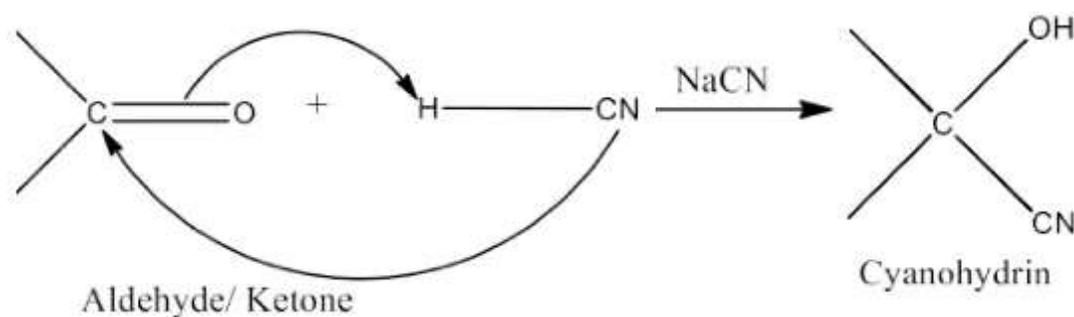
(vi) Oxime

(vii) Ketal

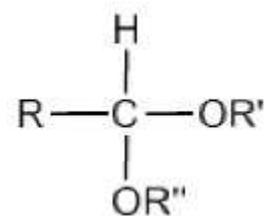
(viii) Imine

(ix) 2,4-DNP-derivative (x) Schiff's base

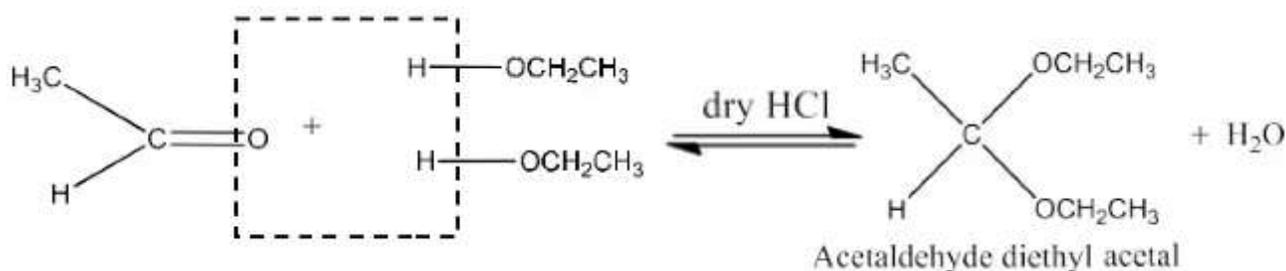
Ans – (i) The organic compounds called cyanohydrins consist of $RR'(OH)CN$, wherein R & R' might represent a chemical combination of aryl or alkyl substances. Aldehydes & ketones interact via hydrogen cyanide (HCN) in the form of cyanohydrin when excessive sodium cyanide (NaCN) is present as a catalyst in the mixture. We refer to this as cyanohydrin interactions. The following is the response:

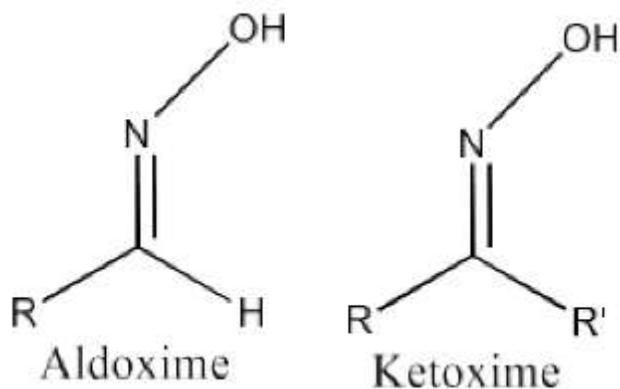


(ii) Acetals can be gem-dialkoxy alkanes with 2 alcoholic categories attached to the final carbon atom. One link is connected to an alkyl category while the additional link is connected to an atom of hydrogen.

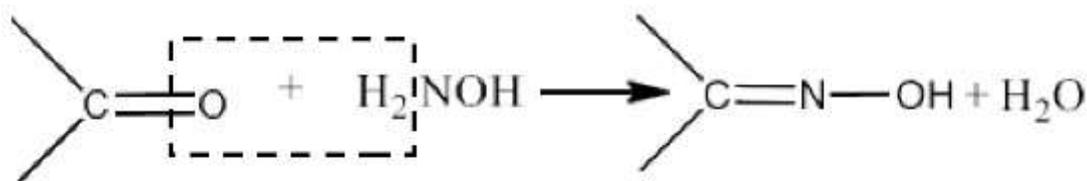


Hemiacetals happen whenever two monohydric alcohol substitutes are exposed to dry HCl gases; these hemiacetals then combine with a different alcohol molecule to make acetal. The following is the response:

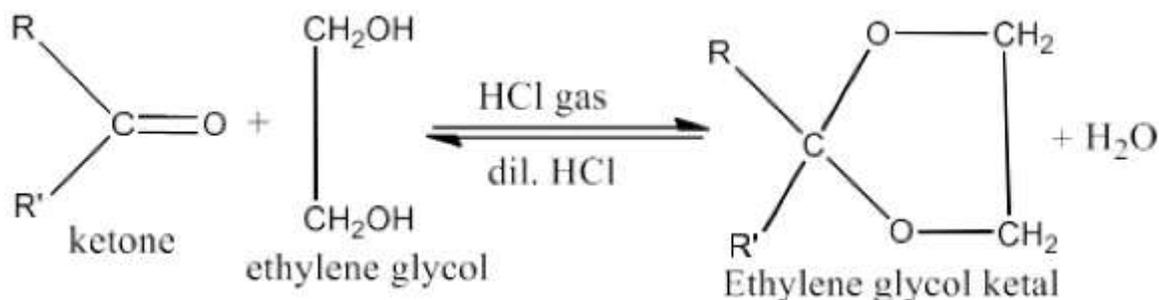




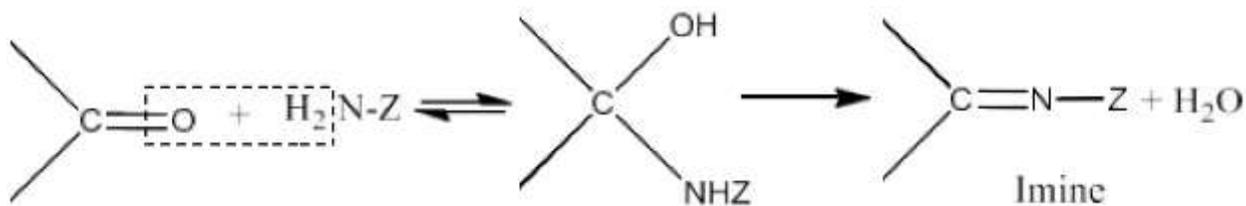
During a moderately acid medium, hydroxylamine is used for treating aldehydes or ketones produced by oximes. The following constitutes the response:



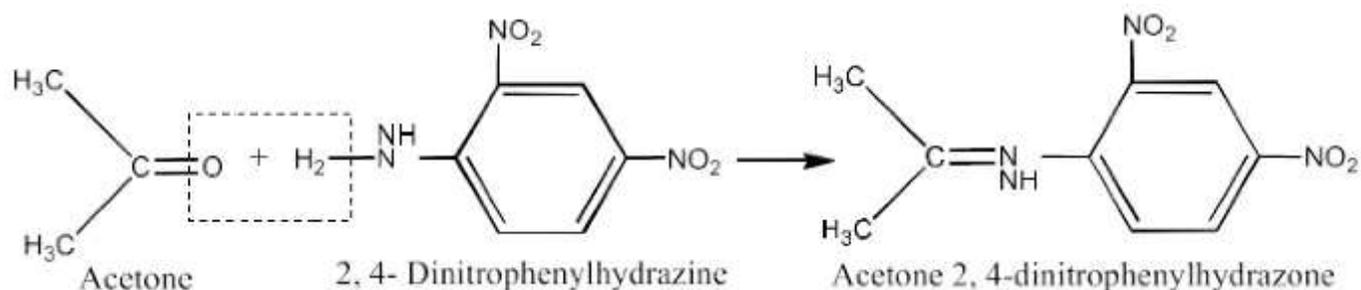
(vii) Ketals were gemdioxalcanes that have 2 alcoholic compounds upon the same atom of carbon throughout the chain of molecules. Two distinct sets of alkyls are connected to each other via 2 carbon linkages. Ketones and ethylene glycol combine to form ethylene glycol ketals, a cycle-like molecule when HCl dry gas is present. Here is an illustration of how a ketal gets formed:



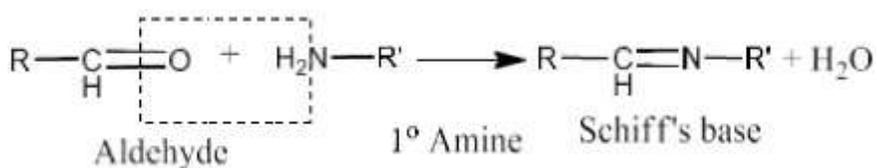
(viii) Chemical compounds with a dual carbon-nitrogen link are known as imines. Whenever ketones & aldehydes interact with ammonia & their byproducts, imines are produced. The following constitutes the response:



(ix) Dinitrophenylhydrazones 2, 4 under the scenario of aldehydes or ketones, 2, 4-dinitrophenylhydrazine is used to create 2, 4-DNP- compounds under weakly acidic media. The following constitutes the response:

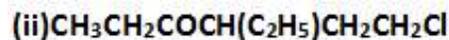
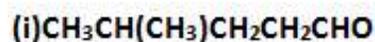


(x) Schiff's bases are comprised of aldehyde or ketone substances in which an imine or azomethine category has taken over the role of the carbonyl group in their structure. Schiff's base, also known as azomethine, is a chemical substance that contains an aryl or alkyl unit with no atoms of hydrogen. This is composed of carbon and nitrogen elements which is two times of nitrogen. Their equation is the standard $\text{R}_1\text{R}_2\text{C}=\text{NR}_3$ since an imine. It bears the work of famous scientist Hugo Schiff. The following is the response:



8.2

Name the following compounds according to IUPAC system of nomenclature:



Ans – (i) 4-Methyl pentanal

(ii) 6-Chloro-4-ethylhexan-3-one

(iii) But-2-en-1-al

(iv) Pentane-2,4-dione

(v) 3,3,5-Trimethyl-hexan-2-one

(vi) 3,3-Dimethyl butanoic acid

(vii) Benzene-1,4-dicarbaldehyde

8.3

Draw the structures of the following compounds.

(i) 3-Methylbutanal

(ii) p-Nitropropiophenone

(iii) p-Methylbenzaldehyde

(iv) 4-Methylpent-3-en-2-one

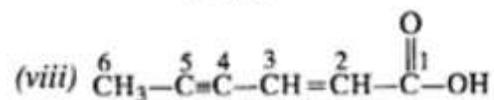
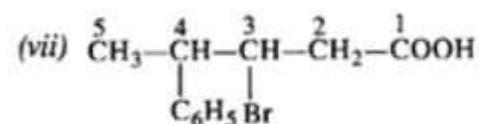
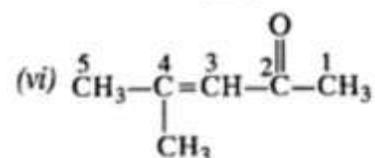
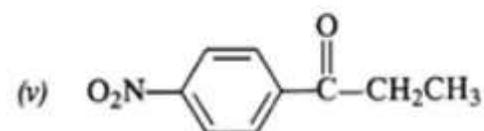
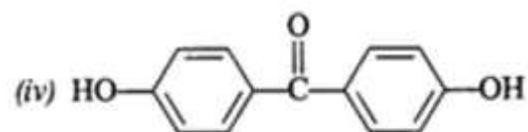
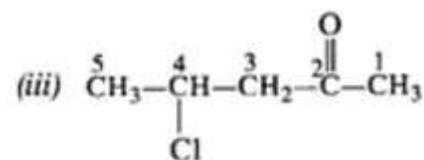
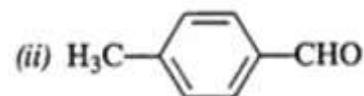
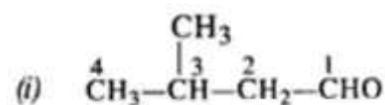
(v) 4-Chloropentan-2-one

(vi) 3-Bromo-4-phenylpentanoic acid

(vii) p,p'-Dihydroxybenzophenone

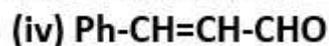
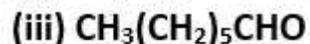
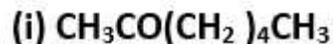
(viii) Hex-2-en-4-ynoic acid

Ans –



8.4

Write the IUPAC names of the following ketones and aldehydes. Wherever possible, give also common names.



Ans – (i) IUPAC name – Heptan-2-one

Common name – Methyl n-pentyl ketone

(ii) IUPAC name – 4-Bromo-2-methylhexanal

Common name – γ -Bromo- α -methyl caproaldehyde

(iii) IUPAC name – Heptanal

Common name – NA

(iv) IUPAC name – 3-Phenylprop-2-enal

Common name – β -phenylacrolein

(v) IUPAC name – Cyclopentanecarbaldehyde

Common name – NA

(vi) IUPAC name – Diphenylmethanone

Common name – Benzophenone

8.5

Draw structures of the following derivatives.

(i) The 2,4-dinitrophenylhydrazone of benzaldehyde

(ii) Cyclopropanone oxime

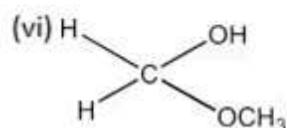
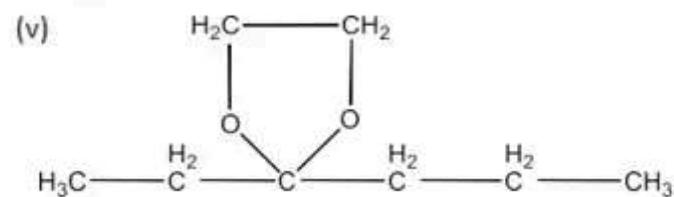
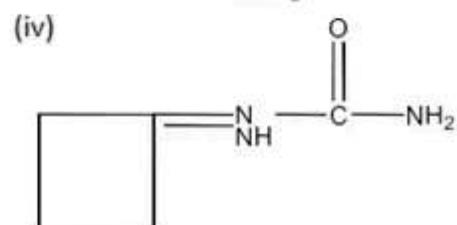
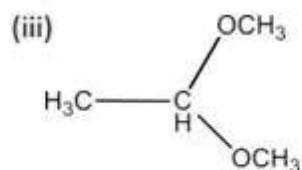
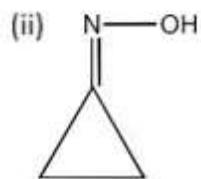
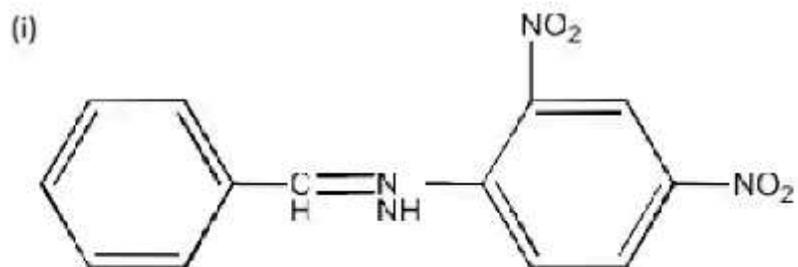
(iii) Acetaldehydedimethylacetal

(iv) The semicarbazone of cyclobutanone

(v) The ethylene ketal of hexan-3-one

(vi) The methyl hemiacetal of formaldehyde

Ans –



8.6

Predict the products formed when cyclohexanecarbaldehyde reacts with following reagents.

(i) PhMgBr and then H₃O⁺

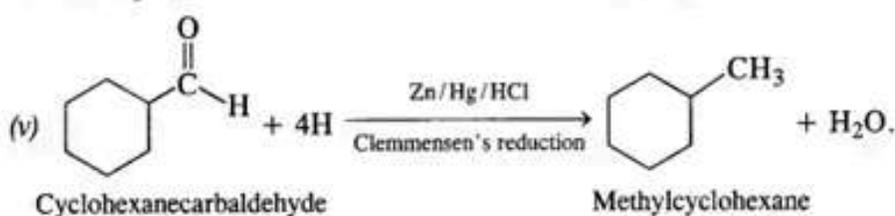
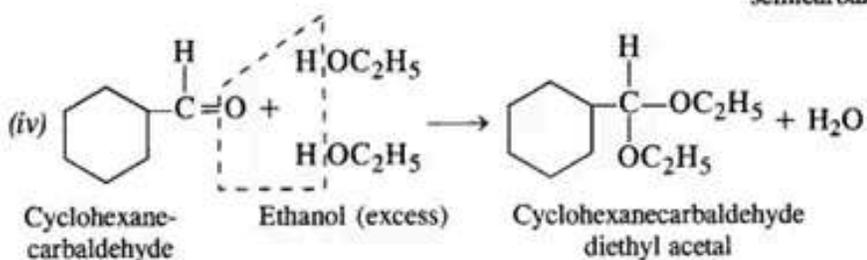
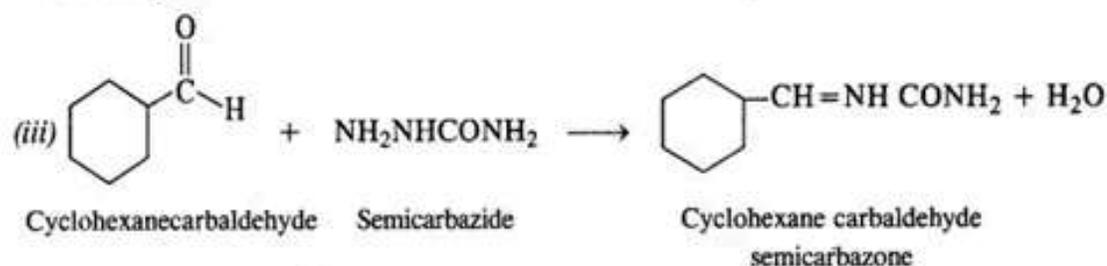
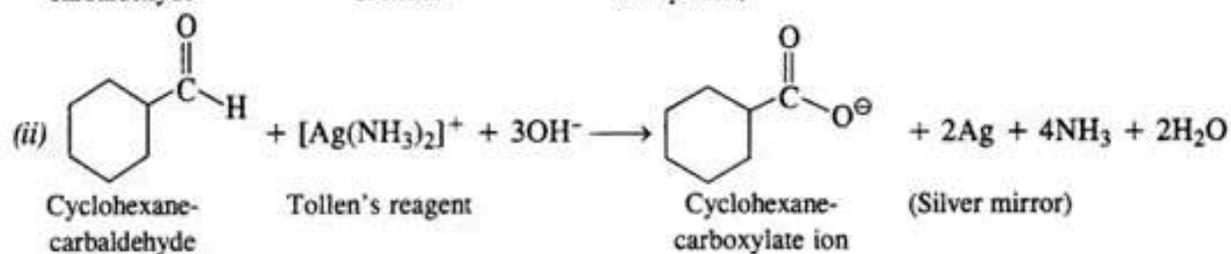
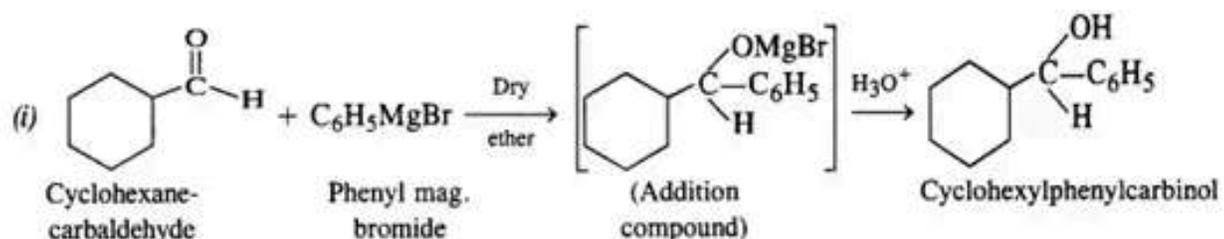
(ii) Tollens' reagent

(iii) Semicarbazide and weak acid

(iv) Excess ethanol and acid

(v) Zinc amalgam and dilute hydrochloric acid

Ans –



8.7

Which of the following compounds would undergo aldol condensation, which the Cannizzaro reaction and which neither? Write the structures of the expected products of aldol condensation and Cannizzaro reaction.

(i) Methanal (ii) 2-Methylpentanal (iii) Benzaldehyde

(iv) Benzophenone (v) Cyclohexanone (vi) 1-Phenylpropanone

(vii) Phenylacetaldehyde (viii) Butan-1-ol

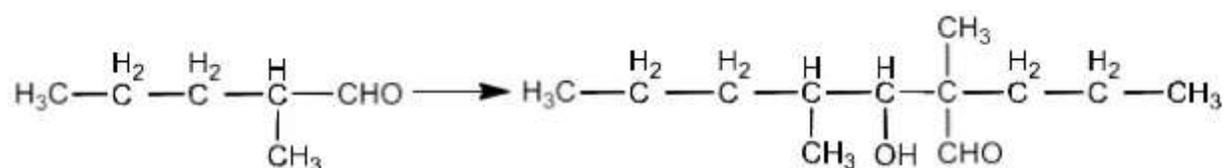
(ix) 2,2-Dimethylbutanal

Ans – The Cannizzaro reaction was given its name in honour of a renowned scientist Stanislao Cannizzaro. It's a type of chemical procedure in which two distinct molecular substances that form non-enolizable aromatic compounds are disproportionated by a substance called base to produce a primary alcohol alongside a compound known as carboxylic acid.

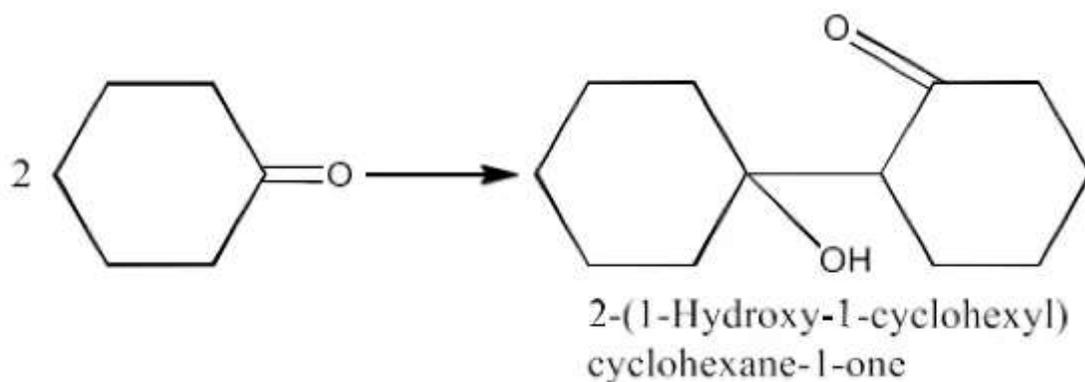
The Cannizzaro Reaction Process describes how to convert two separate molecules concerning a certain aldehyde into one alcohol molecular structure alongside a single carboxylic acid compound. During the year 1853, chemist Stanislao Cannizzaro was able to separate potassium benzoate & benzyl alcohol using benzaldehyde.

Aldol condensation occurs in ketones & aldehydes that contain a minimum of single α -hydrogen. Several α -hydrogen atoms can be found in the substances (ii) 2-methylpentanal, (v) cyclohexanone, (vi) 1-phenylpropanone & (vi) phenylacetaldehyde. Consequently, aldol condensation occurs in them.

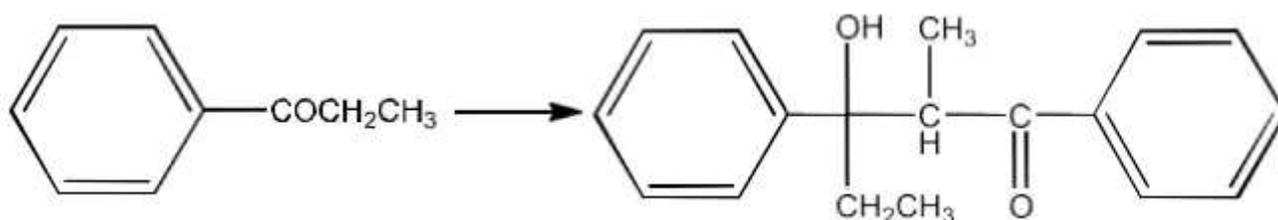
The outcome of 2-Methylpentanal's aldol condensation is defined as, 3-Hydroxy-2,4-dimethyl-2-propylheptanal. The following constitutes the response:



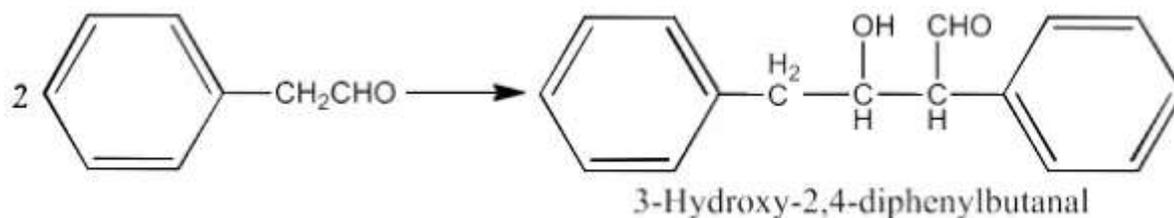
2-(1-Hydroxy-1-cyclohexyl) cyclohexane-1-one will be the final substance of cyclohexanone's aldol condensation. The following constitutes the response:



The outcome of 1-phenylpropanone's aldol condensation becomes 3-Hydroxy-2-methyl-1,3-diphenylpentan-1-one. The following applies to the response:



The product created by the aldol condensation of Phenylacetylaldehyde will be, 3-Hydroxy-2,4-diphenylbutanal. Regarding the reaction, what follows is relevant:

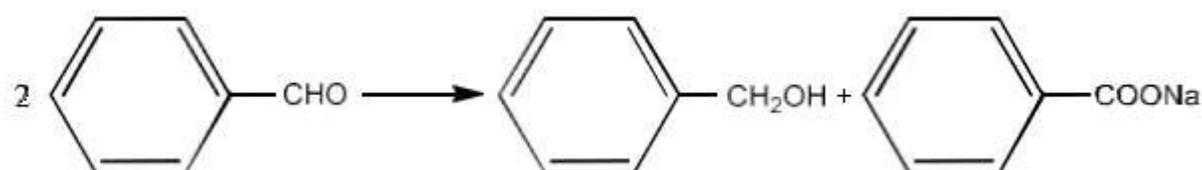


Cannizzaro events are shown by aldehydes that lack α -hydrogen atoms. There's no α -hydrogen present in the substances (i) methanal, (iii) benzaldehyde & (ix) 2, 2-dimethylbutanal. Those elements experience Cannizzaro effects.

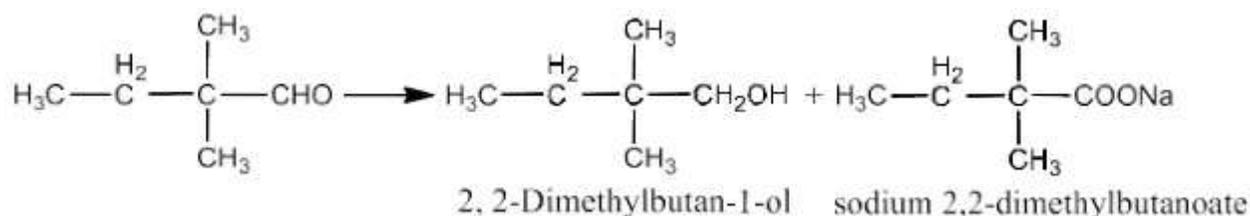
Methanol & sodium methanoate were the end byproducts of the Cannizzaro process that produces methanal. The following constitutes the response:



Benzyl alcohol & sodium benzoate constitute the end byproducts of the Cannizzaro response in reacting with benzaldehyde. The following represents the explanation:



When 2,2-Dimethylbutanal undergoes the Cannizzaro response, sodium benzoate, and benzyl alcohol become the end compounds. The following serves as the response:



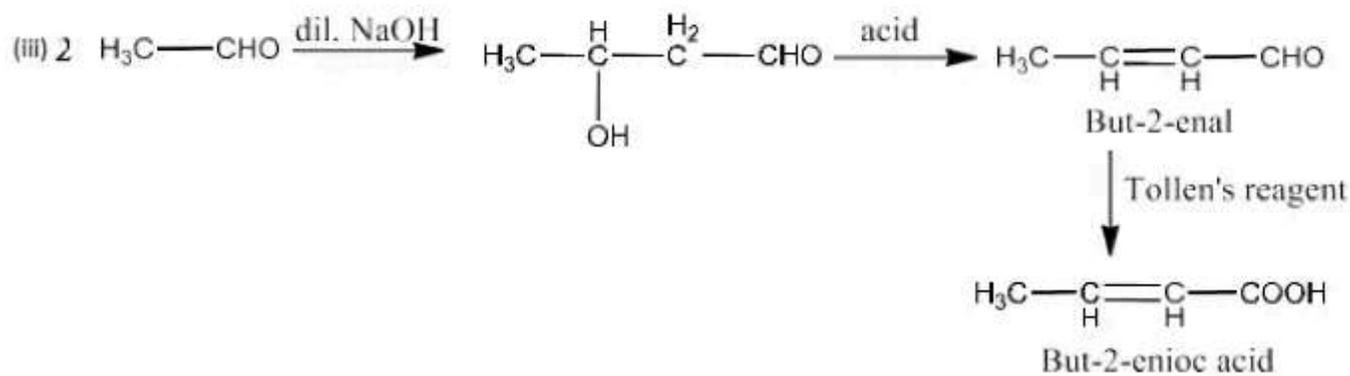
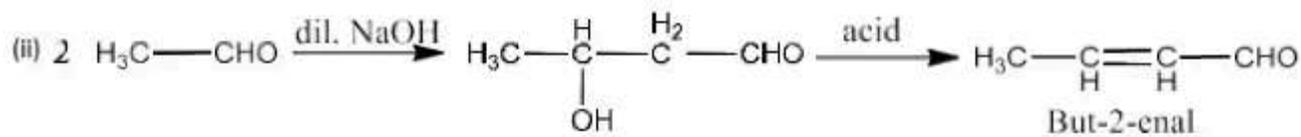
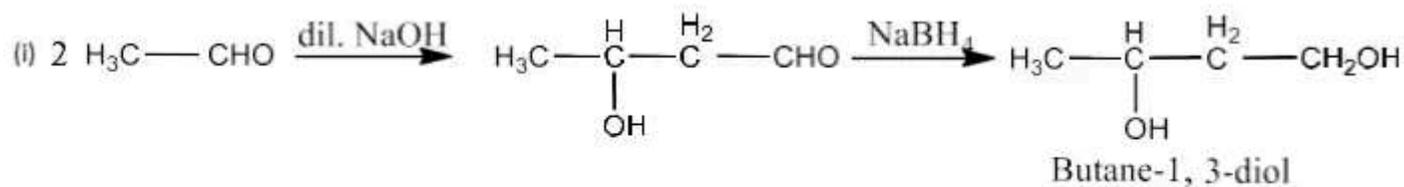
Mixture (iv) (viii) Butan-1-ol constitutes an alcohol, whereas benzophenone serves as a ketone without having an α -hydrogen element. As a result, neither Cannizzaro interactions nor aldol condensation occurs when using these substances.

8.8

How will you convert ethanal into the following compounds?

(i) Butane-1,3-diol (ii) But-2-enal (iii) But-2-enoic acid

Ans –

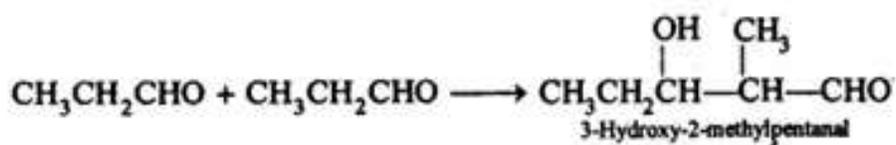


8.9

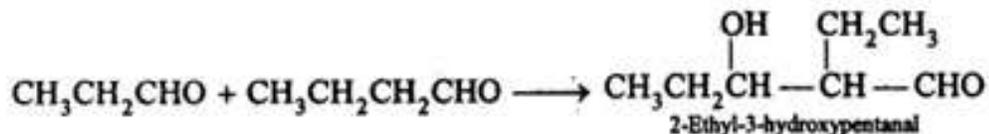
Write structural formulas and names of four possible aldol condensation products from propanal and butanal. In each case, indicate which aldehyde acts as nucleophile and which as electrophile.

Ans –

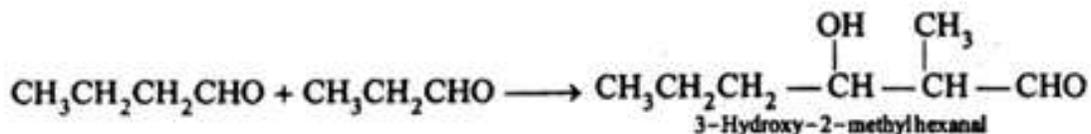
(a) Propanal acts as both nucleophile as well as electrophile.



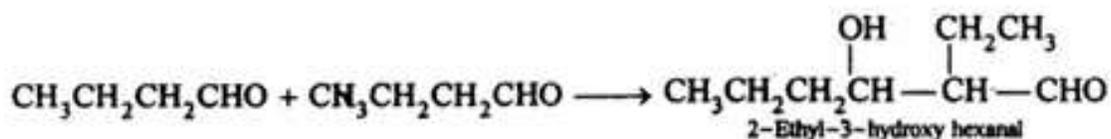
(b) Propanal as electrophile and butanal as nucleophile.



(c) Butanal as electrophile and propanal as nucleophile.



(d) Butanal acts as both nucleophile as well as an electrophile.



8.10

An organic compound with the molecular formula $\text{C}_9\text{H}_{10}\text{O}$ forms 2,4-DNP derivative, reduces Tollens' reagent and undergoes Cannizzaro reaction. On vigorous oxidation, it gives 1,2-benzenedicarboxylic acid. Identify the compound.

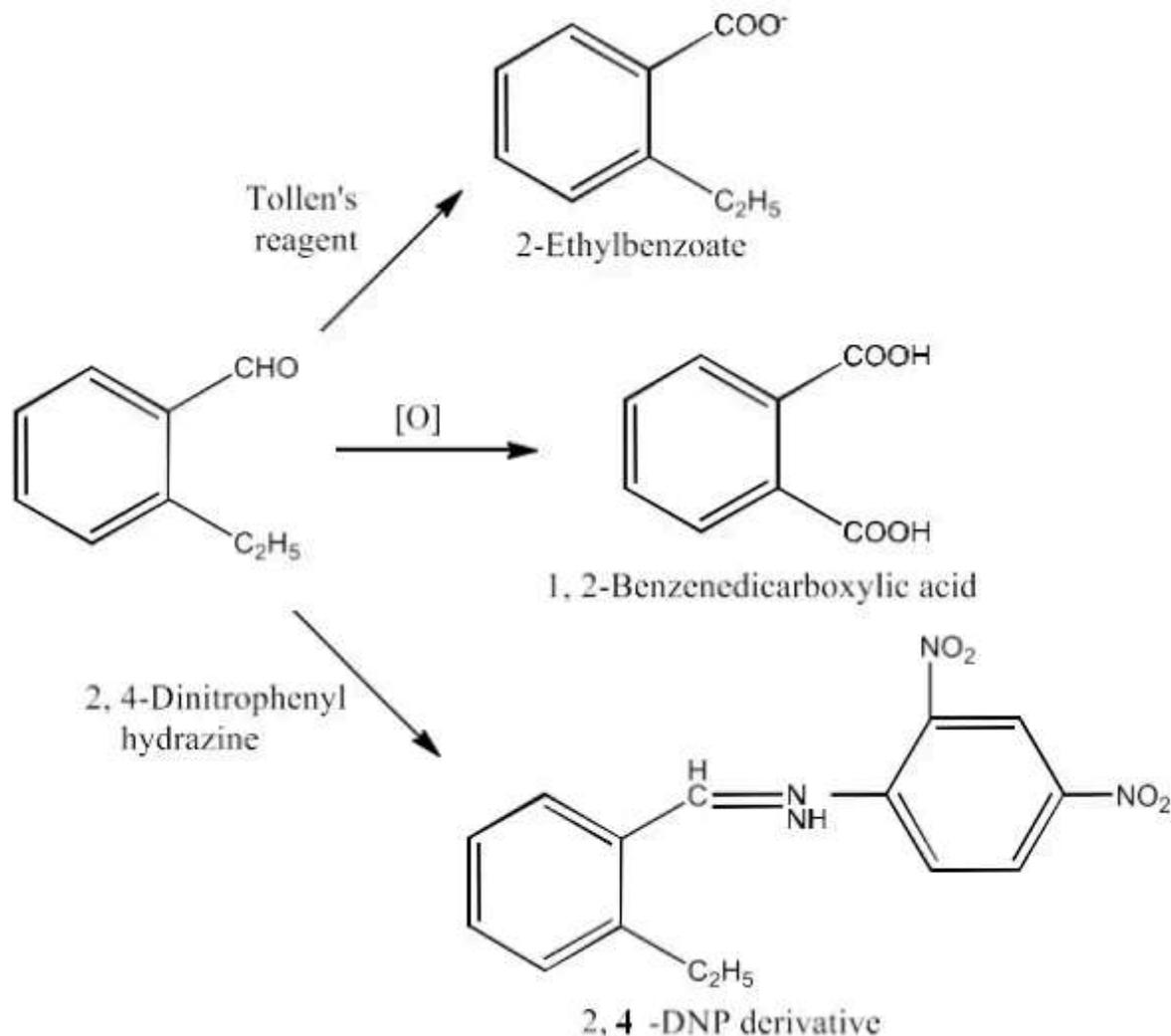
✦ Key Points to Note from Question

Key Concept:

- **2,4-DNP Test & Tollen's Test:** Presence of an aldehyde or ketone.
- **Cannizzaro Reaction:** Indicates a non-enolizable aldehyde (no α -hydrogen).
- **Oxidation to 1,2-Benzenedicarboxylic Acid:** Suggests an ortho-substituted benzaldehyde.
- **Molecular Formula ($\text{C}_9\text{H}_{10}\text{O}$):** Indicates a benzaldehyde with an additional alkyl group.

Ans – The reason for this is due to the organic compound ($\text{C}_9\text{H}_{10}\text{O}$) decreases the Tollen reagent & produces a chemical product of 2, 4-DNP. Therefore, the substance has to be an aldehyde. The result undergoes Cannizzaro's process again, whereas oxidation yields 1,2-benzenedicarboxylic

alcohol. As a result, the CHO unit is ortho-substituted in place of benzaldehyde & instantly joined by a benzene chain. Hence, the chemical substance involved is 2-ethyl benzaldehyde.



8.11

An organic compound (A) (molecular formula $C_8H_{16}O_2$) was hydrolysed with dilute sulphuric acid to give a carboxylic acid (B) and an alcohol (C). Oxidation of (C) with chromic acid produced (B). (C) on dehydration gives but-1-ene. Write equations for the reactions involved.

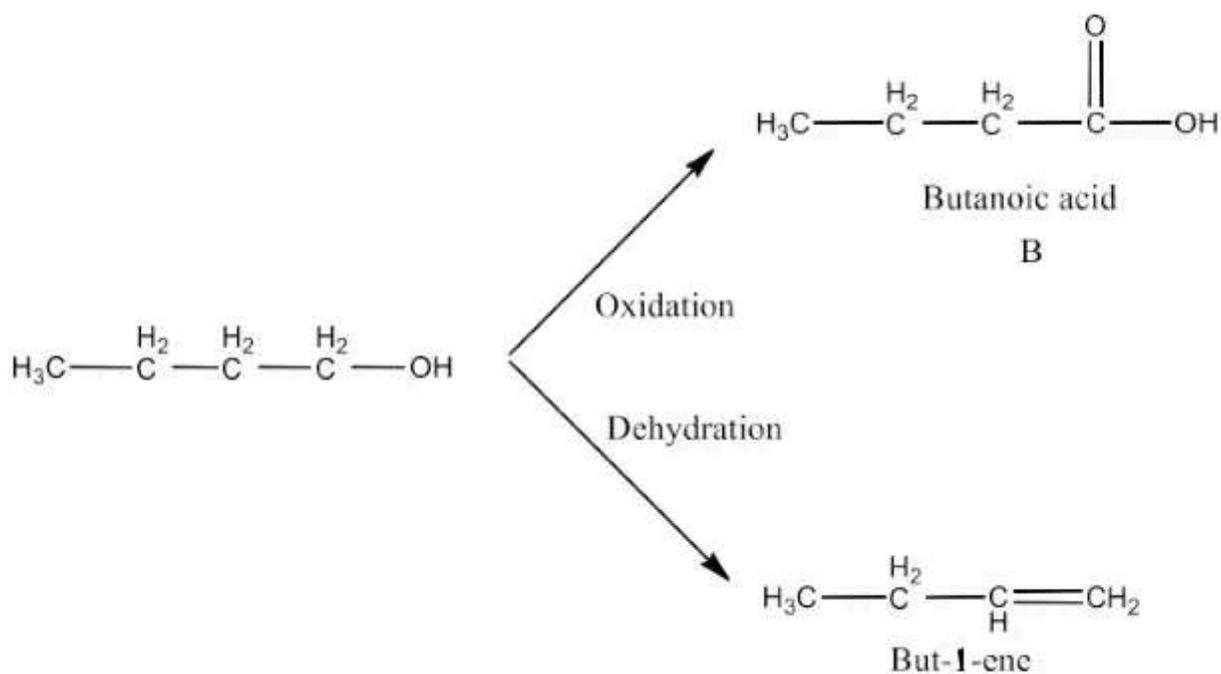
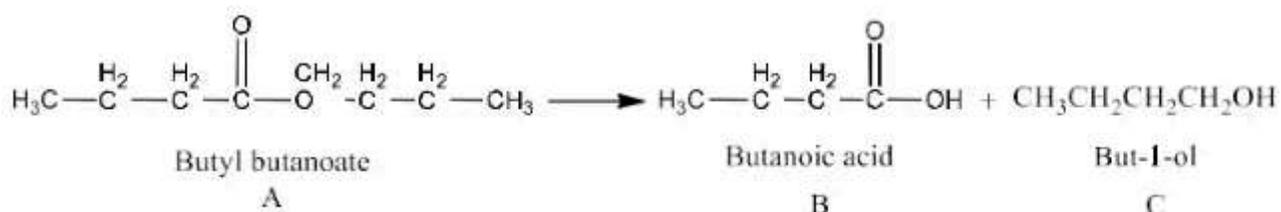
✦ Key Points to Note from Question

Key Concept:

- **Hydrolysis of (A) → Carboxylic Acid (B) + Alcohol (C):** Indicates (A) is an ester.
- **Oxidation of (C) → (B):** Suggests (C) is a primary alcohol.
- **Dehydration of (C) → But-1-ene:** Indicates (C) is butan-1-ol.
- **Molecular Formula ($C_8H_{16}O_2$):** Matches an ester of butanoic acid and butan-1-ol.

Ans – An equation for a molecule Alcohol (C) with diluted sulfuric acid & carboxylic acid (B) hydrolyze an element called $C_8H_{16}O_2$. Thus, compound A's composition must be a type of ester. Additionally, alcohol C supplies acid B for the oxidation of chromic acid. Consequently, B & C must have the same quantity of atoms made of carbon. Compound A possesses eight carbon atoms, whereas compounds B & C apiece have four carbon atoms.

Whenever alcohol C becomes dehydrated, but-1-ene is once more produced. Because C is straight ahead, butane-1-ol is produced. Once butane-1-ol undergoes oxidation, a substance called butanoic acid is produced. Butanoic acid consequently counts as a B acid. Therefore, the chemical structure of ester $C_8H_{16}O_2$ represents butyl butanoate. Listed below are all the responses for the inquiries such as,



8.12

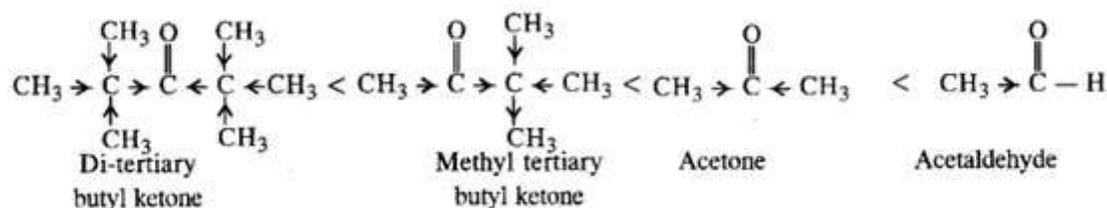
Arrange the following compounds in increasing order of their property as indicated:

(i) Acetaldehyde, Acetone, Di-tert-butyl ketone, Methyl tert-butyl ketone (reactivity towards HCN)

(ii) $\text{CH}_3\text{CH}_2\text{CH}(\text{Br})\text{COOH}$, $\text{CH}_3\text{CH}(\text{Br})\text{CH}_2\text{COOH}$, $(\text{CH}_3)_2\text{CHCOOH}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ (acid strength)

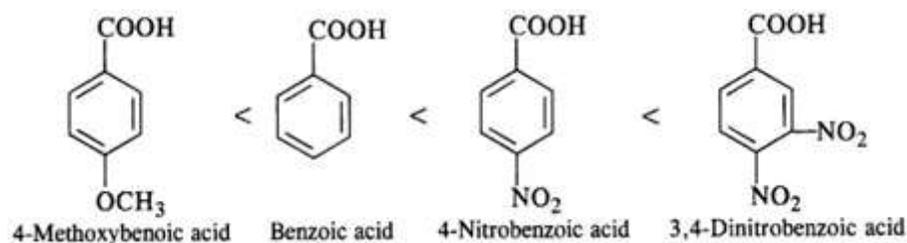
(iii) Benzoic acid, 4-Nitrobenzoic acid, 3,4-Dinitrobenzoic acid, 4-Methoxybenzoic acid (acid strength)

Ans – (i) The process that occurs when the nucleophile (CN^- ion) assaults the carbon atom as part of the carbonyl compound ends in the formation of cyanohydrin derivatives. When the alkyl group's +I impact increases, the sequence of reactivity diminishes. It also drops when the steric barrier rises because of the alkyl groups' length and quantity. Given the facts provided, the reactivity's descending sequence is as follows:



(ii) We are aware because the strength of acid is reduced by alkyl groups through the +I action. Compared to n-propyl groups, isopropyl groups have a greater +I impact. Comparably the acidic strength is increased by bromine (Br) due to the -I-effect. The more powerful the acid, the more closely it is in proximity to the carboxyl (COOH) unit in the corresponding carbon atom cord, and the greater its -I-effect. Given the above, the acidic strength increases in the following sequence: $(\text{CH}_3)_2\text{CHCOOH} < \text{CH}_3\text{CH}_2\text{CH}_2\text{COOH} < \text{CH}_3\text{CH}(\text{Br})\text{CH}_2\text{COOH} < \text{CH}_3\text{CH}_2\text{CH}(\text{Br})\text{COOH}$.

(iii) We now know the fact that benzoic acid's capability of acidic nature is reduced by the group that donates electrons (OCH_3). The electron-withdrawing component (NO_2) also rises at the identical period. In light of the aforementioned, the pH level increases in the following order of importance:

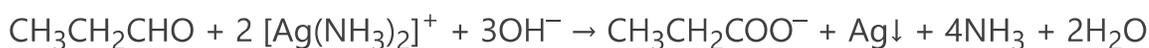


Give simple chemical tests to distinguish between the following pairs of compounds.

(i) Propanal and Propanone (ii) Acetophenone and Benzophenone (iii) Phenol and Benzoic acid (iv) Benzoic acid and Ethyl benzoate (v) Pentan-2-one and Pentan-3-one (vi) Benzaldehyde and Acetophenone (vii) Ethanal and Propanal

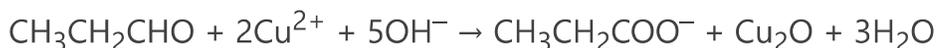
Ans – (i) a) Tollen's test

Tollens' test, often referred to as the silver mirror assessment, is a qualitative scientific procedure used to differentiate between ketone & aldehyde. The process makes use of the fact that ketones aren't easily oxidized, but the compounds of aldehydes do. Propanal acts as a type of aldehyde which decreases the sensitivity of the Tollen reagent. However, Tollen's reagent cannot be reduced by propanone as it is part of ketone.



b) Fehling's test

Fehling's test is an analytical procedure used to identify reductive sugars & distinguish between functional units of ketone & water-soluble polysaccharides. Ketones don't succeed in the Fehling examination. Meanwhile, the compound aldehydes have cracked it. On the other hand, the substance propanone failed to modify the above compounds into a reddish-brown Cu_2O precipitate, but the combination of aldehyde-propanal has been able to do that.



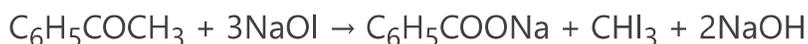
c) Iodoform test

Aldehydes & ketones are produced when one of the methyl groups connected to the atomic structure of carbonyl carbon responds to the assessment performed using iodoform. Sodium hypoiodite (NaOI) can oxidize them & produce iodoform. Propanal isn't a methyl ketone, but propanone is,



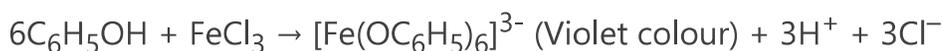
(ii) Iodoform test

While benzophenone is unlikely to produce the Iodoform examination, acetophenone would.

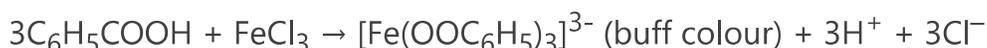


(iii) Ferric chloride test

When utilized alongside neutral ferric chloride, phenol gives off a violet hue.



When mixed together with neutral ferric chloride, benzoic acid can generate the buff coloring.



(iv) Sodium bicarbonate test

Carbon dioxide is produced when benzoic acid & sodium bicarbonate interact.



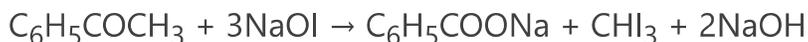
(v) Iodoform test

In the iodoform examination, pentan-2-one is going to respond meanwhile pentan-3-one won't.



(vi) Iodoform test

Benzaldehyde is unlikely to pass the Iodoform assessment, while acetophenone can.



(vii) Iodoform test

Aldehydes & ketones having at least a single methyl group connected to the carbonyl carbon atomic structure are detected by the iodoform test. Ethanol containing a single methyl group joined by an additional carbonyl atom passes this examination. Propanal, however, is unresponsive to this situation because it lacks a group of methyl compounds associated with carbonyl carbon dioxide.



8.14

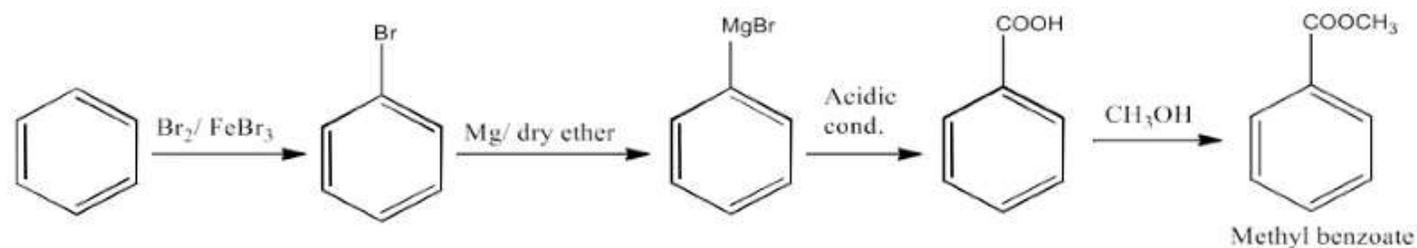
How will you prepare the following compounds from benzene? You may use any inorganic reagent and any organic reagent having not more than one carbon atom

(i) Methyl benzoate (ii) m-Nitrobenzoic acid

(iii) p-Nitrobenzoic acid (iv) Phenylacetic acid

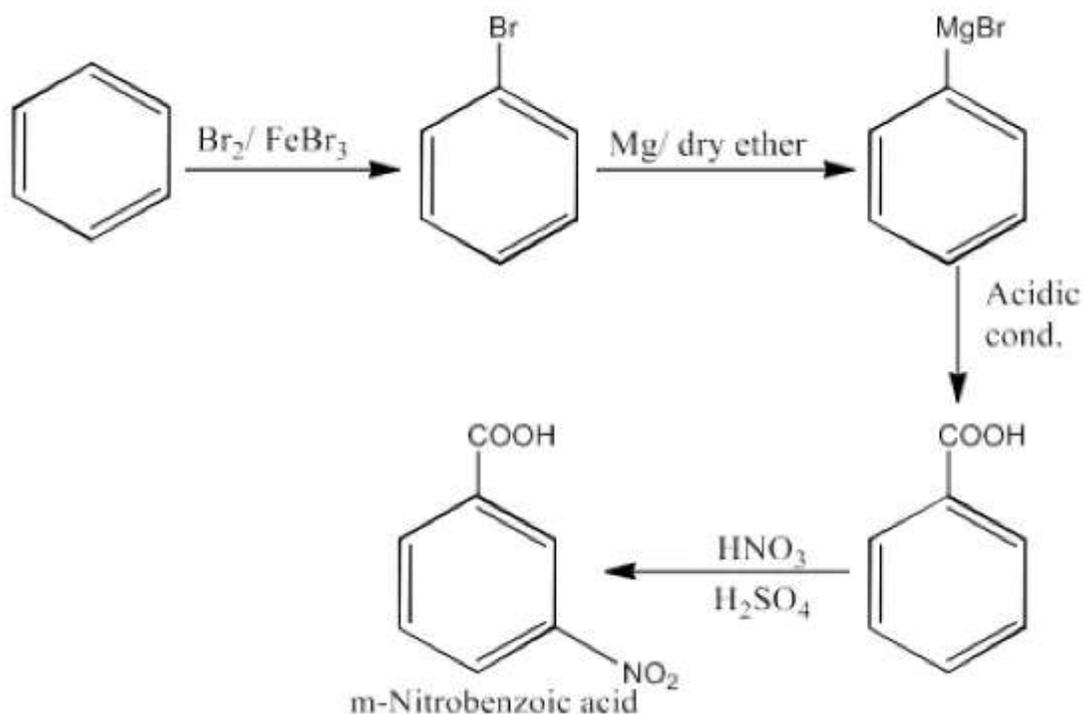
(v) p-Nitrobenzaldehyde.

Ans – (i) Bromobenzene is created when benzene and bromine combine. Benzoic acid will eventually be produced from the threshold of bromobenzene. Methyl benzoate is currently being produced using benzoic acid. The one that follows constitutes the response:

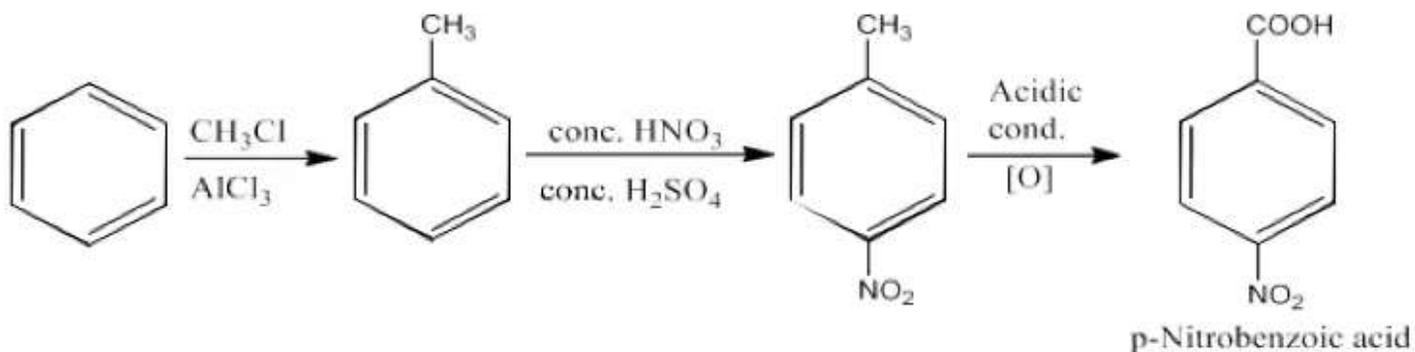


(ii) Bromobenzene is created when benzene and bromine interact. Benzoic acid will be produced from these bromobenzene. m-nitro benzoic acid is currently being produced from the

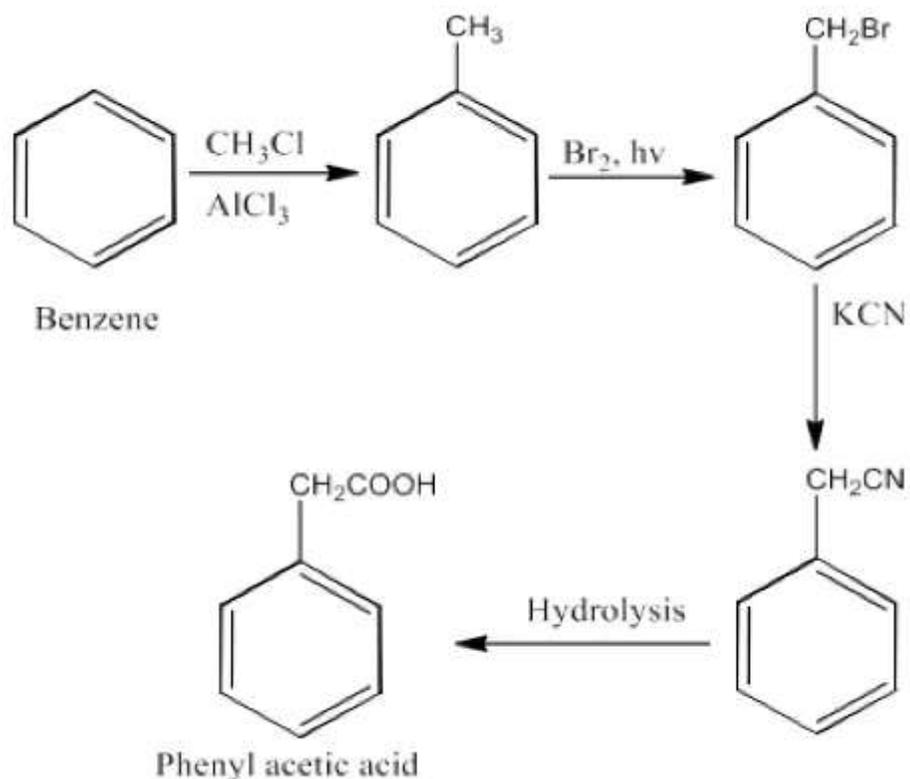
above benzoic acid. The following represents the answer:



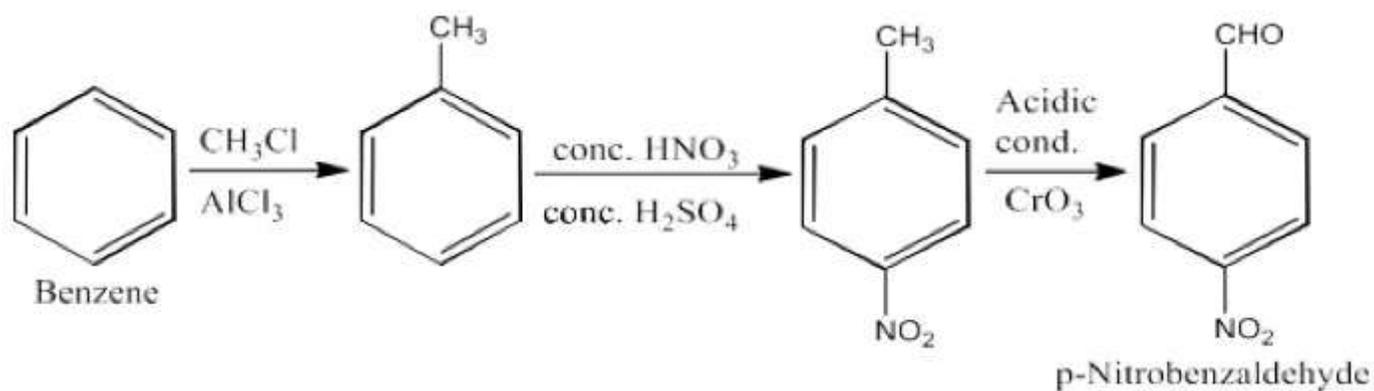
(iii) Toluene is going to be produced from benzene. P-nitrotoluene has now been generated from toluene. During the oxidation procedure, this p-nitrotoluene gets completely transformed into p-nitrobenzoic acid. The following serves as the response:



(iv) Toluene is tend to be modified from benzene. The chemical Toluene is currently undergoing a conversion to become benzyl bromide, which will first go through another conversion to produce benzyl cyanide. Phenylacetic acid is supposed to be produced by hydrolyzing benzoyl cyanide. The one that follows constitutes the response:



(v) Toluene is going to be produced from benzene. P-nitrotoluene will shortly be produced from toluene. Upon oxidative reactions, this p-nitrotoluene will turn into p-nitrobenzaldehyde. The one that follows represents the response:



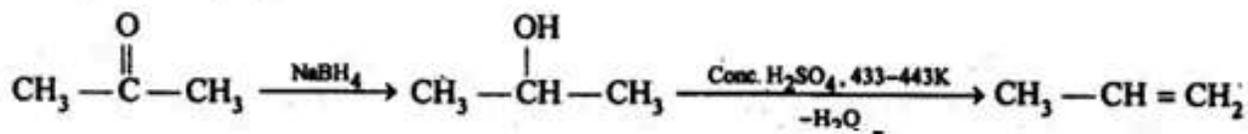
8.15

How will you bring about the following conversions in not more than two steps?

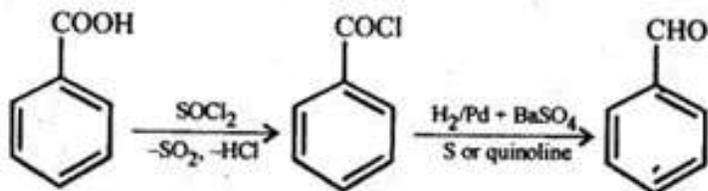
- (i) Propanone to Propene
- (ii) Benzoic acid to Benzaldehyde
- (iii) Ethanol to 3-Hydroxybutanal
- (iv) Benzene to m-Nitroacetophenone
- (v) Benzaldehyde to Benzophenone
- (vi) Bromobenzene to 1-Phenylethanol
- (vii) Benzaldehyde to 3-Phenylpropan-1-ol
- (viii) Benzaldehyde to α -Hydroxyphenylacetic acid
- (ix) Benzoic acid to m- Nitrobenzyl alcohol

Ans –

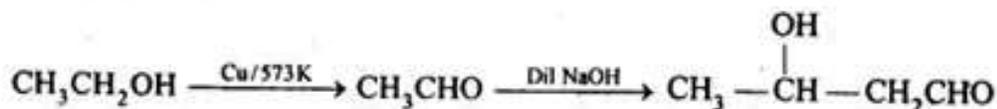
(i) Propanone to propene:



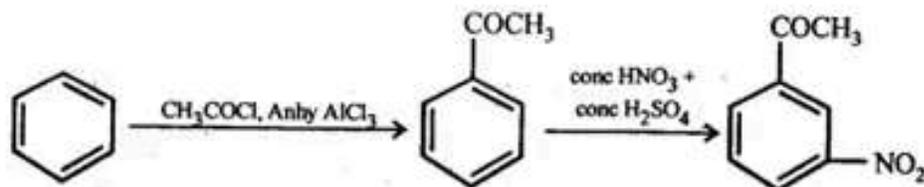
(ii) Benzoic acid to benzaldehyde:



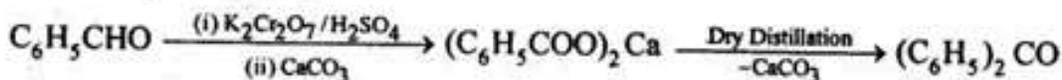
(iii) Ethanol to 3-hydroxy butanal:



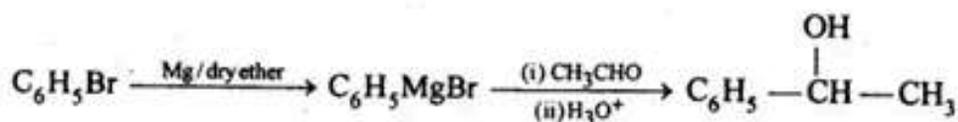
(iv) Benzene to *m*-nitroacetophenone:



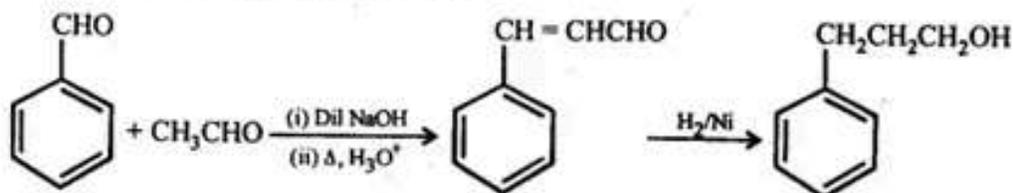
(v) Benzaldehyde to benzophenone:



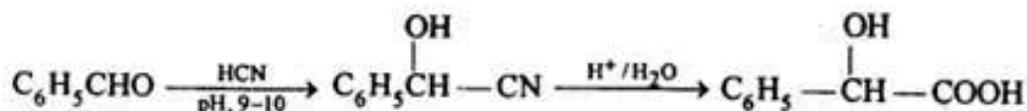
(vi) Bromobenzene to 1-phenylethanol:



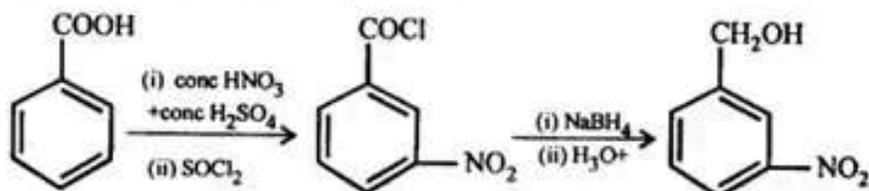
(vii) Benzaldehyde to 3-phenylpropan-1-ol:



(viii) Benzaldehyde to α -hydroxyphenylacetic acid:



(ix) Benzoic acid to *m*-nitrobenzyl alcohol:



8.16

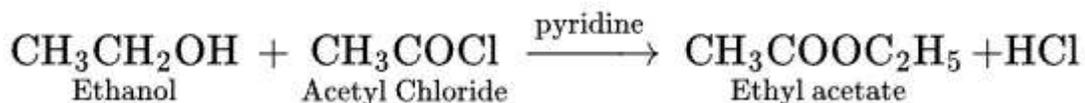
Describe the following:

- (i) **Acetylation**
- (ii) **Cannizzaro reaction**
- (iii) **Cross aldol condensation**
- (iv) **Decarboxylation**

Ans – (i) An ester is considered a substance that gets the end molecule of an acetylation process in which the hydrogen atom of the group that contains alcohol is swapped in exchange for an acetyl compound. Freestanding hydroxyl compounds are available in the substrate element for these types of peculiar interactions.

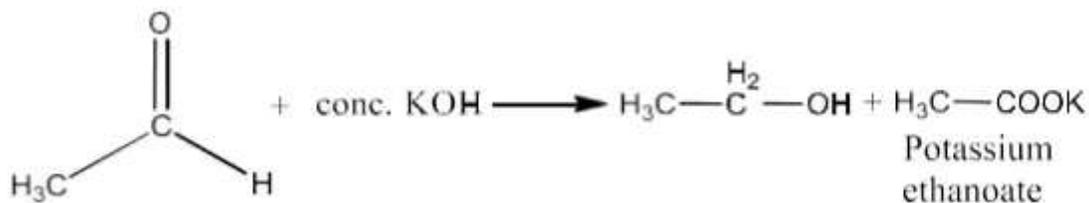
In the field of chemistry, the acetylation method represents an organic esterification procedure that incorporates acetic acid. A chemical-based molecular unit is offered to link with acetyl compounds. These kinds of compounds are commonly referred to as acetates or acetate esters.

In organic molecules, the terminology "acetylation" refers to the inclusion of the acetyl functional element in the compound. Usually, a base like a pyridine & dimethylaniline has been employed during the process. This involves substituting an ensemble of acetyls for a functional hydrogen atomic particle. Acetic anhydride & acetyl chloride are the two most often used acetylating reagents. For instance, ethyl acetate is produced by ethanol acetylation.



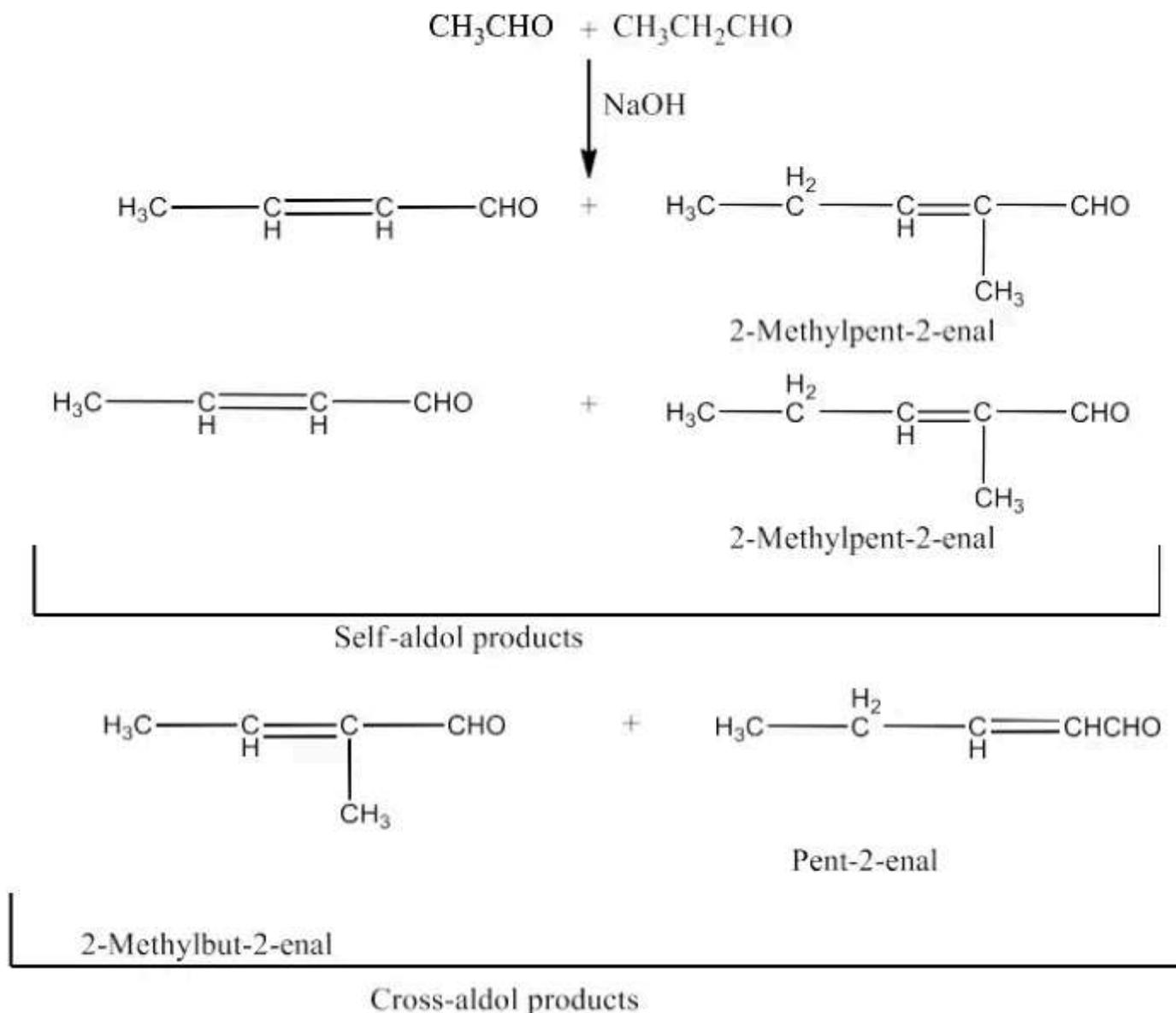
(ii) The Cannizzaro Reaction Process describes how to convert two separate molecules concerning a certain aldehyde into one alcohol molecular structure alongside a single carboxylic acid compound. During the year 1853, chemist Stanislao Cannizzaro was able to separate potassium benzoate & benzyl alcohol using benzaldehyde.

The Cannizzaro response or an individual oxidation-reduction process (disproportion) are other names for the response of aldehydes without α -hydrogen towards saturated alkaline substances. The procedure involves the reduction of a single aldehyde molecular structure to alcohol & the oxidation of another molecule towards carboxylic acid. For instance, saturated potassium hydroxide treatment results in the production of ethanol alongside potassium ethanoate.



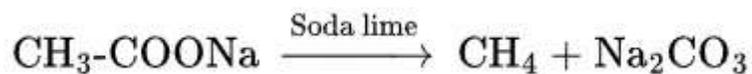
(iii) Aldol condensation produces β -hydroxy aldehydes, often known as aldols when aldehydes containing α -hydrogen react against a diluted base. Aldol condensation is a frequently used term for this process. It is referred to as crossed aldol condensation when the process of condensation takes place amid two distinct carbonyl molecules.

It happens when two different aldehydes, 2 different ketones, or an aldehyde with a ketone conduct aldol condensation. 4 compounded byproducts are created when the two separate reacting substances containing α -hydrogen are interlinked. For instance, ethanol and propanal react to 4 different compounds.



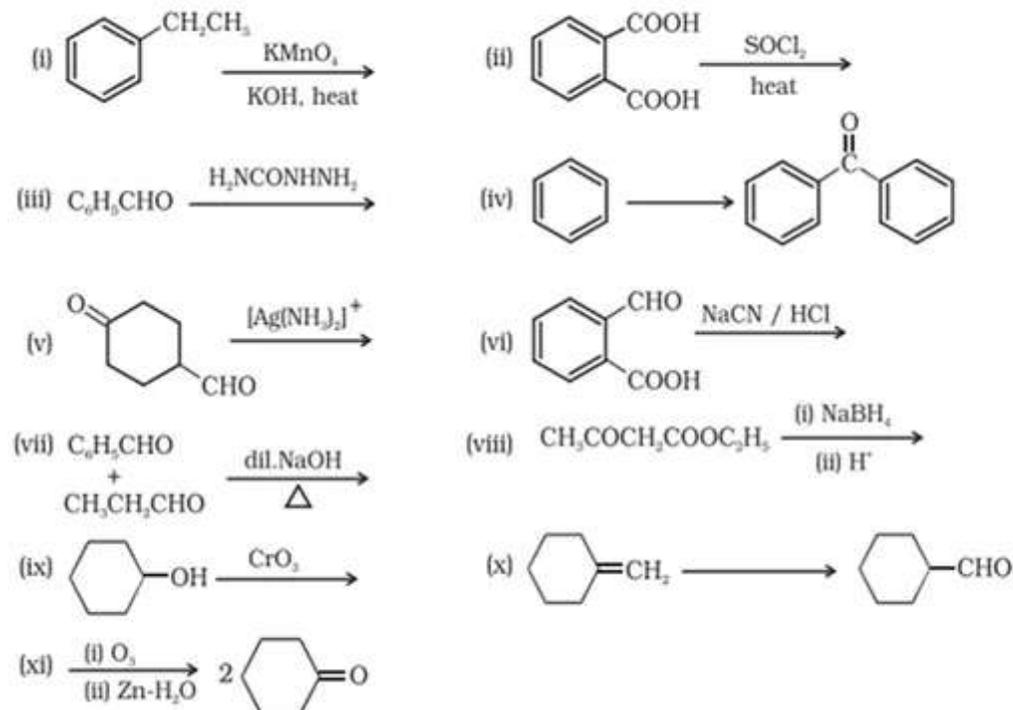
(iv) A chemical procedure known as decarboxylation releases carbon dioxide (CO_2) when the carboxyl component is eliminated. Decarboxylation is a generic name for a reaction between carboxylic acid substances that removes a carbon atom of a carbon cord. The initial chemical step in the process of photosynthesis is carboxylation, which is the incorporation of CO_2 into an existing material.

Oxidation is a counterproductive process that occurs as the initial chemical-based stage in photosynthesis. Carbohydrate decarboxylation is triggered by enzymatic processes called decarboxylases. This refers to the process through which carboxylic acids form hydrocarbons over losing carbon dioxide once their sodium salts undergo heating using soda-lime.

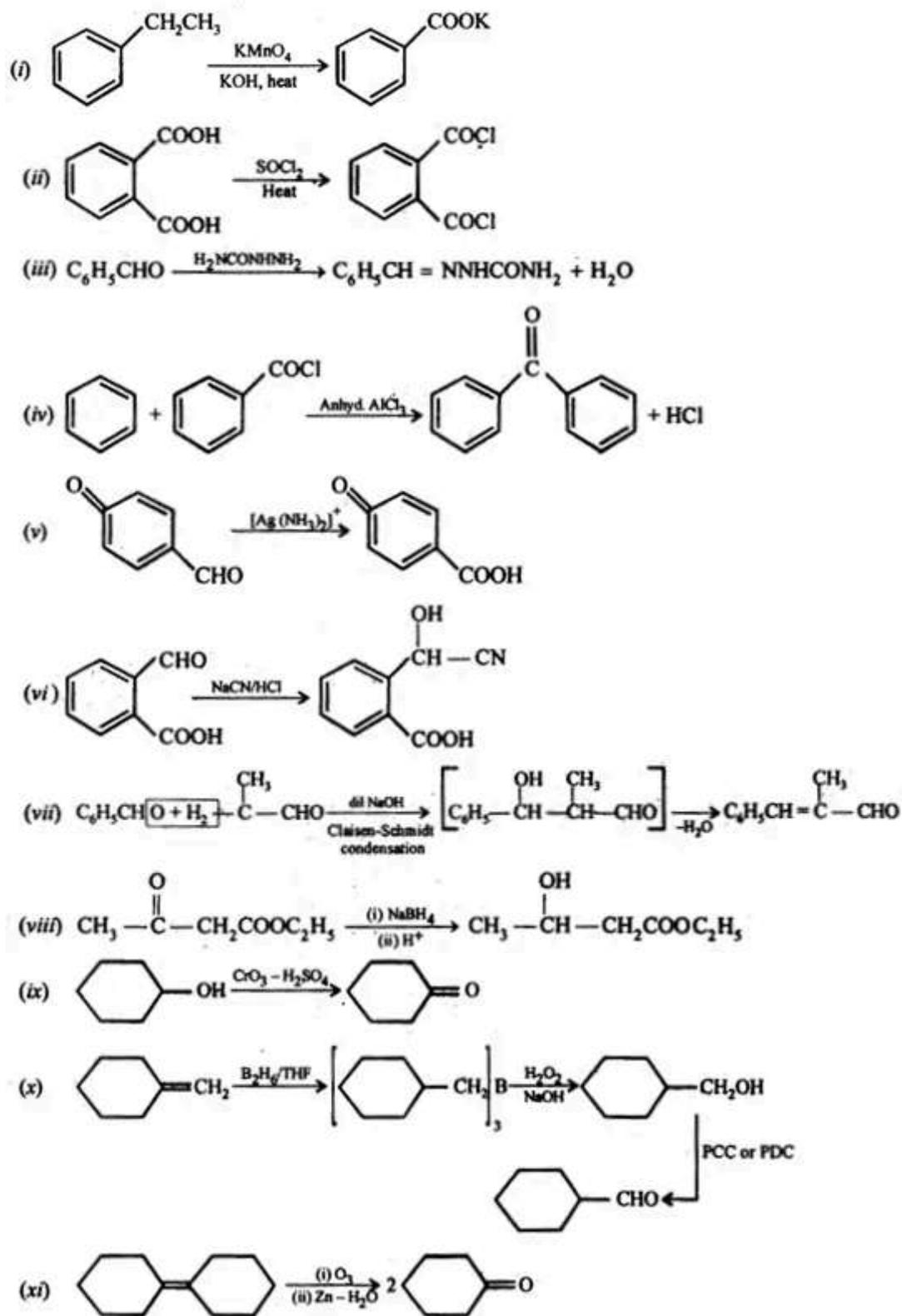


8.17

Complete each synthesis by giving missing starting material, reagent or products



Ans –



Give plausible explanation for each of the following:

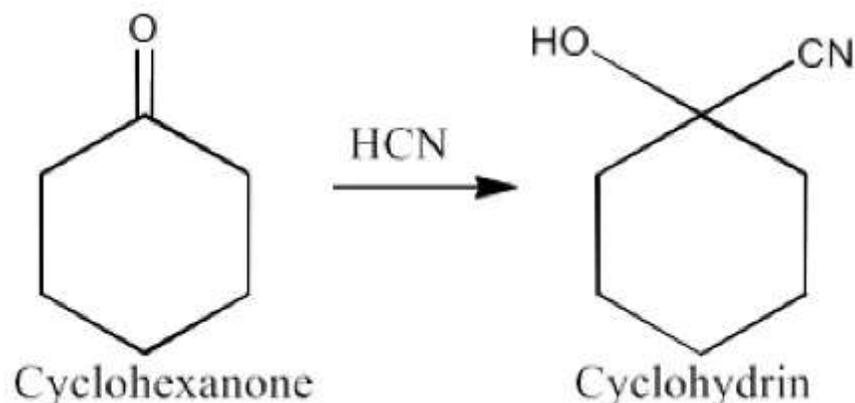
- (i) Cyclohexanone forms cyanohydrin in good yield but 2,2,6-trimethylcyclohexanone does not.
- (ii) There are two -NH_2 groups in semicarbazide. However, only one is involved in the formation of semicarbazones.
- (iii) During the preparation of esters from a carboxylic acid and an alcohol in the presence of an acid catalyst, the water or the ester should be removed as soon as it is formed.

✦ **Key Points to Note from Question**

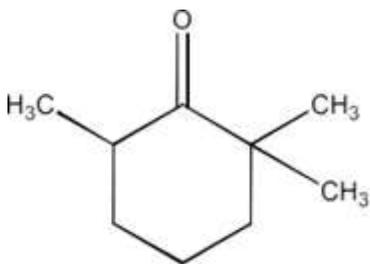
Key Concept:

- (i) **Steric Hindrance in Nucleophilic Addition** – 2,2,6-Trimethylcyclohexanone has bulky methyl groups that hinder cyanide attack on the carbonyl carbon.
- (ii) **Resonance Effect in Semicarbazide** – One NH_2 is involved in resonance with the adjacent C=O , reducing its nucleophilicity, while the free NH_2 group reacts with carbonyl compounds.
- (iii) **Le Chatelier's Principle in Esterification** – Ester formation is reversible, so removing water or ester shifts equilibrium toward ester production.

Ans – (i) The remainder of this formula describes how cyclohexanones convert into cyanohydrins.

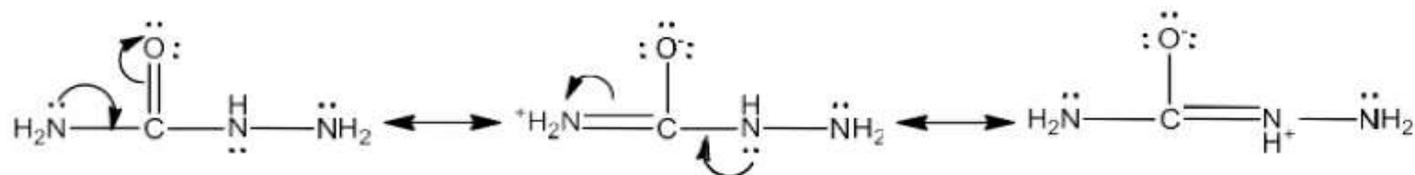


Nucleophiles (CN^-) do readily navigate this situation while encountering a steric barrier. However, α -positioned methyl chains in 2,2,6-trimethylcyclohexanone provide steric hurdles, which prevent CN^- from attacking properly.



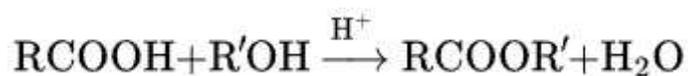
The body is unable to produce cyanohydrins as a result.

(ii) The more active of each of these compounds -NH_2 that is directly connected alongside the carbonyl carbon particles makes semicarbazide resonance.



As a result, the concentration of electrons at -NH_2 correspondingly falls when the resonance energy increases. Effectively as a consequence, the compounds fail to function in the capacity of nucleophiles. The second type of compound, -NH_2 , could operate as a nucleophile enzyme and target aldehydogen alongside ketone carbonic atomic particles to produce semicarbazones because it is not engaged with a state of resonance.

(iii) Both carboxylic acid & alcohol are permanently converted into ester & water when acidic substances remain present.



The components that react respond to the reaction's reversible change if water or ester has not been removed during formation. Consequently, in order to move the equilibrium ahead in an additional ester manner, either of those elements needs to be removed.

8.19

An organic compound contains 69.77% carbon, 11.63% hydrogen and rest oxygen. The molecular mass of the compound is 86. It does not reduce Tollens' reagent but forms an addition compound with sodium hydrogensulphite and give positive iodoform test. On vigorous oxidation it gives ethanoic and propanoic acid. Write the possible structure of the compound.

◆ Key Points to Note from Question

Key Concept:

- **Elemental Analysis** → Helps determine empirical formula.
- **Tollens' Test (-ve)** → Absence of aldehyde group.
- **NaHSO₃ Addition** → Presence of a carbonyl group (ketone).
- **Iodoform Test (+ve)** → Presence of CH₃CO- group (methyl ketone).
- **Oxidation Products (Ethanoic & Propanoic Acid)** → Indicates the ketone is asymmetrical (C-C cleavage).

Ans – As we all know,

69.77% is the proportion of atoms made up of carbon.

11.63% is the proportion of atoms that are hydrogen.

The oxygen atomic particles proportion will be,

$$100 - (69.77 + 11.63) = 18.6\%$$

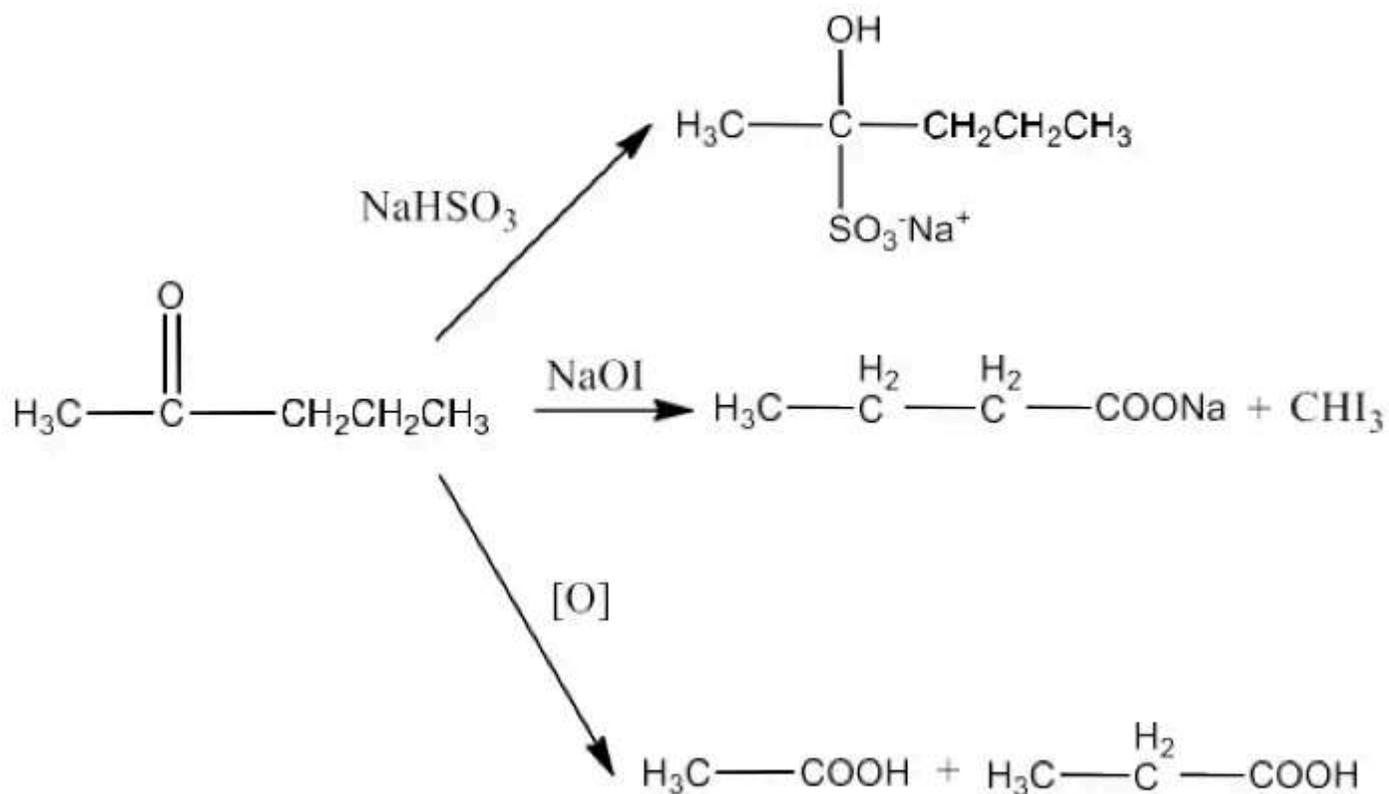
Consequently, the organic element's carbon, hydrogen & oxygen atomic particles proportion may be expressed in the following manner:

$$\begin{aligned} \text{C : H : O} &= \frac{69.77}{12} : \frac{11.63}{1} : \frac{18.6}{16} \\ &= 5.81 : 11.63 : 1.16 \\ &= 5 : 10 : 1 \end{aligned}$$

Therefore, C₅H₁₀O constitutes the compound's empirical structure. Thus, the compound's composition is equal to 5 × 12 + 10 × 1 + 1 × 16 = 86. Given that the specified molecular weightage mass is 86 as well. C₅H₁₀O represents the chemical formula in the above equation.

The above-mentioned compound doesn't constitute a substance called aldehyde since it does not eliminate Tollen's reagent. Another instance in which the synthetic substance produces sodium hydrogen sulfate which gets supplemented with an affirmative Iodoform analysis.

Since it does not belong to an aldehyde, the molecular structure is bound to be a form of methyl ketone. The defined chemical substance is also produced by interlinking propanoic acid with ethanoic acid. As a result, pentan-2-ol will be serving here as the chemical compound. Given below are the reactions in the question:



8.20

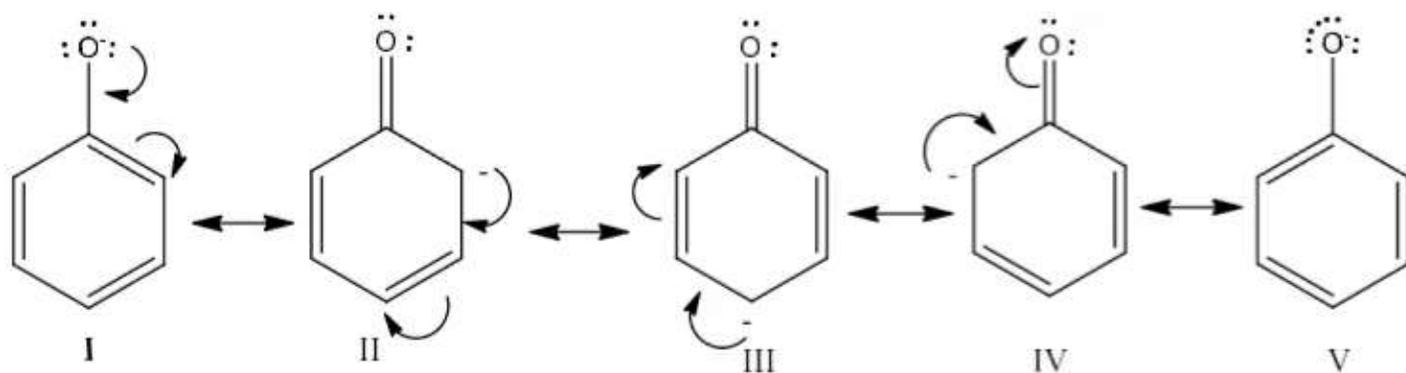
Although phenoxide ion has more number of resonating structures than carboxylate ion, carboxylic acid is a stronger acid than phenol. Why?

✦ **Key Points to Note from Question**

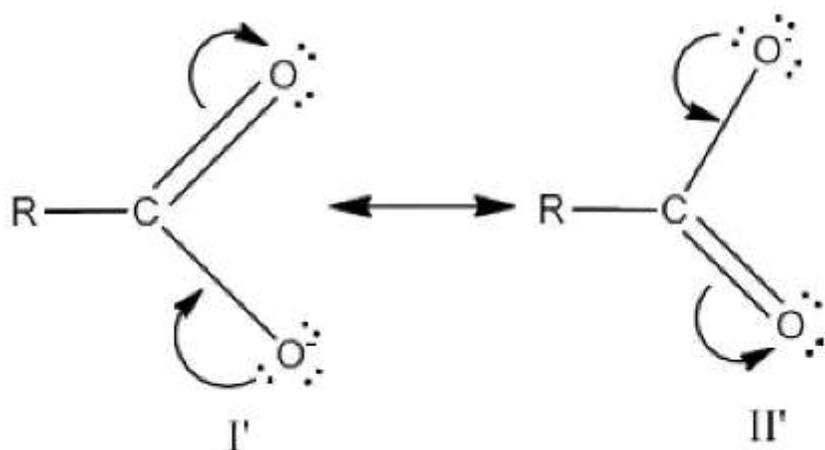
Key Concept:

- **Resonance Stability** → Both phenoxide and carboxylate ions are resonance stabilized.
- **Charge Distribution** → In the carboxylate ion, the negative charge is delocalized over two equivalent oxygen atoms, leading to **greater stability**.
- **Phenoxide Ion Delocalization** → The negative charge remains on the oxygen and is less effectively dispersed across the benzene ring.
- **Stronger Acid** → Greater stability of the conjugate base (carboxylate ion) makes carboxylic acid a stronger acid than phenol.

Ans – The phenoxide ion's resonance configurations consist of the following situations:



For a smaller electronegative atomic particle of carbon surrounding II, III & IV, the configuration could have demonstrated that the resonance arrangements of ions formed due to phenoxide possess a negative electrical charge. As a result, the resonance equilibrium of the phenoxide ion is little affected by all three of these combinations. Consequently, these kinds of structures could potentially be eliminated. Particularly in formations I & V the majority of electronegative in nature atoms of oxygen carry the most adverse burden. The carboxylate ion's resonant networks have been located similar to the ones that follow:



An electrical charge that is generated from an extremely high electronegative element like an oxygen atom is available within resonating patterns I' & II' to create the carboxylate ion. Additionally, the negative energy becomes dispersed across a pair of oxygen molecules in resonant formations I' & II'. However, the negative electrical charge is concentrated on the exact identical oxygen atom that exists within the phenoxide ion's resonant configurations I alongside V.

As a result, the carboxylate ion's resonant properties influence a greater percentage of its ability to remain stable as opposed to the phenoxide ion features. Consequently, compared to phenoxide ions, carboxylate ions are significantly more resonance-stabilized. Because of this, carboxylic acid-based substances appear to be more potent as opposed to phenol.