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19/MTH01/302

CHM 102 (CARBOXYLIC ACID)

Assignment

1) Give the IUPAC names of the following compounds

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

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

2) Discuss briefly the physical properties of carboxylic acids under the following headings.

Physical appearance, boiling point & solubility.

a) 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 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.

c) Solubility: Low molecular mass carboxylic acids with up to four carbon atoms in their molecules are soluble in water, this largely due to the ability to form hydrogen bonds with water molecules. The water solubility of the acids relative to molecular mass increases because the structure becomes relatively more hydrocarbon in nature and hence covalent. All carboxylic acids are soluble in organic solvents.

3) Write 2 industrial preparations of carboxylic acids.

a) From petroleum: liquid phase air oxidation of C_5-C_7 alkanes, obtainable from petroleum at high temperature and pressure. All give C_5-C_7 carboxylic acids with methane, propanoic and butanedioic acids as by-products.
 $\text{C}_5-\text{C}_7 \xrightarrow{\text{O}_2/\text{high temperature and pressure}}$ C_5-C_7 carboxylic acids

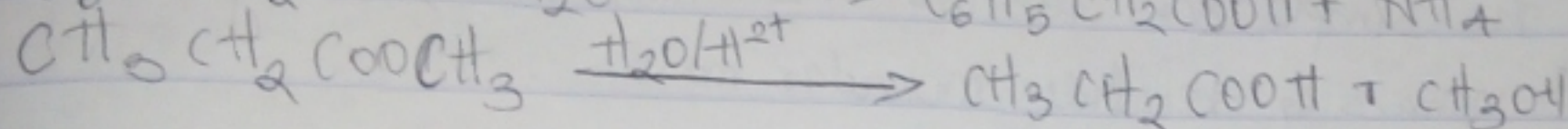
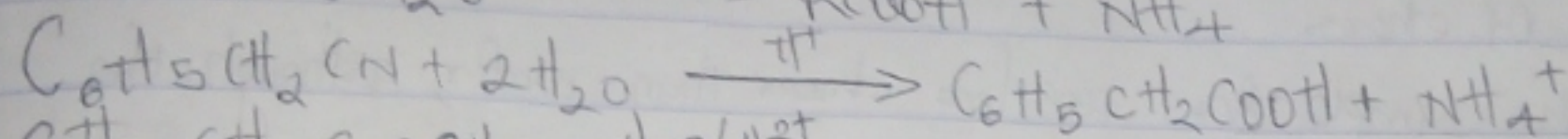
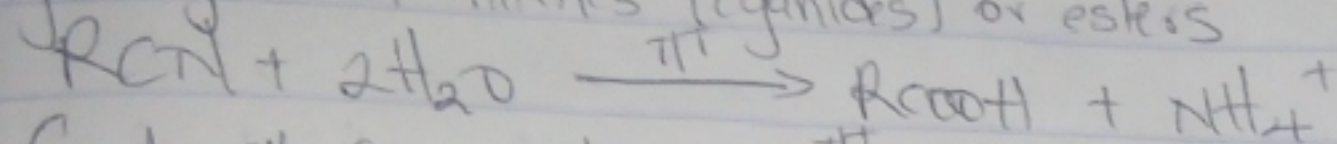
d) from ethanol: Ethanoic acid is obtained commercially by the liquid phase air oxidation of 5% solution of ethanol to ethanoic acid using manganate (IV) ethanoate catalyst

$$CH_3CH_2OH \xrightarrow{dil. H_2SO_4/H_2SO_4} CH_3COOH \xrightarrow{Ca/CH_3COO} CH_3COOCH_3$$

4) With equations and brief explanation, discuss the synthetic preparation of Carboxylic acid:

Answers

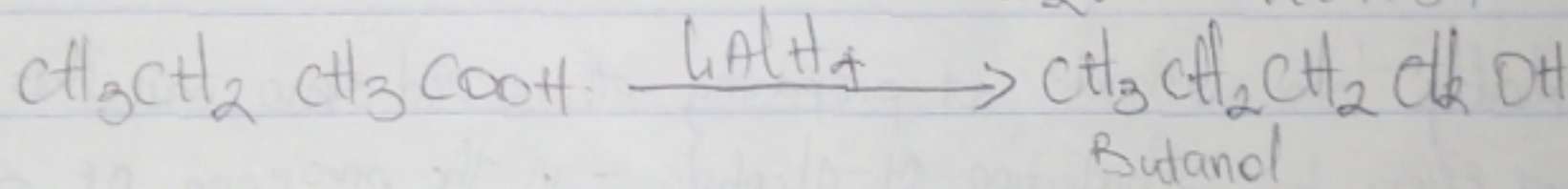
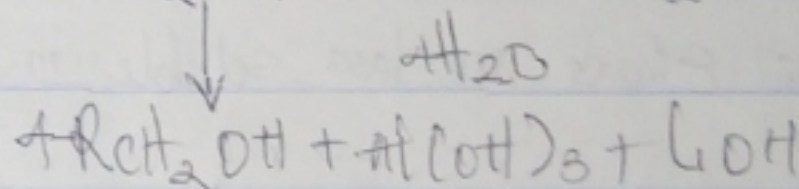
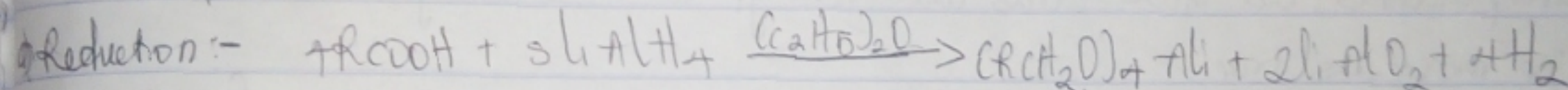
Hydrolysis of nitriles (cyanides) or esters



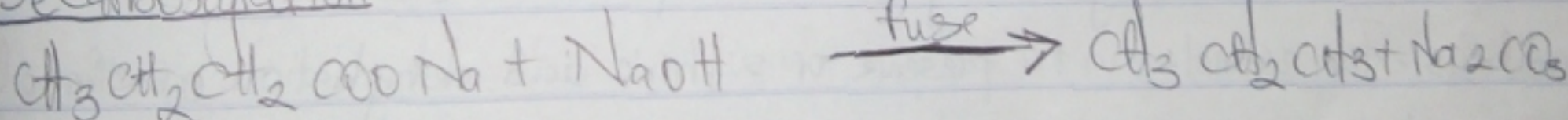
R = alkyl or aryl radical

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

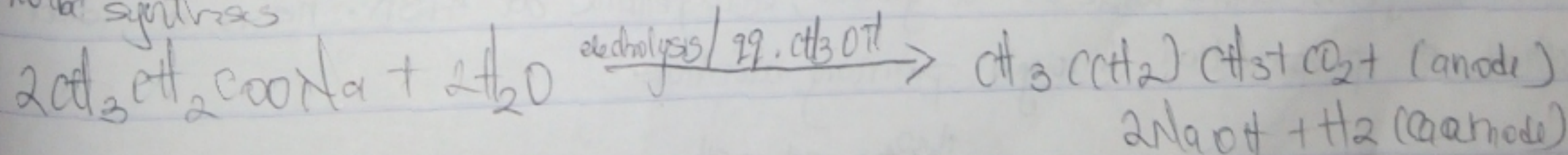
Answers



Decarboxylation



Kolbe synthesis



Esterification

