

- i)  $\text{HCOOH}$  - 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)  $\text{HO}_2\text{C-CO}_2\text{H}$  - 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 appearance: Carboxylic acids up to  $\text{C}_6$  are liquids at room temperature. Most other carboxylic acids are solid at room temperature.

- i) Boiling points: It increases with increasing relative molecular mass. Aromatic carboxylic acids are crystalline and have higher melting points than aliphatic compounds of comparable relative molecular mass.
- ii) Solubility: The water solubility of the acids decreases as the relative molecular mass increases. All carboxylic acids are soluble in organic solvents.

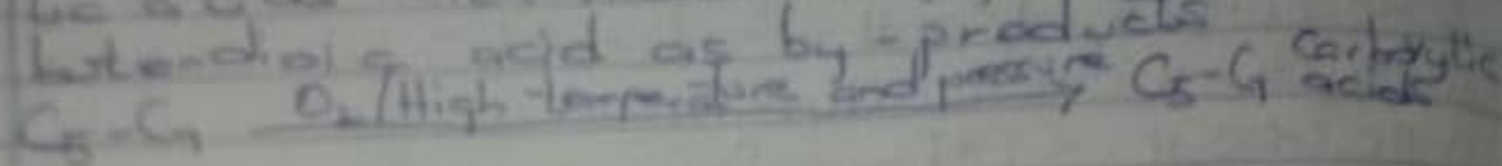
3) Industrial preparation of carboxylic acids

i) From carbon(IV) oxide: Methanoic acid is manufactured by adding carbon(IV) oxide under pressure to hot aqueous solution of sodium hydroxide. The free carboxylic acid is liberated by careful reaction with  $\text{H}_2\text{SO}_4$ .

$$\text{CO} \xrightarrow{\text{NaOH}} \text{HCOONa} \xrightarrow{\text{H}_2\text{SO}_4} \text{HCOOH} + \text{NaHSO}_4$$

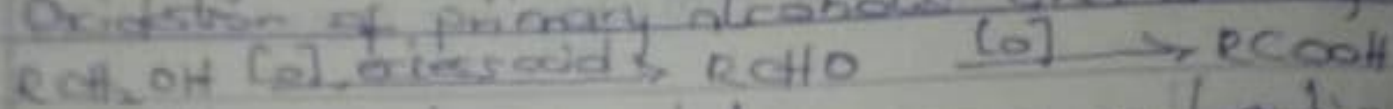
## ii) From petroleum

Liquid phase air oxidation of C<sub>5</sub>-C<sub>7</sub> alkanes obtainable from petroleum at high temperature and pressure will give C<sub>5</sub>-C<sub>7</sub> carboxylic acids with methanoic, propanoic and butenedioic acid as by-products.



## ii) The synthetic preparation of carboxylic acid

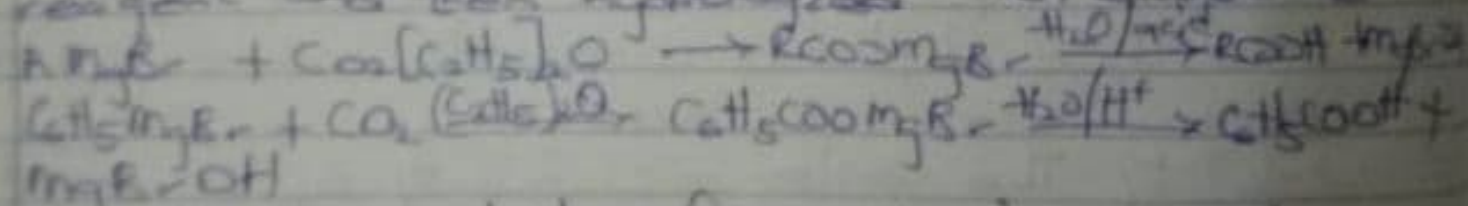
### a Oxidation of primary alcohols and aldehydes



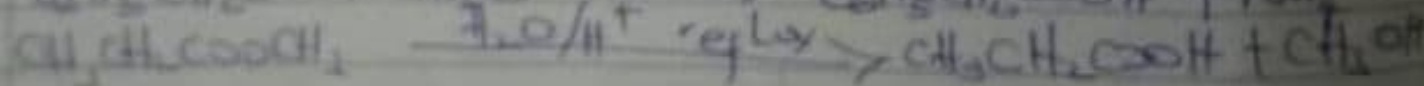
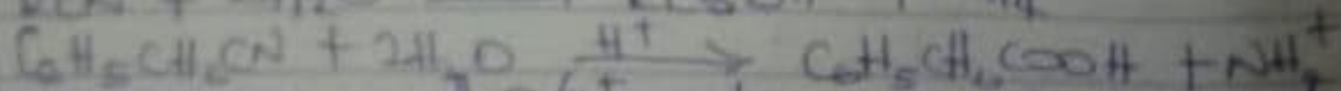
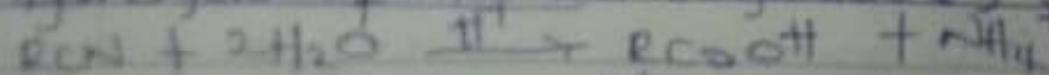
This can be used to prepare carboxylic acids using the usual oxidizing agent (K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>/KMnO<sub>4</sub>) in acidic solution.

### b Carbonation of Grignard reagent

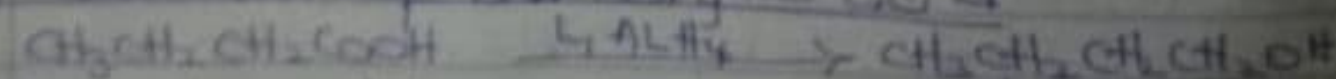
Aliphatic carboxylic acids are obtained by bubbling carbon (iv) oxide into the Grignard reagent and then hydrolyzed with dilute acid.



### c Hydrolysis of nitriles (Cyanides) or esters



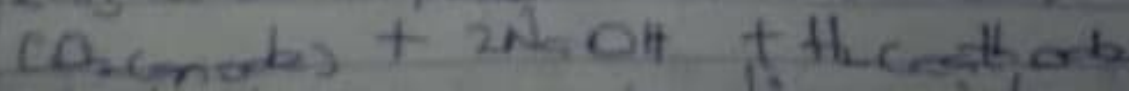
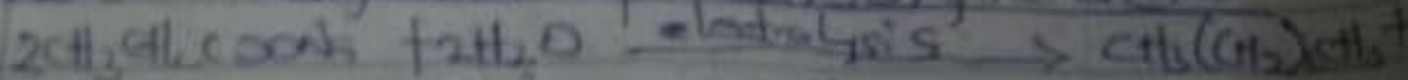
### iii) Reduction of carboxylic acid



Butanoic acid

Butanol

### iv) Decarboxylation of carboxylic acid



## Esterification of carboxylic acid

