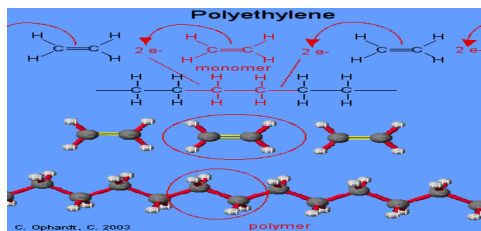
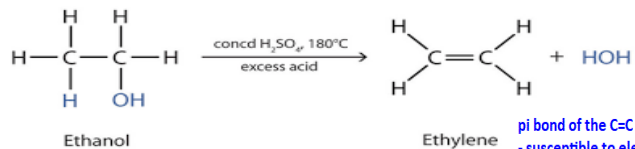
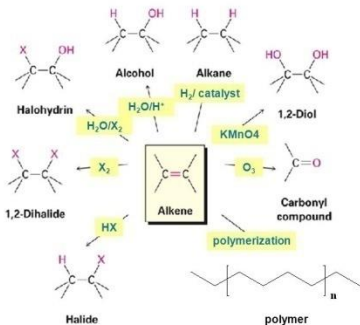
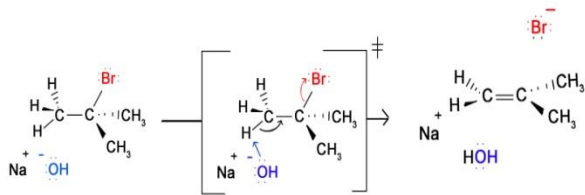
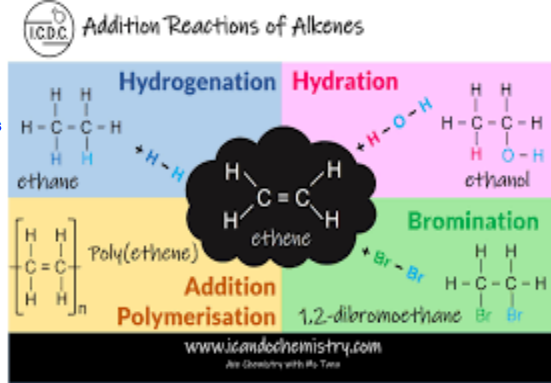
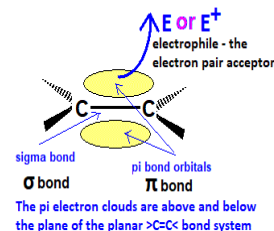


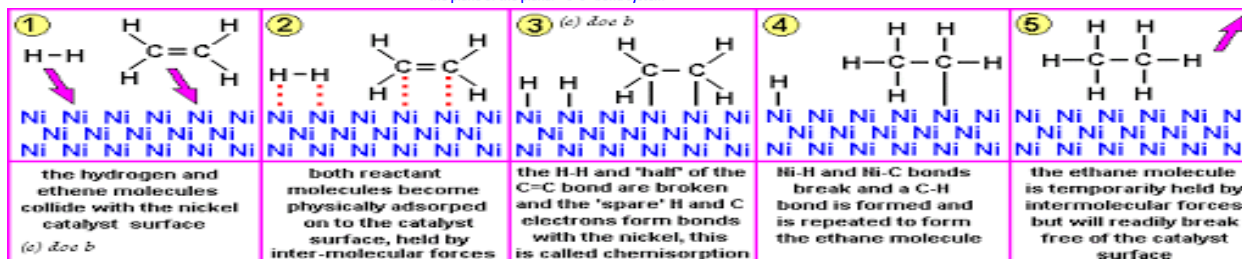
## Summary of the Addition Reactions of Alkenes



pi bond of the C=C double bond in alkenes - susceptible to electrophilic attack



1. The base will deprotonate the haloalkane
2. The leaving group will depart from the molecule
3. The deprotonated carbon will rehybridize from sp<sup>3</sup> to sp<sup>2</sup>.



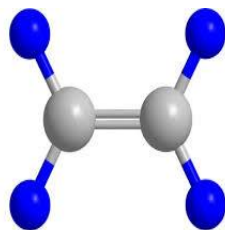
**Dr. Suryawanshi V.S.**

Dept. of Chemistry,

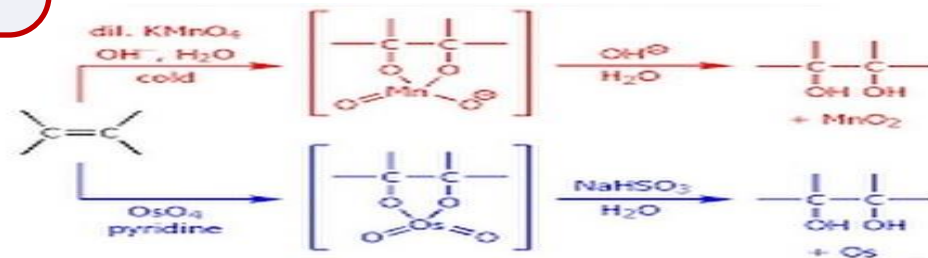
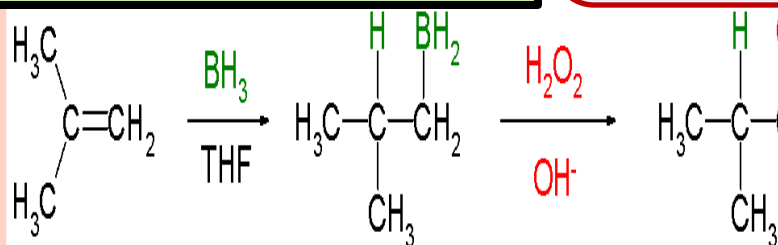
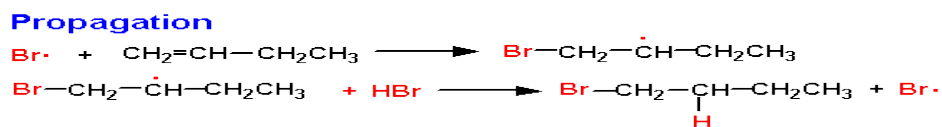
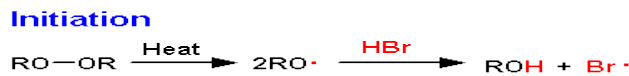
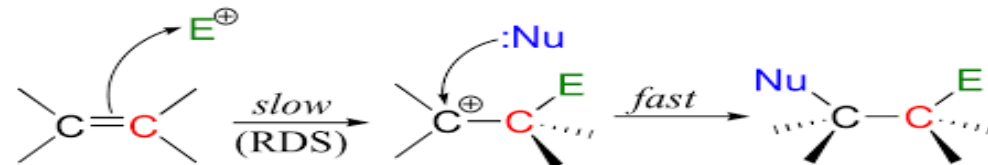
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## Chapter-V ALKENES



## OUTLINE OF MY PRESENTATION:

- Nomenclature of alkenes
- Methods of formation:
  - A) Mechanisms of dehydration of alcohols
  - B) Dehydrohalogenation of alkyl halides.
- The Saytzeff rule
- Hofmann elimination
- Physical properties of alkenes
- Relative stabilities of alkenes.
- Chemical reactions of alkenes
  - Mechanisms involved in hydrogenation
  - Electrophilic and free radical additions
  - Markownikoff's rule
  - Hydroboration
  - Oxidation with  $\text{KMnO}_4$ .
  - Polymerization of alkenes.



# INTRODUCTION:

- ❑ Alkenes are **unsaturated hydrocarbons** containing at least one **carbon-carbon double bond** and are represented by the general formula  $C_nH_{2n}$ .
- ❑ They are also called as **olefins**.
- ❑ This word olefins was derived from the word **olefiant gas**.  
**Example:** The name of **ethylene** i.e **oil forming gas**, which on treatment with  $Cl_2$  or  $Br_2$  forms oily liquids.

## ❑ Nomenclature of alkenes:

- 1) **Common name system:** Alkenes are named by **replacing** ending “**ane**” of the corresponding alkane by “**ylene**”.
- 2) **IUPAC Nomenclature:**

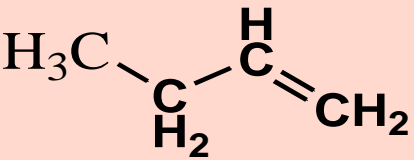
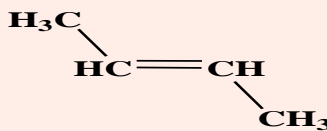
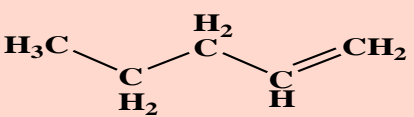
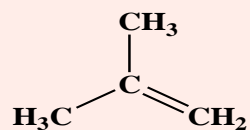
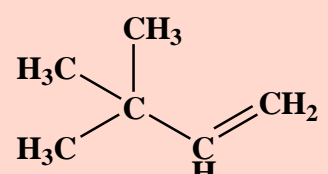
**Rule-I:** select the longest chain containing double bond as parent alkane.

**Rule-II:** The suffix “**ane**” of the parent alkane is **replaced by “ene”**

**Rule-III:** The position of  $C=C$  is indicated by the lowest possible number.

**Rule-IV:** The **number** indicating the **position of double bond** is placed before the name of the alkene or suffix “ene”.

**Rule-V:** The positions of other substituent's on the longest carbon chain are indicated by proper numbers.

Sr. No	Structure of alkene	Parent alkane	Common name	IUPAC name
1	$\text{H}_2\text{C}=\text{CH}_2$	Ethane	Ethylene	Ethene
2	$\text{CH}_3\text{-CH}=\text{CH}_2$	Propane	Propylene	Propene or prop-1-ene
3		Butane	1 or $\alpha$ -Butylene	1-Butene or but-1-ene
4		Butane	2 or $\beta$ -Butylene	2-Butene or but-1-ene
5		Pentane	1 or $\alpha$ -Pentylene	1-Pentene or pent-1-ene
6		Propane	iso-butylene	2-Methyl-1-propene (2-Methyl-prop-1-ene)
7		Butane	Neo-Hexylene	3,3-dimethyl-1-butene (3,3-Dimethyl-but-1-ene)

## Methods of formation of alkene: 1) Dehydration of alcohols:-(-H<sub>2</sub>O)

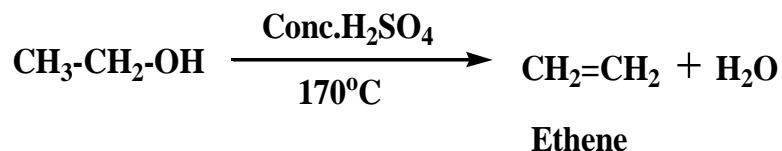
- Alcohols on heating in the presence of **dehydrating agents**, eliminates water (-H<sub>2</sub>O) molecule to form corresponding alkenes.
- 1<sup>o</sup>, 2<sup>o</sup> and 3<sup>o</sup> alcohols differ in their relative ease of dehydration. The order is

Tertiary alcohol > Secondary alcohol > Primary alcohol

↑  
(faster dehydration)

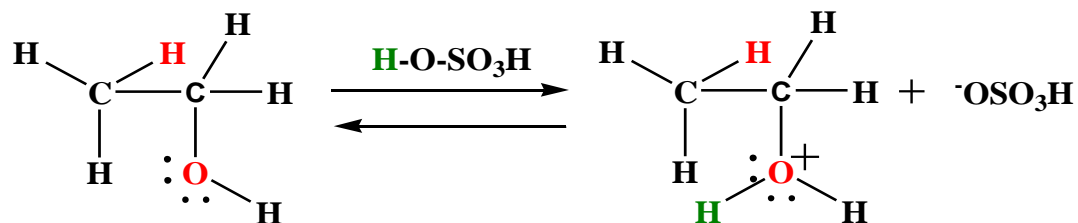
↑  
(Slower dehydration)

- 1) A primary alcohol e.g. ethanol on heating with Conc.H<sub>2</sub>SO<sub>4</sub> or phosphoric acid at 170 C (443K) forms ethene.

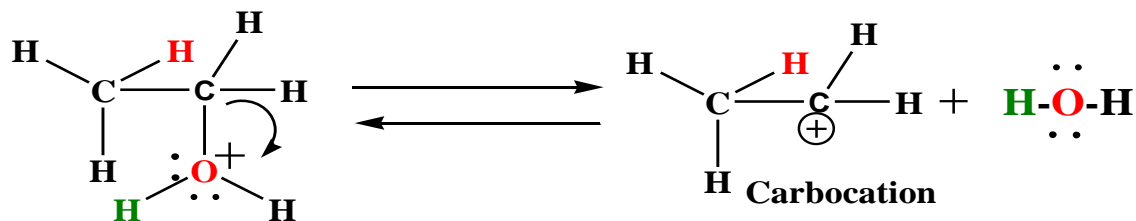


- ❖ **Mechanism** of dehydration of alcohol involves three steps.

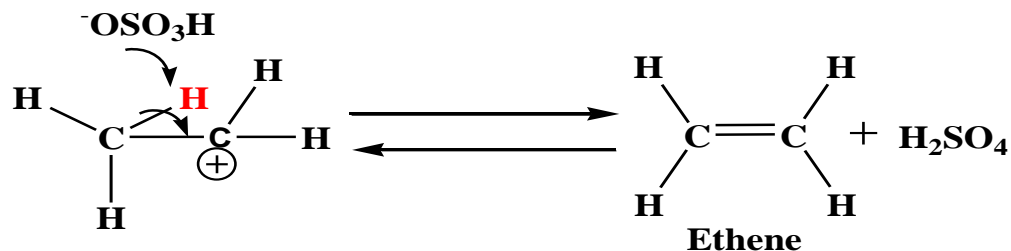
**Step-I :** Conc. H<sub>2</sub>SO<sub>4</sub> **protonates alcohol** to transform the very poor leaving group **-OH into** the **very good leaving group -OH<sub>2</sub>** and results into formation of protonated alcohol and conjugate base of acid.



**Step-II:** The protonated alcohol undergoes heterolysis to form the carbocations and water.



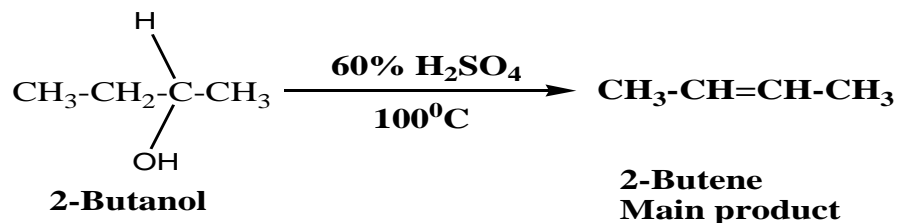
**Step-III:** In this step, Carbocations loses a proton to the base to form alkene.



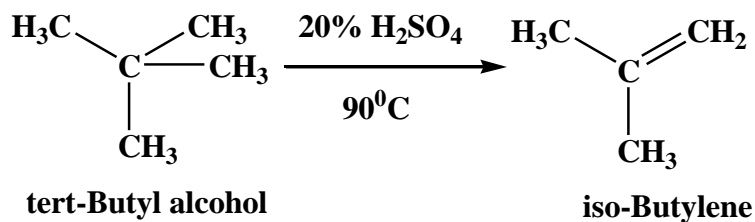
- Dehydration of alcohols is an unimolecular elimination (E1) reaction.
  - It is reversible reaction.
- Under the condition of dehydration, the alkene, being quite volatile, is removed from reaction mixture and thus the equilibrium in third step is shifted to the right to get more quantity of alkene.

**Dehydration** of primary alcohol is carried out by passing alcohol vapors over **alumina** ( $\text{Al}_2\text{O}_3$ ) catalyst at 350-400C, here alumina acts as a **Lewis acid** to remove  $-\text{OH}$  from primary alcohol.

- Secondary alcohol e.g. 2-butanol on heating with 60%  $\text{H}_2\text{SO}_4$  to 100 C forms 2-butene as main product.



- A tertiary alcohol e.g. 2-methyl-2-propanol on heating with 20%  $\text{H}_2\text{SO}_4$  at 90 C gives 2-methyl-1-propene.



**Note:** 2<sup>o</sup> and 3<sup>o</sup> alcohols undergoes dehydration more rapidly than primary alcohols because they easily form more stable secondary and tertiary carbocations respectively.

## 2) Dehydrohalogenation of alkyl halides: (-HX)

When alkyl halide on heating with alcoholic alkali solution (NaOH or KOH) or sodium ethoxide eliminate hydrogen and halogen atoms (-HX) from adjacent ( $\alpha, \beta$  carbon atoms) to form alkenes. Since the reaction takes place with loss of hydrogen halide, it is called as **dehydrogenation**.

