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Department: Electrical/Electronics Engineering

Course: Chem 102

Matric No: 19/ENG04/032.

1) Give the IUPAC Names of the following Compounds:

a) 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) $\text{HO}_2\text{C}-\text{CO}_2\text{H}$ ————— Ethanedioic acid

e) $\text{CH}_3[\text{CH}_2]_4\text{COOH}$ ————— Hexanoic acid

f) $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH}$ ————— Hex-4-enoic acid

2) 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 point:

This 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.

Q) Solubility:

Lower molecular mass carboxylic acids with up to four carbon atoms in their molecules are soluble in water, this is largely due to their ability to form hydrogen bonds with water molecules.

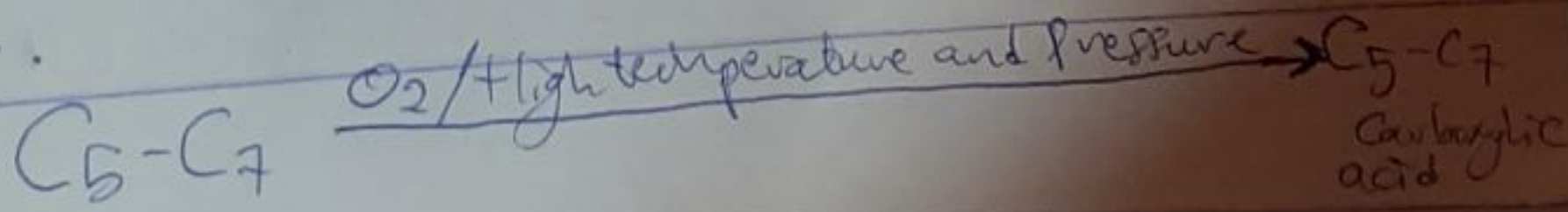
The water solubility of the acids decreases as the relative molecular mass increases because the structure becomes relatively more hydrocarbon in nature and hence covalent. Carboxylic acids are soluble in organic solvents.

3) Write two industrial preparations of carboxylic acids.

Answers

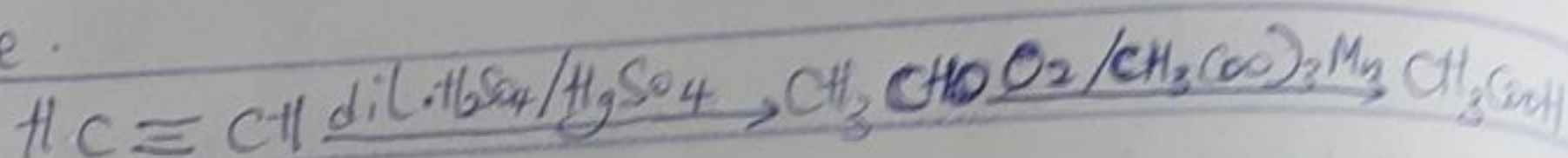
Q) From petroleum:

Liquid phase air oxidation of C₅-C₇ alkanes, obtainable from petroleum at high temperature and pressure will give C₅-C₇ carboxylic acids with methanoic, propanoic and butanedioic acids as by-products.



b) From ethanal

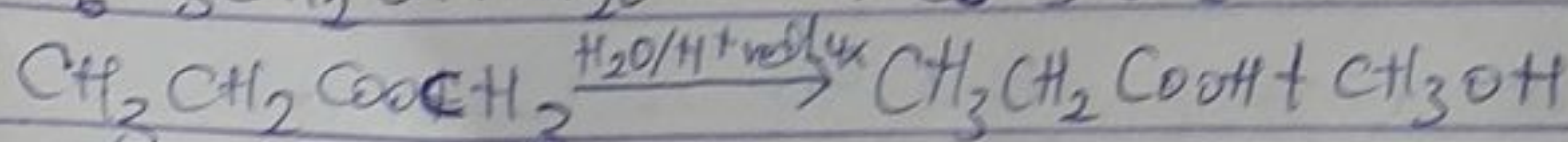
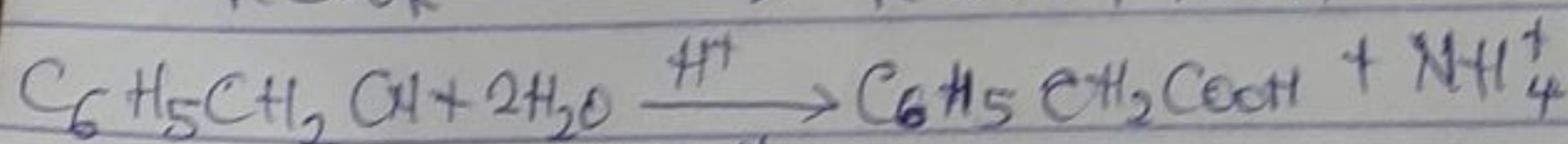
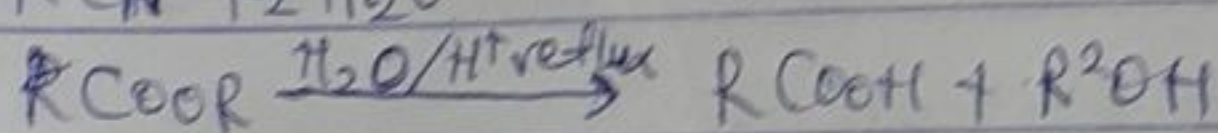
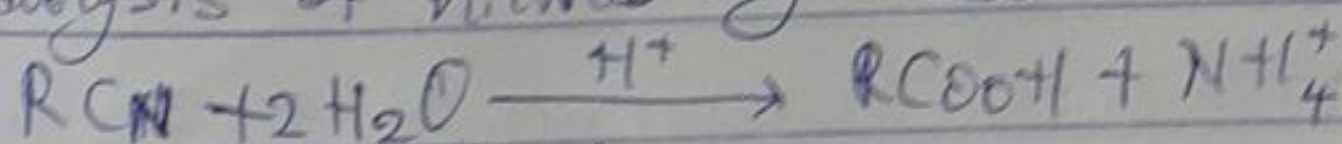
Ethanoic acid is obtained commercially by the liquid phase air-oxidation of 5% solution of ethanal to ethanoic acid using ~~permanganate~~ manganate (II) ethanoate catalyst. Ethanal itself is obtained from ethylene.



4d) With equations and brief explanation, discuss the synthetic preparations of carboxylic acids.

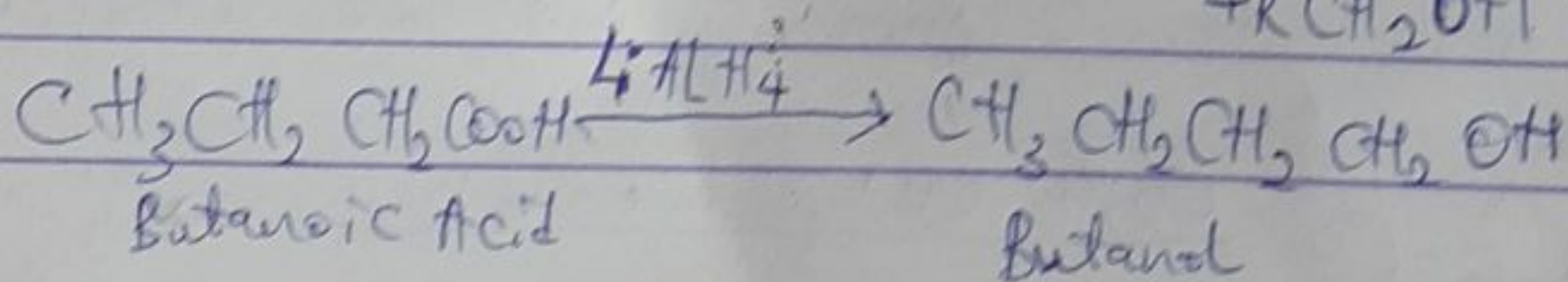
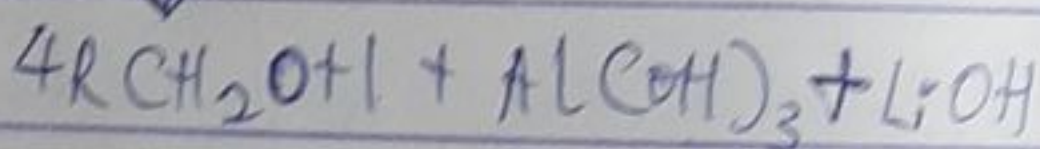
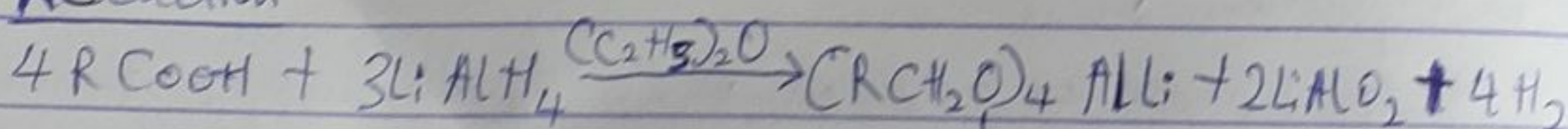
Answer

Hydrolysis of nitriles (cyanides) or esters



R = alkyl or aryl radical.

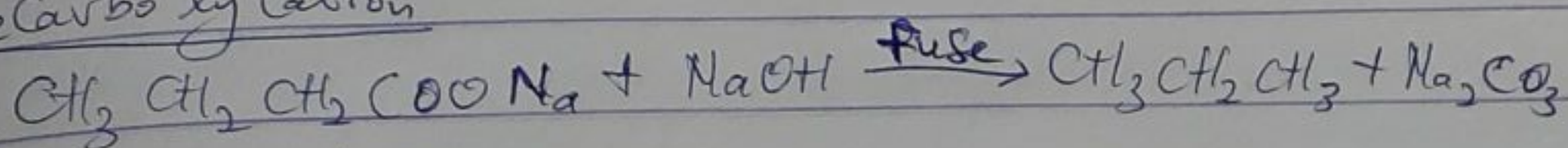
5a) Reduction



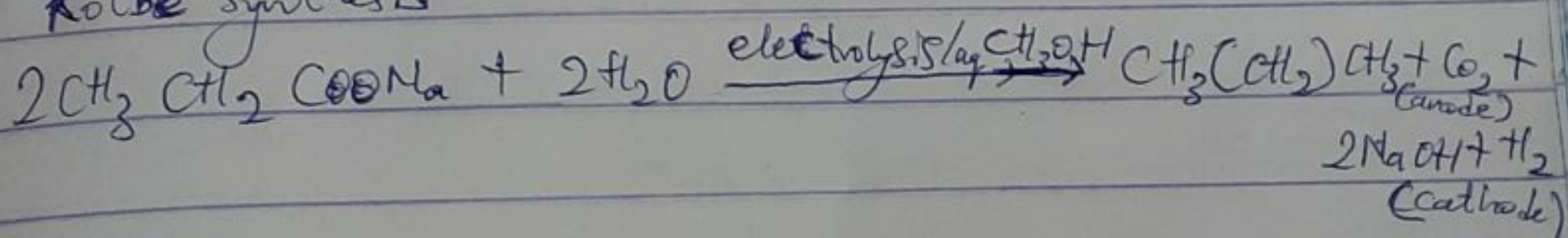
Butanoic Acid

Butanol

b) Decarboxylation



Kolbe Synthesis



c) esterification

