oxidation of 5% solution of Ethanol to Ethanoic acid using manganate(VII) ion catalyst. Ethanol itself is obtained from ethylene (addition)

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).

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

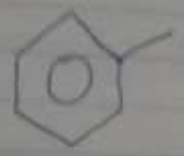
11) Hydrolysis of Nitriles (cyanides) or esters

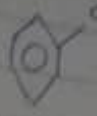
$$RCN + 2H_2O \xrightarrow{H^+} RCOOH + NH_4^+$$

(R = alkyl or aryl radical)

$$RCOOR' \xrightarrow[\text{reflux}]{H_2O/H^+} RCOOH + R'OH$$

Specific examples



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

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

CH_3OH

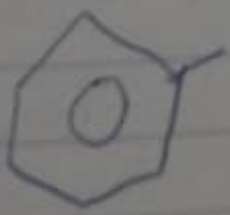
5.) Esterification

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

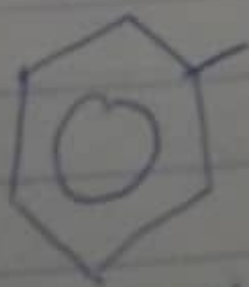
$CH_3CH_2CH_2CO_2H + CH_3CH_2CH_2OH \xrightleftharpoons{H^+}$

$CH_3CH_2CH_2COOCH_2CH_2CH_3 + H_2O$

Propylbutanoate



$+ CH_3OH \rightleftharpoons$



$+ H_2O$

methylbenzoate

- Decarboxylation

$CH_3CH_2CH_2COONa + NaOH \xrightarrow{\text{Fuse}}$

$CH_3CH_2CH_3 \dashrightarrow Na_2CO_3$

Electrolysis / aq. CH_3OH

$2CH_3CH_2COONa + 2H_2O \dashrightarrow$

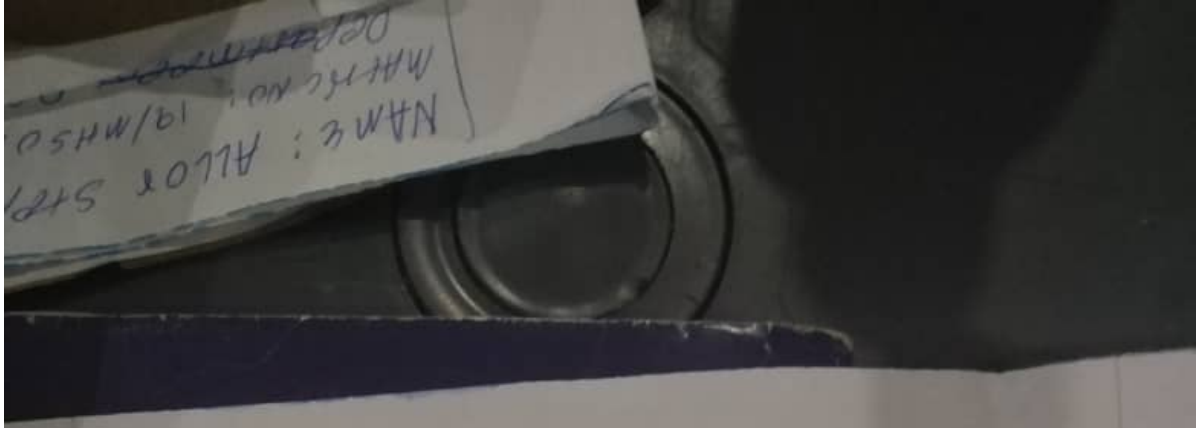
$CH_3(CH_2)_2CH_3 + CO_2$ (Anode) $+ 2NaOH + H_2$

(Cathode)

-

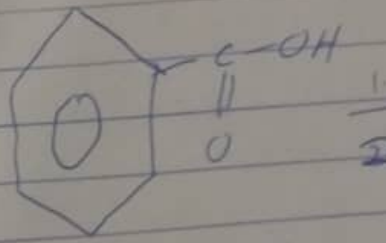
- Reduction of carboxylic acid

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



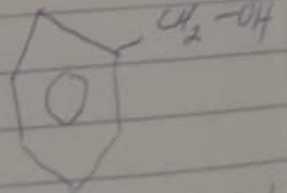
$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-OH \xrightarrow[2.\ H_3O^+]{1.\ LiAlH_4} CH_3-CH_2-CH_2-OH$

propanoic acid → propanol



benzoic acid

$\xrightarrow[2.\ H_3O^+]{1.\ LiAlH_4}$



benzyl alcohol

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

$CO \xrightarrow{NaOH} HCOONa \xrightarrow{H_2SO_4} HCOOH + NaHSO_4$

methanoic acid

2.) From Ethanol

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

ii) Boiling Points

Boiling point 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.

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)