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Assignment

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
$CH_3CH=CHCH_2CH_2COOH$ → hex-4-enoic acid

2) i) Physical Appearance
All simple aliphatic carboxylic acids up to C_{10} are liquids at room temperature. Most others are solid at room temperature.

ii) Boiling Points
Their boiling points increases with increasing relative molecular mass.

iii) Solubility
Lower molecular mass carboxylic acids with up to four carbon atoms in their molecule are soluble in water. The water solubility of the acids decrease with increase in relative molecular mass. All carboxylic acids are soluble in organic solvent.

3) Industrial Preparations of Carboxylic Acids
i) From ~~Ethanol~~ Ethanol
Ethanoic acid is obtained commercially by the liquid phase air oxidation of 5% solution of ethanal to ethanoic acid using (II) ethanoate catalyst

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

ii) 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 H_2SO_4

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

4) Synthetic Preparations of Carboxylic Acid

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

$$CH_3CH_2OH \xrightarrow{[O]\ excess\ KMnO_4} CH_3CHO \xrightarrow{[O]} CH_3COOH$$

5) ~~Reduction~~

~~$CH_3COOH + LiAlH_4$~~

~~$\downarrow (C_2H_5$~~

5) i) Reduction

$$CH_3CH_2COOH \xrightarrow{LiAlH_4} CH_3CH_2CH_2OH$$

propanoic acid → propanol

ii) Decarboxylation

$$HO-\overset{O}{\overset{\|}{C}}-CH_2-\overset{O}{\overset{\|}{C}}-OH \xrightarrow{heat} HO-\overset{O}{\overset{\|}{C}}-CH_2-H + CO_2$$

malonic acid

iii) Esterification

$$CH_3CH_2COOH + CH_3CH_2OH \longrightarrow$$

$$\updownarrow H^+$$

$$CH_3CH_2COOCH_2CH_3 + H_2O$$