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DEPT: PHARMACY

MAT NO: 19/MHS11/077

CHEM 102 ASSIGNMENT ON CARBOXYLIC ACIDS

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IUPAC NAMES FOR THE FOLLOWING COMPOUNDS

I, 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, $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH}$: HEX-4-ENE OIC ACID

VI, $\text{CH}_3[\text{CH}_2]_4\text{COOH}$: HEXANOIC ACID

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PHYSICAL PROPERTIES OF CARBOXYLIC ACIDS

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.

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.

Solubility

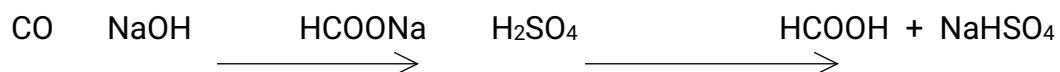
Lower molecular mass carboxylic acids with up to four carbon atoms in their molecules are soluble in water; this largely due to their ability to form hydrogen bonds with water molecules. The water solubility of the acids decreases as the relative molecular mass increases because the structure becomes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

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INDUSTRIAL PREPARATIONS

From Carbon(II) oxide

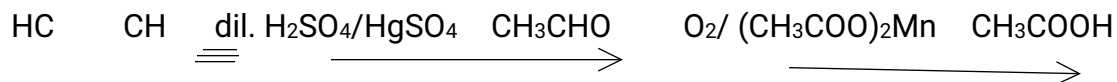
Methanoic acid (formic acid) is manufactured by adding carbon(II)oxide under pressure to hot aqueous solution of sodium hydroxide. The free carboxylic acid is liberated by careful reaction with tetraoxosulphate (vi) acid (H_2SO_4)



From ethanal

Ethanoic acid is obtained commercially by the liquid phase air-oxidation of 5% solution

of ethanal to ethanoic acid using manganite (II) ethanoate catalyst. Ethanal itself is obtained from ethylene



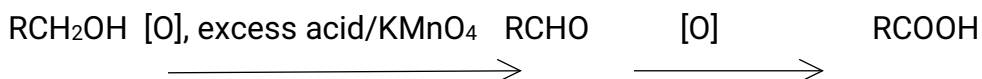
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SYNTHETIC PREPARATIONS OF CARBOXYLIC ACIDS

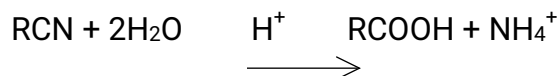
There are a lot of ways to prepare the carboxylic acid synthetically, but I will just state two briefly with the respective equations.

Oxidation of primary alcohols and aldehydes

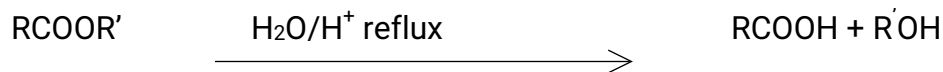
Oxidation of primary alcohols and aldehydes can be used to prepare carboxylic acids using the usual oxidizing agents (i.e $\text{K}_2\text{Cr}_2\text{O}_7$ or KMnO_4) in acidic solution



Hydrolysis of nitriles (cyanides) or esters



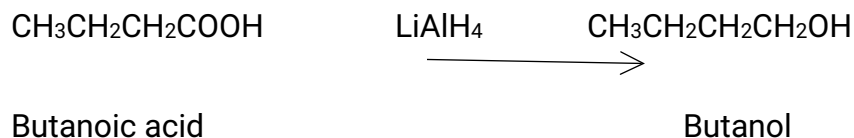
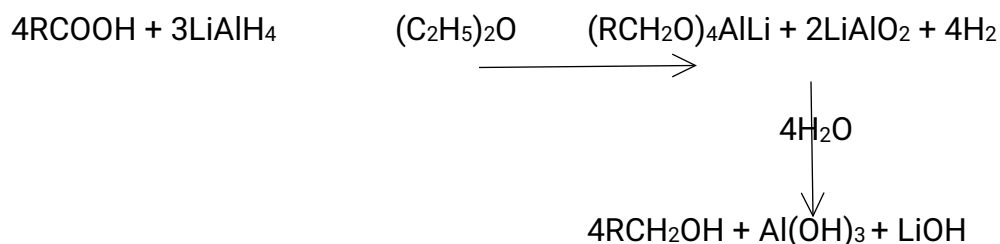
(R=alkyl or aryl radical)



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Reduction to primary alcohol

Carboxylic acids are very difficult to reduce by catalytic hydrogenation or dissolving metals but lithium tetrahydridoaluminate (III) and diborane form intermediate compounds with the acids which liberate the alcohol on hydrolysis

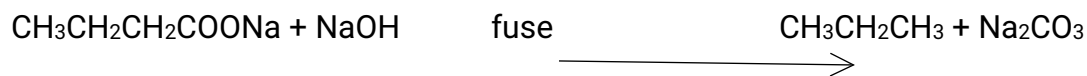


Decarboxylation

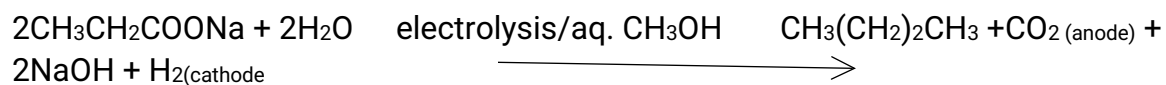
This involves removal of the carboxyl group from the acid to give a hydrocarbon or its derivatives.

Thermal decarboxylation

Carboxylic acids with a strong electron attracting group eg $-\text{COOH}$, $-\text{CN}$, NO_2 , $\text{C}=\text{O}$ decarboxylate readily on heating to $100\text{-}150^\circ\text{C}$ while others decarboxylate when their salts are heated with soda lime



Kolbe synthesis



Esterification

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

