

1. Give the IUPAC names of the following compounds

HCOOH - Methanoic acid $\text{HCOOCCH}_2\text{CH}_2\text{COOH}$ - Pentan-1,3-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 $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH}$ - Hex-4-enoic acid

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

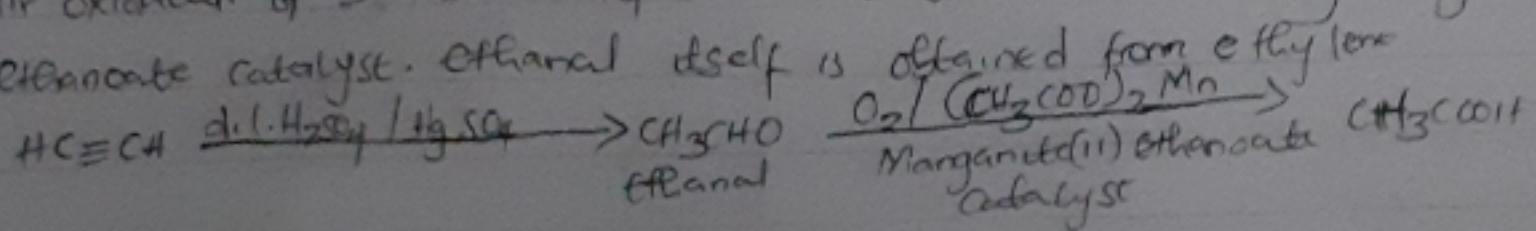
i. Physical appearance: All simple aliphatic carboxylic acids up to C_{10} are liquids at room temperature. Most other carboxylic acids are solids at room temperature although anhydrous carboxylic acid (acetic acid) also known as glacial ethanoic acid freezes to an ice-like solid below the room temperature.

ii. Boiling points: Boiling point 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.

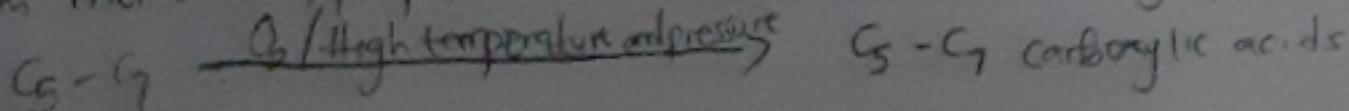
iii. Solubility: Lower molecular mass carboxylic acids with up to four carbon atoms in their molecules are soluble in water; this largely due to their ability to form hydrogen bonds with water molecules. The water solubility of the acids decreases as the relative molecular mass increases because the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

3. Write two industrial preparations of carboxylic acid

i. 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. Ethanal itself is obtained from ethylene

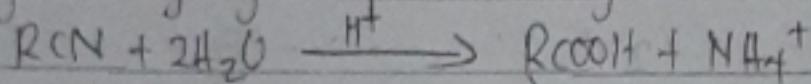


ii. From Petroleum: Liquid phase air oxidation of C_5-C_7 alkanes, obtainable from petroleum at high temperature and pressure will give C_5-C_7 carboxylic acid with methanoic, propanoic and butanoic acids as by-products

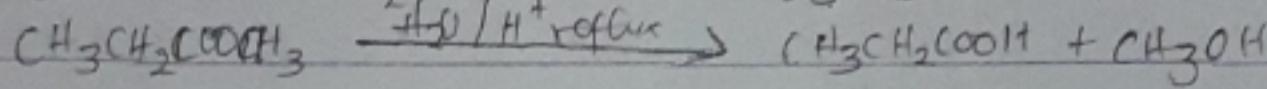
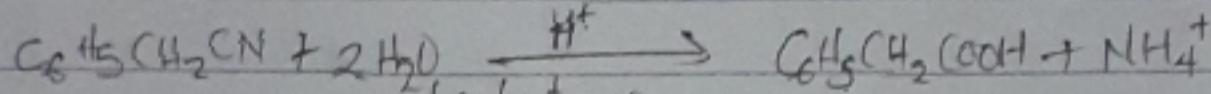
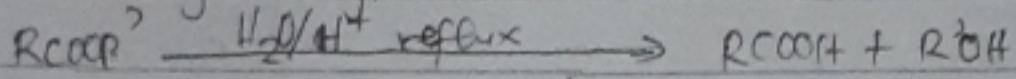


2) with equations and brief explanation discuss the Synthetic preparation of citroylic acid

1. Intramolecular hydrolysis of nitrilos (cyanides) or esters

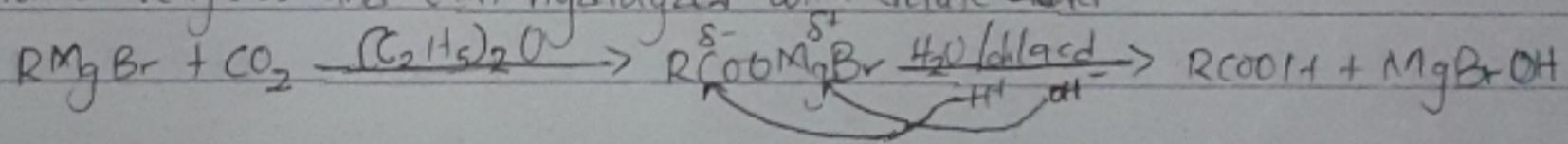


(R = alkyl or aryl radical)



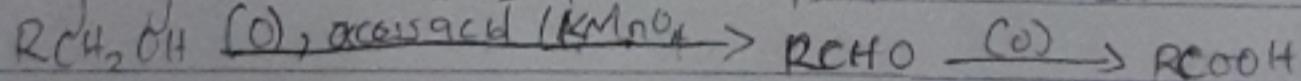
11) Carbonation of Grignard reagent

Aliphatic carboxylic acids are obtained by bubbling carbon (IV) oxide into the Grignard reagent and then hydrolyzed with dilute acid.



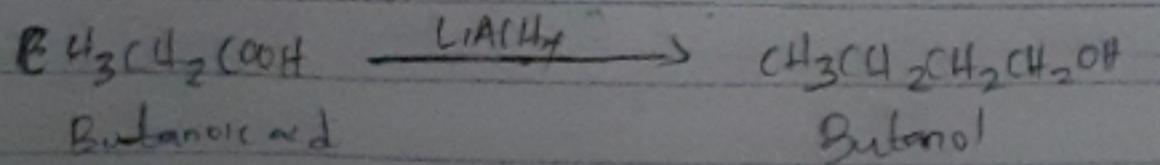
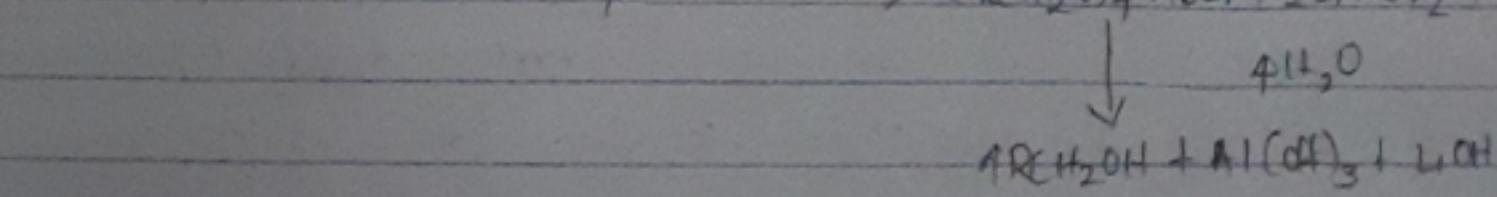
R may be 1°, 2°, 3° aliphatic alkyl or aryl radical

iii) Oxidation of primary alcohols and aldehydes: Oxidation of primary alcohols and aldehydes can be used to prepare carboxylic acids using the usual oxidizing agents (i.e. $K_2Cr_2O_7$ or $KMnO_4$) in acidic solutes.



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

$$\text{Reduction: } 4\text{RCOOH} + 3\text{LiAlH}_4 \longrightarrow (\text{RCOCH}_2)_4\text{AlLi} + 2\text{LiAlD}_2 + 4\text{H}_2$$



Thermal decarbonylation

