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Chm102

1) $HCOOH$ → Methanoic acid
$HOOCCH_2CH_2CH_2COOH$ → Pentan-1, 5-dioic acid
$CH_3CH_2CH_2COOH$ → Butanoic acid
HO_2C-CO_2H → Ethanedioic acid
$CH_3(CH_2)_4COOH$ → Hexanoic acid
~~$CH_3(CH_2)_4COOH$~~ $CH_3CH=CHCH_2CH_2COOH$ → Hex-4-enoic acid

2) Physical Appearance
All simple aliphatic carboxylic acids up to C_{10} are liquids at room temperature although most other carboxylic acid (~~acetic acid~~) ~~also~~ are solid at room temperature, anhydrous carboxylic acid (acetic acid) also known as glacial ethanoic acid freezes to an ice-like solid below the room temperature

- Boiling Point
This increases with increasing relative molecular mass. Aromatic carboxylic acids are crystaline solid and have higher melting points than their aliphatic counterparts of comparable relative molecular mass

- Solubility
Lower molecular mass carboxylic acid (with up to four Carbon in their molecules to the answer) are soluble in water, this largely due to form hydrogen bonds with water molecules The water solubility of the acids decrease as the relative molecular mass increase because the structure becomes relatively more hydrocarbon in nature and hence covalent. All carboxylic acids are soluble in organic solvents

3)- From Petroleum:

Liquid Phase air oxidation of C_5-C_7 alkanes, obtainable from petroleum of high temperature and pressure will give C_5-C_7 Carboxylic acid with methanoic, propanic and butanedioic acid as by-products

$$C_5\text{-}C_7 \xrightarrow{O_2/\text{high temperature and Pressure}} C_5\text{-}C_7 \text{ Carboxylic acid}$$

- From Ethanol

Ethanoic acid is obtained commercially by the liquid phase air-oxidation of 35% Solution of ethanal to ethanoic acid using manganese(II) ethanoate catalyst. Ethanal today is obtained from ethyne

$$HC\equiv CH \xrightarrow{dil.\ H_2SO_4/HgSO_4} CH_3CHO \xrightarrow{O_2/(CH_3COO)_2Mn} CH_3COOH$$

4) Hydrolysis of nitriles (cyanides) or esters

$$RCN + 2H_2O \xrightarrow{H^+} RCOOH + NH_4^+$$
$$RCOOR \xrightarrow{H_2O/H^+\text{ reflux}} RCOOH + R^2OH$$
$$C_6H_5CH_2CN + 2H_2O \xrightarrow{H^+} C_6H_5CH_2COOH + NH_4^+$$
$$CH_3CH_2COOCH_3 \xrightarrow{H_2O/H^+\text{ reflux}} CH_3CH_2COOH + CH_3OH$$

R = alkyl

5) Reduction

$$4RCOOH + 3LiAlH_4 \xrightarrow{(C_2H_5)_2O} (RCH_2O)_4AlLi + 2Li_2AlO_2 + 4H_2$$
$$\downarrow 4H_2O$$
$$4RCH_2OH + Al(OH)_3 + LiOH$$

$$CH_3CH_2CH_2COOH \xrightarrow{LiAlH_4} CH_3CH_2CH_2CH_2OH$$

Butanoic acid — Butanol

- Decarboxylation

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

Kolbe synthesis

$$2CH_3CH_2COONa + 2H_2O \xrightarrow{\text{Electrolysis}/\ CH_3OH} CH_3(CH_2)CH_3 + CO_2 + 2NaOH + H_2$$

- Esterification

$$CH_3CH_2CH_2COOH + CH_3CH_2CH_2OH \xleftrightarrow{H^+} CH_3CH_2CH_2COOCH_2CH_2CH_2 + H_2O$$