

NAME - MARKMANUEL AGBEZIBE MARKBERE WINNER

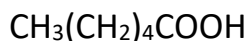
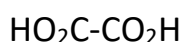
DEPT - MECHANICAL ENGINEERING

MATRIC NO – 19/ENG06/035

CHEM 102: GENERAL CHEMISTRY II

### Assignment

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

### ANSWERS

1. HCOOH - Methanoic acid

HOOCCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>COOH - Pentan-1,5-dioic acid

CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>COOH - Butanoic acid

HO<sub>2</sub>C-CO<sub>2</sub>H - Ethanedioic acid

CH<sub>3</sub>(CH<sub>2</sub>)<sub>4</sub>COOH - Hexanoic acid

CH<sub>3</sub>CH=CHCH<sub>2</sub>CH<sub>2</sub>COOH - Hex-4-eneoic acid

2.

i. Physical appearances All simple aliphatic carboxylic acids up to C<sub>10</sub> 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.

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. Industrial preparations of carboxylic acids

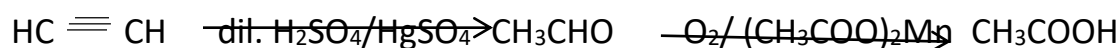
a. From Carbon(II) oxide

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 tetraoxosulphate (vi) acid (H<sub>2</sub>SO<sub>4</sub>)



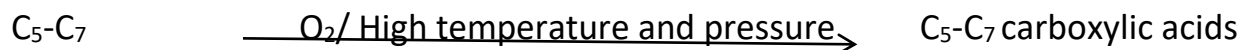
b. From ethanal

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



c. From petroleum

Liquid phase air oxidation of C<sub>5</sub>-C<sub>7</sub> alkanes, obtainable from petroleum at high temperature and pressure will give C<sub>5</sub>-C<sub>7</sub> carboxylic acids with methanoic, propanoic and butanedioic acids as by-products.



4. Synthetic preparation of carboxylic acid

a. 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<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> or KMnO<sub>4</sub>) in acidic solution



b. Carbonation of Grignard reagent

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

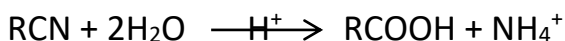


R may be 1°, 2°, 3° aliphatic alkyl or aryl radical

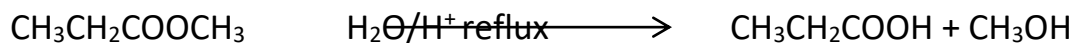
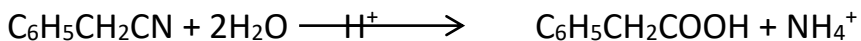
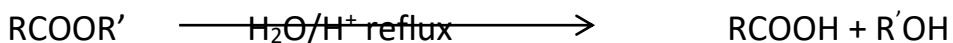
In the preparation of benzoic acid, the reagent is added to solid carbon (IV) oxide (dry ice) which also serves as coolant to the reaction mixture



c. Hydrolysis of nitriles (cyanides) or esters

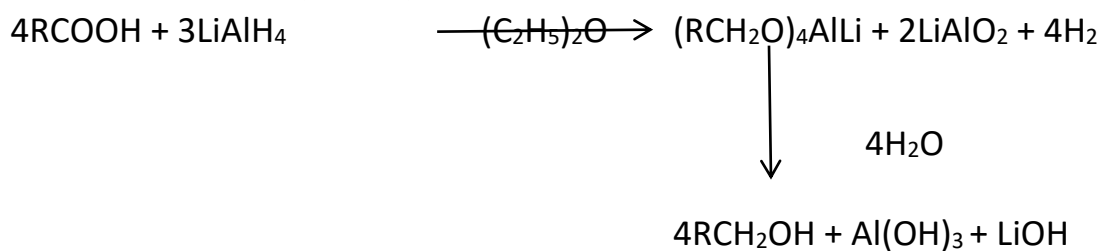


(R=alkyl or aryl radical)



5.

a. Reduction to primary alcohol



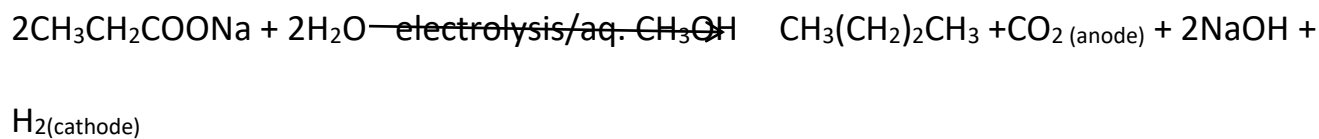
Butanoic acid

Butanol

b. Decarboxylation



Kolbe synthesis



c. Esterification

