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COURSE: CHEM 102

MAT NO: 19/ENG 06/026

Mechanical Engin

1) Give the IUPAC names of the following compounds

a) HCOOH \longrightarrow Methanoic acid

b) $\text{HOOCCH}_2\text{CH}_2\text{COOH}$ \longrightarrow Propane-1,3-dioic acid

c) $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{COOH}$ \longrightarrow Benzoic acid

d) $\text{HO}_2\text{C}-\text{CO}_2\text{H}$ \longrightarrow Ethanedioic acid

e) $\text{CH}_3(\text{CH}_2)_4\text{COOH}$ \longrightarrow Hexanoic acid

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

2) Discuss briefly the physical properties of carboxylic acids under the following headings: Physical appearance, Boiling point and Solubility.

(a) Physical appearance: All simple aliphatic carboxylic acids up to C_{10} are liquids at room temperature although anhydrous carboxylic acid (acetic acid) also known as glacial acetic acid freezes to an ice-like solid below the room temperature.

(b) Boiling point: This increases with increasing relative molecular mass. Aliphatic carboxylic acids are crystalline solids and have higher melting points than their aliphatic counterparts of comparable relative molecular mass.

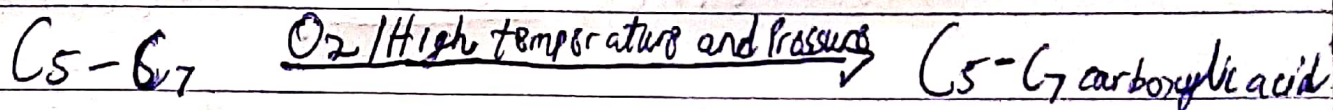
(c) Solubility: Lower molecular mass carboxylic acids with up to four carbon atoms in their molecules are soluble in water, this largely

due to their ability to form hydrogen bonds with water molecules.

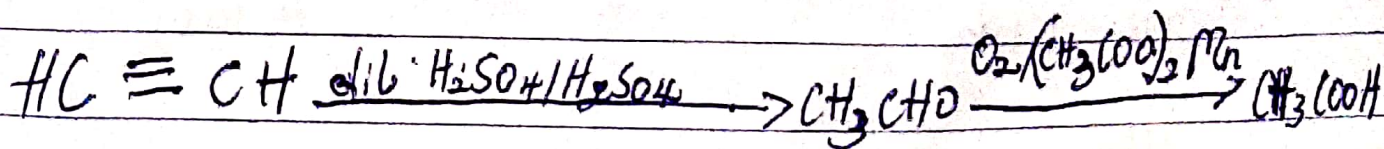
The water solubility of the acids decreases as the relative molecular mass increases because the structure becomes relatively more hydrocarbon in nature and hence covalent. All carboxylic acids are ~~soluble~~ soluble in organic solvents.

3) Write two industrial preparations of carboxylic acids.

(a) From Petroleum: Liquid phase air oxidation of C₅-C₇, obtainable from petroleum of high temperature and pressure will give C₅-C₇ carboxylic acid with methanoic, propanoic and butanoic acids as by-products.

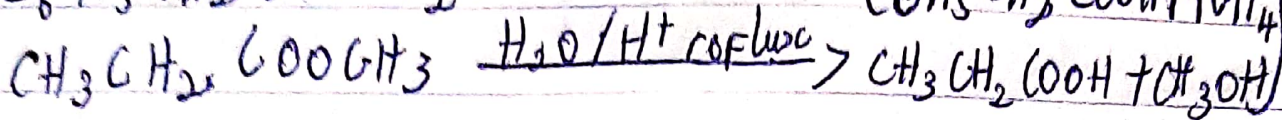
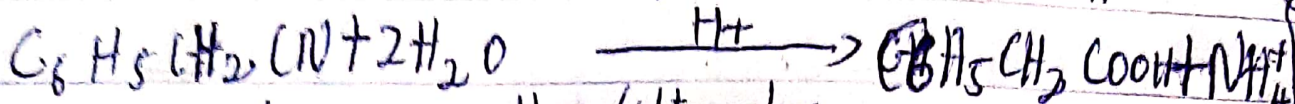


(b) From Ethanol: Ethanoic acid is obtained commercially by the liquid phase air-oxidation of 5% solution of ethanol to ethanoic acid using manganese (ii) ethanoate catalyst. Ethanol itself is obtained from ethylene.



4) With the equations and brief explanations, discuss the synthetic preparation of carboxylic acid.

Hydrolysis of nitriles (cyanides) or esters



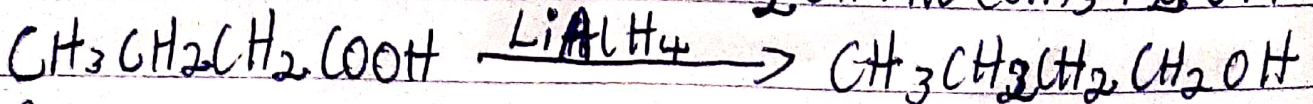
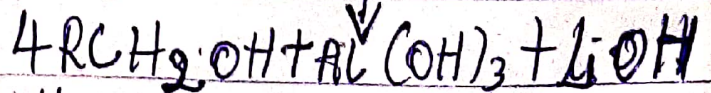
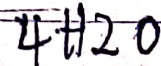
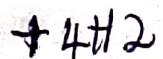
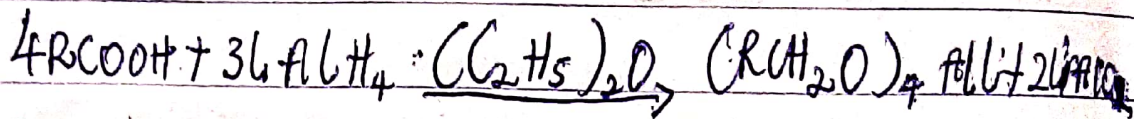
R-aldehyde
or acyl

radical

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

Answers

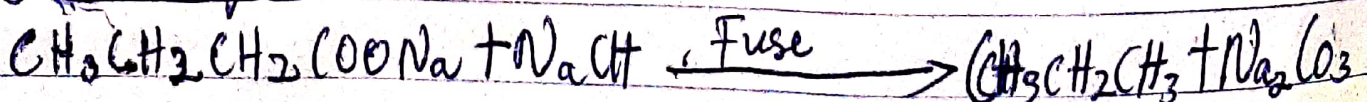
(a) Reduction



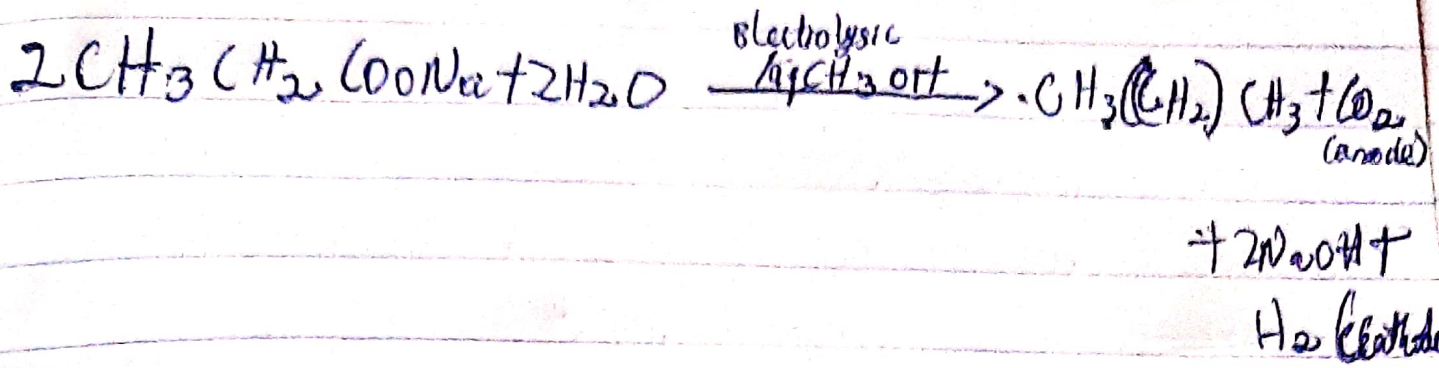
Butanoic acid

Butanol

b.) Decarboxylation:



Kolbe Synthesis



(c) Esterification

