Class 12 Aldehydes, Ketones and Carboxylic Acids Important Questions with Answers

Short Answer Type Questions

Q1. Why is there a significant difference in the boiling points of butanal and butanol?

Answer:

Bhutanol has a higher boiling point than butanal because butanol has a polar O-H bond, due to which it forms intermolecular hydrogen bonding, which is absent in butanal. Thus leading to a higher boiling point of Butanol.

Q2. Write a test to differentiate between pentan-2-one and pentan-3-one.

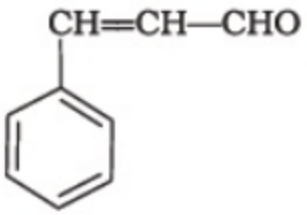
Answer:

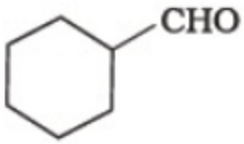
The iodoform test can distinguish Pentan-2-one and pentan-3-one.
Iodoform test:
Pentan-2-one, a methyl ketone, responds to the iodoform test. But pentan-3-one, not being a methyl ketone, does not respond to the iodoform test.

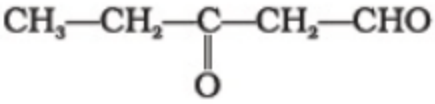
$CH_3CH_2CH_2COCH_3 + 3NaOI \rightarrow CH_3CH_2CH_2COONa + CHI_3$(Yellow ppt of Iodoform) $+ 2NaOH$

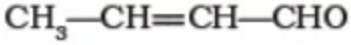
$CH_3CH_2COCH_2CH_3 + NaOI \rightarrow$ No yellow ppt of iodoform

Q3. Give the IUPAC names of the following compounds.

(i) 

(ii) 

(iii) 

(iv) 

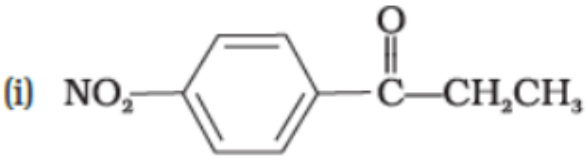
Answer:

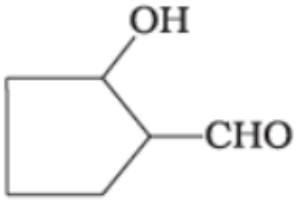
(i) 3-phenyl prop-2-en-1-al
(ii) cyclohexanecarbaldehyde
(iii) 3-oxo-pentanal
(iv) But-2-en-1-al

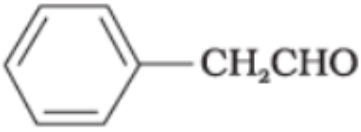
Q4. Give the structure of the following compounds.
(i) 4- Nitro Propiophenone
(Ii) 2-Hydroxy Cyclopentanecarbaldehyde
(iii) Phenyl acetaldehyde

Answer:

The structure of the above compounds are:

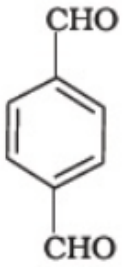
(i) 

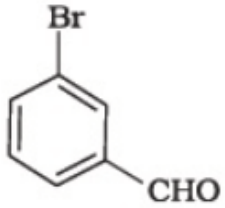
(ii) 

(iii) 

Q5. Write IUPAC names of the following structures.

(i) 

(ii) 

(iii) 

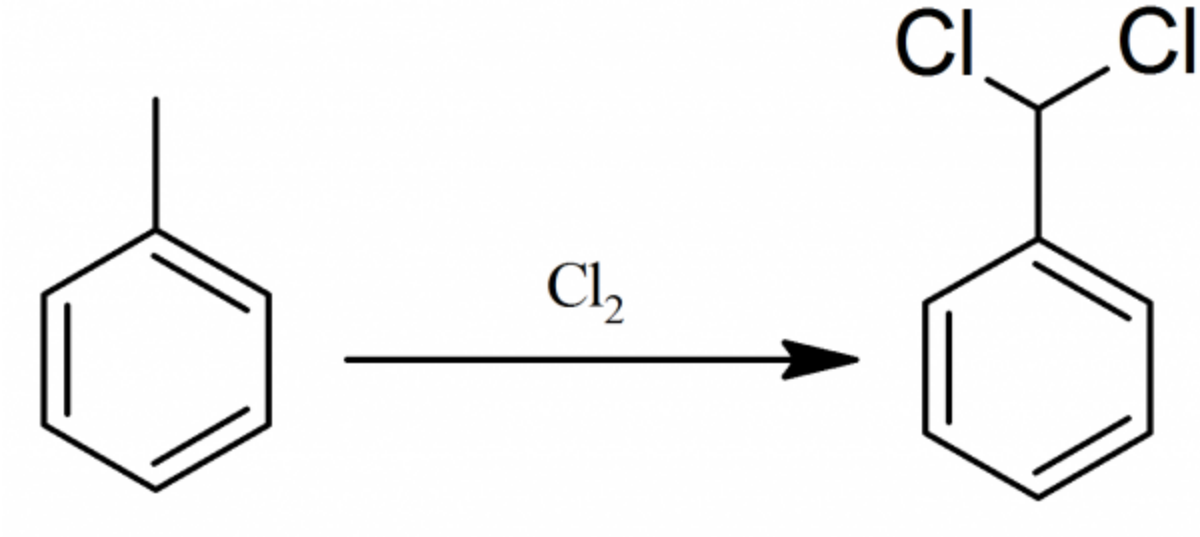
Answer:

(i) Ethanedial
(ii) 3- formylbenzaldehyde or 1,4 diformylbenzene
(iii) 2 -bromobenzaldehyde

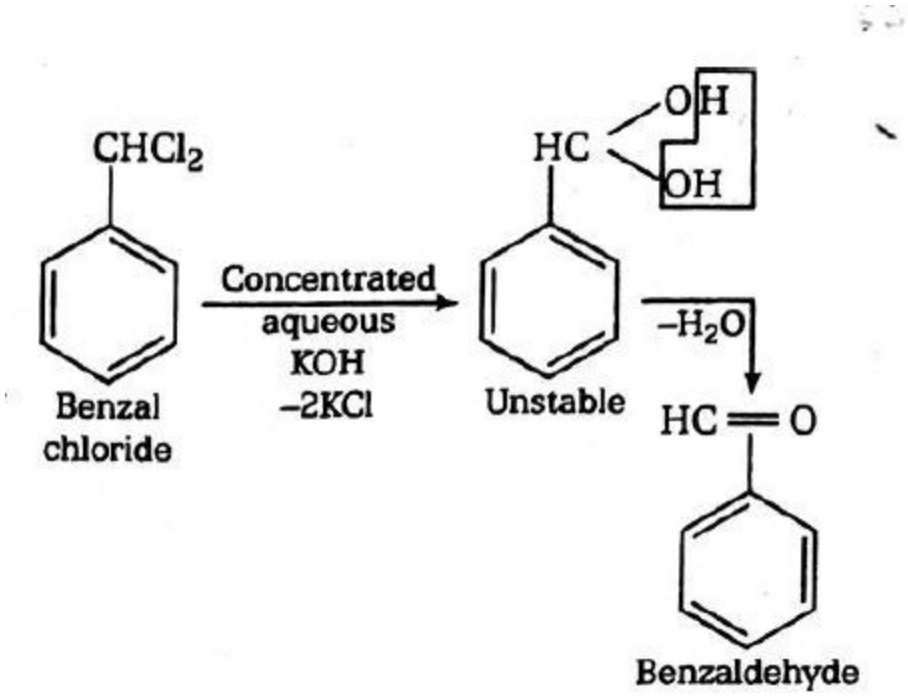
Q6. Benzaldehyde can be obtained from benzal chloride. Write reactions for obtaining benzal chloride and then benzaldehyde from it.

Answer:

We can synthesise benzal chloride by chlorinating toluene in the presence of sunlight.



We can convert benzal chloride to benzaldehyde by reacting with water at 373 K.

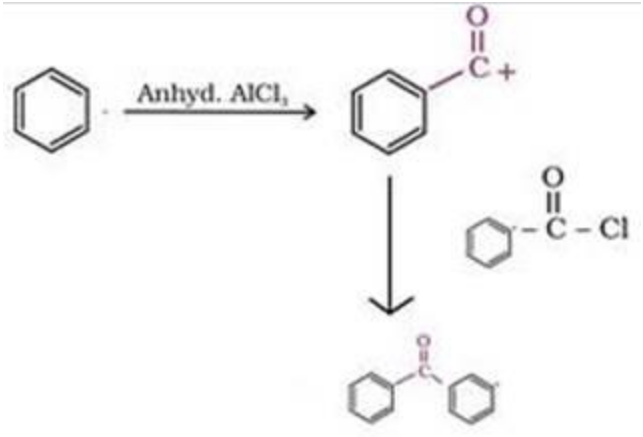


Q7. Name the electrophile produced in the reaction of benzene with benzoyl chloride in the presence of anhydrous AlCl3. Name the reaction also.

Answer:

The electrophile produced in the reaction of benzene with benzoyl chloride in the presence of anhydrous AlCl3 is benzoylinium cation. The product formed in this reaction is benzophenone. This reaction is called Friedel Crafts acylation reaction.

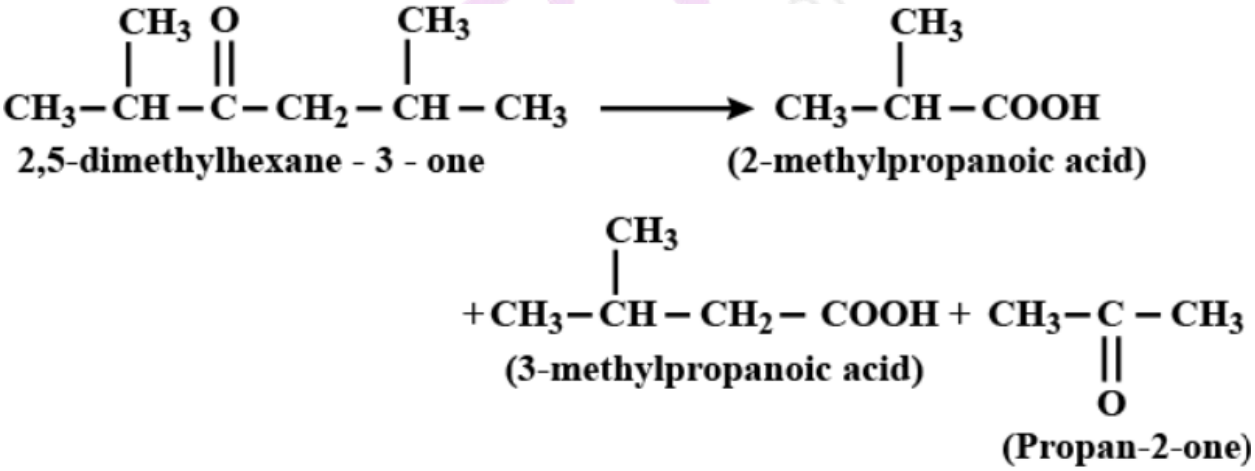
The chemical reaction involved when benzene reacts with benzoyl chloride in the presence of anhydrous AlCl3:

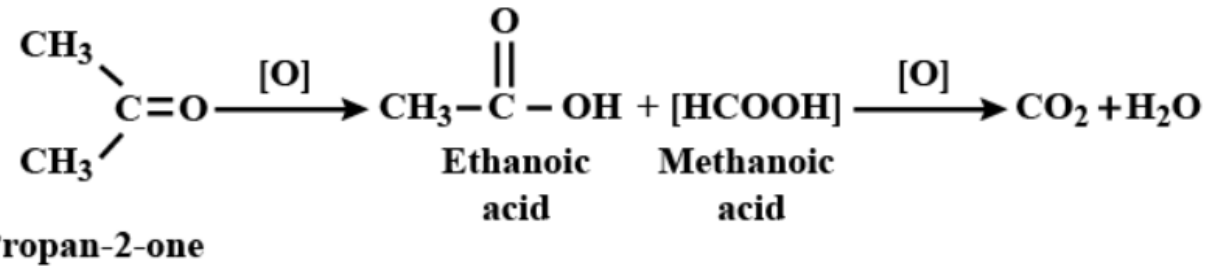


Q8. Oxidation of ketones involves carbon-carbon bond cleavage. Name the products formed on oxidation of 2, 5-dimethyl hexane-3-one.

Answer:

Being unsymmetrical, ketone oxidation occurs on either side of the C = O group giving a mixture of 2-methyl propanoic acid, 3-methyl propanoic acid and propane 2 one.





Q9. Arrange the following in decreasing order of their acidic strength and give the reason for your answer.
CH_3CH_2OH, CH_3COOH, $ClCH_2COOH$, FCH_2COOH, $C_6H_5CH_2COOH$

Answer:

The stronger the electron-withdrawing substituents, the more significant the dispersal of the negative charge and, hence, the stronger the acid will be. Hence, the order of acidity is

$FCH_2COOH > ClCH_2COOH > C_6H_5CH_2COOH > CH_3COOH > CH_3CH_2OH$

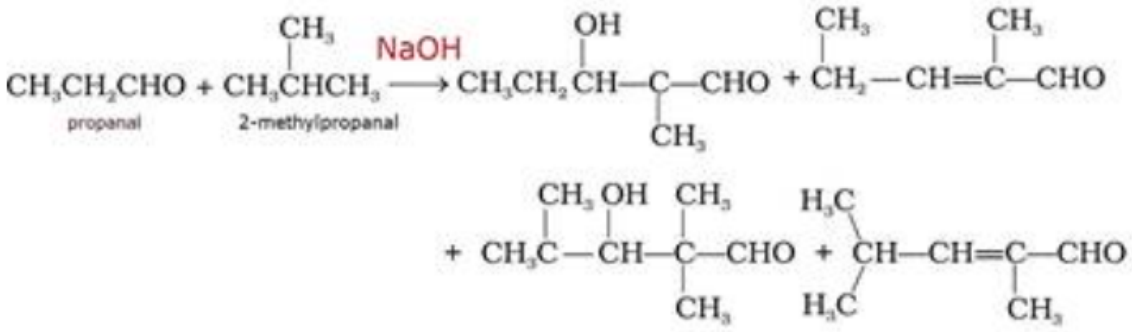
Q10. What product will be formed on reaction of propanal with 2-methyl propanal in the presence of NaOH? What products will be formed? Write the name of the reaction also.

Answer:

When propanal reacts with 2-methyl propanal in the presence of NaOH, the mixture of aldehydes is formed.

Both the reactants have an alpha-hydrogen and hence, can undergo cross aldol reaction in the presence of NaOH.

The products formed in this reaction are



This is a cross aldol reaction.

Q11. Arrange the following in decreasing order of their acidic strength. Explain the arrangement.
C_6H_5COOH, FCH_2COOH, NO_2CH_2COOH

Answer:

The higher the conjugate base's stability, the higher the acidity.

In C_6H_5COOH, the phenyl group is insulated, so it exerts only −I effect on the resonance hybrid of the carboxyl group, stabilising it by withdrawing electron density due to higher electronegativity of sp^2 hybridised carbon atoms.

$-NO^{2-}$ and fluorine are electron-withdrawing, thus decreasing the electron density on the carbon atom and stabilising it. $-NO^{2-}$ is more electronegative than fluorine. Thus NO_2CH_2COOH would be most acidic, followed by FCH_2COOH and C_6H_5COOH.

$NO_2CH_2COOH > FCH_2COOH > C_6H_5COOH$.

Q12. Alkenes (C=C) and carbonyl compounds (C=0) contain a pie bond, but alkenes show electrophilic addition reactions, whereas carbonyl compounds show nucleophilic addition reactions. Explain.

Answer:

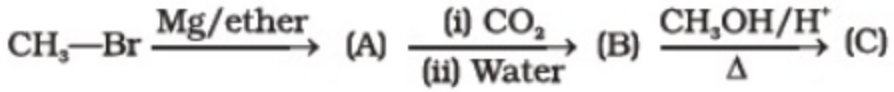
Alkenes undergo electrophilic addition, whereas aldehydes and ketones undergo nucleophilic addition because, in alkenes, the double bond joins two carbon atoms, and there is no resultant polarity. While in carbonyl compounds, the double bond joins atoms having different polarities. The polarity in the carbonyl bond makes it vulnerable to a nucleophile addition reaction.

Q13. Carboxylic acids contain the carbonyl group but do not show the nucleophilic addition reaction like aldehydes or ketones. Why?

Answer:

Due to resonance, carboxylic acid groups do not show the nucleophilic addition reaction like aldehydes or ketones. The partial positive charge on the carbonyl carbon atom is reduced.

Q14. Identify the compounds A, B and C in the following reaction.



Answer:

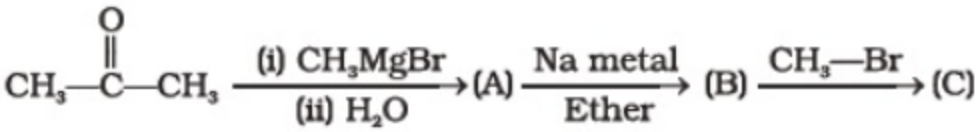
A= CH_3MgBr
B= $CH_3COOMgBr$
C= CH_4

Q15. Why are carboxylic acids more acidic than alcohols or phenols, although they all have hydrogen atoms attached to an oxygen atom (-0-H)?

Answer:

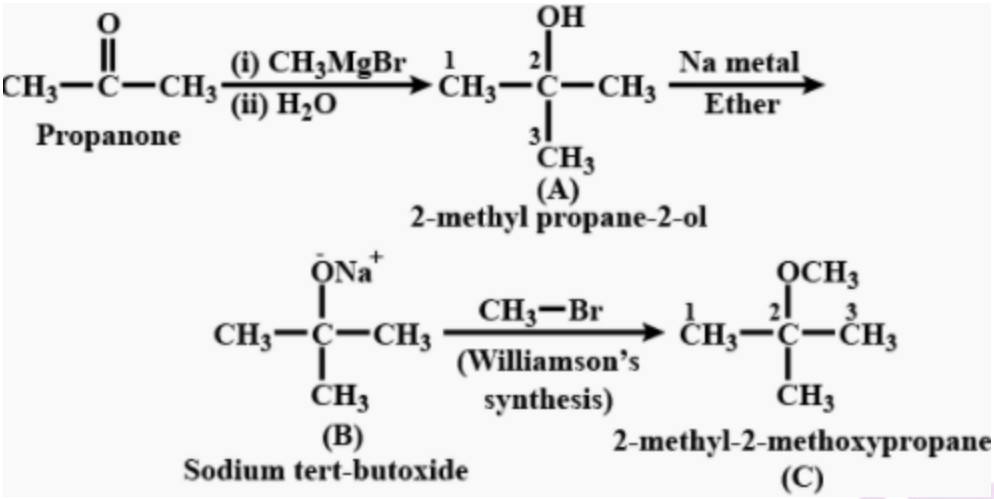
Carboxylic acids are more acidic than alcohols or phenols. However, they all have a hydrogen atom attached to an oxygen atom (—O—H) because the conjugate base of carboxylic acids or the carboxylate ion is stabilised by resonance. Due to the resonance in carboxylic acids, the negative charge is at the more electronegative atom (oxygen atom). In alcohols or phenols, the negative charge is on the less electronegative atoms. Thus, carboxylic acids can release protons easier than alcohols or phenols.

Q16. Complete the following reaction sequence.



Answer:

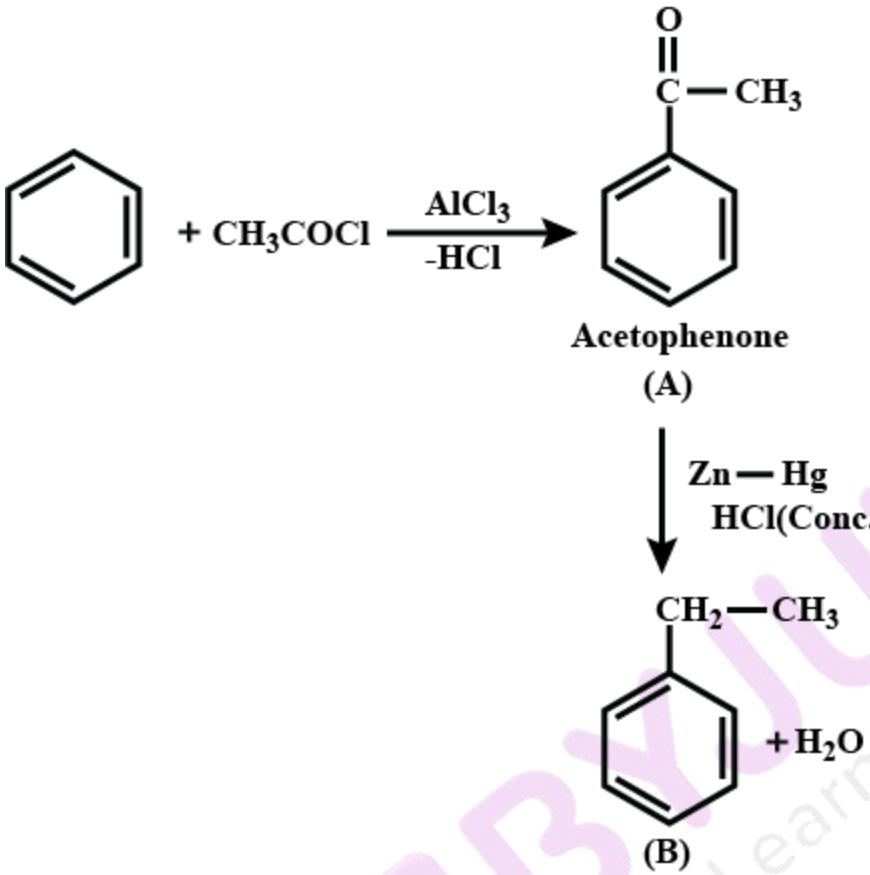
Here,
A = 2-methyl propane-2-ol
B = Sodium tert-butoxide
C = 2-methyl-2-methoxypropane



Q17. Ethylbenzene is generally prepared by acetylation of benzene followed by reduction and not by direct alkylation. Think of a possible reason.

Answer:

Preparation of ethylbenzene from acylation of benzene and reduction is shown as:



Direct alkylation is not performed because a polysubstituted product is formed. Due to the disadvantage of poly substitution, Friedel-Craft's alkylation reaction is not used to prepare alkylbenzenes. Instead of Friedel-Craft's acylation is used.

Q18. Can Gattermann-Koch reaction be considered similar to Friedel Craft's acylation? Discuss.

Answer:

Yes, the Gattermann-Koch reaction can be considered similar to Friedel-crafts acylation. The reason is that in Friedel-craft acylation reactions, benzene (or any other arene) is treated with an acid chloride in the presence of anhydrous AlCl3. Since HCOCl (formyl chloride) is not stable, in the Gattermann-Koch reaction, it is prepared in situ by reacting CO with HCl gas in the presence of anhydrous AlCl3. Thus, the Gattermann-Koch reaction is considered similar to Friedel-crafts acylation reaction.

Long Answer Type Questions

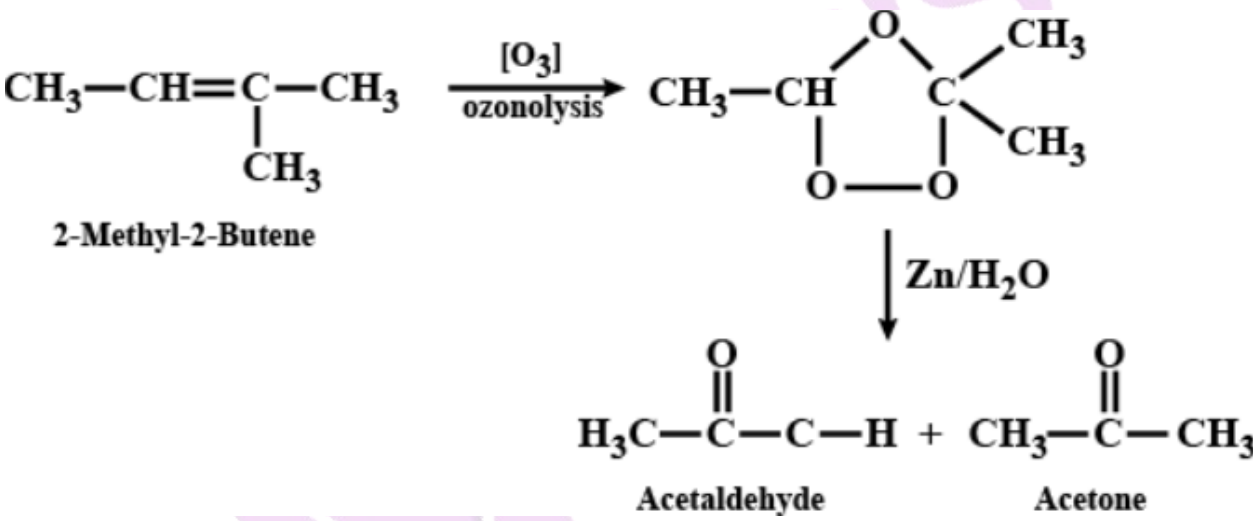
Q1. An alkene 'A' (Mol. formula C_5H_{10}) on ozonolysis gives a mixture of two compounds, 'B' and 'C'. Compound B' gives positive Fehling's test and forms iodoform on treatment with I_2 and NaOH.

Compound C' does not give Fehling's test but forms iodoform. Identify the compounds A, B, and C. Write the reaction for ozonolysis and formation of iodoform
from B and C.

Answer:

(i) Compound B gives Fehling's test, which means it is aldehyde also. It forms an iodoform, so compound B is acetaldehyde, among aldehydes.
(ii) Compound C does not give Fehling's test but gives iodoform, so ketone must have a methyl group attached to carbonyl.

Reactions for ozonolysis and formation of iodoform from B and C are



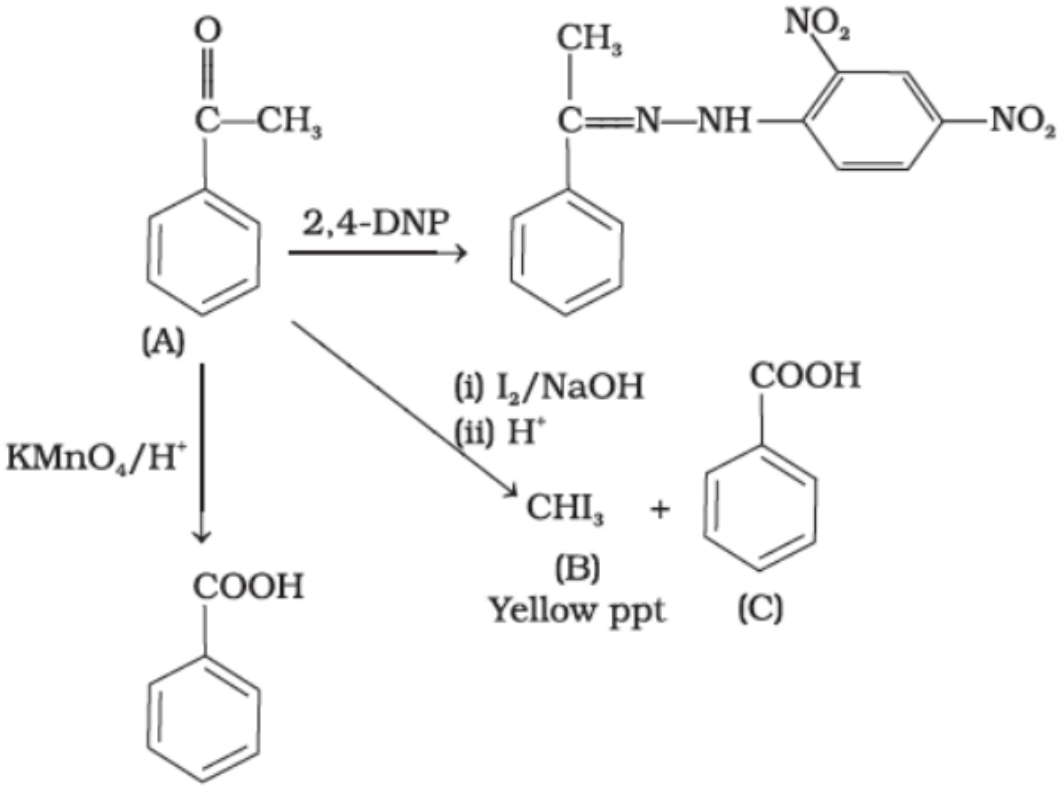
2-Methyl-2-Butene

Q2. An aromatic compound "A' (Molecular formula C_8H_8O) gives a positive 2, 4-DNP test. It gives a yellow precipitate of compound 'B' on treatment with iodine and sodium hydroxide solution. Compound A' does not give Tollen's or Fehling's test. On severe oxidation with potassium permanganate forms a carboxylic acid 'C' (Molecular formula $C_7H_60_2$), which is also formed along with the yellow compound in the above reaction. Identify A, B and C and write all the reactions involved.

Answer:

Since the aromatic compound, 'A' does not give Tollen's reagent test or Fehling's test, it is not an aromatic aldehyde. It responds to the iodoform test, indicating a methyl ketone.

The series of reactions involved are listed.



Q3. Write down functional isomers of a carbonyl compound with molecular formula C_3H_6O. Which isomer will react faster with HCN and why? Explain the mechanism of the reaction also. Will the reaction lead to the completion with the conversion of the whole reactant into product reaction conditions? If a strong acid is added to the reaction mixture, what will be the effect on the concentration of the product and why?

Answer:

Functional isomers of C_3H_6O containing carbonyl group are CH_3CH_2CHO (Propanal) and CH_3COCH_3 (Propanone).

(a) Propanal CH_3CH_2CHO will react faster with HCN because less steric hindrance and electronic factors increase its electrophilicity.
(b) It does not lead to completion because it is a reversible reaction. Equilibrium is established,
(c) If A strong acid is added to the reaction mixture, the reaction is inhibited because the production of CN^- ions is prevented.

Q4. When liquid 'A' is treated with a freshly prepared ammonical silver nitrate solution, it gives a bright silver mirror. The liquid forms a white crystalline solid on treatment with sodium hydrogen sulphite.

Liquid ′B′ also forms a white crystalline solid with sodium hydrogen sulphite, but it does not give a test with ammoniacal silver nitrate. Which of the two liquids is aldehyde? Write the chemical equations of these reactions also.

Answer:

Liquid ′A′ must be Aldehyde because it reacts with both NaHSO3 and ammonical silver nitrate.
Liquid ′B′ must be ketone because it does not react with ammonical silver nitrate but react with NaHSO3.