

Name: Okwuchi Aritus Chukwuebuna

Department: Chemical Engineering

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CHM 102

1 Give the IUPAC name of the following compounds

- i HCOOH - Methanoic acid
- ii $\text{HOOCCH}_2\text{CH}_2\text{CH}_2\text{COOH}$ - Pentanedioic 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 $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH}$ - Hex-4-enoic acid

2 Physical properties of Carboxylic acid

i Physical appearance

All simple carboxylic acids up to C_{10} are liquids at room temperature, most other carboxylic acids are solid at room temperature although aliphatic acid (e.g. lactic acid or anhydrous carboxylic acid) freezes to an ice-like solid below room temperature.

ii Boiling points

BP increases with 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

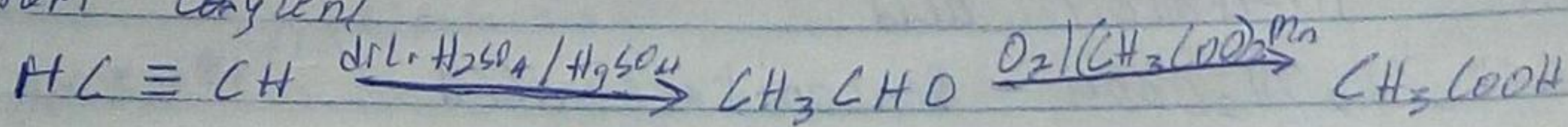
Lower molecular mass carboxylic acids with up to four carbon atoms in their molecules are soluble in water. The water solubility of the acids decreases as the relative molecular mass increases because the structure becomes relatively more hydrocarbon in nature and hence covalent. All carboxylic acids are soluble in organic solvents.

Industrial

3 Preparation of Carboxylic acids

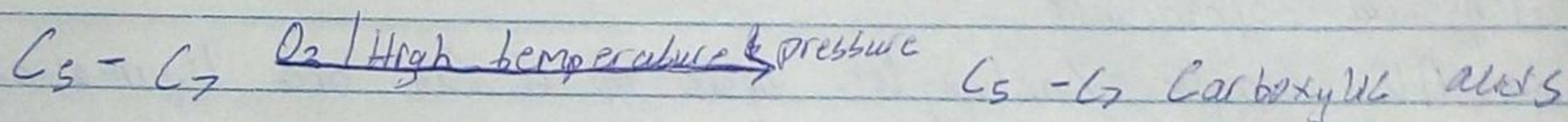
i From ethanol

Ethanoic acid is obtained commercially by the liquid phase air-oxidation of 5% solution of ethanol to ethanoic acid using manganese (II) ethanoate catalyst. Ethanol itself is obtained from ethylene.



ii From petroleum

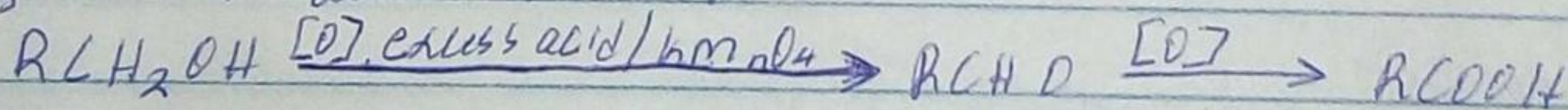
Liquid phase air oxidation of C₅-C₇ alkanes, obtainable from petroleum at high temperature and pressure will give C₅-C₇ carboxylic acids, with methanoic, propanoic and butanedioic acids as by-products.



4 Synthetic preparation of Carboxylic acid

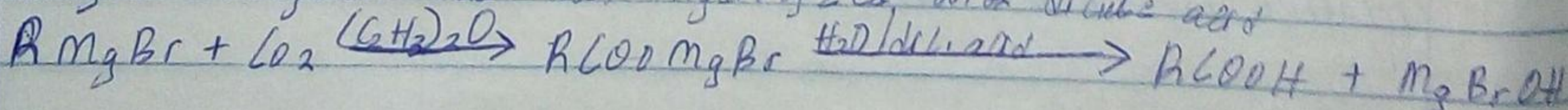
i Oxidation of primary alcohols and aldehydes

This can be used to prepare carboxylic acids using oxidizing agents in acidic solution.

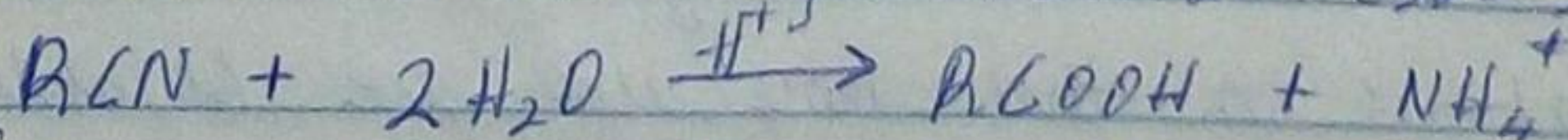


ii Carbonation of Grignard reagent

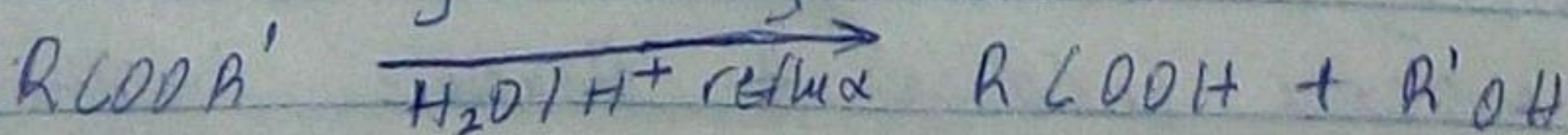
Aliphatic carboxylic acids are obtained by bubbling CO₂ into the Grignard reagent and then hydrolyzed with dilute acid.



iii Hydrolysis of nitriles (cyanides) or esters



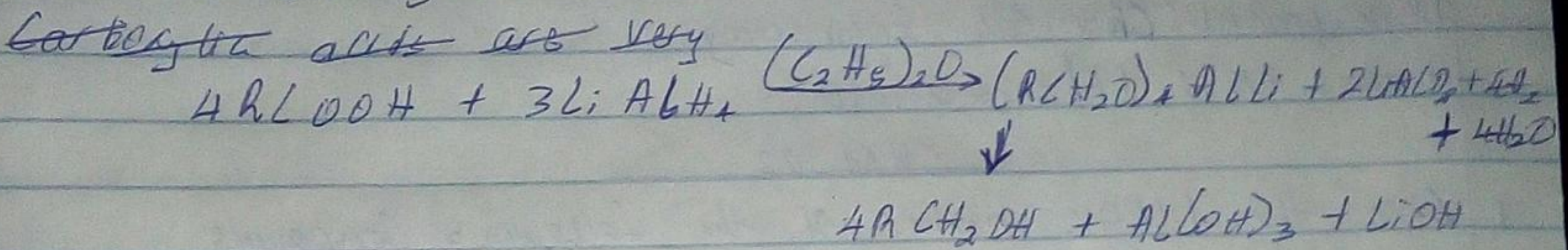
(R = alkyl or aryl radical)



5 Chemical reactions

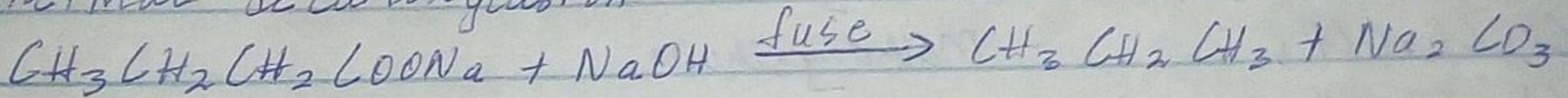
i Reduction of Carboxylic acid

Carboxylic acids are very

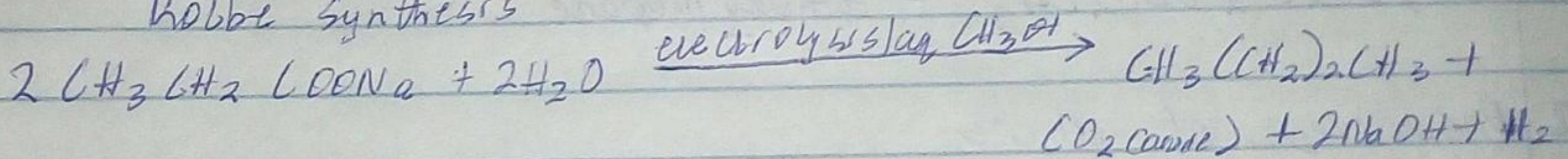


ii DeCarboxylation

Thermal deCarboxylation



Kolbe synthesis



iii Esterification

