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Matric No: 17/ENG09/018  
Course: Chemistry 102 Carboxylic acids

1) Give the IUPAC names of the following compounds:

Answers

- a.  $\text{HCOOH} \rightarrow$  methanoic acid
- b.  $\text{HOOC}(\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}) \rightarrow$  Pentan-1,5-dioic acid
- c.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH} \rightarrow$  Butanoic acid
- d.  $\text{HO}_2\text{C}-\text{CO}_2\text{H} \rightarrow$  Ethanedioic acid
- e.  $\text{CH}_3(\text{CH}_2)_4\text{COOH} \rightarrow$  Hexanoic acid
- f.  $\text{CH}_3(\text{CH}=\text{CH})\text{CH}_2\text{CH}_2\text{COOH} \rightarrow$  Hex-4-enoic acid

2) Discuss briefly the physical properties of Carboxylic acids under the following headings: Physical appearance, Boiling points & Solubility.

Answer.

a - Physical appearance:

All simple aliphatic carboxylic acids up to  $\text{C}_{10}$  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.

- Solubility: Lower molecular mass carboxylic acids with up to

Four carbon atoms in their molecules are soluble in water; this is due to their large ability to form hydrogen bonds with water molecules.

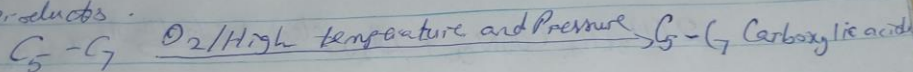
The water solubility of the acids decreases as the relative molecular mass increases because the structure becomes relatively more hydrocarbon in nature and hence covalent. All carboxylic acids are soluble in organic solvents.

3) Write two industrial preparation of Carboxylic acids.

Answer

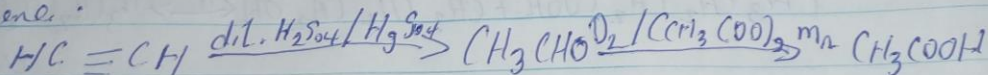
a) from petroleum

Liquid phase air oxidation of  $C_5-C_7$  alkanes, obtainable from petroleum of high temperature and pressure will give  $C_5-C_7$  Carboxylic acids with methanoic, propanoic and butanoic acids as by-products.



b) from ethanal

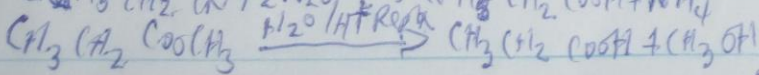
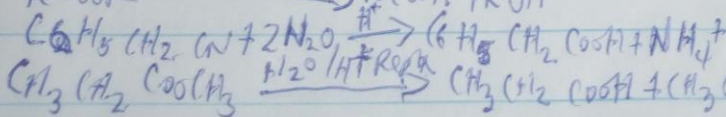
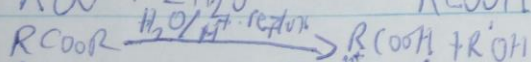
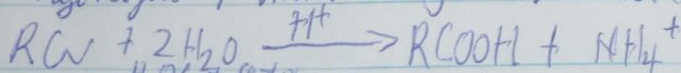
Ethanoic acid is obtained commercially by the liquid phase air-oxidation of 5% solution of ethanal to ethanoic acid using manganese(II) ethanoate catalyst. Ethanol itself is obtained from ethylene.



c) With equation and brief explanation, discuss the synthetic preparation of Carboxylic acid.

Answer

Hydrolysis of nitriles (cyanides) or esters

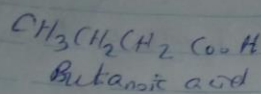
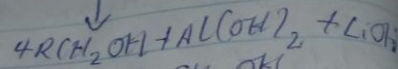
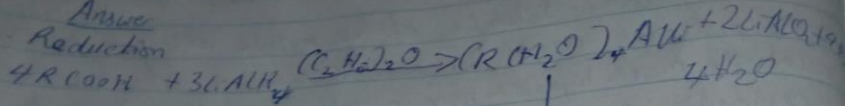


R = alkyl or aryl  
R' = alkyl

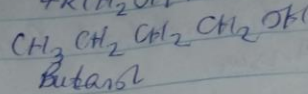
With chemical equation only outline the reduction, decarboxylation and esterification of Carboxylic acid.

Answer

a. Reduction

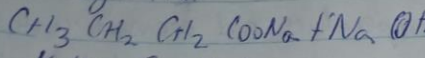


Butanoic acid

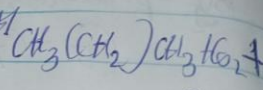
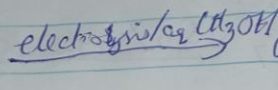
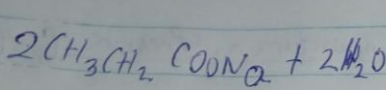
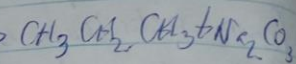


Butanol

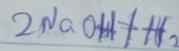
b. Decarboxylation:



Kolbe Synthesis



(anode)



(cathode)

Esterification

