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MAT NO: 19/MHSD1/274

DEPT: MBBS

CHEM 102 ASSIGNMENT

1. Give the IUPAC names of the following compounds.

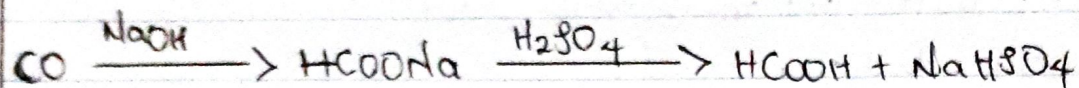
- i. HCOOH - Methanoic acid
- ii. $\text{HOOCCH}_2\text{CH}_2\text{CH}_2\text{COOH}$ - Pentan-1,5-dioic acid
- iii. $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ - Butanoic acid
- iv. $\text{HO}_2\text{C}-\text{CO}_2\text{H}$ - Ethanedioic acid
- v. $\text{CH}_3(\text{CH}_2)_4\text{COOH}$ - Hexanoic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

2. Discuss briefly the physical properties of carboxylic acids under the following headings.

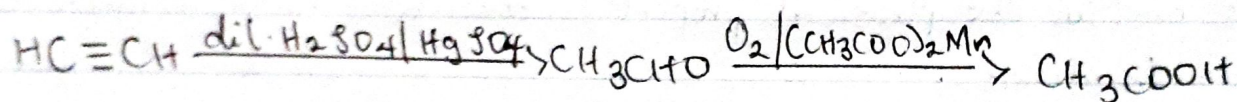
- i. Physical appearance
 - ii. Boiling point
 - iii. Solubility
- i. Physical appearance: All simple aliphatic carboxylic acids up to C_{10} are liquids at room temperature. Most other carboxylic acids are solid at room temperature although anhydrous carboxylic acids (acetic acids) also known as glacial ethanoic acid freezes to an ice-like 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 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 is 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) Write two industrial preparations of carboxylic acids.

i) 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).

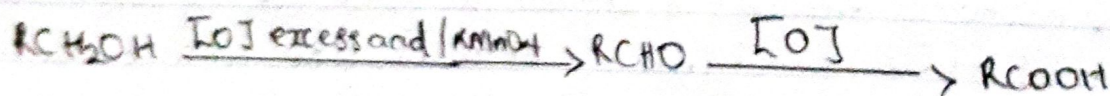


ii) From ethanol: Ethanoic acid is obtained commercially by the liquid phase air-oxidation of 5% solution of ethanal to ethanoic acid using manganite(II)ethanoate catalyst. Ethanal itself is obtained from ethylene:



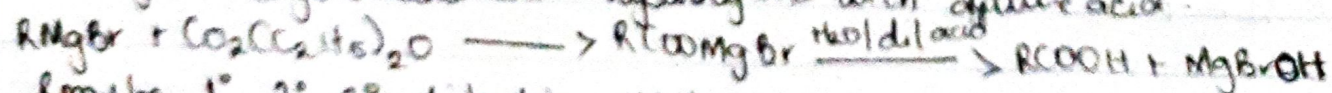
4) With equations and brief explanation discuss the synthetic preparation of carboxylic acid.

i) Oxidation of primary alcohols and aldehydes: Oxidation of primary alcohols and aldehydes can be used to prepare carboxylic acids using the usual oxidizing agents (ie $K_2Cr_2O_7$ or $KMnO_4$) in acidic solution.



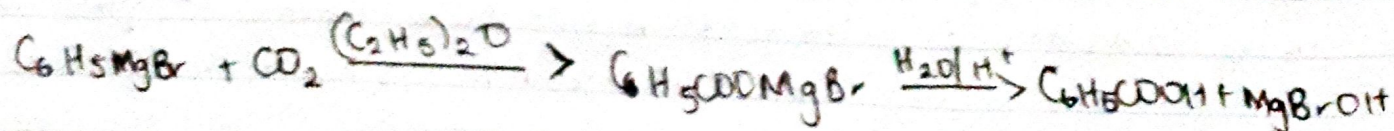
ii) Carbonation of Grignard reagent

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

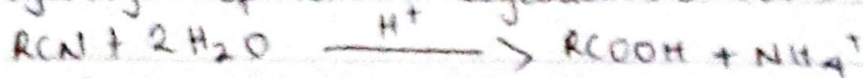


R may be 1°, 2°, 3° aliphatic alkyl or aryl radical

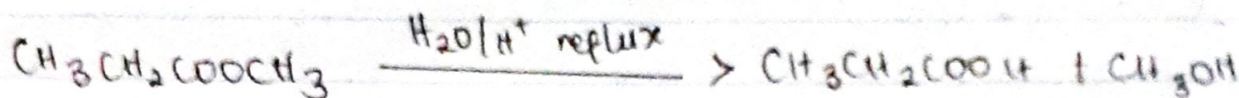
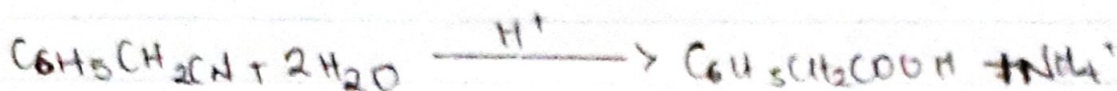
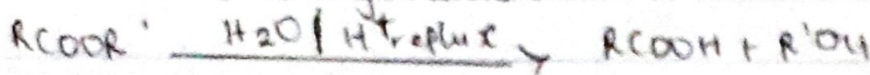
In the preparation of benzoic acid, the reagent is added to solid carbon(IV)oxide (dry ice) which also serves as coolant to the reaction mixture



iii) Hydrolysis of nitriles (Cyanides) or esters

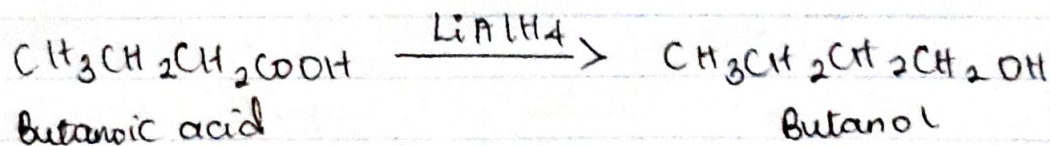
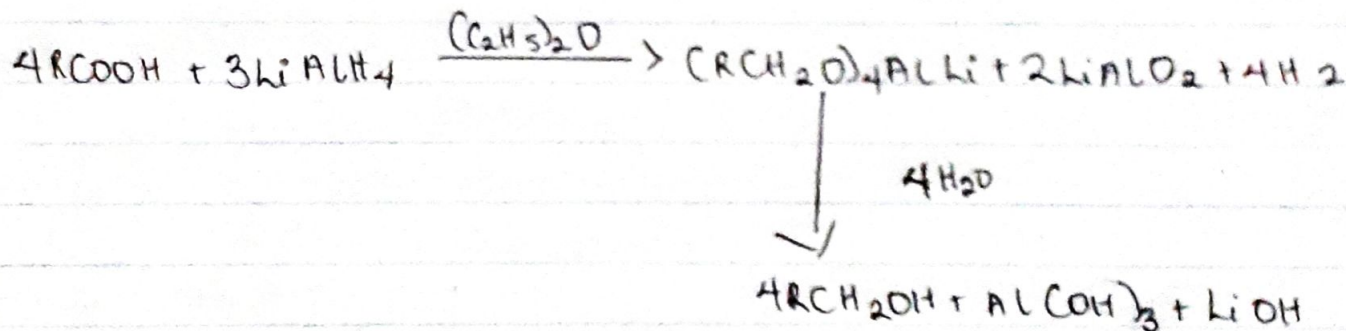


(R = alkyl or aryl radical)



4) With chemical equation only, outline the reduction, decarboxylation and esterification of carboxylic acid.

i) 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.



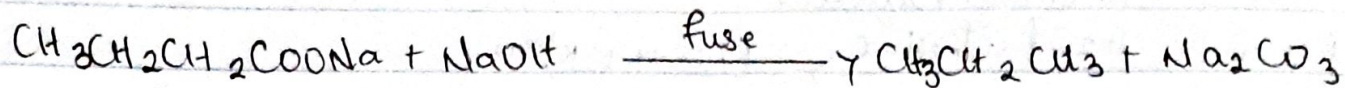
2. Decarboxylation

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

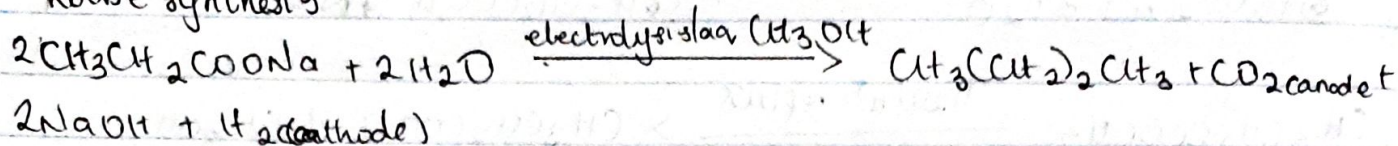
Thermal decarboxylation

Carboxylic acids with a strong electron attracting group eg $-\text{COOH}$, $-\text{CN}$,

NO_2 , $\text{C}=\text{O}$ decarboxylate readily on heating to $100-150^\circ\text{C}$ while others decarboxylate when their salts are heated with soda lime



Kolbe synthesis



iii) Esterification

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

