

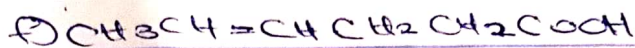
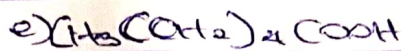
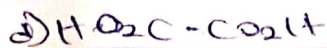
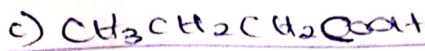
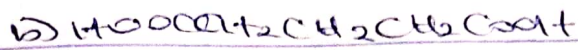
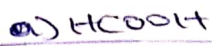
Assignment (CHM 102)

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MBS

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1) Give the IUPAC names of the following compounds



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

i) Physical appearance

ii) Boiling point

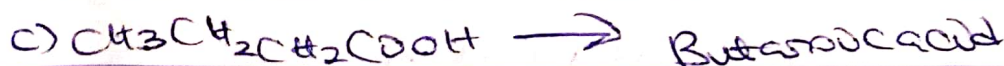
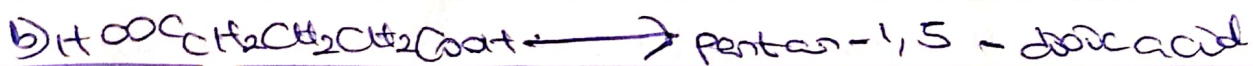
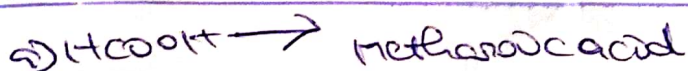
iii) Solubility

3) Write two industrial preparations of carboxylic acids

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

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

Answer



d) $\text{H}_2\text{C}=\text{CO}_2\text{H} \rightarrow$ Ethanoic acid

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

f) $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH} \rightarrow$ 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 solids at room temperature although acetylenic carboxylic acid (acetic acid) also known as glacial ethanoic acid freezes to an ice-like solid below the room temperature.

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.

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) From carbon(Cu) oxide

Methanoic acid (formic acid) is manufactured by adding Cu) oxide under pressure to hot aqueous solution.

1) From ethanal

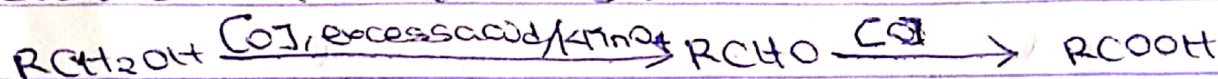
Ethanoic acid is obtained commercially by the liquid phase air-oxidation of 5% solution of ethanal to ethanoic acid, using manganese (II) ethanoate catalyst.

Ethanal itself is obtained from ethylene



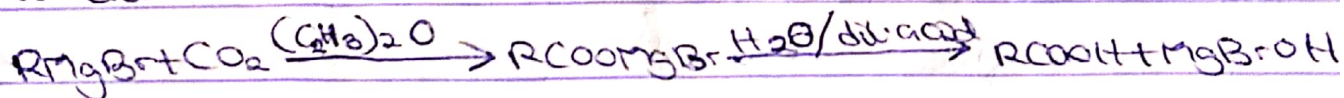
1) Oxidation of primary alcohols and aldehydes

Oxidation of primary alcohols and aldehydes can be used to prepare carboxylic acids using the usual oxidizing agents (i.e. $\text{K}_2\text{Cr}_2\text{O}_7$ or KMnO_4) in acidic solution.



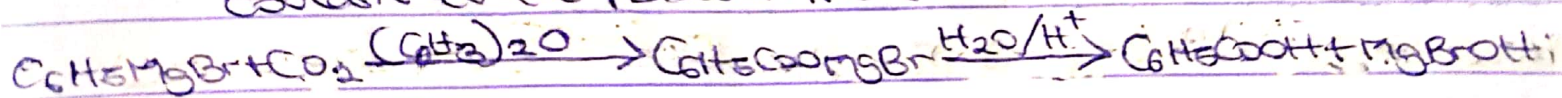
1) Carboxylation of Grignard reagent

Aliphatic carboxylic acids are obtained by bubbling carbon dioxide into the Grignard reagent and then hydrolyzed with dilute acid.

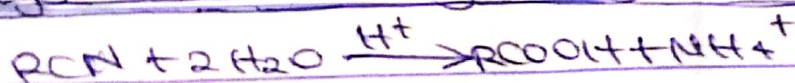


R may be 1°, 2°, 3° aliphatic alkyl or aryl radical

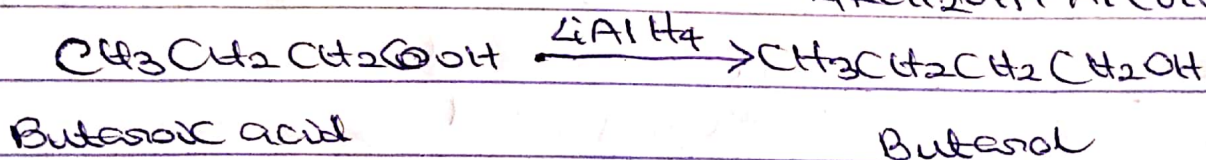
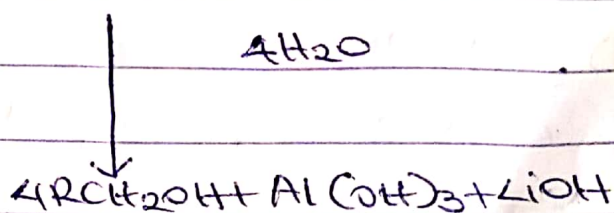
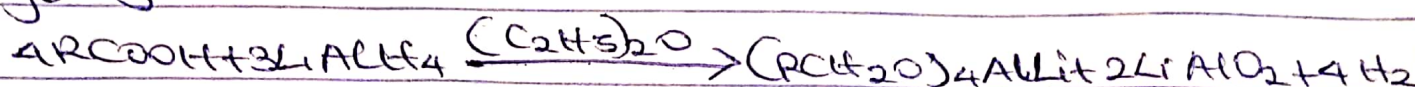
In the preparation of benzoic acid, the reagent is added to solid carbon(IV) oxide (dry ice) which also serves as coolant to the reaction mixture.



1) Hydrolysis of nitriles (cyanides) or esters



Carboxylic acids are very difficult to reduce by catalytic hydrogenation or dissolving metals but lithium tetrahydridoaluminate (III) and diboreane form intermediate compounds with acids which liberate the alcohol on hydrolysis.



4) Decarboxylation

This involves removal of the carboxyl group from the acid to give hydrocarbon or its derivative.

Thermal decarboxylation

Carboxylic acids with a strong electron attracting group eg -COOH, -CN, NO₂, C=O decarboxylate readily on heating to 100-150°C while others decarboxylate when their salts are heated with soda lime.

