ANUGWU FRANKLIN CHIEMERIE
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MBBS

Assignment CHEM 102

1] Give the IUPAC Names of the following compounds

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

2] Discuss briefly the physical properties of carboxylic acids under the following headings

i] Physical Change

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 freezes to an ice-like solid below the room temperature.

ii] 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.

iii] Solubility

Lower molecular mass carboxylic acids with up to four carbon atoms in their molecules are soluble in water. The water solubility of the acids decreases as the relative molecular mass increases. All organic carboxylic acids are soluble in ~~water~~ organic solvents.

3] Write 2 industrial preparations of carboxylic acids.

I. From Carbon(II) oxide

Methanoic acid is manufactured by adding carbon(II) oxide under pressure to ~~hot~~ an aqueous solution of sodium hydroxide. The free carboxylic acid is liberated by careful reaction with tetraoxosulphate(VI) acid

- From ethanal

Ethanoic acid is obtained commercially by the liquid phase air-oxidation of 5% solution of ethanal to ethanoic acid using manganese(II) ethanoate catalyst. Ethanal itself is obtained from ethylene.

4] With equations and brief explanation, discuss the synthetic preparation of carboxylic acid

- Oxidation of primary alcohols and aldehydes can be used to prepare carboxylic acids using the usual oxidizing agents (i.e $K_2Cr_2O_7$ or $KMnO_4$) in acidic solution.

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

- Hydrolysis of nitriles (cyanides) or esters

$$RCN \xrightarrow{2H_2O} \xrightarrow{H^+} RCOOH + NH_4^+$$

$$RCOOR' \xrightarrow{H_2O/H^+ \text{ reflux}} RCOOH + R'OH$$

$$C_6H_5CH_2CN + 2H_2O \xrightarrow{H^+} C_6H_5CH_2COOH + NH_4^+$$

$$CH_3CH_2COOCH_3 \xrightarrow{H_2O/H^+ \text{ reflux}} CH_3CH_2COOH + CH_3OH$$

5] With chemical equation only, outline the reduction, decarboxylation and esterification of carboxylic acid

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

$$\downarrow$$

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

$$CH_3CH_2CH_2COOH \xrightarrow{LiAlH_4} CH_3CH_2CH_2CH_2OH$$

butanoic acid → butanol

Reduction

- Decarboxylation

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

Kolbe synthesis

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

- Esterification