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CHM 102

1. $HCOOH$ - Methanoic acid
$HOOCCH_2CH_2CH_2COOH$ - Pentan-1,5-dioic acid
$CH_3CH_2CH_2COOH$ - Butan-1-oic acid
HO_2C-CO_2H - Ethanedioic acid
$CH_3CH_2CH_2CH_2COOH$ - Hexanoic acid
$CH_2CH=CHCH_2CH_2COOH$ - Hex-4-enoic acid

2. PHYSICAL APPEARANCE
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

3. BOILING POINT
Boiling point increases with increasing relative molecular mass. Aromatic carboxylic acids are crystalline solids and have higher melting point than their aliphatic counterpart

4. 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

3) From ethanol
Ethanoic acid is obtained commercially by the liquid phase air-oxidation of 5% solution of ethanol to ethanoic acid using manganese (II) ethanoate as a catalyst

$RCH_2OH \xrightarrow[\text{heating}]{[O]} RCHO \xrightarrow{[O]} RCOOH$

From Carbon (II) oxide
Methanoic 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 concentrated sulphuric acid H_2SO_4

$CO \xrightarrow{NaOH} HCOO^-Na^+ \xrightarrow{H_2SO_4} HCOOH + NaHSO_4$

4) Oxidation of primary alcohols and aldehydes
It can be used to prepare carboxylic acids using the usual oxidizing agents (i.e $K_2Cr_2O_7$ or $KMnO_4$) in acidic solution

$RCH_2OH \xrightarrow[\text{heating}]{[O]} RCHO \xrightarrow{[O]} RCOOH$

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

$C_2H_5MgBr + CO_2 \xrightarrow{\text{dry } Et_2O} C_2H_5COOMgBr \xrightarrow{H_3O^+} C_2H_5COOH + Mg(OH)Br$

5) Reduction
$CH_3CH_2CH_2COOH \xrightarrow{LiAlH_4} CH_3CH_2CH_2CH_2OH$
Butanoic acid → Butanol

Decarboxylation
$CH_3CH_2CH_2COO^-Na^+ + NaOH \xrightarrow{\text{fuse}} CH_3CH_2CH_3 + Na_2CO_3$

Esterification
$CH_3CH_2CH_2COOH + CH_3CH_2CH_2CH_2OH \xrightarrow{H^+} CH_3CH_2CH_2COOCH_2CH_2CH_3 + H_2O$