

1a) ENG 06/005

Mechanical Engineering

1-) IUPAC names of the following compounds

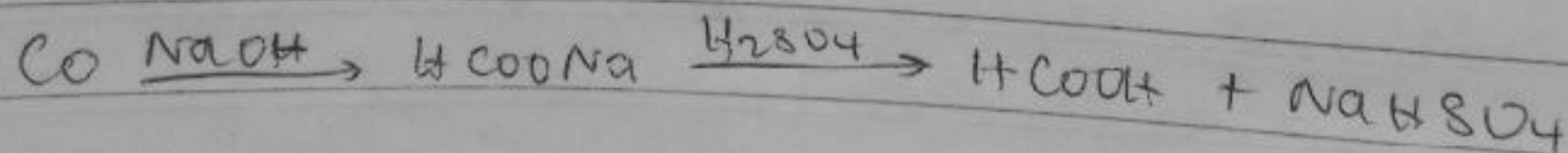
- $\text{HCOOH}$  - Methanoic acid
- $\text{HOOCCH}_2\text{CH}_2\text{CH}_2\text{COOH}$  - Pentan-1,5-dioic acid
- $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$  - Butanoic acid
- $\text{HO}_2\text{C}-\text{CO}_2\text{H}$  - Ethanedioic acid
- $\text{CH}_3(\text{CH}_2)_4\text{COOH}$  - Hexanoic acid
- $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH}$  - Hex-4-enoic acid

2-) Physical Properties of Carboxylic acids under the following heads

- i) Physical appearance: All simple aliphatic carboxylic acids up to  $\text{C}_{10}$  are liquids at room temperature, most are solid at room temperature although acetic acid freezes to an ice-like solid below room temperature
- ii) Boiling points: It increases with increasing relative molecular mass, aromatic acids are crystalline <sup>Solids</sup> have high m.p than aliphatic counterparts of comparable molecular mass
- iii) Solubility: Lower molecular mass carboxylic acids with up to four carbon atoms are soluble in water largely because of their ability to form hydrogen bonds with water. All carboxylic acids are soluble in organic solvents

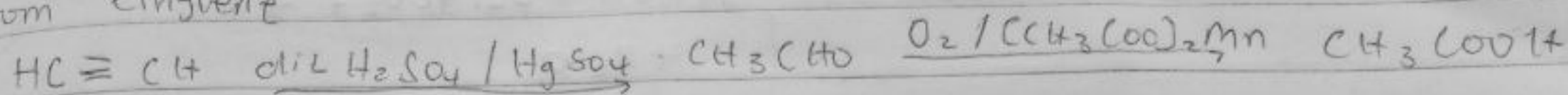
3-) Two industrial preparation of Carboxylic acids

i) From Carbon (II) Oxide: Methanoic (acid) acid (formic acid) is manufactured by adding  $\text{CO}$  under pressure to hot  $\text{NaOH(aq)}$ , the free carboxylic acid is liberated by careful reaction with  $\text{H}_2\text{SO}_4$



ii) From ethanal: Ethanoic acid is obtained commercially by the liquid phase air-oxidation of 5% solution of ethanal to

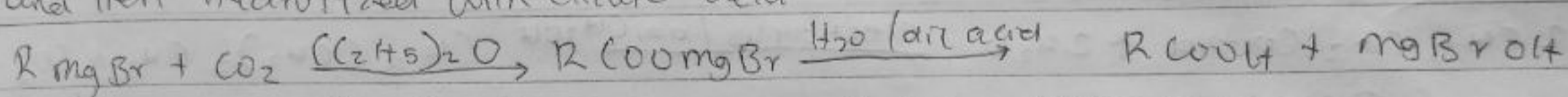
ethanoic acid using magrite (ii) ethanoate catalyst, ethanal is obtained from ethylene



4) with equation and brief explanation, discuss the synthetic preparation of carboxylic acid

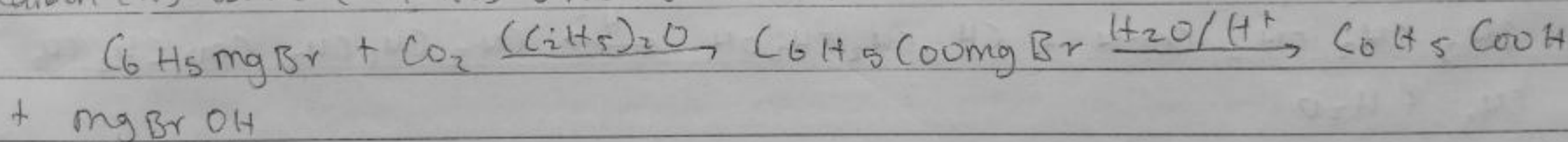
1.) Oxidation of primary alcohols and aldehydes. It can be used to prepare carboxylic acids using the usual oxidizing agents (i.e.  $\text{K}_2\text{Cr}_2\text{O}_7$  or  $\text{KMnO}_4$ ) in acidic solution  $\text{RCH}_2\text{OH} \xrightarrow{\text{excess acid / KMnO}_4} \text{RCHO} \xrightarrow{[\text{O}]} \text{RCOOH}$

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

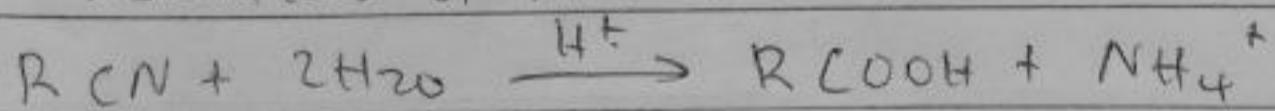


R may be  $1^\circ, 2^\circ, 3^\circ$  aliphatic alkyl or aryl radical

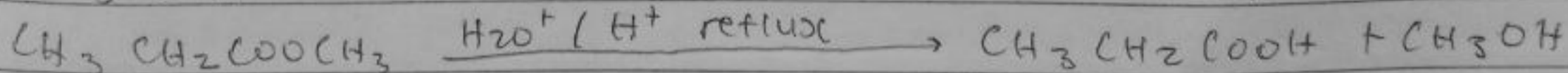
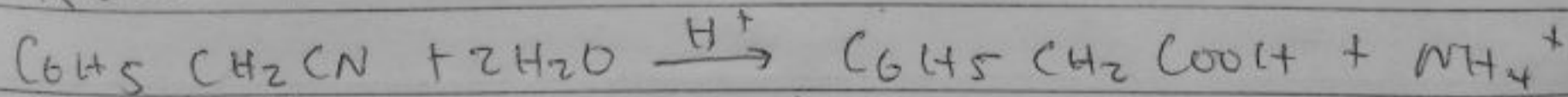
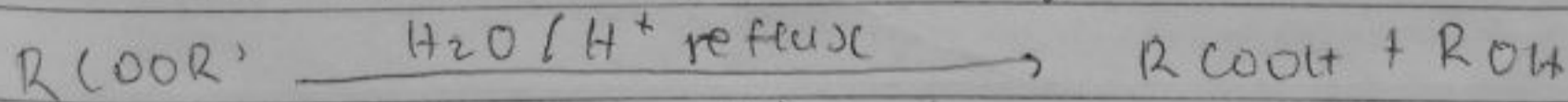
In preparation of benzoic acid, the reagent is added to solid carbon (iv) oxide (ditile) which serves as a solvent to the reaction mixture



3.) Hydrolysis of nitriles (cyanides) or esters

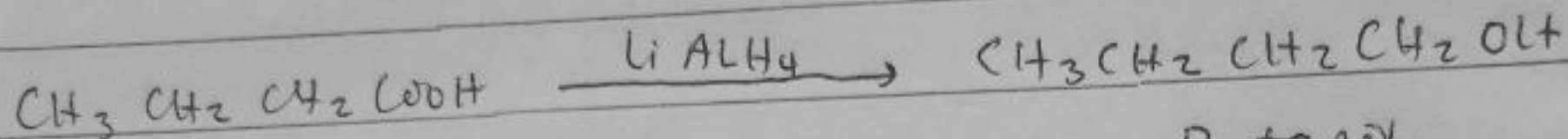
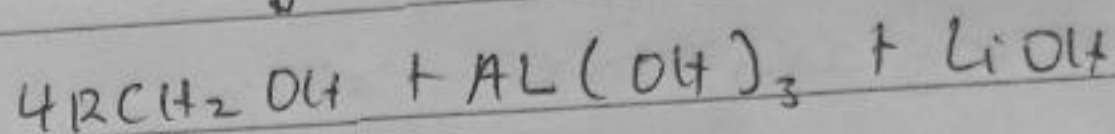
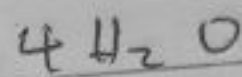
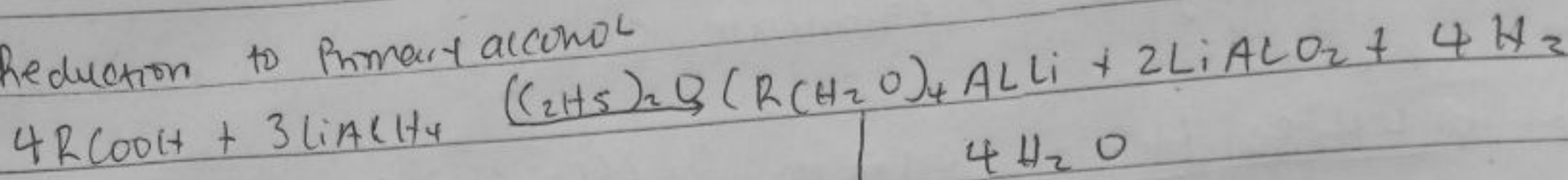


(R = alkyl or aryl radical)



5) with chemical equation, outline the reduction, decarboxylation and esterification of carboxylic acid

- Reduction to primary alcohol

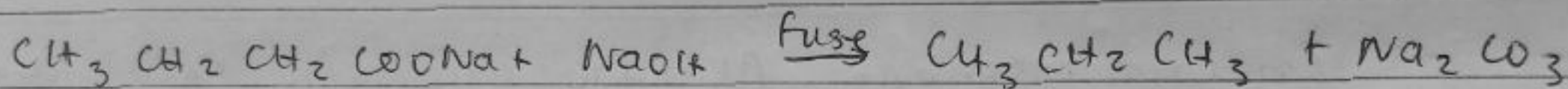


Butanoic acid

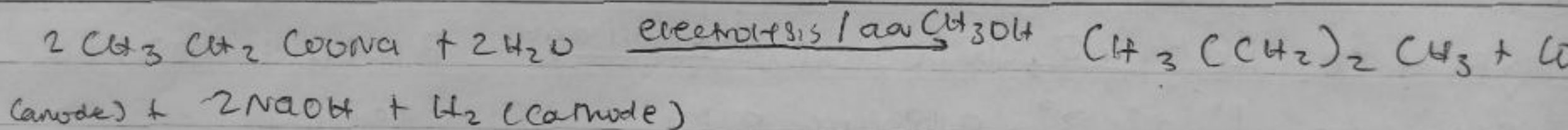
Butanol

- Decarboxylation

Thermal decarboxylation



Kolbe synthesis



- Esterification

