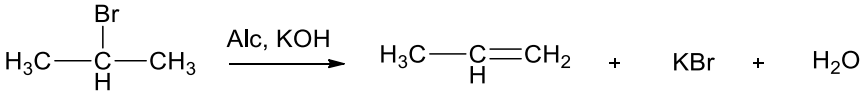
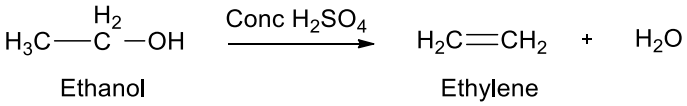
Ex: a) Dehydrohalogenation of alkyl halides



b) Dehydration of alcohols



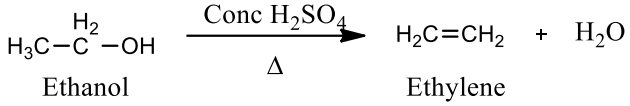
Alkenes

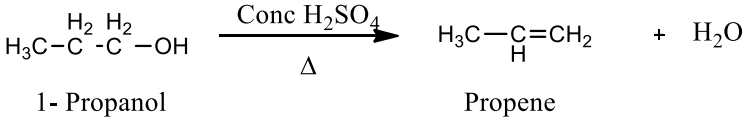
Alkenes are having general formula C_nH_{2n}.These are unsaturated hydrocarbons in which at least one carbon – carbon double bond is present. These are also called as olefins

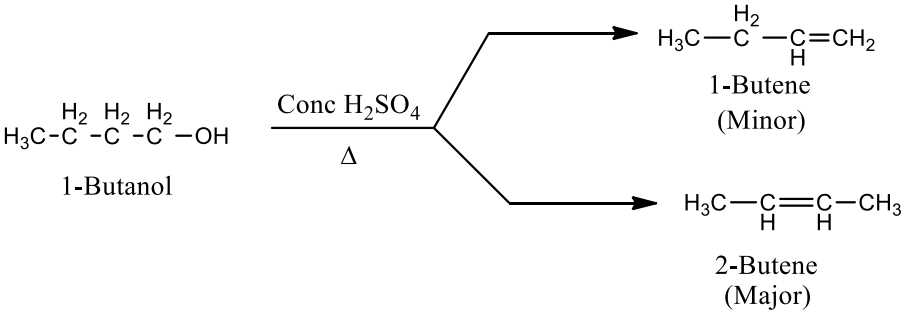
Ex: CH_2=CH_2 (Ethylene), CH_3-CH=CH_2 (Propene)

Methods of preparation of alkenes:

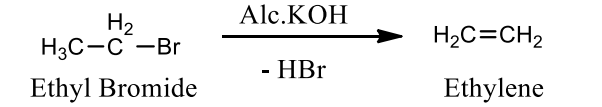
1) **By dehydration of alcohols:** Heating of alcohols in the presence of an acid catalyst (like Conc H_2SO_4, H_3PO_4, and P_2O_5 etc.) at 170^0C - 200^0C alkenes are formed.
Ex:

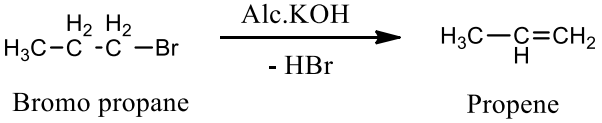






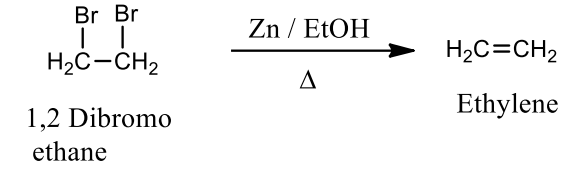
2) **By dehydrohalogenation of alkyl halides:** on heating an alkyl halides with alcoholic KOH alkenes are formed by the elimination of HX.
Ex:



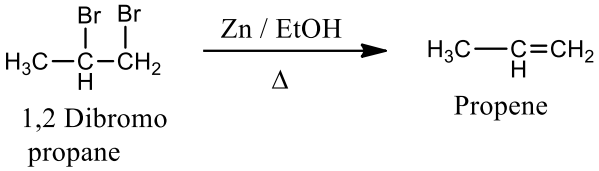


3) **By dehalogenation of Vicinal dihalides:** on heating vicinal dihalides with zinc/Ethanol forms alkenes.

Ex:



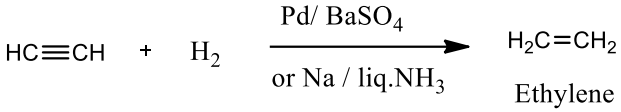
1,2 Dibromo ethane — Ethylene



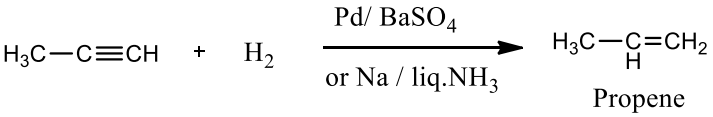
1,2 Dibromo propane — Propene

4) **By Partial Hydrogenation of Alkynes:** By partial reduction of Alkynes with Lindlar Catalyst ($Pd/BaSO_4$) or Na/liq. NH_3, alkenes are formed. With Lindlar Catalyst ($Pd/BaSO_4$) a *Cis* – Alkene is produced but Na/liq. NH_3 *Trans* – Alkene is produced.

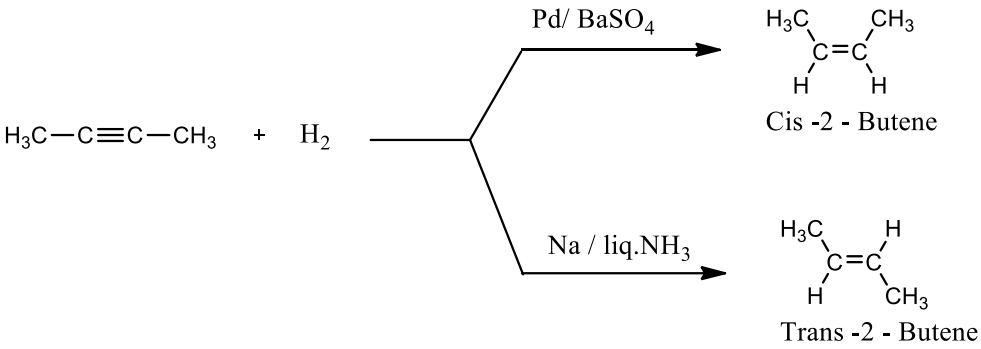
Ex:



Ethylene



Propene



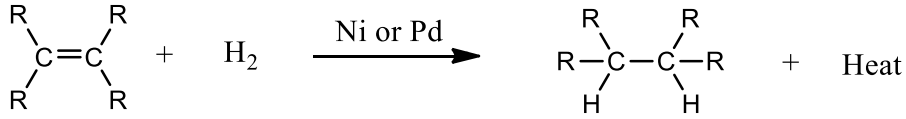
Cis -2 - Butene

Trans -2 - Butene

Chemical Properties of Alkenes:

1) **Heat of hydrogenation**:

The amount of heat energy released when one mole of alkene is converted to alkane during hydrogenation is called as Heat of hydrogenation. Heat of hydrogenation of alkenes can be measured experimentally.

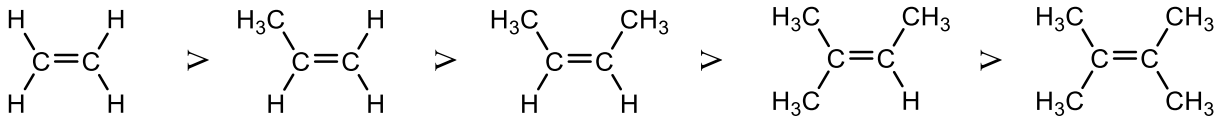


Alkene — Alkane

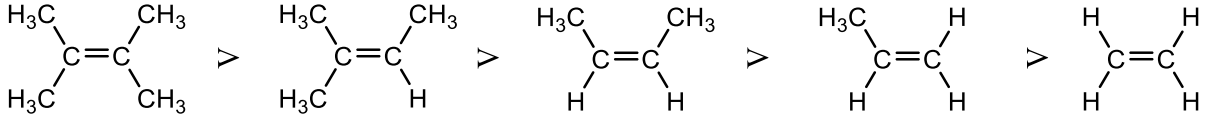
By using Heat of hydrogenation values, we can explain the stability of alkenes, if heat of hydrogenation of an alkene is more, its energy content is more and it should be less stable.

Heat of hydrogenation α $\frac{1}{\text{Stability of alkenes}}$

The order of heat of hydrogenation of some of the alkenes is

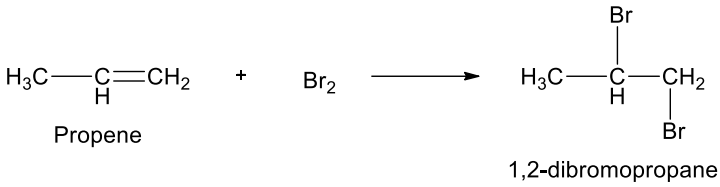


Hence the stability of above alkanes is

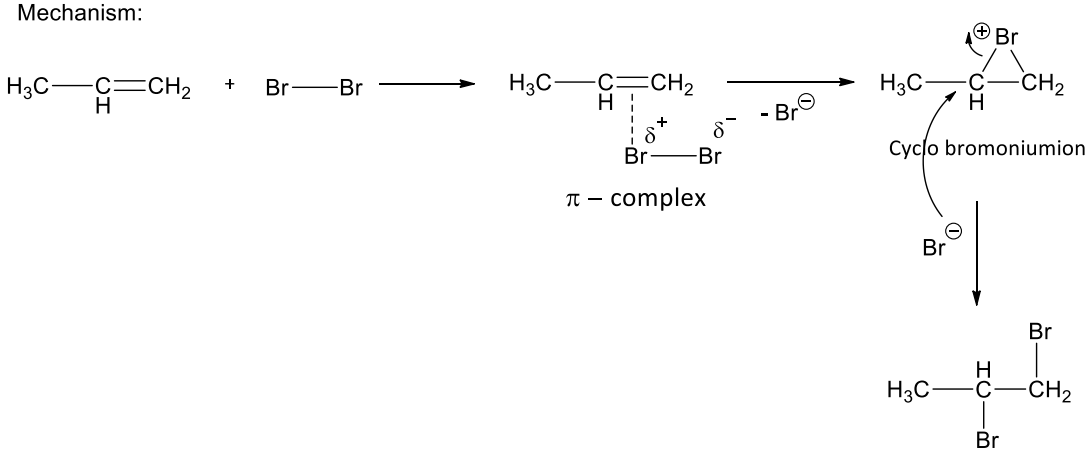


2) Reaction with Halogens:

Chlorine and bromine add to alkenes to form vicinal dihalide.



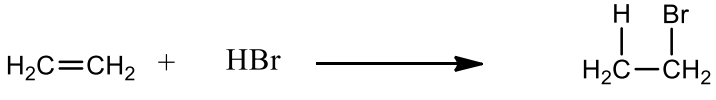
Mechanism:



3) Reaction with Halogen acids (HX = HCl, HBr and HI):

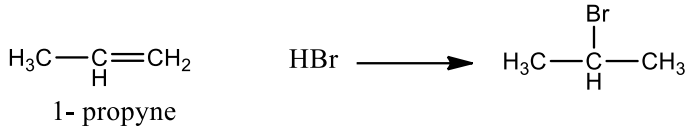
Alkenes react with Halogen acids to form alkyl halides

i) **Addition to symmetrical alkenes:** Halogen acids add to symmetric alkenes to form alkyl halides via a carbocation intermediate.



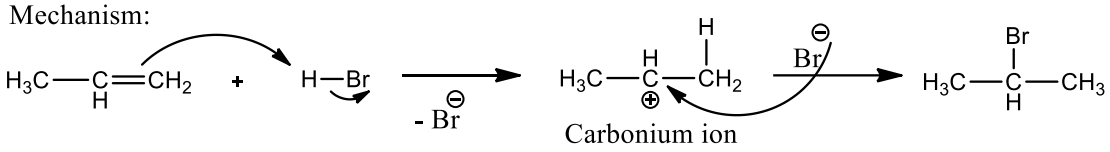
ii) **Addition to unsymmetrical alkenes:** Addition of halogen acids to unsymmetric alkenes takes place according to **Markownikoff's rule**.

Markownikoff's rule: In an electrophilic addition reaction of alkene, negative part of the reagent adds to the alkene carbon atoms which are having less number of hydrogen atoms.



1- propyne

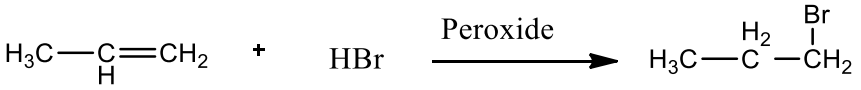
Mechanism:



Carbonium ion

4) <u>Addition of HBr in presence of Peroxide:</u>

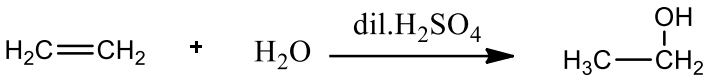
Addition of HBr to unsymmetric alkenes in presence of peroxides takes place according to **Anti Markownikoff's rule.** This is also called as Kharasch effect or peroxide effect.
Ex: Addition of HBr to propene in presence of peroxide gives 1 –bromopropane via a radical intermediate.



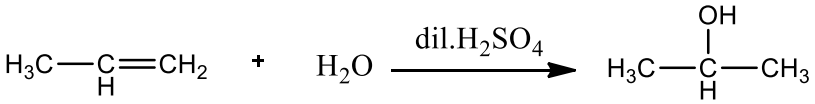
1- propyne 1-bromopropane

5) <u>Reaction with water(H_2O):</u>

Alkenes form alcohols when react with water in presence of acids.



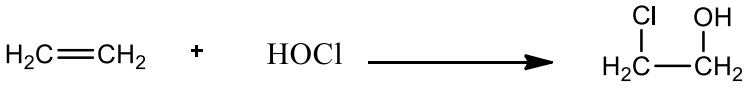
Ethene Ethanol



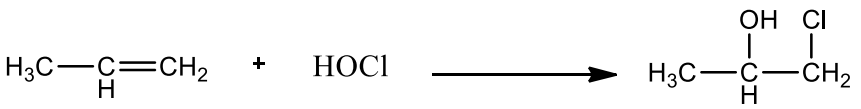
1- propyne 2-propanol

6) <u>Reaction with Hypochlorous acid(HOCl):</u>

Chloro alcohols are formed when alkenes react with HOCl.



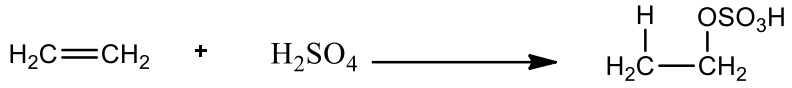
Ethene 2-chloroethanol



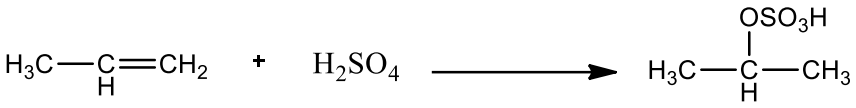
1- propyne 1-chloro-2-propanol

7) <u>Reaction with Sulphuric acid(H_2SO_4):</u>

Alkyl hydrogen sulfates are formed when alkenes react with H_2SO_4.



Ethene ethyl hydrogen sulfate



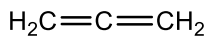
1- propyne isopropyl hydrogen sulfate

Dienes

Hydrocarbons which contain two double bonds are called as dienes. General formula of dienes is C_nH_{2n-2}. Based on the position of double bonds present in straight chain carbon skeleton these are divided into three types.

i) **Cumulated dienes:** if two double bonds are present on same carbon then those are called as cumulated dienes. These are also called as allenes

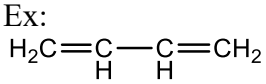
Ex:



1,2 - propadiene

ii) **Conjugated dienes:** In this type of dienes two double bonds are separated by one single bond.

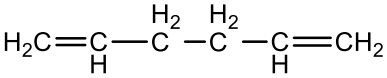
Ex:



1,3 - Butadiene

iii) **Isolated dienes:** In this type of dienes two double bonds are separated by more than one single bond.

Ex:

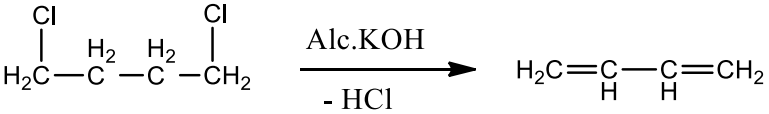


1,5 - Hexadiene

<u>Preparation methods of 1,3 - Butadienes:</u>

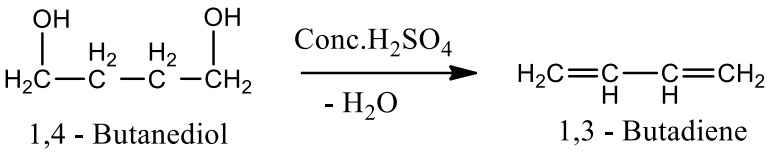
i) **Dehydrohalogenation of 1,4 – dihalo alkanes:**

1, 4 – dichloro butane converted to 1,3 – butadiene when reacts with alc.KOH



1,4-dichlorobutane 1,3 - Butadiene

ii) **Dehydration of 1, 4 – diols:** 1, 4 –butane diol reacts with acid to form 1, 3 – butadiene.



1,4 - Butanediol 1,3 - Butadiene

Chemical properties of 1, 3 – butadiene:

Conjugated dienes undergo addition reaction with hydrogen, halogens and HBr like alkenes.