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100 LEVEL
19/MHS01/077
MEDICINE AND SURGERY
MEDICINE AND HEALTH SCIENCES

CHEM 102 - GENERAL CHEMISTRY II

ASSIGNMENT

1. Give the IUPAC names of the following organic compounds

CH_3OCH_3 - Methoxymethane

$CH_3CH_2OCH_2CH_3$ - Ethoxymethane

$(CH_3CH_2CH_2CH_2)_2O$ - Butoxymethane

$CH_3CH_2OCH_3$ - Methoxyethane

$CH_3CH_2CH_2OCH_2CH_3$ - Ethoxypropane

2. Discuss the properties of Ethers.

At room temperature, ethers are colourless, neutral liquids with pleasant odours. The lower aliphatic ethers are highly flammable gases or volatile liquids.

Ethers are less soluble in water than are the corresponding alcohols. Lower molecular weight ethers such as methoxymethane and methoxyethane are fairly soluble in water since the molecule are able to form hydrogen bonds with the water molecules but as the hydrocarbon content of the molecule increases, there is a rapid decline in solubility. They are miscible with most organic solvents.

Most of the simple ethers are less dense than water, although the density increases with increasing relative molecular mass and some of the aromatic ethers are in fact denser than water.

Low molecular mass ethers have a lower boiling point than the corresponding alcohols but for those ethers containing alkyl radicals larger than four carbon

atoms, the reverse is true. The boiling point of ethers tend to approximate those of hydrocarbons of same relative molecular mass from which it can be concluded that the molecules are not associated in the liquid phase as there are no suitably available hydrogen for association through hydrogen bonds.

Ethers are inert at moderate temperature. Their inertness at moderate temperature leads to their wide use as reaction media.

Simple ethers are not found commonly in nature but the ether linkage is present in such natural products as sugars, starches and cellulose.

3. Discuss explicitly two methods of preparing ethers and show equations of reactions.

Method 1

Preparation of Ethers by dehydration of Alcohols

In the presence of protic acids (sulphuric acid), alcohols undergo catalytic dehydration to produce alkenes and ethers under different conditions. The process of continuous etherification occurs here. For example: in the presence of sulphuric acid, dehydration of ethanol at 443K (or between 170°C - 180°C) yields ethene whereas it yields ethoxyethane at 413K (140°C). This is an ideal method of preparation through primary alcohols.

$$2ROH \xleftarrow{\text{conc. } H_2SO_4 \,/\, 140^\circ C} R-O-R + H_2O$$

Eg

$$2CH_3CH_2OH \xleftarrow{\text{conc. } H_2SO_4 \,/\, 140^\circ C} CH_3CH_2-O-CH_2CH_3 + H_2O$$

or:

$$CH_3CH_2OH \begin{cases} \xrightarrow[443K]{H_2SO_4} CH_2 = CH_2 \\ \xrightarrow[413K]{H_2SO_4} C_2H_5OC_2H_5 \end{cases}$$

The preparation of ethers by dehydration of alcohol is a nucleophilic substitution reaction. The two molecules of the alcohol act as a substrate and a nucleophile each. It can follow either an S_N1 or S_N2

mechanism. The choice of the mechanism depends on whether the protonated alcohol loses water before or simultaneously upon the attack of a second alcohol molecule. Generally, the secondary and tertiary alcohols follow the S_N1 mechanism while the primary alcohol follows the S_N2 mechanism.

Method 2

Preparation of Ethers by Williamson Synthesis

Williamson synthesis is an important method for the preparation of symmetrical and asymmetrical ethers in laboratories. Here, alkyl halides (primary and secondary) react with sodium alkoxide ($R'ONa$) or Potassium alkoxide ($R'OK$) to produce ethers.

$$R-X + R'ONa \longrightarrow ROR'$$

Tertiary alkyl halides are not used in Williamson's Synthesis because tertiary alkyl halides prefer to undergo elimination instead of substitution. Hence, if we are to prepare t-Butyl methyl ether, we will use $(CH_3)_3CONa$ and CH_3Br; and not $(CH_3)_3CBr$ and CH_3OH.

4. State three uses of ethylene oxide.

(i) Ethylene oxide is used as an intermediate in the hydrolytic manufacture of ethylene glycol (paracetamol).

(ii) Ethylene oxide is used as a gaseous sterilizing agent.

(iii) Ethylene oxide is used in the preparation of nonionic emulsifying agents, plastics, plasticizers and several synthetic textiles.