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19/ENG04/1046
CHM102

1) a) $HCOOH$ – Methanoic Acid
b) $CH_3CH_2CH_2COOH$ – Butanoic acid
c) HO_2C-CO_2H – Ethanedioic acid
d) $CH_3(CH_2)_4COOH$ – Hexanoic acid
e) $CH_3CH=CHCH_2CH_2COOH$ – Hex-4-enoic Acid

2) a) Physical appearance: Simple carboxylic's up to C_{10} are liquid at room temperature. Most carboxylic's are solid at room temperature although anhydrous carboxylic's also known as glacial ethanoic acid freezes to an ice-like solid below the room temperature.
b) Boiling Point; The 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
c) Solubility; Lower molecular mass carboxylic acids with up to four carbon atoms in their molecules are soluble in water; this is largely due to the ability to form hydrogen bonds with water molecules. The solubility in water decreases with an increase in the molecular mass. All carboxylic's are soluble in organic solvents.

3) a) 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 tetraoxosulphate (VI) acid (H_2SO_4)

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

b) From petroleum.
Liquid phase air oxidation of C_5-C_7 alkanes, obtainable from petroleum at high temperature and pressure will give C_5-C_7 carboxylic acids with methanoic, propanoic and butanedioic acids as by-products.

$$C_5-C_7 \xrightarrow{O_2 \text{ high temp. and pressure}} C_5-C_7 \text{ Carboxylic acids.}$$

4) a) By the Oxidation of primary alcohols and aldehydes.
The oxidation of primary alcohols and aldehydes can be used to prepare carboxylic acids using the usual oxidizing agents in acidic solution.

$$RCH_2OH + [O] \xrightarrow{\text{Excess acid/KMnO}_4} RCHO \xrightarrow{[O]} RCOOH.$$

5) a) Reduction of Primary Alcohols:

$$4RCOOH + 3LiAlH_4 \xrightarrow{(C_2H_5)_2O} (RCH_2O)_4AlLi + 2LiAlO_2 + 4H_2$$
$$\downarrow 4H_2O$$
$$4RCH_2OH + Al(OH)_3 + LiOH$$

$CH_3CH_2CH_2COOH \xrightarrow{LiAlH_4} CH_3CH_2CH_2CH_2OH$
Butanoic Acid → Butanol

b) Decarboxylation.

$CH_3CH_2CH_2COONa + NaOH \xrightarrow{fuse} CH_3CH_2CH_3 + Na_2CO_3$

kolbe Synthesis.

$2CH_3CH_2COONa + 2H_2O \xrightarrow{Electrolysis/aq\,CH_3OH} CH_3(CH_2)_2CH_3 + CO_2 + 2NaOH + H_2$ (cathode)

c) Esterification

$CH_3CH_2CH_2COOH + CH_3CH_2CH_2OH \xleftrightarrow{H^+} CH_3CH_2CH_2COOC-H_2CH_2CH_3 + H_2O.$