- Decarboxylation

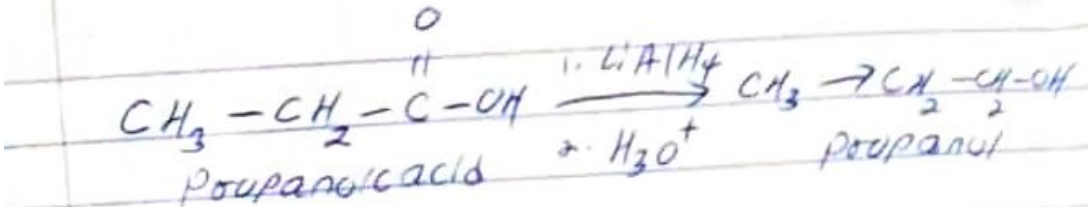
$CH_3CH_2CH_2COONa + NaOH \xrightarrow{\text{Fusion}} CH_3CH_2CH_3 + Na_2CO_3$

Electrolysis / aq. CH_3OH

$2CH_3CH_2COONa + 2H_2O \longrightarrow CH_3(CH_2)_2CH_3 + CO_2$ (Anode) $+ 2NaOH + H_2$ (Cathode)

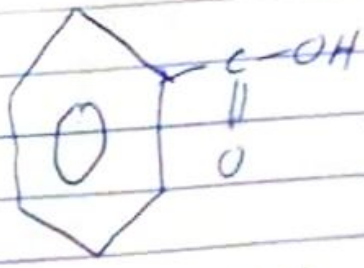
- Reduction of carboxylic acid

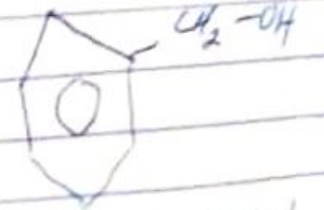
most reductions of carboxylic acids lead to the formation of primary alcohols. These reductions are normally carried out using a strong reducing agent, such as lithium aluminium hydride ($LiAlH_4$)

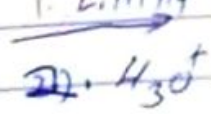


propanoic acid

propanol







benzoic acid

benzyl alcohol

oxidation of 5% solution of Ethanol to Ethanoic acid using manganese(II) Ethanoate catalyst. Ethanal itself is obtained from ethyne (acetylene)

Synthetic preparations

4) oxidation of primary alcohols and aldehydes

oxidation of primary alcohols and aldehydes can be used to prepare carboxylic acids using the oxidising agents (i.e $K_2Cr_2O_7$ or $KMnO_4$ in acid solution).

$$RCH_2OH \xrightarrow[K_2Cr_2O_7 \text{ or } KMnO_4]{[O],\ \text{Excess acid}} RCHO \xrightarrow{[O]} RCO$$

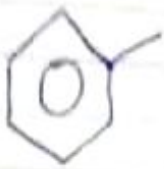
5) Hydrolysis of Nitriles (cyanides) or esters

$$RCN + 2H_2O \xrightarrow{H^+} RCOOH + NH_4^+$$

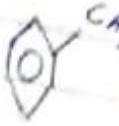
(R = alkyl or aryl radical)

$$RCOOR' \xrightarrow{H_2O/H^+} RCOOH + R'OH$$

Specific example:



$+ 2H_2O \xrightarrow{H^+}$



$CH_3CH_2COOCH_3 \xrightarrow[\text{reflux}]{H_2O/H^+} CH_3CH_2COOH +$

CH_3OH

5.) Esterification

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

$CH_3CH_2CH_2CO_2H + CH_3CH_2CH_2OH \overset{H^+}{\rightleftharpoons}$

$CH_3CH_2CH_2COOCH_2CH_2CH_3 + H_2O$

Propylbutanoate

$+ CH_3OH \rightleftharpoons$

$+ H_2O$

methylbenzoate

$CO \xrightarrow{NaOH} HCOONa \xrightarrow{H_2SO_4} HCOOH$

$CO \xrightarrow{NaOH} HCOONa \xrightarrow{H_2SO_4} HCOOH + Na_2SO_4$

methanoic acid

2.) From Ethanal

Ethanoic acid is obtained commercially by the liquid phase air-oxidation of 5% solution of Ethanal to Ethanoic acid using manganate(II) Ethanoate catalyst. Ethanal itself is obtained from Ethyne (acetylene)

ii) Boiling points

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

iii) Solubility

Lower molecular mass carboxylic acids, with up to four carbon atoms in their molecules are soluble in water; this is 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. Benzoic acid is only slightly soluble in cold water but readily dissolves in hot water. All carboxylic acids are soluble in organic solvents.

3.) INDustrial preparations

i) from carbon(ii) oxide

Methanoic (formic acid) is manufactured by adding carbon(II)oxide under pressure to hot ~~and~~ aqueous solution of sodium hydroxide. The free carboxylic acid is liberated by careful reaction with tetraoxosulphate(VI) acid (H_2SO_4)

1) Give IUPAC NAMES of the following compounds

i) $HCOOH$ = Methanoic acid (Formic acid)

ii) $HCOOCH_2CH_2CH_2COOH$ = Butane 1,4-dioic acid (succinic acid)

iii) $CH_3CH_2CH_2COOH$ = Butanoic acid

iv) HO_2C-CO_2H = Ethane dioic acid

v) $CH_3(CH_2)_4COOH$ = Hexanoic acid

vi) $CH_3CH=CHCH_2CH_2COOH$ = Hex-4-enoic acid.

2.) Physical appearances

All simple aliphatic carboxylic acids up to C_{10} are liquids at room temperature. Most other carboxylic acids are solid 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 (i.e 17°C)