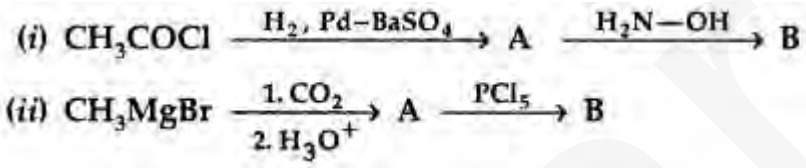
IMPORTANT QUESTIONS CLASS – 12 CHEMISTRY CHAPTER – 8 ALDEHYDES, KETONES AND CARBOXYLIC ACIDS

Question 1.

(a) Write the structures of A and B in the following reactions:



(b) Distinguish between:

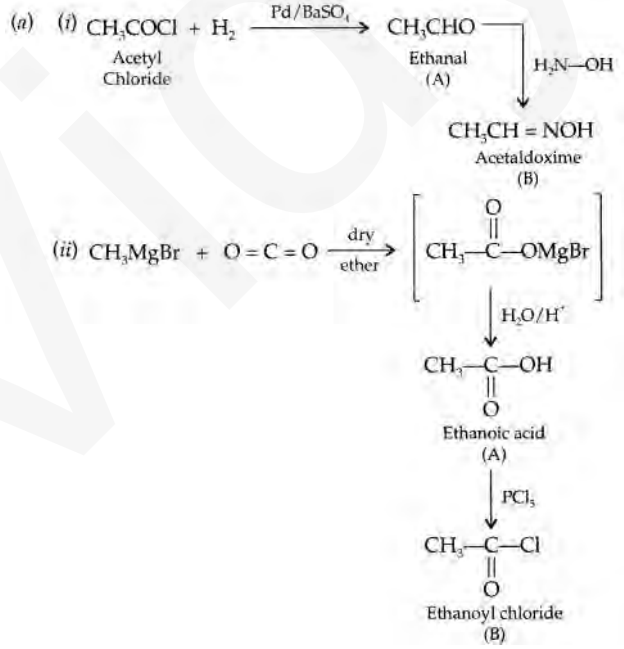
(i) C_6H_5— $COCH_3$ and C_6H_5— CHO

(ii) CH_3COOH and HCOOH

(c) Arrange the following in the increasing order of their boiling points:

CH_3CHO, CH_3COOH, CH_3CH_2OH

Answer:



(b) (i) Benzaldehyde and acetophenone :
By Iodoform test: Acetophenone being a methyl ketone on treatment with I_2 and NaOH (NaOI) undergoes iodoform test to give yellow ppt. of iodoform on heating whereas benzaldehyde does not.

$$\underset{\text{Acetophenone}}{C_6H_5COCH_3} + 3NaOI \longrightarrow \underset{\text{Sod. benzoate}}{C_6H_5COONa} + \underset{\substack{\text{Iodoform}\\\text{(yellow ppt.)}}}{CHI_3\downarrow} + 2NaOH$$

$$\underset{\text{Benzaldehyde}}{C_6H_5CHO} \xrightarrow{NaOI} \text{No yellow ppt.}$$

(ii) CH_3COOH (Acetic acid) and HCOOH (Formic acid). Formic acid is the only acid which contains aldehydic group and thus shows reactions with Tollen's reagent (silver nitrate) and Fehling's solution which Acetic acid does not show.
Tollen's Test:
Add ammonical solution of silver nitrate to both the compounds, HCOOH gives silver mirror but CH_3COOH does not

$$HCOOH + 2[Ag(NH_3)_2]^+ + 2OH^- \xrightarrow{\Delta} \underset{\text{Silver mirror}}{2Ag} + 4NH_3 + CO_2 + 2H_2O$$

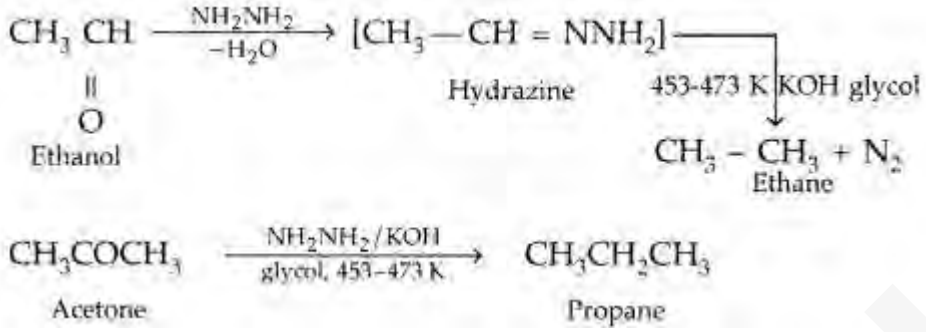
(c) $CH_3CHO < CH_3CH_2OH < CH_3COOH$

Question 2.
(a) Write the chemical reaction involved in Wolff-Kishner reduction.
(b) Arrange the following in the increasing order of their reactivity towards nucleophilic addition reaction:
$C_6H_5COCH_3$, CH_3-CHO, CH_3COCH_3
(c) Why carboxylic acid does not give reactions of carbonyl group?
(d) Write the product in the following reaction

$$CH_3CH_2CH=CH-CH_2CN \xrightarrow[2.\ H_2O]{1.\ (i-Bu)_2AlH}$$

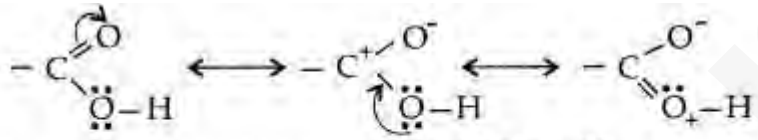
(e) A and B are two functional isomers of compound C_3H_6O. On heating with NaOH and I_2, isomer B forms yellow precipitate of iodoform whereas isomer A does not form any precipitate. Write the formulae of A and B.

Answer:
(a) Wolff-Kishner reduction reaction : The reduction of aldehydes and ketones to the corresponding hydrocarbons by heating them with hydrazine and KOH or potassium tert-butoxide in a high boiling solvent like ethylene glycol is called Wolff-Kishner reduction.



(b) $C_6H_5COCH_3 < CH_3COCH_3 < CH_2CHO$

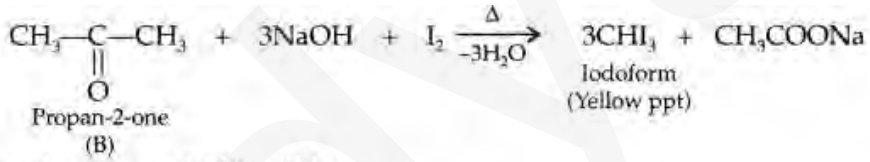
(c) The carboxylic carbon is less electrophilic than carbonyl carbon because of the possible resonance structure.



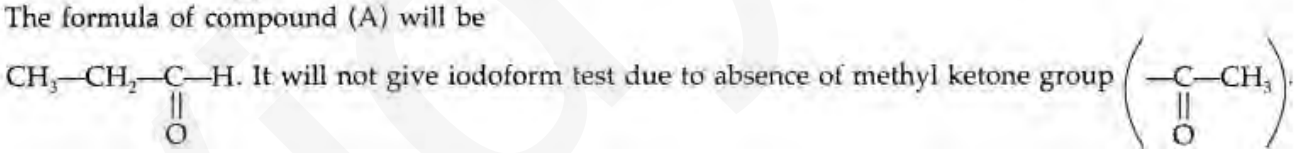
(d) $CH_3CH_2CH = CH—CH_2CN \xrightarrow[2.\ H_2O]{1.\ (i—Bu)_2\ AlH} CH_3CH_2CH = CHCH_2CHO$

Hex-3-enal

(e) The given compound has molecular formula C_3H_6O. One of its functional isomer i.e., B shows iodoform test which can be only shown by compounds having methyl ketone so the compound B will be Acetone or 2-propanone. Its functional isomer A will be propanal.

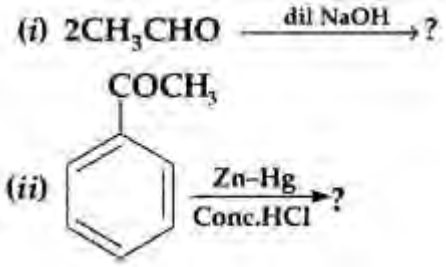


The formula of compound (A) will be



Question 3.

(a) Write the product(s) in the following :



(b) Give simple tests to distinguish the following pairs of compounds :

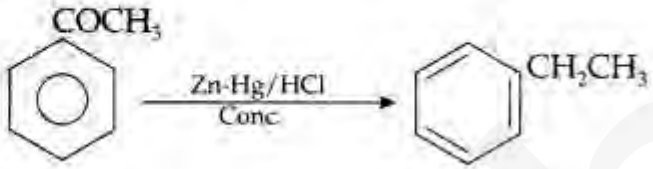
(i) Ethanal and Propanal

(ii) Benzaldehyde and Acetophenone

(iii) Benzoic acid and Ethyl benzoate

Answer:

(a) (i) **Aldol condensation :** $2CH_3CHO \xrightarrow{NaOH(aq)} CH_3-\underset{OH}{\underset{|}{CH}}-CH_2-CHO$

(ii) **Clemmensen reduction :** 

Ethyl Benzene

(b) (i) On heating with NaOH and I_2, ethanal forms yellow ppt of CHI_3 whereas propanal can not.

$CH_3CHO + 3I_2 \rightarrow NaOH\ -4\ CHI_3 + 3NaI + HCOONa + 3H_2O$

(ii) On heating with NaOH and I2, aceptophenone forms yellow ppt of CHI3 whereas benzaldehyde does not.

$C_6H_5COCH_3 + 3NaOI \rightarrow C_6H_5COONa + CHI_34 + 2NaOH$

(iii) On adding NaHCO,, benzoic acid produces brisk effervescence of C02 gas whereas ethylbenzoate does not.

$$C_6H_5COOH + NaHCO_3 \rightarrow \underset{\text{Sodium Benzoate}}{C_6H_5COONa} + CO_2\uparrow + H_2O$$

Question 4.

(a) Give reasons :

(i) CH_3—CHO is more reactive than CH_3COCH_3 towards HCN.

(ii) 4-nitrobenzoic acid is more acidic than benzoic acid.

(b) Describe the following :

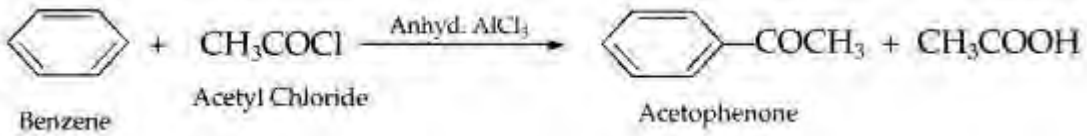
(i) Acetylation (ii) Cannizzaro reaction (iii) Cross aldol condensation

Answer:

(a) (i) Because carbonyl carbon of CH_3—CHO is more electrophilic than CH_3COCH_3 due to only one electron donating CH_3– group.

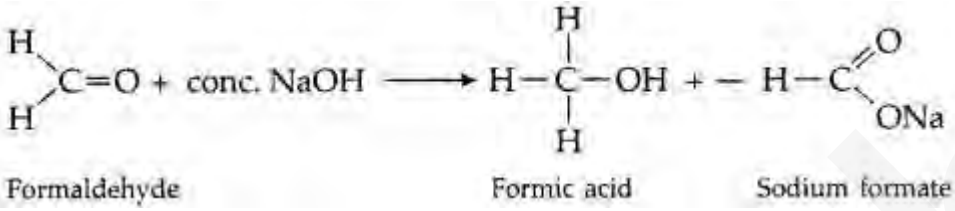
(ii) Because of electron withdrawing nature of $-NO_2$ group.

(b) (i) Acetylation : Introduction of an acetyl group/CH3CO- by heating an organic compound with acetyl chloride/acetic anhydride.

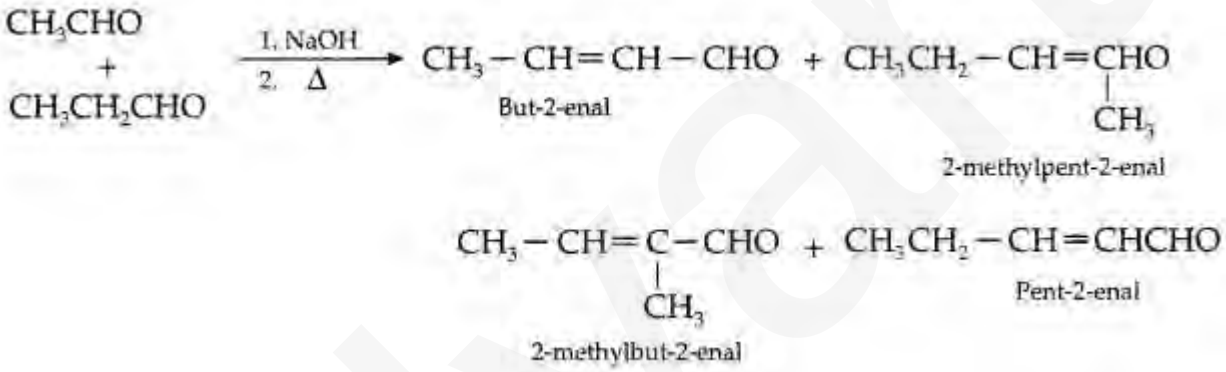
e.g.: 

Benzene — Acetyl Chloride — Acetophenone

(ii) Cannizzaro reaction : Aldehydes having no a-hydrogen atom when treated with cone. NaOH, undergoes self-oxidation and self-reduction simultaneously

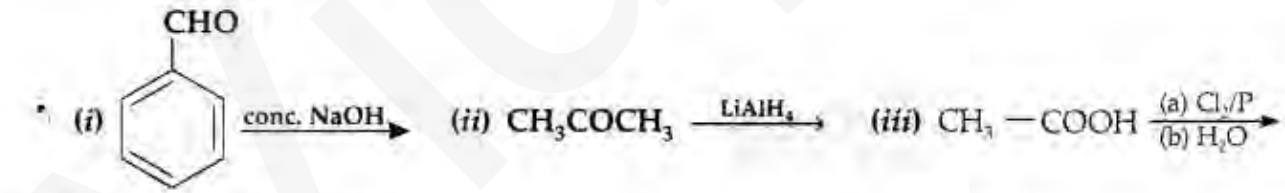


(iii) Cross Aldol Condensation : When aldol condensation is carried out between two different aldehydes or ketones, it is called cross aldol condenstation.

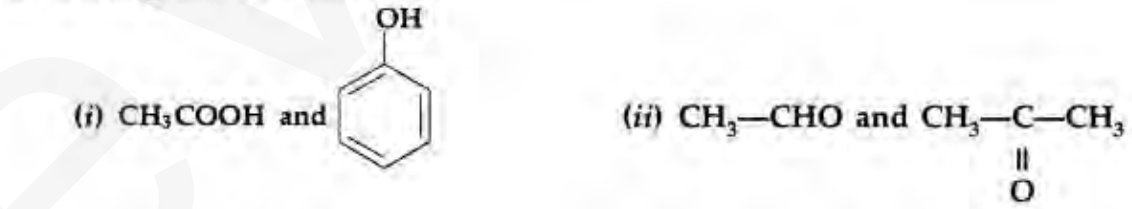


Question 5.

(a) Complete the following equations :

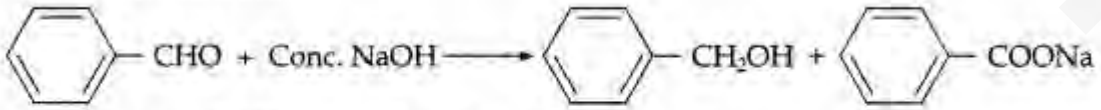


(b) Distinguish between :



Answer:

(a) (i) **Cannizzaro reacion :**



(ii) $CH_3COCH_3 \xrightarrow{LiAlH_4} CH_3CH(OH)\,CH_3$

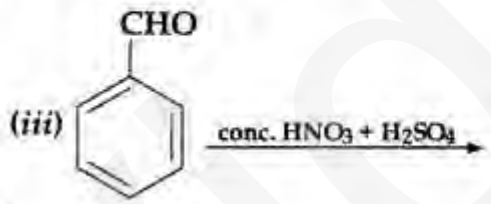
(iii) $CH_3-COOH \xrightarrow[(ii)\ H_2O]{(i)\ Cl_2/\text{Red phosphorus}} \underset{\displaystyle Cl}{\overset{\displaystyle CH_2-COOH}{|}}$

(b) (i) On adding $NaHCO_3$, CH_3COOH produces brisk effervescence of CO_2 gas whereas phenol does not.
(ii) On heating with Tollen's reagent, CH_3CHO forms silver mirror whereas CH_3COCH_3 does not.

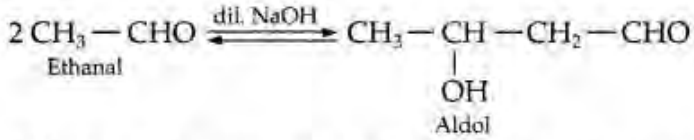
Question 6.
(a) What is meant by the following terms? Give an example of the reaction in each case.
(i) Aldol (ii) Semicarbazone
(b) Complete the following :

(i) $CH_3COCl \xrightarrow{H_2,Pd-BaSO_4}$ (ii) $CH_3-CH=CH-CN \xrightarrow{DIBAL-H}$

(iii)



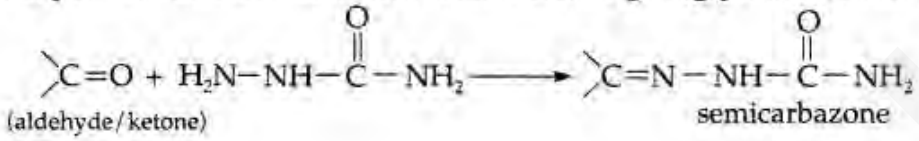
Answer:
(a) (i) Two molecules of aldehyde and ketones containing a-hydrogen atom react in the presence of
aqueous alkali giving product known as Aldol.
Example :



Ethanal

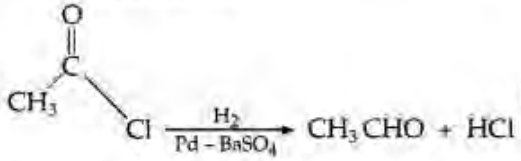
Aldol

(*ii*) Aldehyde and ketones react with semicarbazide giving product called semicarbazone.

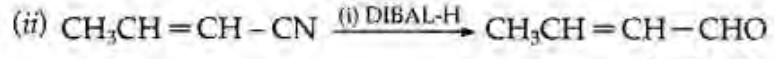


(aldehyde/ketone)

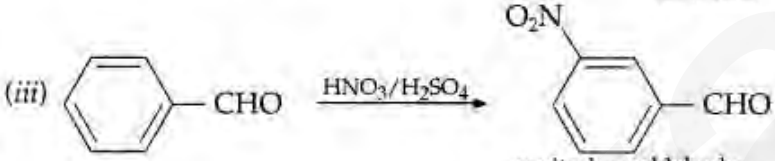
semicarbazone

(*b*) (*i*) 

Rosenmund reaction

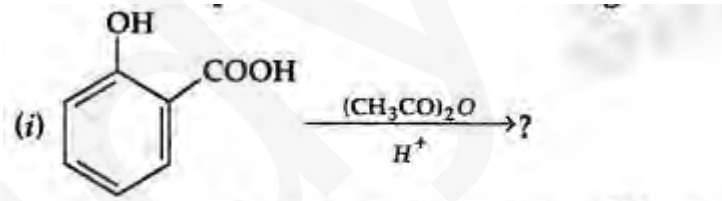
(*ii*) 

but-2-enal

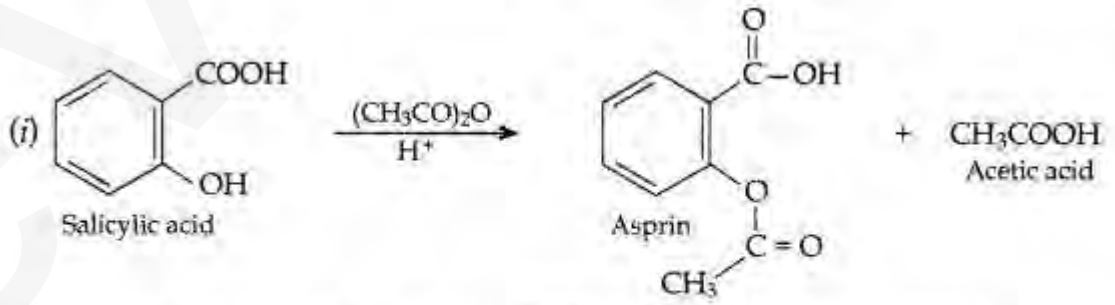
(*iii*) 

n-nitrobenzaldehyde

Question 7.
Write the product(s) in the following reactions.



Answer:



Salicylic acid

Asprin

Acetic acid

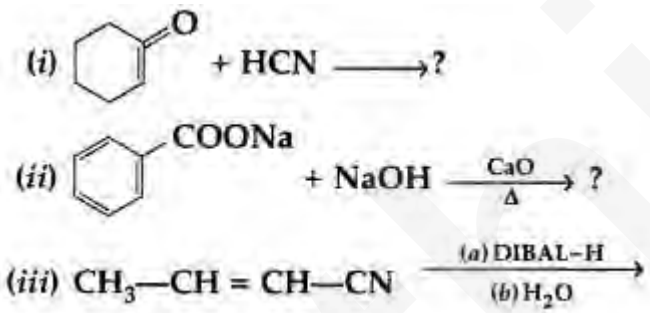
(*ii*) $CH_3-CH=CH-CH_2-OH \xrightarrow{PCC} CH_3-CH=CH-CHO$

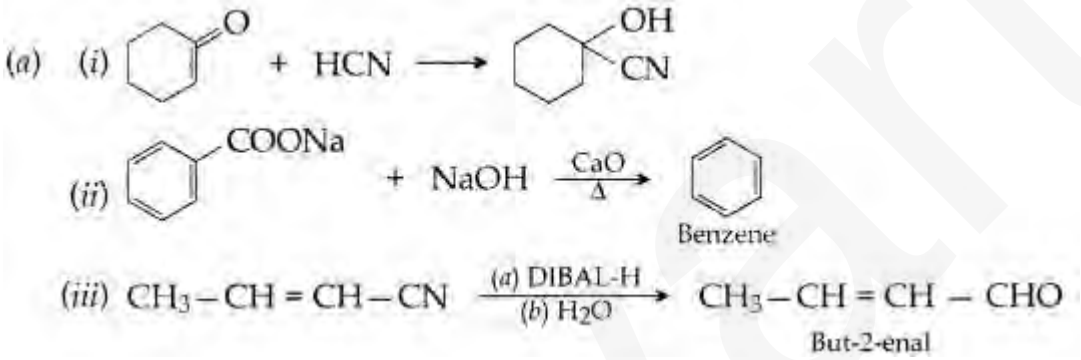
But-2-enol

But-2-enal

Question 8.
(a) Write the product(s) in the following reactions:

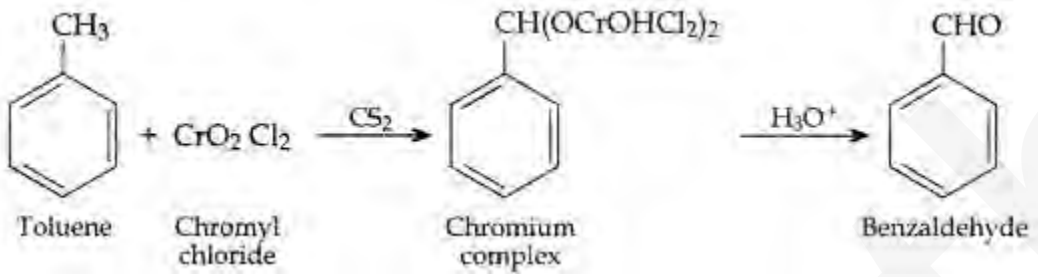
(b) Give simple chemical tests to distinguish between the following pairs of compounds:
(i) Butanal and Butan-2-one (ii) Benzoic acid and Phenol
Answer:



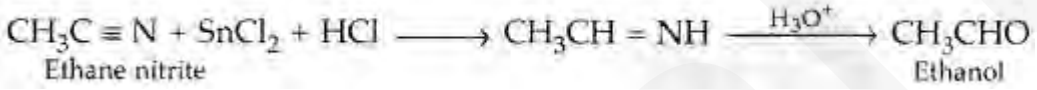


(b) (i) Pollen's reagent test. Add ammoniacal solution of sliver nitrate (Tollen's Reagent) in both the solutions. Butanal gives silver mirror whereas Butan-2-one does not. Therefore Butanal gives Tollen's test.
(ii) Ferric chloride test. Add neutral $FeCl_3$ in both the solutions, phenol reacts with neutral $FeCl_3$ to form an iron-phenol complex giving violet colour but benzoic acid does not.

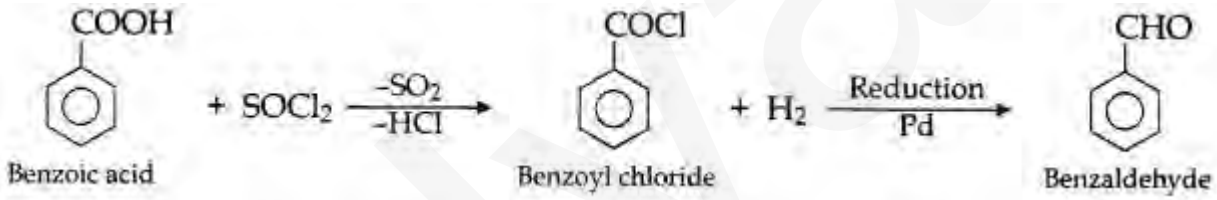
Question 9.
(a) Write the reactions involved in the following:
(i) Etard reaction (ii) Stephen reduction
(b) How will you convert the following in not more than two steps:
(i) Benzoic acid to Benzaldehyde (ii) Acetophenone to Benzoic acid
(iii) Ethanoic acid to 2-Hydroxyethanoic acid (All India 2017)
Answer:
(a) (i) Etard reaction



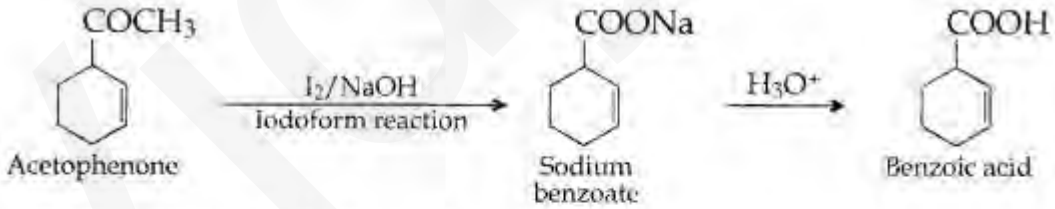
(ii) Stephen reduction:



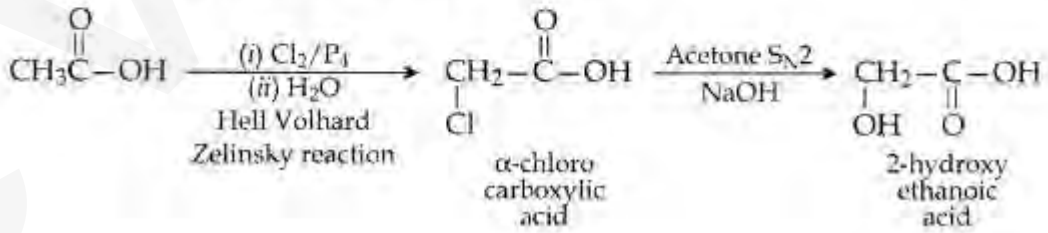
(b) (i) Benzoic acid to Benzaldehyde



(ii) Acetophenone to Benzoic acid



(iii) ***Ethanoic acid to 2-Hydroxyethanoic acid:***



Question 10.

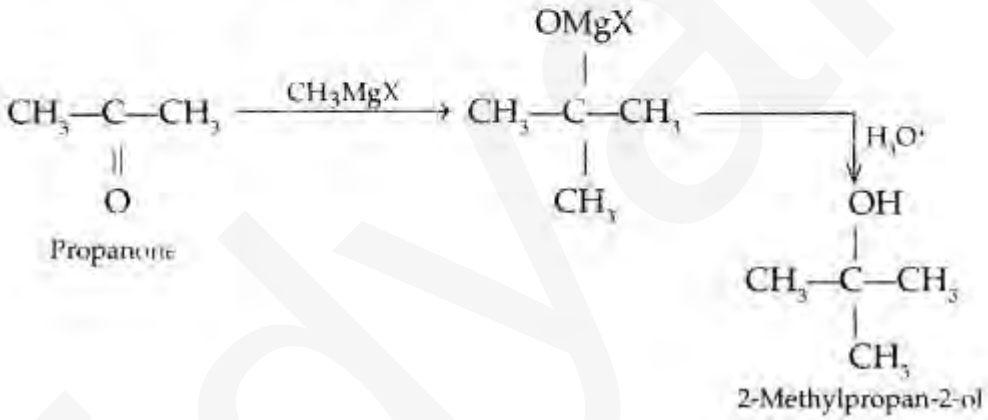
(a) How will you convert:

(i) Benzene to acetophenone (ii) Propanone to 2-Methylpropan-2-ol

(b) Give reasons :

(i) Electrophilic substitution in benzoic acid takes place at meta position.
(ii) Carboxylic acids are higher boiling liquids than aldehydes, ketones and alcohols of comparable molecular masses.
(iii) Propanal is more reactive than propanone in nucleophilic addition reactions. (Comptt. Delhi 2017)
Answer:
(i) Benzene to acetophenone

(ii) **Propane to 2-methylpropan-2-ol**



(b) (i) Because -COOH group is electron withdrawing group and deactivates the benzene ring. As a result of this ortho and para position acquires positive charge but only meta does not, so electrophile can attack on rneta position.
(ii) Because -COOH group of carboxylic acids is capable to do intermolecular hydrogen bonding forming a dimer while alcohols, aldehydes and ketones can not.

(iii) Because of smaller +1 effect of one alkyl group in propanal as compared to larger + I effect ol 2 alkyl groups of propanone, the magnitude of positive charge on the carbonyl carbon is more in propanal than propanone.