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**CHEMISTRY ASSIGNMENT ON CARBOXYLIC ACID.**

1. HCOOH ( Methanoic Acid)

b) HOOCCH2CH2CH2COOH( Pentan-1,5-dioc Acid)

c) CH3CH2CH2COOH( Butan-1-dioc Acid)

d) HO2CCO2H ( Ethanedioc Acid)

e) CH3(CH2)4COOH( Hexanoic Acid)

f) CH3CH=CHCH2CH2COOH( Hex-4-eneoic Acid)

2. **Properties of Carboxylic Acid under the following;**

i) **Physical Appearance**:

All simple aliphatic Carboxylic Acid up to C10 are liquid 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-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 then 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 easily. The water solubility of these acids decrease with increase in molecular mass as the structure becomes more relatively more hydrocarbon in nature and hence covalent. All Carboxylic Acids are soluble in organic solvents .

**3. Industrial Preparations of Carboxylic Acids are;**

a) From Carbon(ii)oxide

Methanoic Acid( formic acid) is manufactured by adding Carbon(ii)oxide under pressure to hot

Aqueous solution of Sodium Hydroxide( NaOH). The free carboxylic Acid is liberated by careful

reaction with tetraoxosulphate(vi) acid (H2SO4)

CO NaOH HCOONa H2SO4 HCOOH + NaHSO4

b) From ethanal

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

HC≡CH dil. H2SO4 / H2SO4  CH3CHO O2 / (CH3COO)2 Mn  CH3COOH

4. SYNTHETIC PREPARATIONS 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 the usual oxidizing agents(i.e. K2Cr2O7 or KMnO4) in acidic solution.

RCH2OH [O] excess acid/KMnO4 RCHO [O] 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 + CO2  (C2H5)2O RCOOMgBr H20/dil. acid RCOOH + MgBrOH

R may be 1⁰, 2⁰, 3⁰ 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 a coolant to the reaction mixture.

C6H5MgBr + CO2 (C2H5)2O  C6H5COOMgBr H2O/H+ C6H5COOH + MgBrOH

c) Hydrolysis of nitriles (cyanides) or esters

RCN + 2H2O H+  RCOOH + NH4+

(R=alkyl or aryl radical)

RCOOR’ H2O/H+ reflux RCOOH+ R’OH

C6H5CH2CN + 2H2O H+  C6H5CH2COOH + NH4+

CH3CH2COOCH3  H2O/H+ reflux CH3CH2COOH +CH3OH

5) Chemical Reactions involving Carboxylic Acids;

a) Reduction to primary alcohol: Carboxylic Acids can be reduced to primary alkanols, using lithium tetrahydridoaluminate(iii) and diborane form intermediate compounds with the acids which liberate the alcohol on hydrolysis

4RCOOH + 3LiAlH4 (C2H5)2O   (RCH2O)4Ali +2LiALO2 + 4H2

4H2O

4RCH2OH + Al(OH)3 + LiOH

CH3CH2CH2COOH LiALH4 CH3CH2CH2CH2OH

Butanoic Acid Butanol

b) Decarboxylation: This involves removal of the carboxyl group from the acid to give a hydrocarbon or its derivative.

Thermal decarboxylation

Carboxylic acids with a strong electron attracting group e.g. –COOH, -CN,NO2, C=O decarboxylate readily on heating to 100-150oC while others decarboxylate when their salts are heated with soda lime.

CH3CH2CH2COONa + NaOH  fuse CH3CH2CH3 + Na2CO3

Kolbe Synthesis

2CH3CH2COONa + 2H2O  electrolysis/aq. CH3OH  CH3(CH2)2CH3 +CO2 (anode) + 2NaOH + H2(cathode)

c) Esterification: In the presence of strong acid catalyst, carboxylic acids react with alcohols to form esters

CH3CH2CH2COOH + CH3CH2CH2OH H+  CH3CH2CH2COO CH2CH2CH3 + H2O.