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- (i)  $\text{HCOOH}$   $\rightarrow$  Methanoic acid
- $\text{HCOOCCH}_3$   $\rightarrow$  Methyl methanoate
- $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$   $\rightarrow$  Butanoic acid
- $\text{HO}_2\text{C}-\text{CO}_2\text{H}$   $\rightarrow$  Ethanedioic acid
- $\text{CH}_3(\text{C}_2\text{H}_5)_2\text{COOH}$   $\rightarrow$  Hexanoic acid
- $\text{CH}_3\text{CH}=\text{CHCH}_2\text{COOH}$   $\rightarrow$  Hex-4-enoic acid

(ii) Physical appearance: All simple aliphatic carboxylic acid are to low are liquid of room temperature. Most lower aliphatic acids are solid at room temperature, although like solid below room temperature.

(iii) Boiling point: Boiling point increases with increasing relative molecular mass. Aromatic carboxylic acids are crystalline solid and have lower higher melting points than their aliphatic counterparts of comparable relative molecular mass.

(iv) Solubility: Lower molecular mass carboxylic acids with up to four carbon atoms in their molecules are soluble in water. The water solubility of the acid decreases while the relative molecular mass increases. All carboxylic acids are soluble in organic solvents.

- (v) from Petroleum
- (vi) from Carbonic Acid.

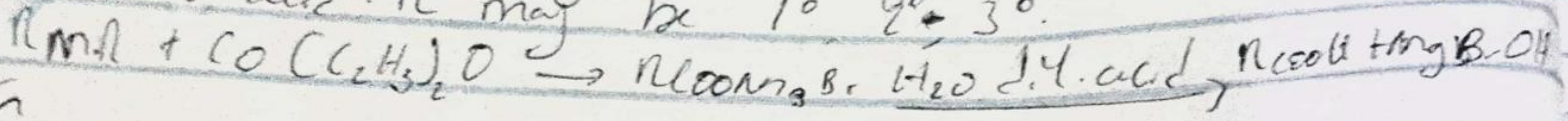


④ Synthetic preparations

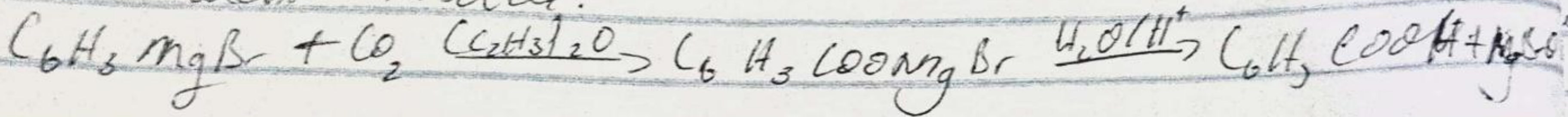
① Oxidation of primary alcohol and aldehydes  
 This method can be used to prepare Carboxylic acids using the oxidizing agents in acidic solution...  $\text{KMnO}_4$  or  $\text{K}_2\text{Cr}_2\text{O}_7$   
 $\text{RCH}_2\text{OH} \xrightarrow{\text{oxidizing agent/acid}} \text{RCHO} \xrightarrow{\text{oxidizing agent/acid}} \text{RCOOH}$

② Carbonation of Grignard reagent:

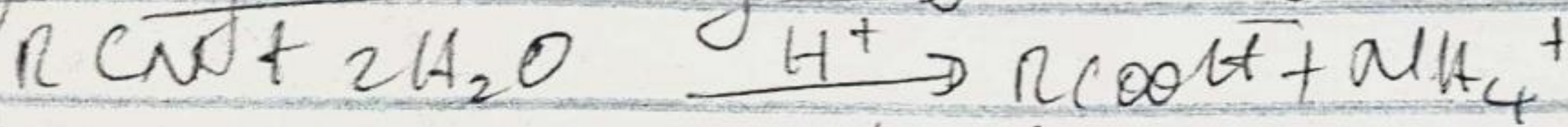
Aliphatic Carboxylic acids are obtained by bubbling  $\text{CO}_2$  (or  $\text{CO}$ ) into the Grignard's reagent and then hydrolyzed with dilute acid.  $R$  may be  $1^\circ, 2^\circ, 3^\circ$ .



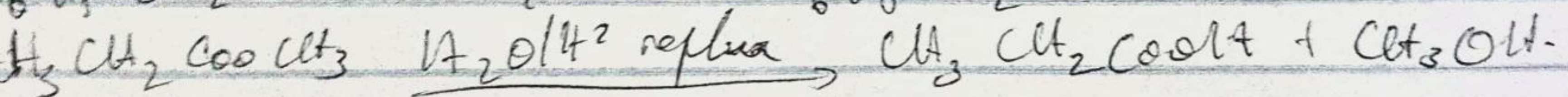
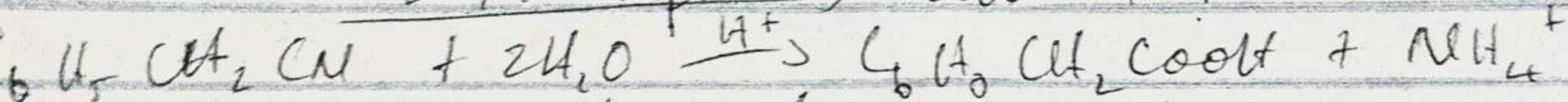
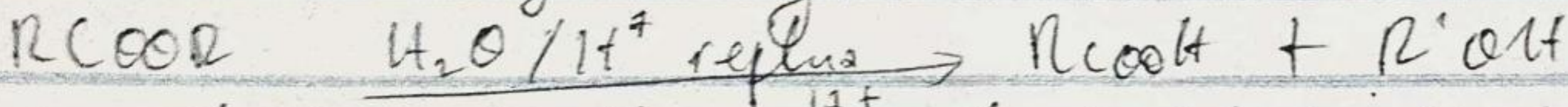
In preparation of Benzoic acid the reagent is added to solid Calcium chloride (dry) which also serves as a coolant to the reaction mixture.



③ Hydrolysis of nitriles (cyanides) or esters?

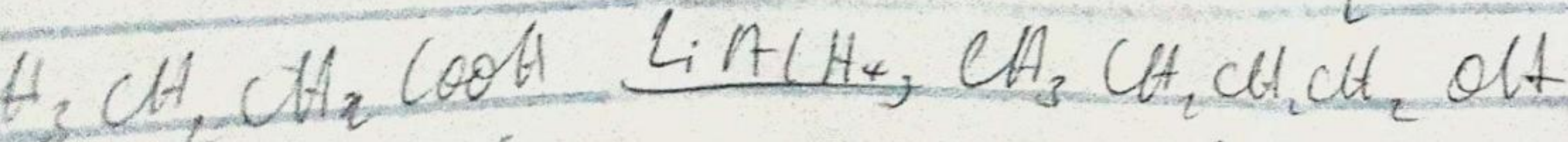
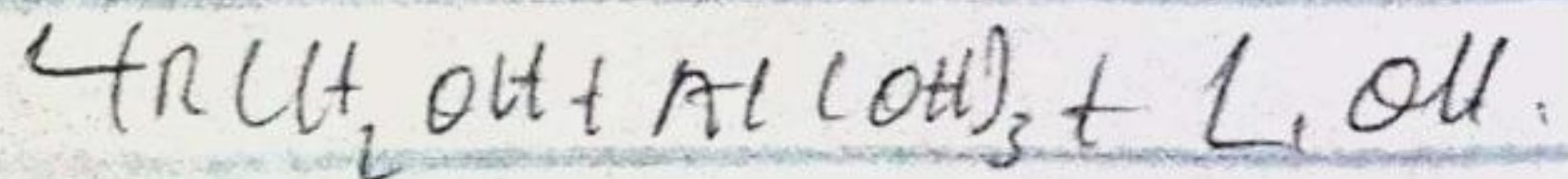
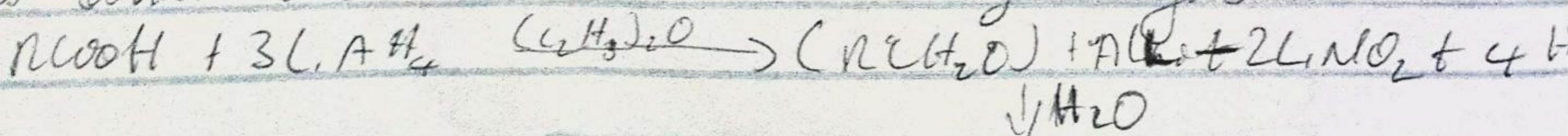


$R \rightarrow$  alkyl or aryl radical



④ Reduction to primary alcohol:

Carboxylic acids are very difficult to reduce by catalytic hydrogenation or ~~reducing~~ <sup>reducing</sup> metals but lithium tetrahydride borohydride ( $\text{LiAlH}_4$ ) and borane formate  $\text{B}(\text{OMe})_3$  form the compounds with the  $\text{H}^-$  which liberate the alcohol on hydrolysis.



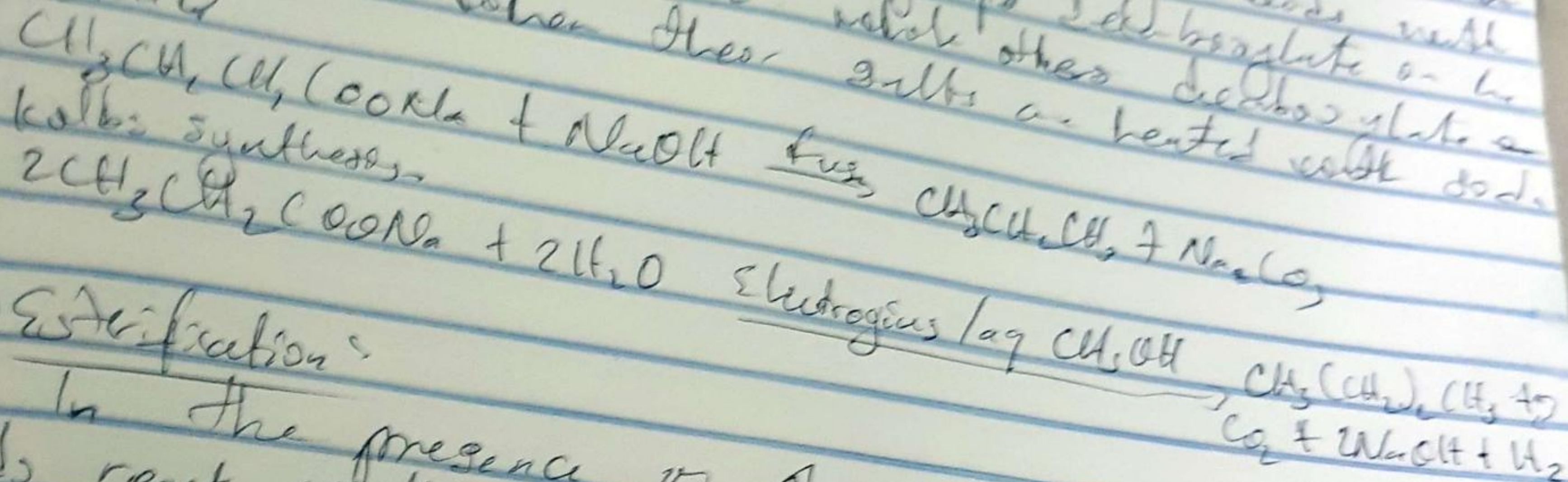
Butanoic acid

Butanol



(iii) Decarboxylation:

These involve removal of the carboxyl group from the acid to give a hydrocarbon or its derivative. These are decarboxylated in weakly acidic groups. Decarboxylation is a strong electron attracting group. Decarboxylation is usually done at 100-150°C when these salts are heated with soda lime.



(iv) Esterification:

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

