

① Give the IUPAC names of the following compounds

Answer

- a)  $\text{HCOOH}$   $\longrightarrow$  Methanoic acid  
b)  $\text{HOOCCH}_2\text{CH}_2\text{CH}_2\text{COOH}$   $\longrightarrow$  Pentan-1, 5-dioic acid  
c)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$   $\longrightarrow$  Butanoic acid  
d)  $\text{HO}_2\text{C}-\text{CO}_2\text{H}$   $\longrightarrow$  Ethanedioic acid  
e)  $\text{CH}_3[\text{CH}_2]_4\text{COOH}$   $\longrightarrow$  Hexanoic acid  
f)  $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH}$   $\longrightarrow$  Hex-4-enoic acid

2) Discuss briefly the physical properties of carboxylic acids under the following headings

### i) PHYSICAL APPEARANCE

All simple aliphatic carboxylic acids up to  $\text{C}_{10}$  are liquids at room temperature. Most other carboxylic acids are solids at room temperature although anhydrous carboxylic acid (acetic acid) also known as glacial ethanoic acid freezes to an ice-like solid below the room temperature.

### ii) Boiling Points

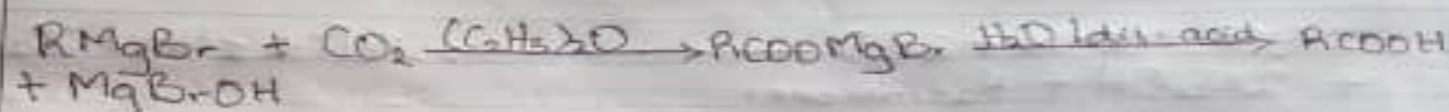
Boiling points increases with increasing relative molecular mass. Aromatic carboxylic acids are crystalline solids and have higher melting points than their aliphatic counterparts of comparable relative molecular mass.

### Solubility

Lower molecular mass carboxylic acid with up to four carbon atoms in their molecules are soluble in water.

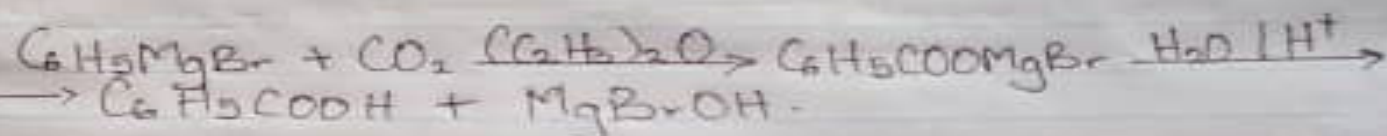
(ii) Carboxylation of Grignard reagent

Aliphatic carboxylic acids are obtained by bubbling carbon dioxide into the Grignard reagent and then hydrolyzed with dilute acid.

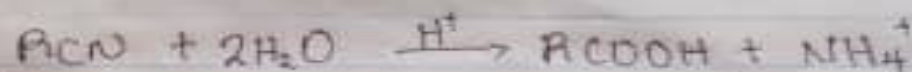


R may be 1°, 2°, 3° aliphatic alkyl or aryl radical

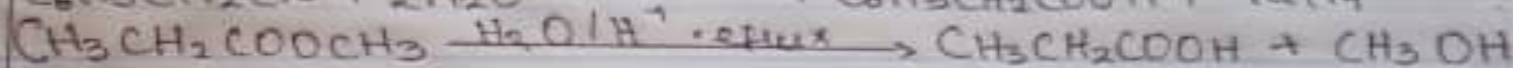
In the preparation of benzoic acid, the reagent is added to solid carbon dioxide (dry ice) which also serves as coolant to the reaction mixture.



(iii) Hydrolysis of nitriles (cyanides) or esters



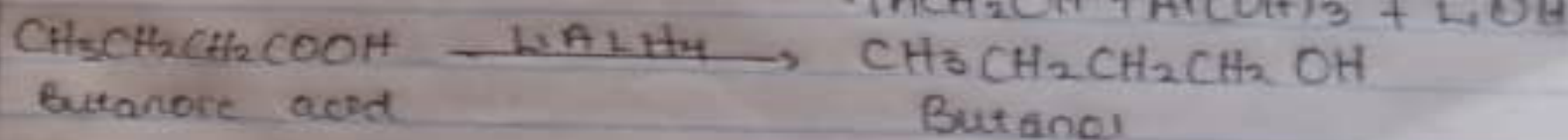
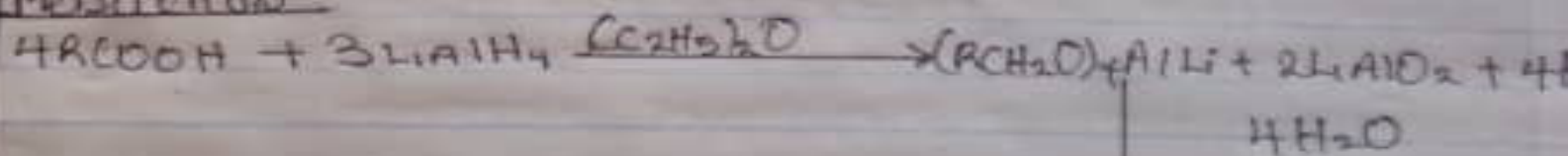
(R = alkyl or aryl radical)



5) With chemical equation only, outline the reduction, decarboxylation and esterification of carboxylic acid.

Answer

Reduction



this largely due to the ability to form hydrogen bonds with water molecules. The water solubility of the acids decreases as the relative molecular mass increases because the structure becomes relatively more hydrocarbon in nature and hence. Covalent. All carboxylic acids are soluble in organic solvents.

3 Write two industrial preparations of carboxylic acids.  
Answer

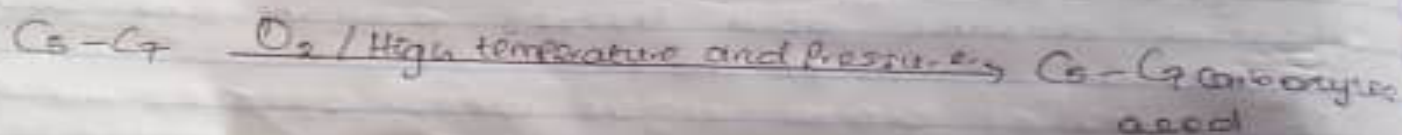
1) From Carbon Dioxide

Methanoic acid (formic acid) is manufactured by the reaction of carbon dioxide under pressure to hot aqueous solutions of sodium hydroxide. The free carboxylic acid is obtained by careful reaction with tetraoxosulphate (VI) acid ( $\text{H}_2\text{SO}_4$ )



2) From Petroleum

Liquid phase air oxidation of  $\text{C}_5$ - $\text{C}_7$  alkanes, obtainable from petroleum at high temperature and pressure will give  $\text{C}_5$ - $\text{C}_7$  carboxylic acids with methanoic, propanoic and butanedioic acid as by-products.



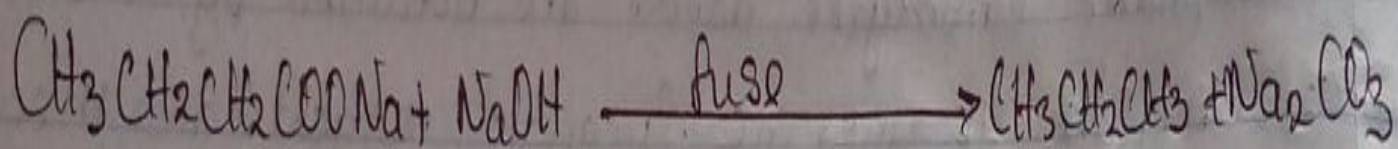
4) With equations and brief explanation discuss the synthetic preparation of carboxylic acid.  
Answer

1) Oxidation of primary alcohols and aldehydes

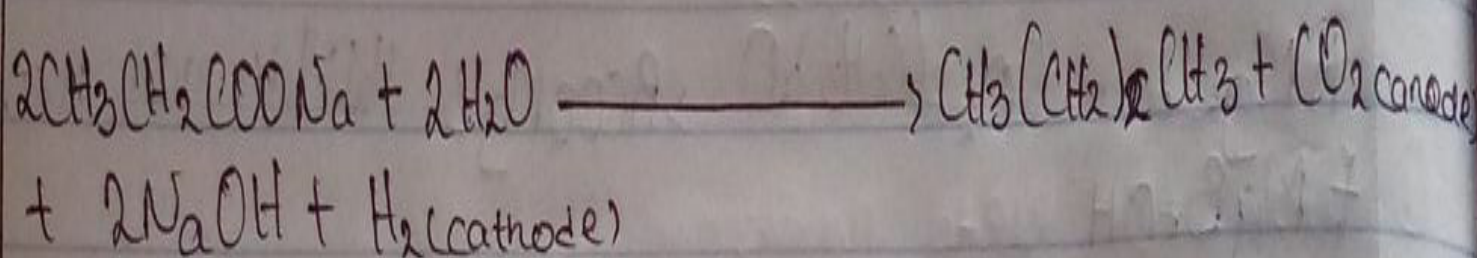
Oxidation of primary alcohols and aldehydes can be used to prepare carboxylic acids using the usual oxidizing agents (i.e.  $\text{K}_2\text{Cr}_2\text{O}_7$  or  $\text{KMnO}_4$ ) in acidic solution



(ii) Decarboxylation



Kolbe Synthesis



(iii) Esterification

