

LECTURER'S NAME:

DATE SUBMITTED: 19/04/20

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DEPARTMENT: MECHANICAL

MATRIC NO: 1916NG051001

Assignment

1. Give the IUPAC names of the following compounds:

i. HCOOH \Rightarrow Methanoic acid.

ii. $\text{HOOCCH}_2\text{CH}_2\text{CH}_2\text{COOH}$ \Rightarrow Pentan-1,5-dioic acid.

iii. $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ \Rightarrow Butanoic acid.

iv. $\text{HO}_2\text{C}-\text{CO}_2\text{H}$ \Rightarrow Oxalanoic acid.

v. $\text{CH}_2\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{COOH}$ \Rightarrow Hex-4-enoic acid.

vi. $\text{CH}_3(\text{CH}_2)_4\text{COOH}$ \Rightarrow Hexanoic acid.

2. Discuss briefly the physical properties of carboxylic acid under the following headings:

i. Physical appearance

ii. Boiling point

iii. Solubility.

a. Physical appearance

All simple aliphatic carboxylic acids up to 40 are liquids at room temperature. Most are 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

Boiling point increases with increasing relative molecular mass. Aromatic carboxylic acids are crystalline solids and have higher boiling points than their aliphatic counterparts of comparable relative molecular mass.

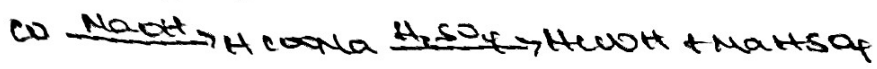
c. Solubility

Lower molecular mass carboxylic acids with up to four carbon atoms in their molecules are soluble in water; this is 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.

2. Write two industrial preparations of carboxylic acids.

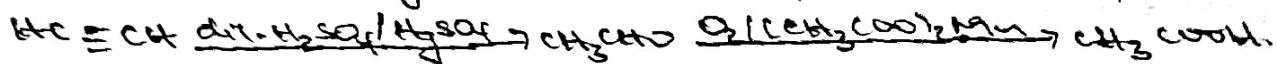
i. from carbon(II)oxide,

Methanoic acid (formic acid) is manufactured by adding carbon(II)oxide under pressure to hot aqueous solution of sodium hydroxide. The free carboxylic acid is liberated by careful reaction with tetraoxosulphuric acid (H_2SO_4)



ii. from ethanal.

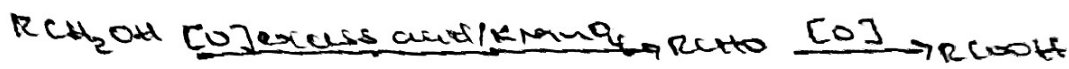
Ethanoic acid is obtained commercially by the liquid phase air-oxidation of 5% solution of ethanal to ethanoic acid using manganese(II) ethanoate catalyst. Ethanal itself is obtained from ethylene.



9. With equations and brief explanation discuss the synthetic preparation of carboxylic acid.

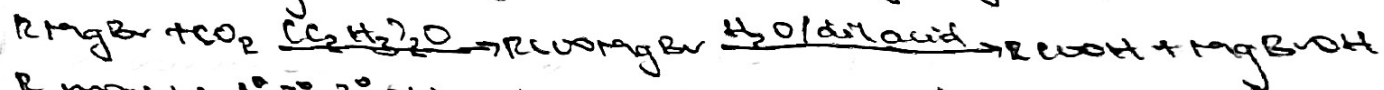
1. Oxidation of primary alcohols and aldehydes.

Oxidation of primary alcohols and aldehydes can be used to prepare carboxylic acids using the usual oxidizing agents like $K_2Cr_2O_7$ or $KMnO_4$ in acidic solution.



2. Carboxylation of Grignard reagent.

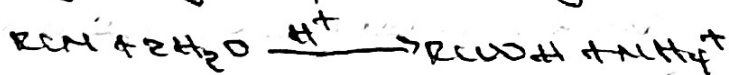
Aliphatic carboxylic acids are obtained by bubbling carbonic oxide into the Grignard reagent and then hydrolyzed with dilute acid.



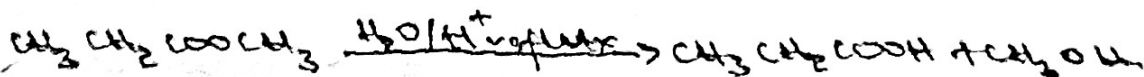
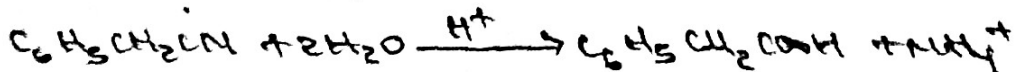
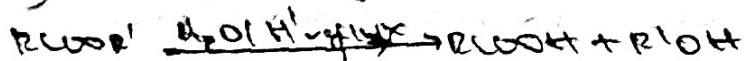
R may be 1°, 2°, 3° aliphatic alkyl or aryl radical.

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

3. Hydrolysis of nitriles (cyanides) or esters.



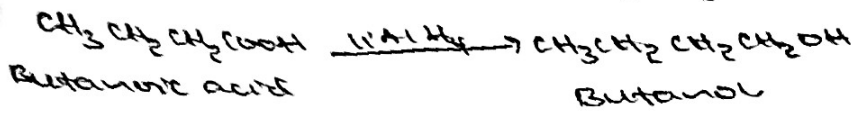
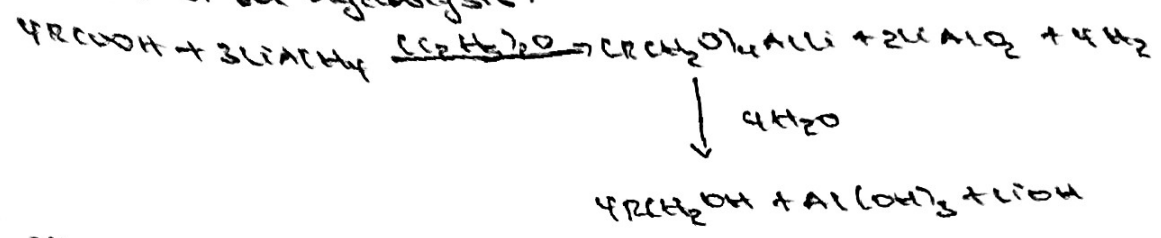
(R = alkyl or aryl radical)



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

1. Reduction of primary alcohol.

Carboxylic acids are very difficult to reduce by catalytic hydrogenation or dissolving metals but lithium tri-tert-butylaluminum hydride (LiAlH₄) and diborane form intermediate compounds with the acid which liberate the alcohol on hydrolysis.

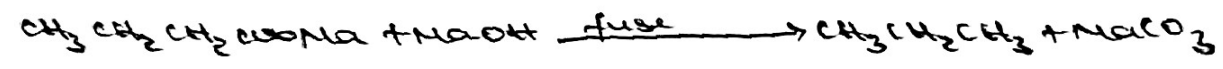


2. Decarboxylation.

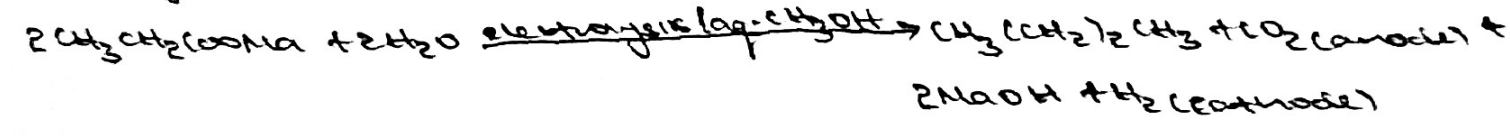
This involves removal of the carboxyl group from the acid to give a hydrocarbon or its derivative.

Thermal decarboxylation.

Carboxylic acids with strong electron attracting groups e.g. -COOH, -CHO, -NO₂ decarboxylate readily on heating to 100-150°C while others decarboxylate when their salts are heated with soda lime.



Kolbe synthesis.



3. Esterification

In the presence of strong acid catalyst carboxylic acids react with alcohols to form esters

