19/ENG05/054 MECHATRONICS ENGINEERING

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CHM 102 // Carboxylic acid

1.) $HCOOH$ $HOOCCH_2CH_2CH_2COOH$

Methanoic acid Pentan-1,5-dioic acid

$CH_3CH_2CH_2COOH$ HO_2C-CO_2H

Butanoic acid Ethan-1,2-dioic acid

$CH_3(CH_2)_4COOH$ $CH_3CH=CHCH_2CH_2COOH$

Hexanoic acid Hex-4-eneoic acid

2) i) Physical Properties

All simple aliphatic carboxylic acids up to C_{10} are liquids at room temperature, while most others are solids at room temperature. Although, anhydrous carboxylic acid freezes to an ice-like solid below the room temperature.

ii) Boiling point

Their boiling points increase with increasing relative atomic mass

iii) Solubility

Carboxylic acids with four or less carbon atoms are soluble in water because they form hydrogen bonds with water molecules, but their solubility decreases as molecular mass increases. All carboxylic acids are soluble in organic solvents.

3) i) $CO \xrightarrow{NAOH} HCOONa \xrightarrow{H_2SO_4} HCOOH + NaHSO_4$

ii) $C_5-C_7 \xrightarrow{O_2/\text{High tp and P}} C_5-C_7$ carboxylic acids

4) Carboxylic acid can be prepared synthetically by the oxidation of primary alcohols and aldehydes, using the usual oxidizing agents ($K_2Cr_2O_7$ or $KMnO_4$) in acidic solution.

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

5) Reduction

$$4RCOOH + 3LiAlH_4 \xrightarrow{(C_2H_5)_2O} (RCH_2O)_4AlLi + 2LiAlO_2 + 4H_2$$

$$\downarrow + 4H_2O$$

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

$$CH_3CH_2CH_2COOH \xrightarrow{LiAlH_4} CH_3CH_2CH_2CH_2OH$$

Decarboxylation

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

$$2CH_3CH_2COONa + 2H_2O \xrightarrow{\text{electrolysis}/aq.CH_3OH} CH_3(CH_2)_2CH_3 + CO_2 + 2NaOH + H_2$$

Esterification

$$CH_3CH_2CH_2COOH + CH_3CH_2CH_2OH \overset{H^+}{\rightleftharpoons} CH_3CH_2CH_2COOCH_2CH_2CH_3 + H_2O$$