Carboxylic acids

Chemistry 102 Assignment

Name: Victor Obi Chigozie Noble

Department: Medicine & Surgery

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1. Give the IUPAC names of the following compounds

Organic Compounds	IUPAC name
$HCOOH$	Methanoic acid
$HOOCCH_2CH_2CH_2COOH$	Pent-1,5-dioic acid
$CH_3CH_2CH_2COOH$	Butanoic acid
HO_2C-CO_2H	Ethane dioic acid
$CH_3CH_2)_4COOH$	Hexanoic acid
$CH_3CH=CHCH_2CH_2COOH$	Hex-4-enoic acid

2 Discuss briefly the physical properties of carboxylic acids under

(i) Physical Appearance: Simple Aliphatic carboxylic acids up to C_9 are liquids at room temp. Other carboxylic acids are solid at room temp excluding acetic acid which freezes to ice-like solid below room temp

(ii) Boiling Points: It increases with RMM. Aromatic carboxylic acids are crystalline solids and have higher melting points

(iii) Solubility: lower molecular mass carboxylic acids with up to four carbon atoms are soluble in water. The water solubility of acids decreases as RMM increases because the become hydrocarbon in nature. Therefore all carboxylic acid s are solublem organic solvents

3 Write 2 industrial preparation of carboxylic acid

1 From CO

Methanoic acid is prepared by adding CO under pressure to hot solution of Sodium hydroxide ($NaOH$). The free carboxylic acid is liberated by careful reaction with H_2SO_4

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

II From Ethanal:

Ethanoic acid is obtained by liquid phase air-oxidation of 5% ethanol to ethanoic acid using magnetite II ethanoate catalyst. Ethanol is gotten from ethylene

$$HC\equiv CH \xrightarrow[dil\ H_2SO_4]{} CH_3CHO \xrightarrow{O_2/(CH_3COO)_2} CH_3COOH$$

8 With equation and brief explanation discuss the synthetic preparation of carboxylic acid

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

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

5 With Chemical equation only outline the reduction, decarboxylation and Esterification of carboxylic acid.

Soln

(i) Reduction to Primary alcohol.

$4RCOOH + 3LiAlH_4 \xrightarrow[\text{ethoxyethane}]{(C_2H_5)_2O} (RCH_2O)_4AlLi + 2LiAlO_2 + 4H_2 + 4H_2O$

$\downarrow$

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

E.g $CH_3CH_2CH_2COOH \xrightarrow{LiAlH_4} CH_3CH_2CH_2CH_2OH$

Butanoic acid

(ii) Decarboxylation

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

Kolbe synthesis

(iii) Esterification

$CH_3CH_2CH_2COOH + C_3H_7OH \xrightleftharpoons{H^+} CH_3CH_2CH_2COOC_3H_7 + H_2O$

Propyl ethanoate