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CHM 102

Assignment

1. Give the IUPAC names of the following compounds
   a. $HCOOH$
   b. $HOOCCH_2CH_2CH_2COOH$
   c. $CH_3CH_2CH_2COOH$
   d. $HO_2C\text{-}CO_2H$
   e. $CH_3(CH_2)_4COOH$
   f. $CH_3CH=CHCH_2CH_2COOH$

a. $HCOOH$ → Methanoic acid
b. $HOOCCH_2CH_2CH_2COOH$ → Pentan-1,5-dioic acid
c. $CH_3CH_2CH_2COOH$ → Butanoic acid
d. $HO_2C\text{-}CO_2H$ → Ethanedioic acid
e. $CH_3(CH_2)_4COOH$ → Hexanoic acid
f. $CH_3CH=CHCH_2CH_2COOH$ → Hex-4-enoic acid

2. Discuss briefly the physical properties of carboxylic acids under the following headings
   i. Physical appearance
   ii. Boiling point
   iii. solubility

I ~~PHYSICAL APPEARANCE~~

~~At room temperature, ethers are colourless, neutral liquids~~

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 carboxylic acid (acetic acid) also known as glacial ethanoic acid freezes to ice-like solid below the room temperature

II BOILING POINTS

The boiling point increases with increasing relative molecular mass Aromatic carboxylic Acids are crystalline solids and have higher melting points than their aliphatic counter parts 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 insolent All carboxylic acids are soluble in organic solvents

3) Write two industrial preparations of carboxylic acid

a) From carbon (II) oxide
b) From ethanol

4) With equations and briefly explanation discuss the synthetic preparation of carboxylic acid

a) Oxidation of primary alcohols and aldehydes:-
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.

$RCH_2OH \rightarrow RCHO \rightarrow RCOOH$

b) Carbonation of Grignard reagent:-
Aliphatic carboxylic acids are obtained by bubbling carbon (IV) oxide into the Grignard reagent and then hydrolyzed with dilute acid

$RMgBr + CO_2 \rightarrow RCOOMgBr \rightarrow RCOOH + Mg(Br)OH$

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

c) Hydrolysis of nitriles (cyanides) or esters
They are organic molecules containing a cyano group which leads to the preparation of carboxylic acids.

$RCN + 2H_2O \xrightarrow{H^+} RCOOH + NH_3$

5. Write chemical equations only, to show the reduction, decarboxylation and esterification of carboxylic acid

a. REDUCTION

$$4RCOOH + 3LiAlH_4 \xrightarrow{(C_2H_5)_2O} (RCH_2O)_4AlLi + 2Li_2O + 4H_2$$

$$(RCH_2O)_4AlLi \xrightarrow{+4H_2O} 4RCH_2OH + Al(OH)_3 + LiOH$$

EXAMPLE

$$CH_3CH_2CH_2COOH \xrightarrow{LiAlH_4} CH_3CH_2CH_2CH_2OH$$

Butanoic acid — Butanol

b. DECARBOXYLATION

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

c. ESTERIFICATION

$$CH_3CH_2CH_2COOH + CH_3CH_2CH_2OH \xrightarrow{H^+} CH_3CH_2CH_2COO$$
$$CH_2CH_2CH_3 + H_2O$$