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Assignment On Carboxylic acid

1a. $HCOOH$ — Methanoic acid

b. $HOOCCH_2CH_2CH_2COOH$ — Pentan-1,5-dioic acid

c. HO_2C-CO_2H — Ethanedioic acid

d. $CH_3CH_2CH_2COOH$ - Butanoic acid

e. $CH_3(CH_2)_4COOH$ - Hexanoic acid

f. $CH_3CH=CHCH_2CH_2COOH$ — Hex-4-enoic acid

2. Physical Properties of Carboxylic Acids

i) 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.

ii) Boiling Points: This 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 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. Industrial Preparation Of Carboxylic Acid.

(i) 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 H_2SO_4

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

(ii) 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 catalyst. Ethanal itself is obtained from ethylene.

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

4. Synthetic Preparation Of Carboxylic Acid.

(i) Oxidation Of Primary Alcohols and Aldehydes : Oxidation of primary alcohols and aldehydes can be used to prepare carboxylic acids using the usual oxidising agents (i.e $K_2Cr_2O_7$ or $KMnO_4$) in acid solution

$$RCH_2OH \xrightarrow{[O]\ excess\ acid / KMnO_4} RCHO \xrightarrow{[O]} RCOOH$$

5.

i) Reduction to Primary alcohol

$$4RCOOH + 3LiAlH_4 \xrightarrow{(C_2H_5)_2O} (RCH_2O)_2AlLi + 2LiAlO_2 + 4H_2$$

$$\downarrow 4H_2O$$

$$4RCH_2OH + Al(OH)_3 + LiOH$$

$$CH_3CH_2CH_2COOH \xrightarrow{LiAlH_4} CH_3CH_2CH_2CH_2OH$$

Butanoic acid — Butanol

ii) Decarboxylation

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

Kolbe synthesis

$$2CH_3CH_2COONa + 2H_2O \xrightarrow{\text{electrolysis } CH_3OH} CH_3(CH_2)_2CH_3 + CO_{2(anode)} + 2NaOH + H_{2(cathode)}$$

iii) Esterification

$$CH_3CH_2CH_2COOH + CH_3CH_2CH_2OH \xrightarrow{H^+} CH_3CH_2CH_2COOCH_2CH_2CH_3 + H_2O$$