

19/ENG05/066

MECHATRONICSENGINEERING

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CHEMISTRY 102

1,, .HCOOH Methanoic acid HOOCCH₂CH₂CH₂COOH Pentan-1,5-dioic acid

CH₃CH₂CH₂COOH Butanoic acid HO₂C-CO₂H Ethanedioic acid

CH₃(CH₂)₄COOH Hexanoic acid CH₃CH=CHCH₂CH₂COOH Hex-4-eneoic acid

2..Physical properties

Physical appearances

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

Boiling points

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 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 the structure becomes relatively more hydrocarbon in nature and hence covalent. All carboxylic acids are soluble in organic solvents

3...INDUSTRIAL PREPARATIONS

1. From Carbon(II) oxide

Methanoic acid (formic acid) is manufactured by adding carbon(II)oxide under pressure to hot aqueous solution of sodium hydroxide. The free carboxylic acid is liberated by careful reaction with tetraoxosulphate (vi) acid (H₂SO₄)

CO NaOH HCOONa H₂SO₄ HCOOH + NaHSO₄

2. 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

4...SYNTHETIC PREPARATIONS

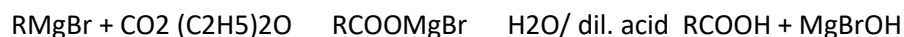
1. Oxidation of primary alcohols and aldehydes

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



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

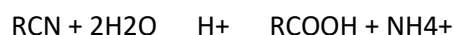


R may be 1o, 2o, 3o aliphatic alkyl or aryl radical

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



3. Hydrolysis of nitriles (cyanides) or esters

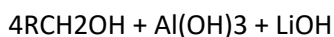
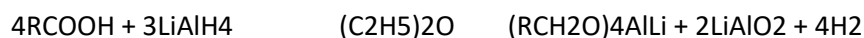


(R=alkyl or aryl radical)



5..CHEMICAL REACTIONS

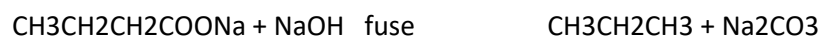
1. Reduction to primary alcohol



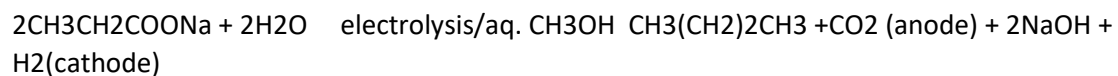
Butanoic acid

Butanol

2. Decarboxylation



Kolbe synthesis



3. Esterification

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

