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CHM 302

1A - HCOOH - Methanoic acid

B - $\text{HOOCCH}_2\text{CH}_2\text{CH}_2\text{COOH}$ - Pentan-1,5-dioic acid

C - $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ - Butanoic acid

D - $\text{CH}_3(\text{CH}_2)_4\text{COOH}$ - Hexanoic acid

E - $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH}$ - Hex-4-eneoic acid

F - $\text{HO}_2\text{C}-\text{CO}_2\text{H}$ - Ethanedioic acid

2 - Properties of Carboxylic acids

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

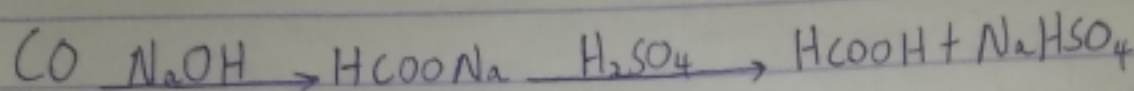
B - Boiling points: Boiling point increases with increasing relative molecular mass. Aromatic carboxylic acids are crystalline solids and have higher melting points than their aliphatic counterparts of comparable relative molecular mass.

C - 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 Preparation of Carboxylic Acids

A- From Carbon (II) oxide

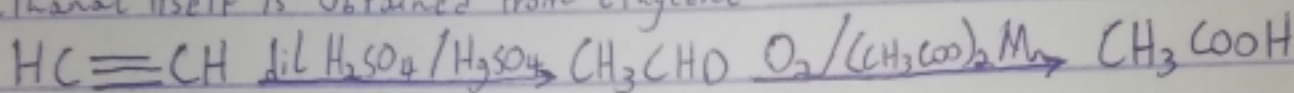
Methanoic acid (formic acid) is manufactured by adding Carbon (II) oxide under pressure to hot aqueous solution of sodium hydroxide. The free carboxylic acid is liberated by careful reaction with tetraoxosulphate (VI) acid (H_2SO_4)



B- 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.

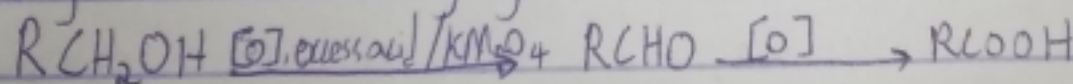
Ethanal itself is obtained from ethylene.



4. Synthetic preparations of Carboxylic acid

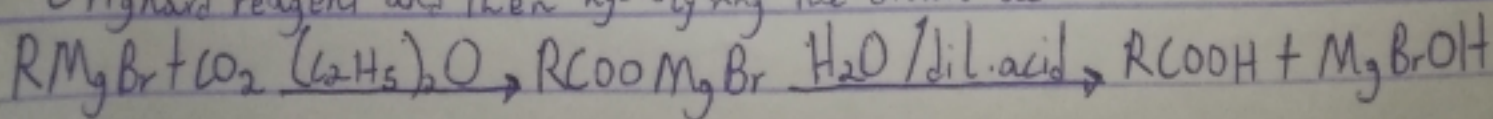
A) Oxidation of Primary alcohols and aldehydes

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



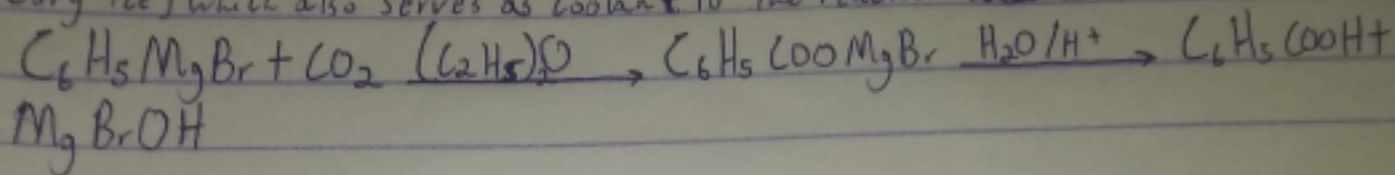
B) Carbonation of Grignard reagent

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



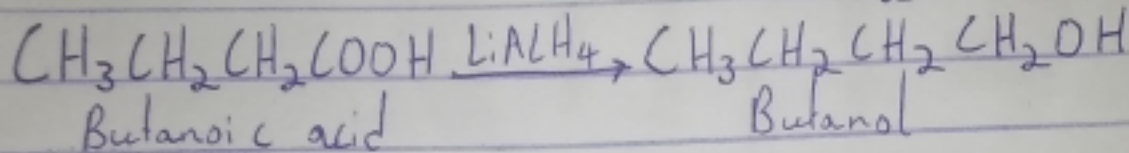
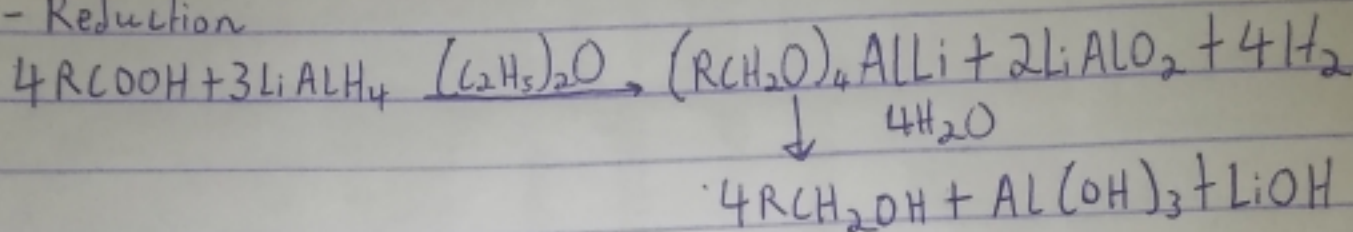
R may be 1°, 2°, 3° aliphatic alkyl or aryl radical.

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~~ mixture.



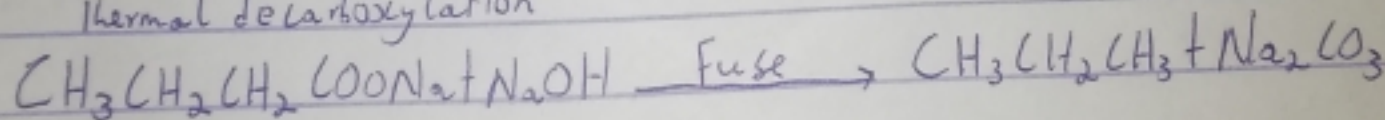
5 - Chemical Reactions of Carboxylic acid

A - Reduction

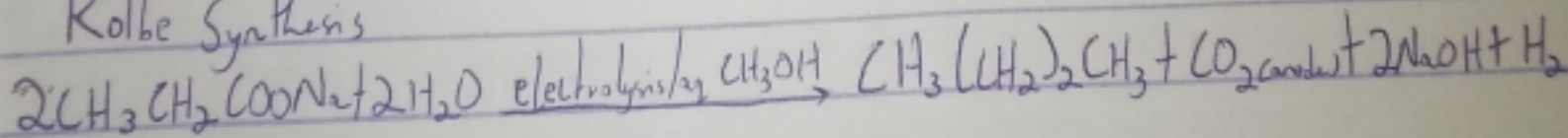


B - Decarboxylation

Thermal decarboxylation



Kolbe Synthesis



C - Esterification

