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Dept: MBBS

Subject: Chemistry Assignment

i) The IUPAC names of the following compounds

a)  $\text{HCOOH} \rightarrow$  Ethanoic acid

b)  $\text{HOOCCH}_2\text{CH}_2\text{CH}_2\text{COOH} \rightarrow$  Pentan-1,5-dioic acid

c)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH} \rightarrow$  Butanoic acid

d)  $\text{HO}_2\text{C}-\text{CO}_2\text{H} \rightarrow$  Ethanedioic acid

e)  $\text{CH}_3(\text{CH}_2)_4\text{COOH} \rightarrow$  Hexanoic acid

f)  $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH} \rightarrow$  Hex-4-enoic acid

ii) Discuss the physical properties of carboxylic acids under the following compounds.

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 comparative relative molecular mass.

iii) Solubility:

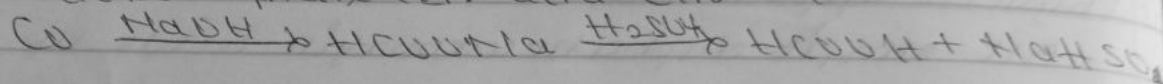
Lower molecular mass carboxylic acid with up to four carbon atoms in their molecules are soluble in water; this largely due to their ability to form hydrogen bonds with water molecules. The water solubility of

acid 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

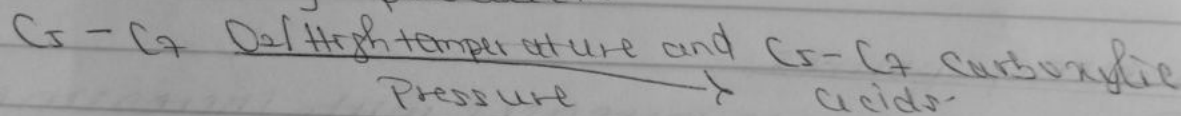
1) From carbon(II) oxide.

Methanoic acid is manufactured by passing carbon(II) oxide under pressure to hot aqueous solution of sodium hydroxide. The free carboxylic acid is liberated by careful reaction with tetraoxosulphate(VI) acid ( $\text{H}_2\text{SO}_4$ )



2) From Petroleum

Liquid phase air oxidation of C<sub>5</sub>-C<sub>7</sub> alkanes obtained from petroleum at high temperature and pressure will give C<sub>5</sub>-C<sub>7</sub> carboxylic acids with methanoic, propanoic and butanedioic acids as by-products.



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

Answer.

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

$$\text{RCH}_2\text{OH} \xrightarrow[\text{excess aq. / KMnO}_4]{\text{O}_2} \text{RCHO} \xrightarrow[\text{O}_2]{\text{O}_2} \text{RCOOH}$$

## Carboxylation of Grignard reagent

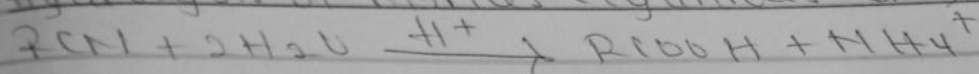
Aliphatic carboxylic acids are obtained by bubbling carbon (IV) oxide into the Grignard reagent and then hydrolyzed with dilute acid.

$$R\text{MgBr} + \text{CO}_2 \xrightarrow{\text{C}_6\text{H}_5\text{I}_2\text{O}} \text{RCO}_2\text{MgBr} \xrightarrow{\text{H}_2\text{O}/\text{H}^+} \text{RCOOH} + \text{MgBrOH}$$

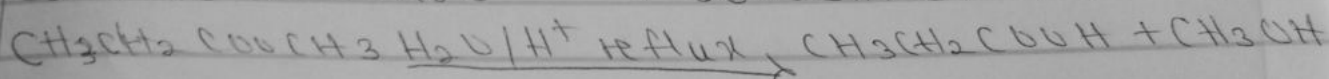
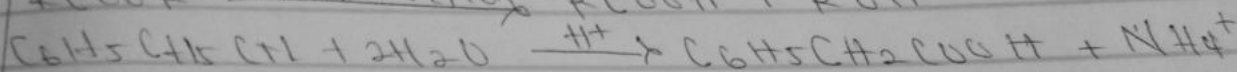
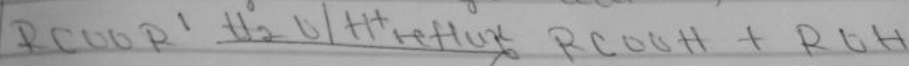
R may be 1°, 2°, 3° aliphatic alkyl or aryl radical. In the preparation of benzoic acid, the reagent is added to solid carbon (IV) oxide (dry ice) which also serves as solvent to the reaction mixture.

$$\text{C}_6\text{H}_5\text{MgBr} + \text{CO}_2 \xrightarrow{\text{C}_6\text{H}_5\text{I}_2\text{O}} \text{C}_6\text{H}_5\text{CO}_2\text{MgBr} \xrightarrow{\text{H}_2\text{O}/\text{H}^+} \text{C}_6\text{H}_5\text{COOH} + \text{MgBrOH}$$

## Hydrolysis of nitriles (cyanides or esters).

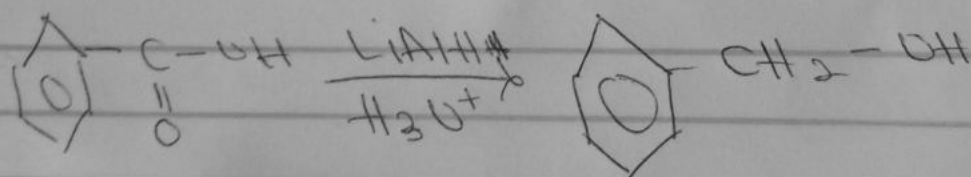
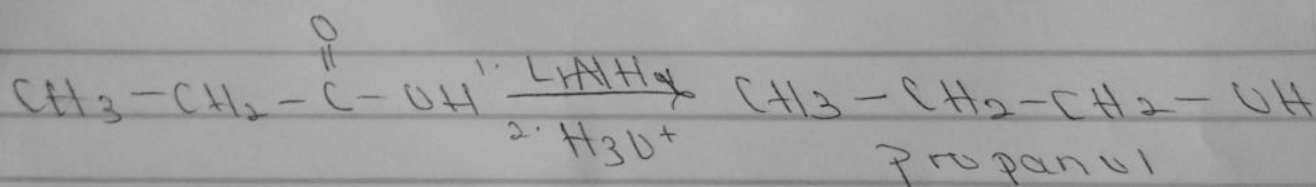


(R = alkyl or aryl radical)

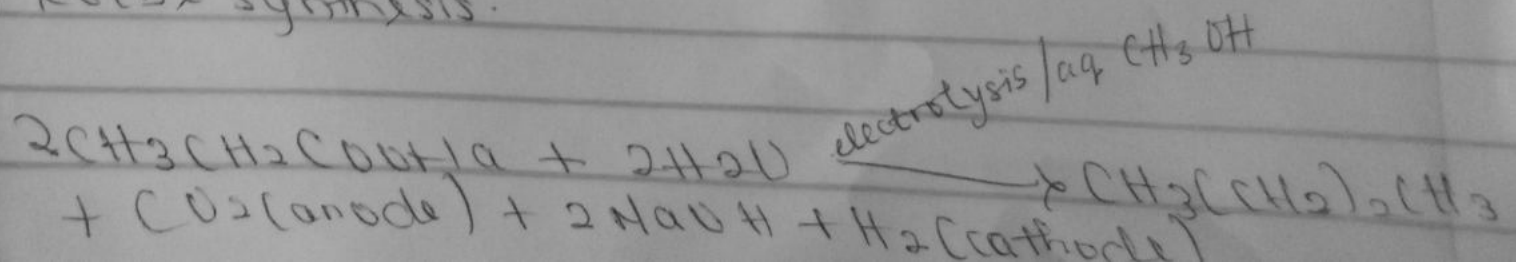
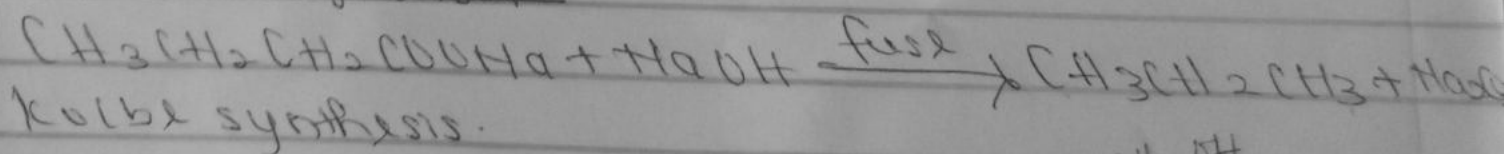


5) With chemical equation only, outline the reduction, decarboxylation and esterification of carboxylic acid.

### i) Reduction



### ii) Decarboxylation



Esterification.

