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Dept.: PHARMACY
Course: CHM 102

Assignment

1. Give the IUPAC names of the following organic compounds

CH_3OCH_3 $CH_3CH_2OCH_3$
$CH_3CH_2OCH_2CH_3$ $CH_3CH_2CH_2OCH_2CH_3$
$CH_3CH_2CH_2CH_2)_2O$

Answer

i. CH_3OCH_3 – Methoxymethane
ii. $CH_3CH_2OCH_2CH_3$ – Ethoxyethane
iii. $(CH_3CH_2CH_2CH_2)_2O$ – Butoxybutane
iv. $CH_3CH_2OCH_3$ – Ethoxymethane
v. $CH_3CH_2CH_2OCH_2CH_3$ – Ethoxypropane

2. Discuss the properties of ethers.

Answer

The properties of ethers will be discussed under their physical and chemical properties.

Physical Properties of Ethers

i. Lower member methylether and methylethylether are gases while higher members are colourless, pleasant smelling, low boiling, and volatile liquids.
ii. They are lighter than water and sparingly soluble in water but readily soluble in organic solvent such as benzene, chloroform.
iii. The boiling points of ethers are much lower than those of isomers alcohols.
iv. Lower ethers acts as anesthetics and their vapours are highly inflammable.
v. Ethers are polar molecules and have definite dipole moment.

Chemical Properties of Ethers

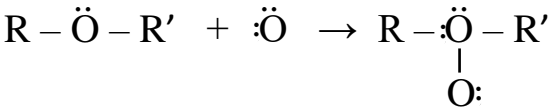
Ethers are chemically less reactive because of their structure. They lack the active hydrogen attached to oxygen as present in alcohols. They show reaction due to the presence of;

i. **Alkyl Radicals:** Their reactions are substitution reactions as in case of alkanes.
ii. **Ethereal Oxygen:** These co-ordinates with electron deficient molecules or lewis acids.
iii. **Carbon-Oxygen Bond:** This carbon-oxygen linkage is fairly stable but not as stable of carbon-carbon linkage and thus it shows some cleavage reactions.

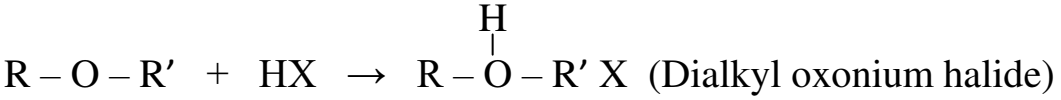
Some of the chemical reactions undergone by ethers include:

a. Reactions of the alkyl group – Substitution
   i. **Halogenations:** Ethers undergo halogenations at alkyl radical when reacted with chlorine or bromine in the presence of sunlight to form halogen substituted ethers.
   ii. **Combustion:** Ethers are volatile and highly inflammable.
   $C_2H_5OC_2H_5 + 6O_2 \rightarrow 4CO_2 + 5H_2O$

b. Reactions of the Ethereal Oxygen.
   i. **Formation of Peroxide:** Ethers form peroxides by the prolonged action of atmospheric oxygen or ozonized oxygen.



   ii. Formation of Oxonium Salts:
   Ethers form oxonium salts with strong mineral acids in high concentration and once formed remain in oxygen.



c. Reaction involving cleavage of carbon-oxygen bond.
   i. **Hydrolysis:** Ethers on boiling with water or when treated with stem are hydrolyzed to form alcohols.

ii. **Action of Sulphuric Acid:** Acid Ethers form the corresponding oxonium salts when treated with hot sulphuric acid.

iii. **Action of Hydrobromic or Hydroiodic Acid:** Ethers react with hydrobromic or hydroiodic acids in cold to form an alcohol and alkyl halide.

$$R - O - R + HI \xrightarrow{Cold} ROH + RI$$

$$CH_3OC_2H_5 + HI \xrightarrow{Cold} \underset{\text{Methyiodide}}{CH_3I} + \underset{\text{Ethanol}}{C_2H_5OH}$$

d. Ethers are oxidized with strong oxidizing agents to form aldehyde or acids.

$$C_2H_5{\cdot}O{\cdot}C_2H_5 \xrightarrow[-\ H_2O]{K_2CrO_7/Acid} \underset{\text{Acetaldehyde}}{2CH_3{\cdot}CHO} \xrightarrow{O} \underset{\text{Acetic Acid}}{2CH_3{\cdot}COOH}$$

e. Dehydration: When ether vapours are passed over heated alumina, dehydration of ethers occurs to form alkenes.

$$C_2H_5{\cdot}O{\cdot}C_2H_5 \xrightarrow[360^0C]{Al_2O_3} 2CH_2 = CH_2 + H_2O$$

3. Discus explicitly two methods of preparing ethers and show equations of reaction.

Answer

Preparation of Ethers

i. Williamson Synthesis:

Williamson synthesis is the most important method of laboratory preparation of ethers and consists of heating alkylhalides with sodium or potassium alkoxides.

$$\underset{\text{Sodium alkoxide}}{R{\cdot}ONa} + \underset{\text{Alkylhalide}}{X\,R'} \xrightarrow{\triangle} \underset{\text{Ether}}{R{\cdot}O{\cdot}R'} + NaX$$

$$\underset{\text{Sodium ethoxide}}{C_2H_5ONa} + \underset{\text{Ethylchloride}}{Cl{\cdot}C_2H_5} \xrightarrow{\triangle} \underset{\text{Ethoxyethane}}{C_2H_5{\cdot}O{\cdot}C_2H_5} + NaCl$$

$$CH_3{\cdot}O{\cdot}K + Br{\cdot}C_2H_5 \xrightarrow{\triangle} CH_3{\cdot}O{\cdot}C_2H_5 + KBr$$

Potassium methoxide — Ethylbromide — Ethoxymethane

The reaction is most suitable for preparing mixed or unsymmetrical ethers. Primary alkylhalides gives fairly good yield of ethers whereas secondary and tertiary alkylhalides form alkenes predominantly.

ii. Dehydration of Alcohols:

Simple or symmetrical ethers are obtained when excess of alcohol is heated with concentrated sulphuric or phosphoric acid. Two molecules of alcohol lose a water molecule amongst themselves to for ethers.

$$R{\cdot}OH + HO{\cdot}R \xrightarrow[\triangle]{H_2SO_4} R{\cdot}O{\cdot}R + H_2O$$

Alcohol (2 moles) — Ether

$$C_2H_5OH + HO{\cdot}C_2H_5 \xrightarrow[100^0C]{H_2SO_4} C_2H_5{\cdot}O{\cdot}C_2H_5 + H_2O$$

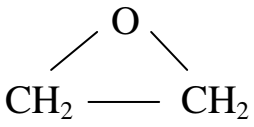
Ethanol (2 molecules) — Ethoxyethane

The method is applicable mainly to the dehydration of primary alcohols as secondary and alcohols under the condition of reaction may form alkenes predominantly.

4. State three uses of ethylene Oxide

Answer

Uses of Ethylene Oxide



Ethylene Oxide (or Epoyethane)

i. Ethylene oxide is used as a fumigant and insecticide for grain, tobacco and dried fruits.
ii. Ethylene oxide is used in preparation of glycol ethers which are used as industrial solvents.
iii. Ethylene oxide is used in the manufacture of non-ionic surface active agents and also polyethylene glycols used as industrial solvents.