

SHIKH WILLIAMS GIKHHEMEN

19/ENGDS/059

MECHATRONICS

CHM 102

1. (i)  $\text{HCOOH}$  - Methanoic acid

(ii)  $\text{HOOCCH}_2\text{CH}_2\text{CH}_2\text{COOH}$  - Pentan-1,5-dioic acid.

(iii)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$  - Butanoic acid.

(iv)  $\text{HO}_2\text{C}-\text{CO}_2\text{H}$  - Ethanedioic acid.

(v)  $\text{CH}_3(\text{CH}_2)_4\text{COOH}$  - Hexanoic acid.

(vi)  $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH}$  - Hex-4-enoic acid.

2. Physical properties:

1. Physical appearance: All simple aliphatic carboxylic acid up to  $\text{C}_6$  are liquids at room temperature although anhydrous carboxylic acid (acetic acid) also known as glacial ethanoic acid freezes to ice like solid below the <sup>room</sup> temperature.

2. Boiling point:

The boiling point of carboxylic acid increases with increasing relative molecular mass. Aromatic carboxylic acid are crystalline solids and have higher melting points than their aliphatic counterparts of comparable relative molecular mass.

3. Solubility:

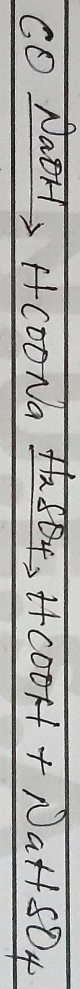
Lower molecular mass carboxylic acids with up to 4 carbon atoms in their molecules are soluble in water.

this largely due to their ability to form hydrogen bonds with water molecules. The water solubility of 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 solvent.

3. Industrial preparation of carboxylic acid.

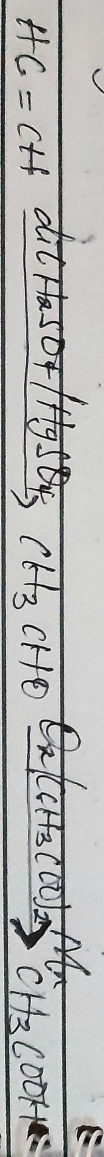
1. From Carbon (II) oxide

Methanoic acid (formic acid) is manufactured by adding 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 (H<sub>2</sub>SO<sub>4</sub>)



2. From ethanol

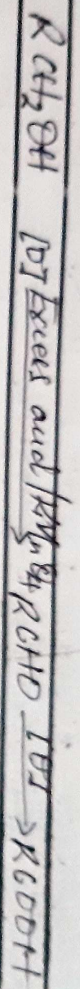
Ethanoic acid is obtained commercially by the liquid phase air-oxidation of 5% solution of ethanol to ethanoic acid using manganese (IV) ethanoate as catalyst. Ethanol itself is obtained from ethylene.



4. Synthetic Preparation:

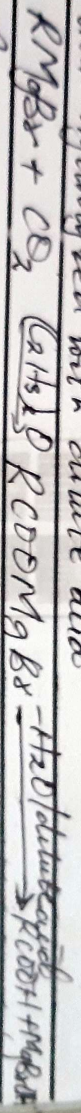
1. Oxidation of primary alcohols and aldehydes

This method can be used by using oxidizing agents (H<sub>2</sub>CrO<sub>4</sub> or KMnO<sub>4</sub>) in acidic solution.



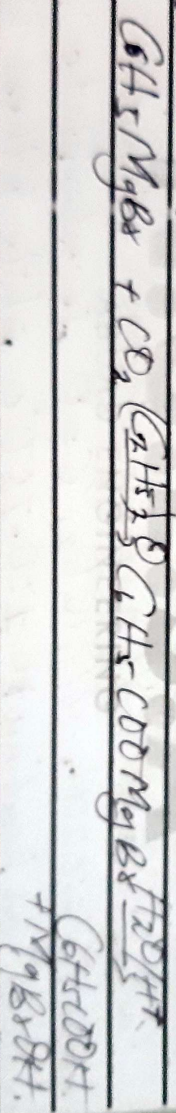
2. Carbonation of Grignard reagent

Aliphatic carboxylic acid are obtained by bubbling carbon (IV) oxide 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 (IV) oxide (dry ice) which also serves as coolant to the reaction mixture.



5 (i) Reduction to primary alcohols

Carboxylic acids are very often catalytic hydrogenation by diastereohydroxyamine (PPT) intermediate compounds will liberate the alcohol on hydrolysis  
 $4RCOOH + 8LiAlH_4 \rightarrow 4RCHO + 8LiOH$

$CH_3CH_2CH_2COOH \xrightarrow{LiAlH_4} CH_3CH_2CH_2OH$   
butanoic acid

(ii) Decarboxylation

This involves removal of the acid to give a hydrocarbon. Terminal decarboxylation

Carboxylic acid with a group e.g.  $-COOH$ ,  $-CN$ ,  $-I$  readily on heating to decarboxylate when soda lime.

$CH_3CH_2CH_2COONa + NaOH$

Kolbe synthesis

$2CH_3CH_2COONa + NaOH$

Esterification:

In the presence of strong acid catalyst, carboxylic acids react with alcohols to form esters

