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NURSING

19/MHS02/101

CHM102 ASSIGNMENT

1.) The IUPAC names of the following compounds

a. $HCOOH$

methanoic acid

b $HOOCCH_2CH_2CH_2COOH$

Pentan-1,5,-dioic acid

c $CH_3CH_2CH_2COOH$

Butanoic acid

d HO_2C-CO_2H

Ethanedioic acid

e $CH_3(CH_2)_4COOH$

Hexanoic acid

f. $CH_3CH=CHCH_2CH_2COOH$

Hex-4-eneoic acid

2. Physical Properties of carboxylic acid

i Physical appearance :-

All simple aliphatic carboxylic acids up to C10 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 :-

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, 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. All carboxylic acids are soluble in organic solvents

3. Industrial Preparation of Carboxylic acid.

a. 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 tetraoxosulphate (vi) acid (H_2SO_4)

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

b) 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) Oxidization of primary alcohols and aldehydes can be used to prepare carboxylic acids using the usual oxidizing agents in acidic solution

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

* Carbonation of Grignard reagent. We can obtain Aliphatic carboxylic acid by bubbling carbon(iv) oxid into grignard reagent and the hydrolyzed with dilute acid

$$RMgBr + CO_2 \xrightarrow{(C_2H_5)_2O} RCOOMgBr \xrightarrow{H_2O/\text{dil acid}} RCOOH + MgBrOH$$

R may be 1°, 2°, 3° aliphatic alkyl or acyl radical.

In Preparing benzoic acid, the reagent is added to solid carbon(iv) oxide (dry ice) which also serves as coolant to the reaction mixture.

$$C_6H_5MgBr + CO_2 \xrightarrow{(C_2H_5)_2O} C_6H_5COOMgBr \xrightarrow{H_2O/H^+} C_6H_5COOH + MgBrOH$$

* Hydrolysis of nitriles (Cyanides) or esters

$$RCN + 2H_2O \xrightarrow{H^+} RCOOH + NH_4^+ \quad (R = \text{alkyl or aryl radical})$$

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

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

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

5i) Reduction

$$4RCOOH + 3LiAlH_4 \xrightarrow{(C_2H_5)_2O} (RCH_2O)_4AlLiAlO_2 + 4H_2$$

$$\downarrow 4H_2O$$

$$4RCH_2OH + AlCO(H)_3 + LiOH$$

$$CH_3CH_2CH_2COOH \xrightarrow{LiAlH_4} CH_3CH_2CH_2CH_2OH$$

Butanoic acid — Butanol

ii) Decarboxylation

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

Kolbe synthesis

$$2CH_3CH_2COONa + 2H_2O \xrightarrow[CH_3OH]{electrolysis} CH_3(CH_2)_2CH_3 + CO_2 (anode) + 2NaOH + H_2 (cathode)$$

iii) Esterification

$$CH_3CH_2CH_2COOH + CH_3CH_2CH_2OH \xleftrightarrow{H} CH_3CH_2CH_2COOCH_2CH_2CH_3 + H_2O$$