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19/mhs01/175
CARBOXYLIC ACID ASSIGNMENT:

A

1.	$HCOOH$	Methanoic acid
2	$HOOCCH_2CH_2CH_2COOH$	pentan-1, 5-dioic acid
3	$CH_3CH_2CH_2COOH$	Butanoic acid
4	HO_2C-CO_2H	Ethanedioic acid
5	$CH_3(CH_2)_4COOH$	Hexanoic acid
6	$CH_3CH=CHCH_2CH_2COOH$	Hex-4-enoic acid

B Physical appearance of carboxylic acid:

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

Boiling point: The 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.

Solubility: lower molecular mass carboxylic acids with up to four carbon atom 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 decrease as the relative molecular mass increases because the structure becomes relatively more hydrocarbon in nature and hence covalent. All carboxylic acids are soluble in water.

C Industrial preparation of carboxylic acid.

1. From carbon (II) oxide:

2. CARBONATION OF GRIGNARD REAGENT

Aliphatic Carboxylic acids are obtained by bubbling Carbon (IV) oxide into the Grignard reagent and then hydrolyzed with dilute acid.

$RMgBr + CO_2 \xrightarrow{(C_2H_5)_2O} RCOOMgBr \xrightarrow{H_2O/H^+} RCOOH + MgBrOH$

N/B: R mg be 1°, 2°, 3°, aliphatic alkyl or aryl radical

In the Preparation of benzoic acid the reagent is added to Solid Carbon (IV) oxide (dry ice) which also Serves as coolant to the reaction mixture

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

3. HYDROLYSIS OF NITRILES (CYANIDES) or ESTERS.

Nitriles undergo hydrolysis to form amides - the amides further undergo reaction in the presence of the Catalyst which then to form:

C

Carboxylic acids. the Catalyst for this reaction is H^+ or OH^- further more, application of mild reaction Condition helpes in ceasing the reaction in the amide stage

$RCN + 2H_2O \xrightarrow{H^+} RCOOH + NH^+_4$

(R = alkyl or aryl radical)

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

$C_6H_5CH_2CN + 2H_2O \xrightarrow{H^+} C_6H_5CH_2COOH + NH^+_4$

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

5. With chemical equation only, outline the reduction, decarboxylation and esteritication of Carboxylic acid

CHEMICAL REACTIONS

1. REDUCTION TO PRIMARY ALCOHOL

$4RCOOH + 3LiAlH_4 \xrightarrow{(C_2H_5)_2O} (RCH_2O)_4AlLi + AlO_2 + 4H_2$

Methanoic acid (formic acid) is manufactured by adding (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)

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

FROM PETROLEUM

liquid phase air oxidation of C_5-C_7 alkanes, obtainable Petroleum at high temperature and pressure will give C_5-C_7 carboxylic acid with methanoic, propanoic and butanedioic acids as by products.

$$\underset{(alkanes)}{C_5-C_7} \xrightarrow{O_2 \text{ / High temp and pressure}} C_5-C_7\text{-carboxylic acids}$$

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

SYNTHETIC PREPARATION OF CARBOXYLIC ACID

i OXIDATION OF PRIMARY ALCOHOLS AND ALDEHYDES

Oxidation of primary alcohols and aldehyde can be used to prepare carboxylic acids using the usual oxidizing agents (i.e $K_2Cr_2O_7$ (potassium dichromate (vi)) or $KMnO_4$ (potassium manganate (vii)) in acidic solution

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

Examples: Oxidation of Ethanol to Ethanoic acid:

$$CH_3CH_2OH + [O] \longrightarrow CH_3CHO + H_2O$$

$$CH_3CHO + [O] \longrightarrow CH$$

$\downarrow 4H_2O$

$4R(CH_2OH) + Al(OH)_3 + LiOH$

$CH_3CH_2CH_2COOH \xrightarrow{LiAlH_4} CH_3CH_2CH_2CH_2OH$

i. DECARBOXYLATION

$CH_3CH_2CH_2COONa + NaO \xrightarrow{fuse} CH_3CH_2CH_3 + Na_2C$

Kolbe Synthesis

$2CH_3CH_2COONa + 2H_2O \xrightarrow{electrolysis/aq.\ CH_3OH} CH_3CH$
$+ CO_2(g)$
$+ 2NaO$
$+ H_2(g)$

3. ESTERIFICATION

$CH_3CH_2CH_2COON + CH_3CH_2CH_2OH \xrightarrow{H^+} CH_3CH_2CH_2COOCH_2$
$+ H_2O$