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19/ENG06/018

CARBOXYLIC ACIDS

CHE 102

28/04/2020

1. = HCOOH -> Methanoic acids

HOOCCH2CH2COOH -> Pentan-1,5-dioic acid

CH3CH2CH2COOH -> Butanoic acid

HO2C-CO2H -> Ethanedioic acid

CH3(CH2)4COOH -> Hex-4-eneoic acid

1. = i) Physical Appearance : All simple aliphatic carboxylic acids up to C10 are liquids at room temperature. Most other carboxylic acids are solid at room temperature although anhydrous carboxylic acid also known as glacial ethanoic acid freezes to an ice-like solid below room temperature.

ii) Boiling Points : Boiling points 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.

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 it becomes more hydrocarbon in nature and hence are soluble in organic solvents.

1. =i) From Carbon (ii) Oxide : Methanoic acids is manufactured by adding carbon (ii)oxide under pressure to hot aqueous solution of NaOH. The free carboxylic acid is liberated by careful reaction with (H2SO4)

CO -> HCOONa -> HCOOH + NaHSO4

NaOH H2SO4

1. = i) Oxidation of primary alcohol and alhydes : Oxidation of primary alcohols and aldehydes can be used to prepare carboxylic acids using the usual oxidizing agents ( i.e K2Cr2O7) in acidic solution

RCH2OH[O]. excess acid/KMnO4 -> RCHO + [O] -> RCOOH .

1. = I) Reduction to primary alcohol : Caarboxylic acids are very difficult to reduce by catalytic hydrogenation or dissolving metals but lithium tetrahydridoaluminate (III) and diborane form intermediate compounds with acids which liberate the alcohol on hydrolysis.

4RCOOH + 3LiAlH4 (C2H5)2O -> (RCH2O)4 AlLi + 2LiAlO2+ 4H2 ↨ 4RCH2OH + Al(OH)3 + LiOH

CH3CH2CH2COOH LiAlH4 -> CH3CH2CH2CH2OH Butanoic Acid Butanol

II) Decarboxyliclation : This inlvoles removal of the carboxyl group from the acid to give a hydrocarbon or its derivative. Carboxylic acids with a strong electron attaching group eg – COOH, -CN, NO2, C=O decarboxylate readily on heating to 100-150\*C while others decarboxylate when their salts are heated with soda lime.

CH3CH2CH2COONa + NaOH (fuse) -> CH3CH2CH3 + Na2CO3

Kolbe Synthesis

2CH3CH2COONa + 2H2O (electrolysis) -> CH3(CH2)2CH3 + CO2 +2NaOH +H2(cathode).

III) Esterfication : In the presence of strong catalyst, carboxylic acids react with alcohols to form esters.

CH3CH2CH2COOH + CH3CH2CH2OH <-> CH3CH2CH2COO CH2CH2CH3 + H2O.