Alcohols and epoxides

B. Sc I Year (Semester-II)

Presented by

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Chapter-4 : Alcohols and Epoxides

A] Alcohols :

- "Organic compounds in which -OH group is attached to saturated carbon atom are called as alcohols."
- They are also called as alkanols.
- The general molecular formula of alcohol is $C_nH_{2n+1}OH$

  Where, n - no. of carbon atoms.

  They are represented as R-OH

  Where, R - alkyl groups.
- Ex. CH_3-OH, CH_3-CH_2-OH

  Methyl alcohol Ethyl alcohol

Classification of alcohols

- Depending on number of -OH groups alcohols are classified as follows.

- **1) Monohydric alcohols:**

  Alcohols containing one hydroxyl group (-OH group) are called as monohydric alcohols.

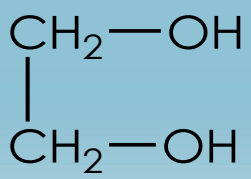
- Ex. i) CH_3-OH Methyl alcohol

  ii) CH_3-CH_2-OH Ethyl alcohol

- **2) Dihydric alcohols :**

  Alcohols containing two hydroxyl groups (-OH group) are called as dihydric alcohols.

- Ex.

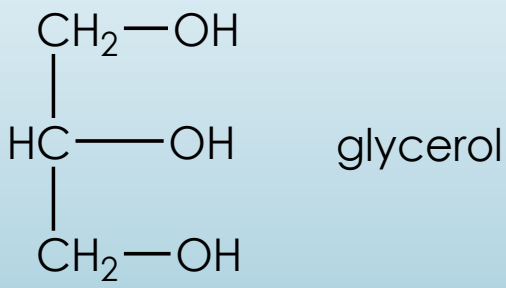


Ethylene glycol

- **3) Trihydric alcohols :**

  Alcohols containing three hydroxyl groups (-OH group) are called as trihydric alcohols.

- Ex.

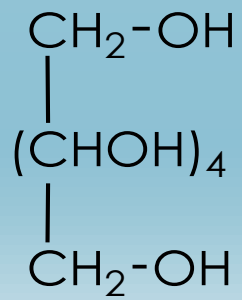


glycerol

- **4) Polyhydric alcohols:**

  Alcohols containing more than three hydroxyl groups (-OH group) are called polyhydric alcohols.

- Ex.



sorbitol

Dihydric Alcohols : Ethylene glycol

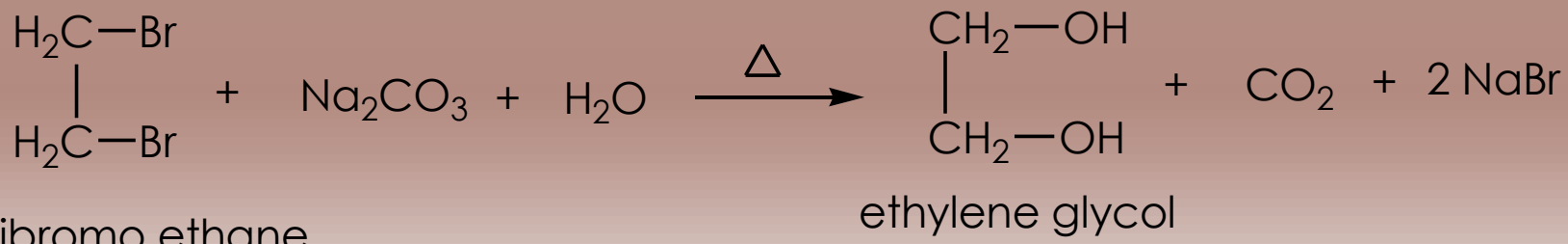
Prepration Methods :

a) From Ethene (ethylene) :

Hydrolyxation of Ethene with cold dilute alkaline KMnO4 gives ethylene glycol.

b) From 1,2-dihaloalkene (1,2-dibromo ethane) :

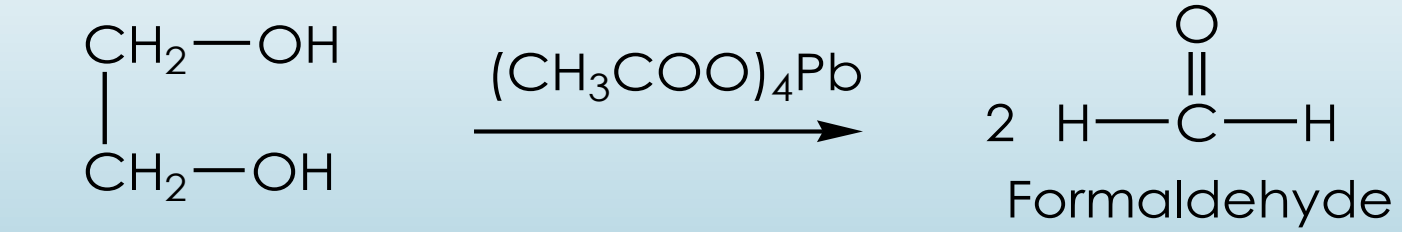
1,2-dibromo ethane on heated with aq. Solution of Na_2CO_3 gives ethylene glycol.



Chemical reactions of Ethylene glycol

a) Reaction with $Pb(OOCCH_3)_4$

- Ethylene glycol on oxidation with lead tetra acetate gives formaldehyde.

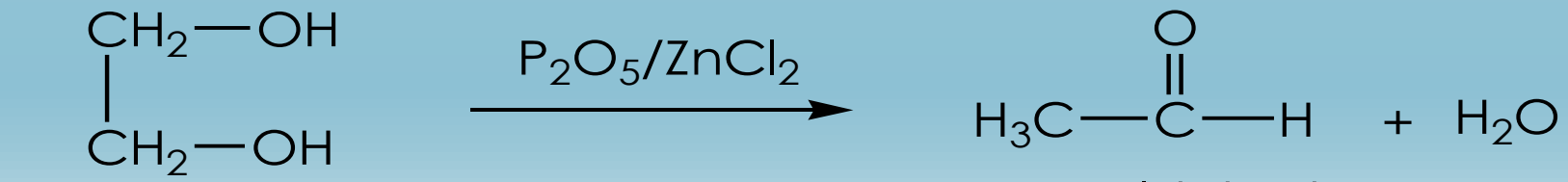


Ethylene glycol

Formaldehyde

b) Reaction with P_2O_5 / $ZnCl_2$

- Ethylene glycol on dehydration with $P_2O_5/ZnCl_2$ gives acetaldehyde.



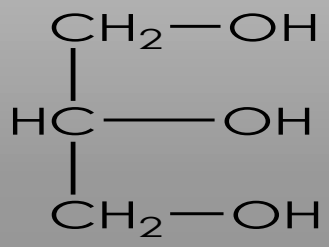
Ethylene glycol

Acetaldehyde

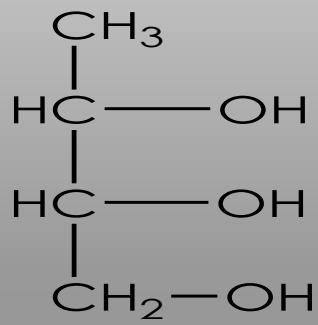
Trihydric alcohols

- Alcohols containing three hydroxyl groups (-OH group) are called as trihydric alcohols.

IUPAC nomenclature of Trihydric alcohols



Propane-1,2,3-triol

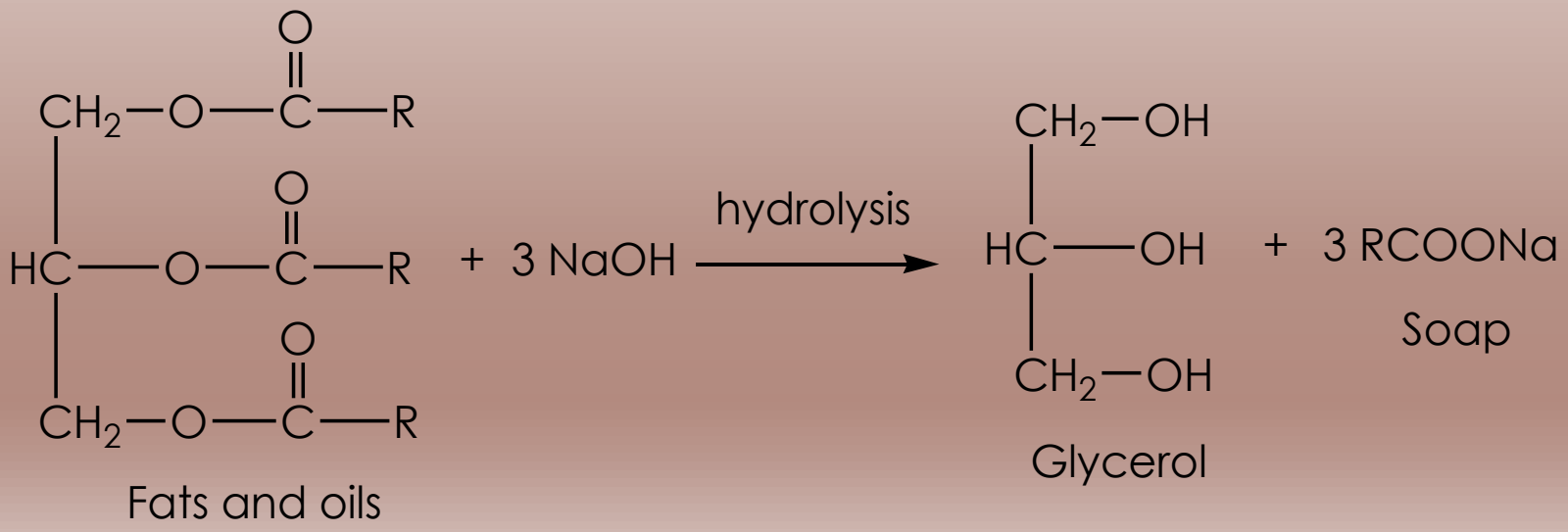


butane-1,2,3-triol

Prepration methods of Glycerol

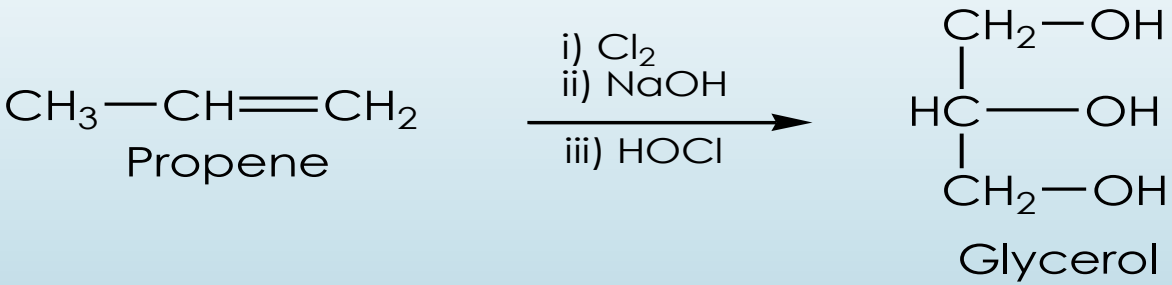
a) From fats and oils

- Fats and oils on alkaline hydrolysis to give glycerol and salts of long chain acids called as soaps.



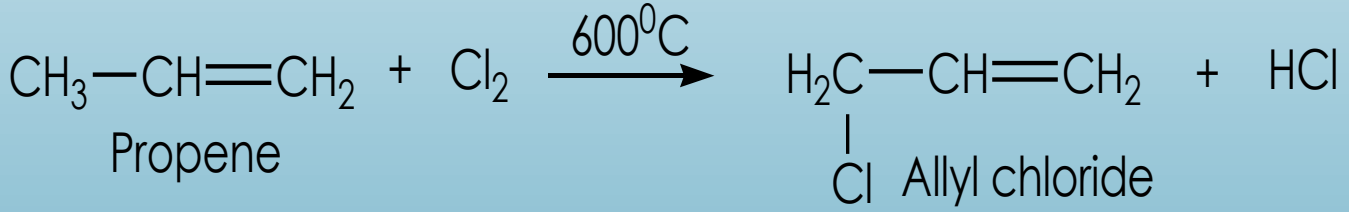
b) From Propene

- Propene on reaction with chlorine, NaOH and HOCl gives glycerol.

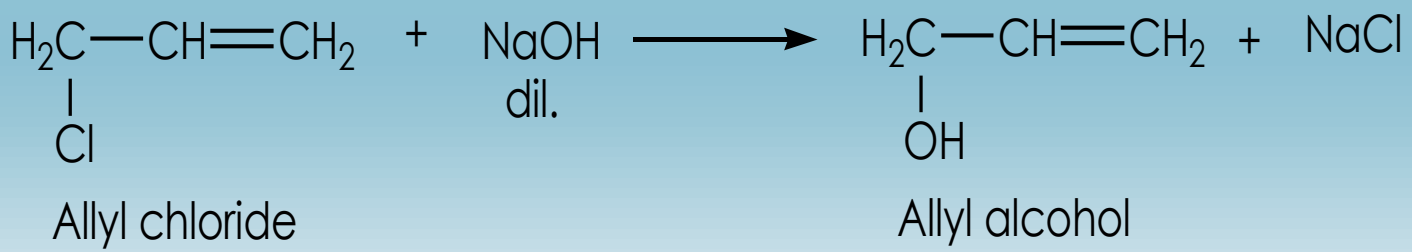


The overall reaction take place in following four steps :

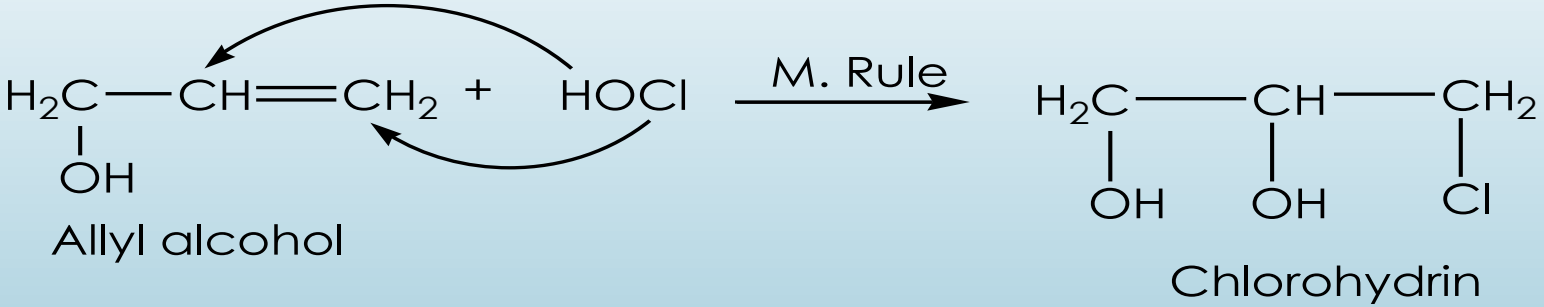
- **Step-I :** Propene react with Cl_2 at 600^0C gives allyl chloride.



- **Step-II :** Allyl chloride react with dil. NaOH gives allyl alcohol.



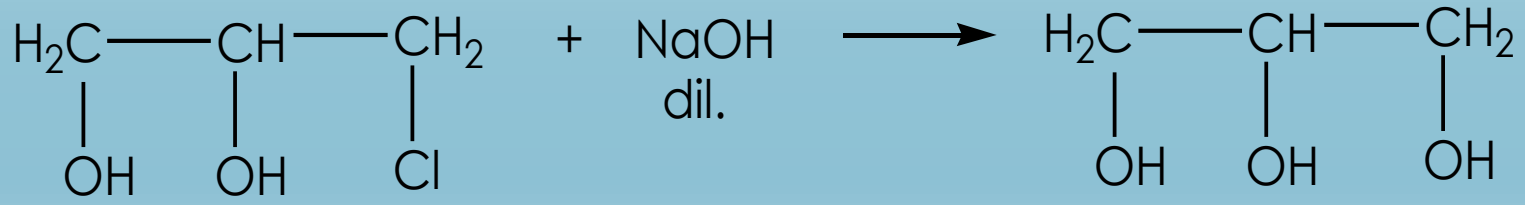
- **Step-III :** Allyl alcohol react with HOCl gives chlorohydrin according to M. rule.



Allyl alcohol

Chlorohydrin

- **Step-IV :** Chlorohydrin react with dil. NaOH gives glycerol.



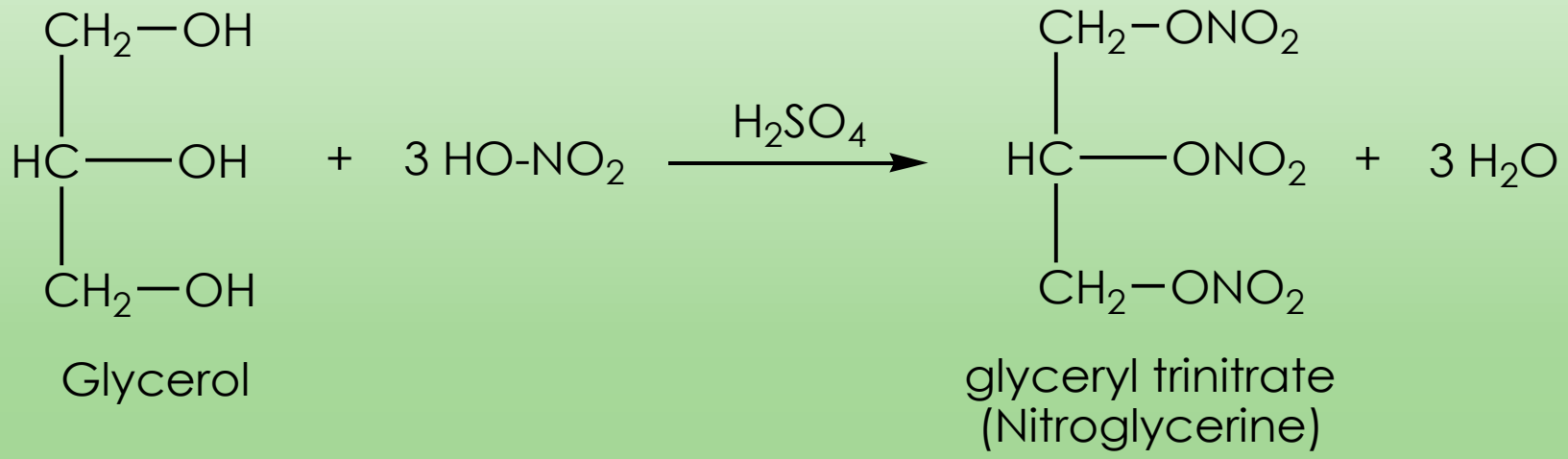
Chlorohydrin

Glycerol

Chemical reactions of Glycerol

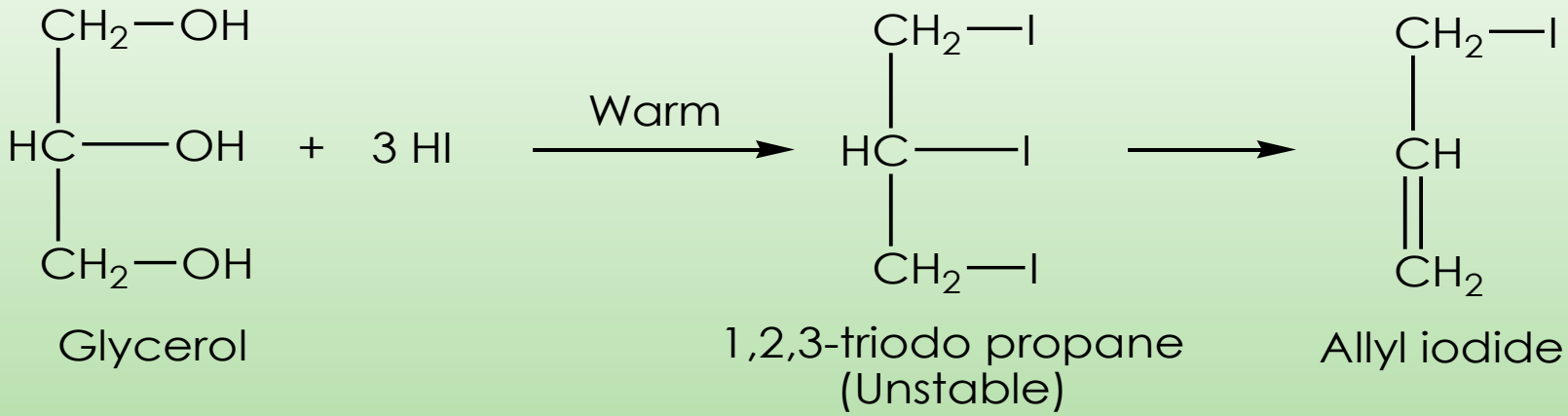
a) Reaction with HNO_3

Glycerol react with HNO_3 in the presence of H_2SO_4 gives glyceryltrinitrate or nitroglycerine. It is used as explosive.



b) Reaction with HI

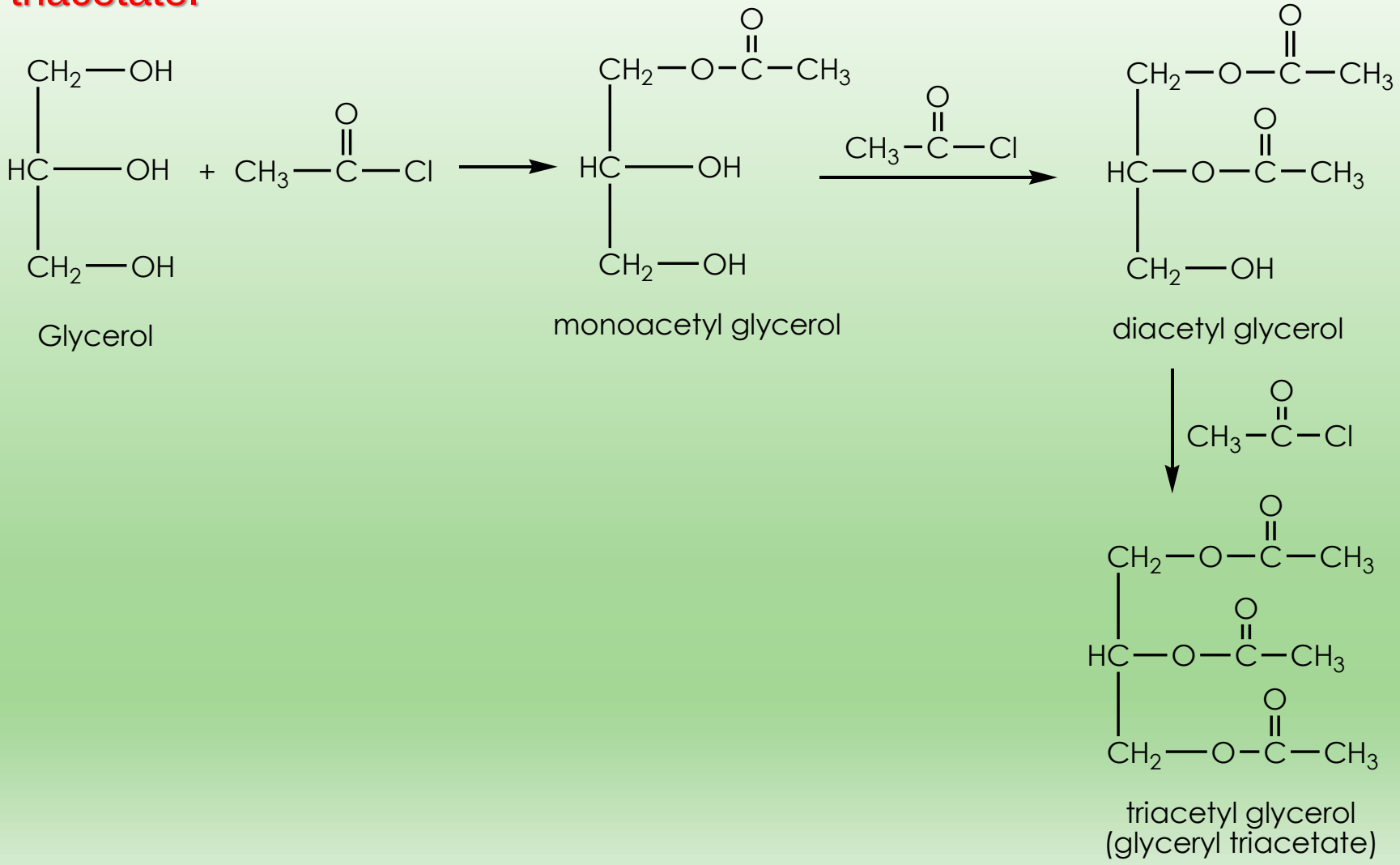
i. When glycerol react with small amount of HI gives allyl iodide.



ii. When glycerol react with large amount of HI gives isopropyl iodide.

c) Reaction with Acetyl Chloride

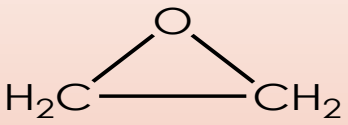
Glycerol react with three molecules of acetyl chloride gives glyceryl triacetate.



B) Epoxides

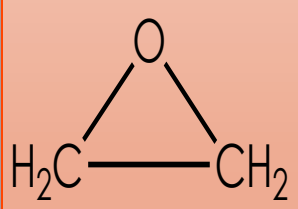
- Epoxides are cyclic ethers in which the ethereal oxygen is a part of three membered ring. They are also called as ‘Oxiranes’

Ex.

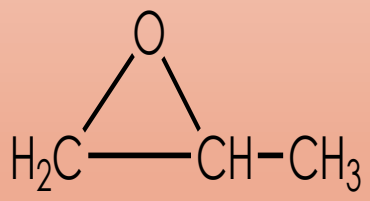


Oxirane
(Epoxy ethane)

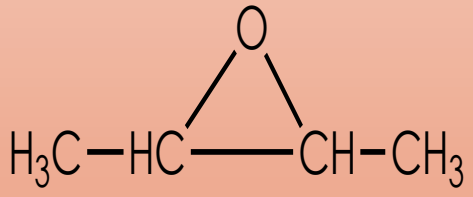
IUPAC nomenclature of Epoxides



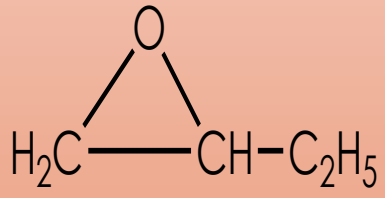
Oxirane



2-methyl oxirane



2,3-dimethyl oxirane

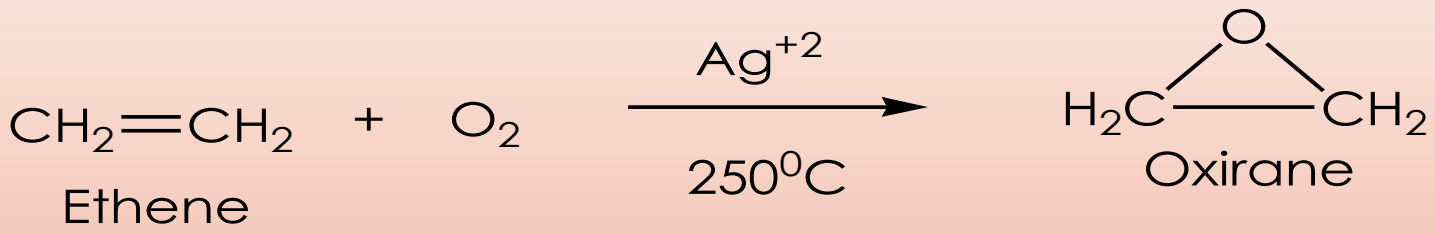


2-ethyl oxirane

Prepration methods of Epoxides

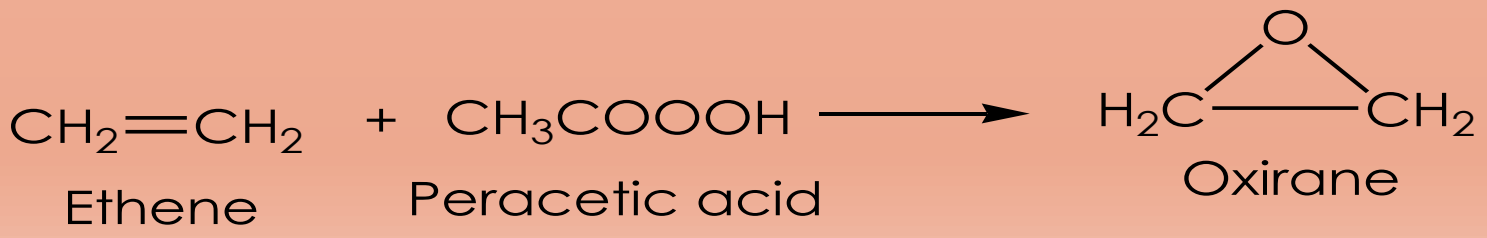
a) Oxidation of Ethene by using Ag^{+2} :

Ethene on oxidation in the presence of Ag^{+2} at 250^0 C gives oxirane.



b) Oxidation of Ethene by using peracids :

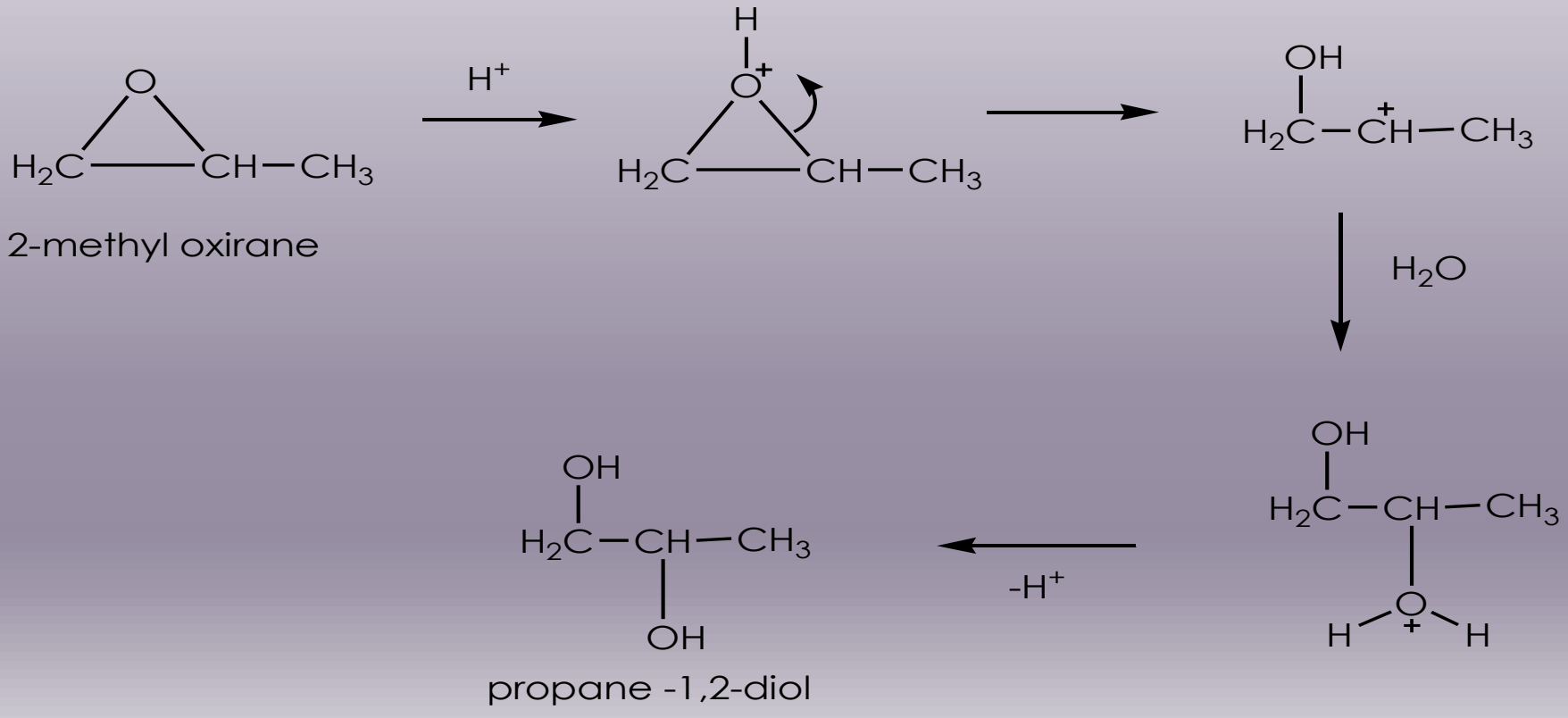
Ethene on oxidation in the presence of peracid gives oxirane.



Chemical reactions of Epoxides

a) Acid catalysed ring opening of epoxide :

- Propylene oxide (2-methyl oxirane) on acid catalysed ring opening gives propane-1,2-diol through more stable sec. carbocation.
- In acid catalysed ring opening reaction of unsymmetrical epoxide, nucleophilic attack on more substituted carbon.

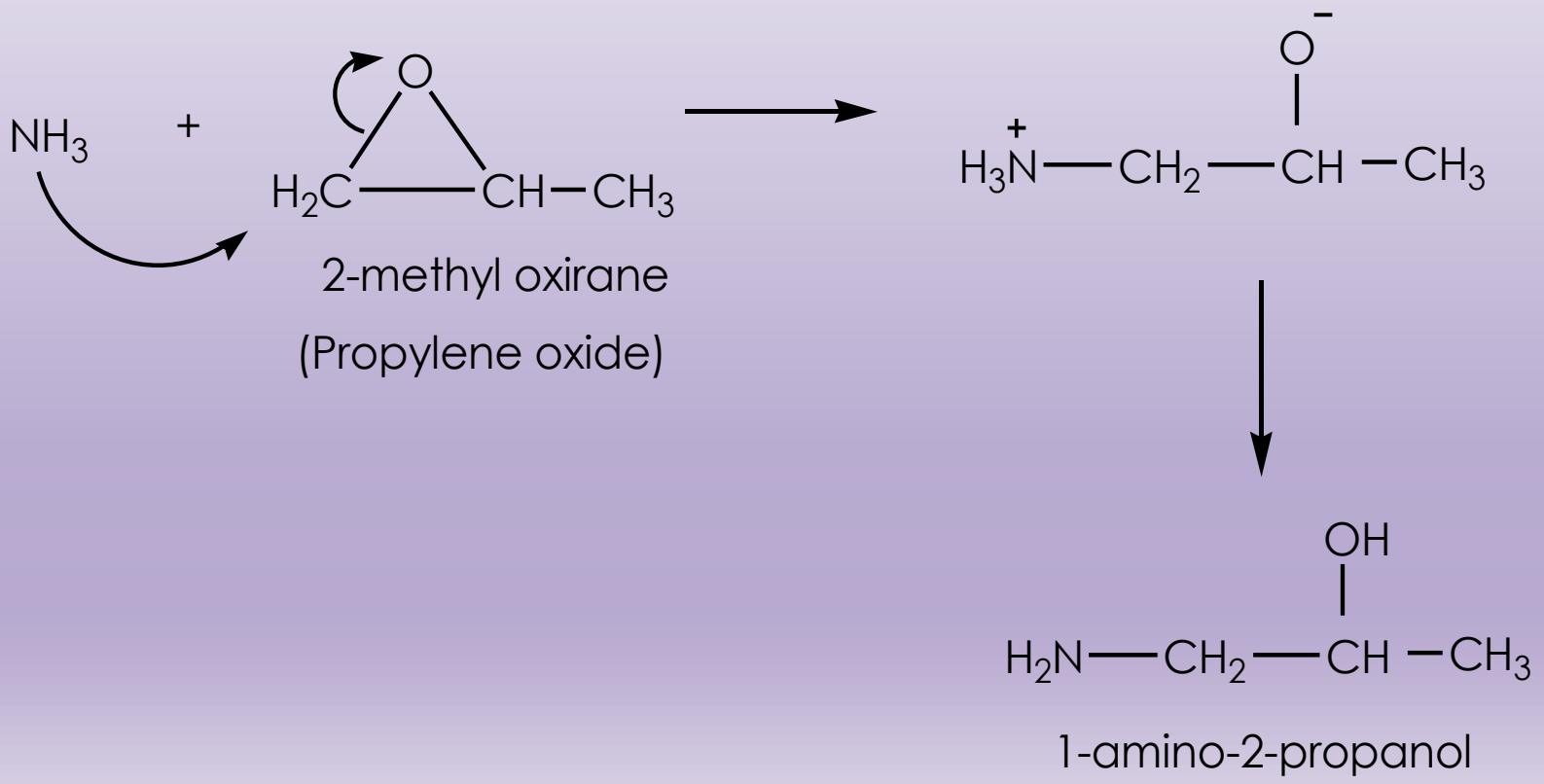


2-methyl oxirane

propane -1,2-diol

b) Base catalysed ring opening of epoxide :

- Propylene oxide (2-methyl oxirane) on base catalysed ring opening gives 1-amino-2-propanol.
- In base catalysed ring opening reaction of unsymmetrical epoxide, nucleophilic attack on less substituted carbon.



Thank You .....