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- Give the IUPAC names of the following compounds
- a) $\text{HCOOH} \rightarrow$ methanoic acid
 - b) $\text{HOOC(CH}_2\text{CH}_2\text{CH}_2\text{COOH)} \rightarrow$ Pentan-1,5-dioic acid
 - c) $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH} \rightarrow$ Butanoic acid
 - d) $\text{HOOC-COOH} \rightarrow$ Ethanedioic acid

Discuss briefly the physical properties of carboxylic acids under the following headings: (i) physical appearance (ii) Boiling point (iii) Solubility.

Answer:

(i) Physical appearance: Carboxylic acids up to C_{10} are liquids at room temperature. Acetic acid freezes to an ice-like solid below room temperature.

(ii) Boiling Points: B.pt of carboxylic acids increase with relative molecular mass. Aromatic carboxylic acids are crystalline solids & have higher melting points than their straight chain counterparts with same relative molecular mass.

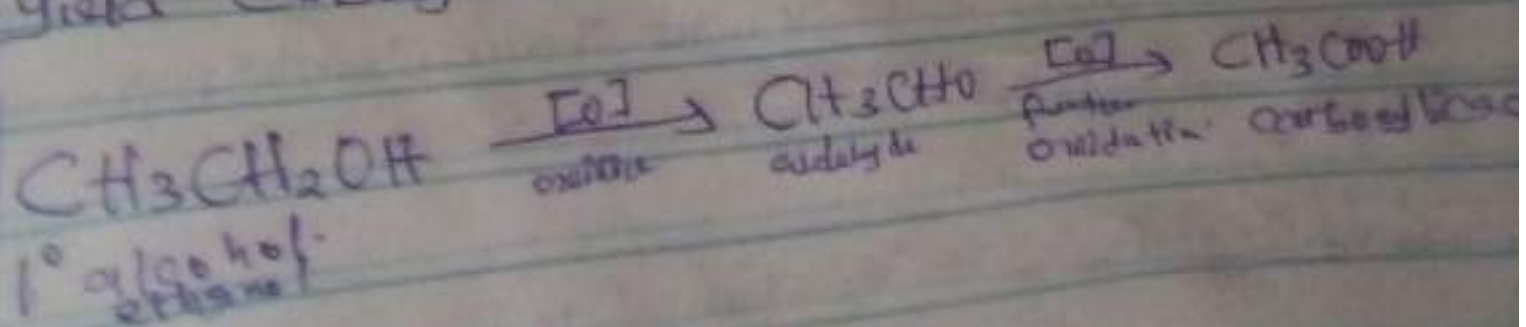
(iii) Solubility: Due to the ability to form hydrogen bonds with water molecules, lower molecular mass carboxylic acids up to 4 carbon atoms in their molecules are soluble in water. Water solubility decreases as the relative molecular mass increases.

Write two industrial preparations of Carboxylic acids
From Petroleum: Liquid phase air oxidation of C₅-C₇ n-alkanes
gotten from petroleum at high-temperature
Yield C₅-C₇ Carboxylics with by-product

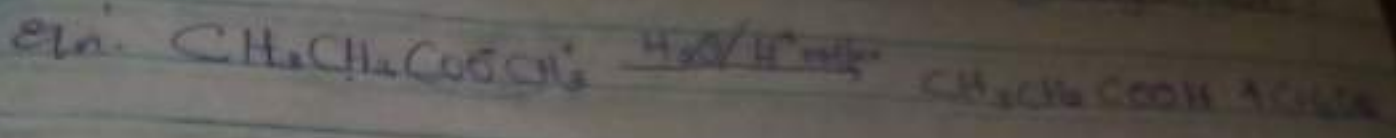
From ethanol: Ethanoic acid is gotten by the liquid phase
air oxidation of 5% solution of ethanol to
ethanoic acid using manganite (II) as a
catalyst.

With equations and brief explanation, discuss the
Synthetic preparation of Carboxylic acid.

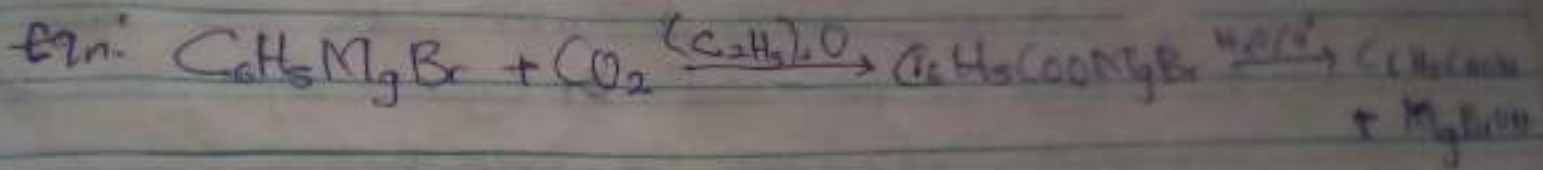
Oxidation of Primary alcohols & aldehydes: Using
oxidizing agents such as K₂Cr₂O₇ or KMnO₄ in acidic
solution, oxidation of primary alcohols and aldehydes
yield Carboxylic acids.



(ii) Hydrolysis of nitriles (cyanides) can be carried out in two ways: either by refluxing in a reflux solution or by using a catalyst.

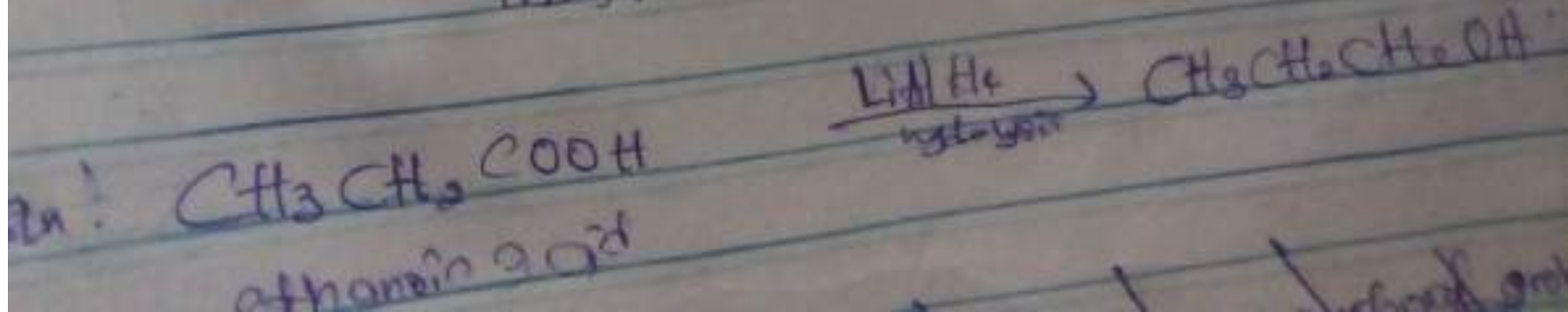


(iii) Carboxylation of Grignard reagent: Aliphatic carboxylic acids are obtained by bubbling CO_2 into the Grignard reagent and then hydrolysed with dilute acid.



(5) With chemical equation only, outlining the reduction, decarboxylation and esterification of Carboxylic acid.
Answer:

(i) Reduction: Carboxylic acids are reduced to primary alcohols using lithium trihydridoaluminate (LiAlH_4) and ^{di-borane} intermediate compounds with acids that liberates the alcohol on hydrolysis.



② Decarboxylation: Removal of the carboxyl group in the acid to give a hydrocarbon or derivative. It is given as:
 Thermal ^{decarboxylation} and Kolbe Synthesis.

Equation for thermal decarboxylation:
 $\text{CH}_3\text{CH}_2\text{CH}_2\text{COONa} + \text{NaOH} \xrightarrow{\text{heat}} \text{CH}_3\text{CH}_2\text{CH}_3 + \text{Na}_2\text{CO}_3$

i.e. Carboxylic acids with strong high electron affinity of $-\text{COOH}$, $-\text{CN}$, $-\text{NO}_2$, $\text{C}=\text{O}$ decarboxylate readily by heating to $100-150^\circ\text{C}$ or by heating their salts with soda lime as shown above.

③ Esterification: This is simply the production of esters when carboxylic acids react with alcohols and liberates water.

