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**ASSIGNMENT ON CARBOXYLIC ACIDS**

1. Give the IUPAC names of the following compounds:

HCOOH – Methanoic acid.

HOOCCH2CH2CH2COOH – Pentan-1,5-dioic acid.

CH3CH2CH2COOH – Butanoic acid.

HO2C-CO2H – Ethan-1,2-dioic acid or ethanedioic acid.

CH3(CH2)4COOH – Hexanoic acid.

CH3CH=CHCH2CH2COOH – Hex-4-eneoic acid.

1. Discuss briefly the physical properties of carboxylic acids under the following headings:
2. **Physical appearance**: All simple aliphatic carboxylic acids up to C10 are liquids at room temperature. Most other carboxylic acids are solids 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.
3. **Boiling point**: 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.
4. **Solubility**: Lower molecular mass carboxylic acids with up to four carbon atoms in their molecules are soluble in water due to their ability to form hydrogen bonds with water molecules. The water solubility of the acids decreases as the relative molecular mass increases becomes the structure becomes relatively more hydrocarbon in nature and hence covalent. All carboxylic acids are soluble in organic solvents.
5. Write two industrial preparations of carboxylic acids.
6. **From Ethanal**

Ethanoic acid is obtained industrially by the liquid phase air-oxidation of 5% solution of ethanol to ethanoic acid using manganite(II)ethanoate catalyst. Ethanal itself is obtained from ethyne.

HC≡CH dil.H2SO4/ HgSO4  CH3CHO O2/(CH3COO)2Mn CH3COOH.

1. **From Petroleum**

Liquid phase air oxidation of C5-C7 alkanes, obtainable from petroleum at high temperature and pressure will give C5-C7 carboxylic acids with methanoic, propanoic and butanedioic acids as by-products.

C5-C7 O2/ High temperature and pressure C5-C7 carboxylic acids.

1. With equations and brief explanations discuss the synthetic preparation of carboxylic acids.
2. **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 K2Cr2O7 or KMnO4) in acidic solution.

RCH2OH [O], excess acid/KMnO4 RCHO [O] RCOOH.

1. **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 H2O/dil.acid RCOOH + MgBrOH.

R may be 10, 20 or 30 aliphatic alkyl or aryl radical

In the preparation of benzoic acid, the reagent is added to the 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.

1. **Hydrolysis of nitriles (cyanides) or esters**

The hydrolysis of nitriles, which are organic molecules containing a cyano group, leads to carboxylic acid formation. These carboxylic reactions can either take place in acidic or basic solutions.

C6H5CH2CN + 2H2O H+ C6H5CH2COOH + NH4+ .

1. With chemical equations only, outline the reduction, decarboxylation and esterification of carboxylic acids.
2. **Reduction to primary alcohols**

4RCOOH + 3LiAlH4 (C2H5)2O (RCH2O)4AlLi + 2LiAlO2 + 4H2 4H2O 4RCH2OH + Al(OH)3 + LiOH.

CH3CH2CH2COOH LiAlH4 CH3CH2CH2CH2OH.

Butanoic acid Butanol

1. **Decarboxylation**

CH3CH2CH2COONa + NaOH fuse CH3CH2CH3 + Na2CO3.

Kolbe synthesis – involves electrolysis

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

1. **Esterification**

CH3CH2CH2COOH + CH3CH2CH2OH H+ CH3CH2CH2COOCH2CH2CH3 + H2O.

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