

CHEMISTRY ASSIGNMENT

1. HCOOH - Methanoic acid
 $\text{HOOCCH}_2\text{CH}_2\text{CH}_2\text{COOH}$ Pentan-1,5-dioic acid
 $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ Butanoic acid
 $\text{HO}_2\text{C}-\text{CO}_2\text{H}$ Ethanedioic acid
 $\text{CH}_3(\text{CH}_2)_4\text{COOH}$ Hexanoic acid
 $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH}$ Hex-4-eneoic acid

2. Physical appearances

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 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. QUESTION 3

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 (H_2SO_4)



2. From ethanol

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



QUESTION 4

a) 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 $\text{K}_2\text{Cr}_2\text{O}_7$ or KMnO_4) in acidic solution



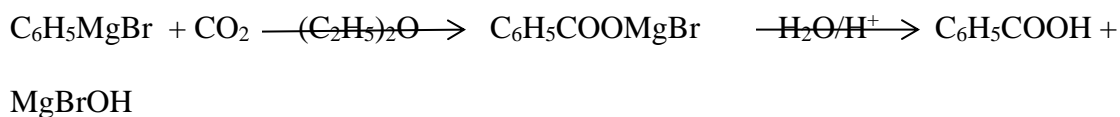
b) Carbonation of Grignard reagent

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

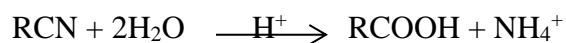


R may be 1° , 2° , 3° aliphatic alkyl or aryl radical

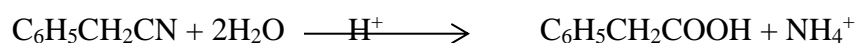
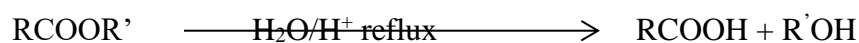
In the preparation of benzoic acid, the reagent is added to solid carbon (IV) oxide (dry ice) which also serves as coolant to the reaction mixture



c) Hydrolysis of nitriles (cyanides) or esters



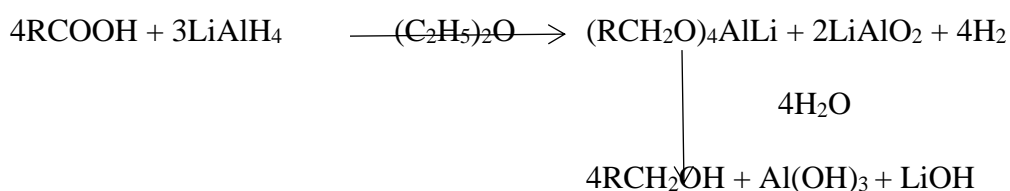
(R=alkyl or aryl radical)



QUESTION 5

a) Reduction to primary alcohol

Carboxylic acids are very difficult to reduce by catalytic hydrogenation or dissolving metals but lithium tetrahydridoaluminate (III) and diborane form intermediate compounds with the acids which liberate the alcohol on hydrolysis



Butanoic acid

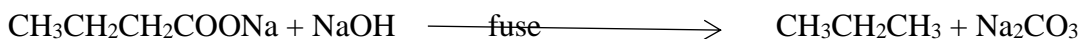
Butanol

b) Decarboxylation

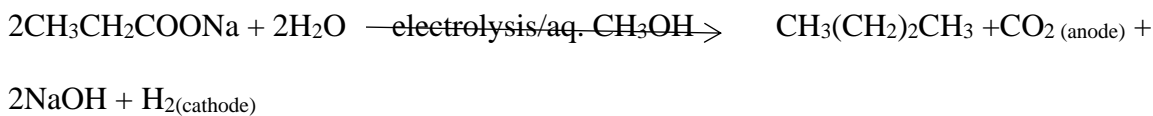
This involves removal of the carboxyl group from the acid to give a hydrocarbon or its derivative.

Thermal decarboxylation

Carboxylic acids with a strong electron attracting group eg $-\text{COOH}$, $-\text{CN}$, NO_2 , $\text{C}=\text{O}$ decarboxylate readily on heating to $100\text{-}150^\circ\text{C}$ while others decarboxylate when their salts are heated with soda lime



Kolbe synthesis



c) Esterification

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

