

Date: 13/11/2023



لجان الشُّفَعَات



تفريغ عضويه 1

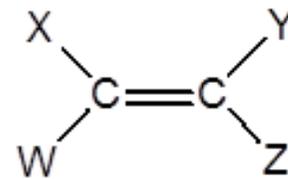
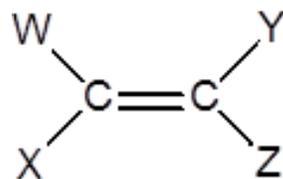
Chapter (2) : موضوع المحاضرة

(6) : رقم المحاضرة

Gufran Khaseeb : إعداد الصيدلانيه

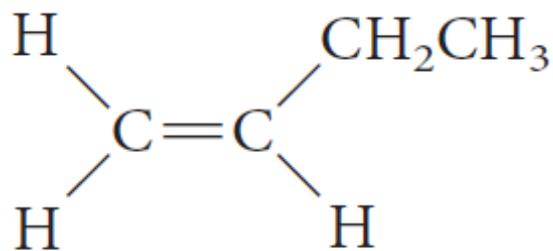


Geometric Isomerism in Alkenes



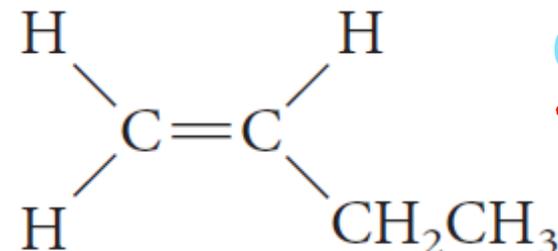
B) If (W = X or Y = Z), geometric isomerism is **not** possible.

(the same carbon have the same group)



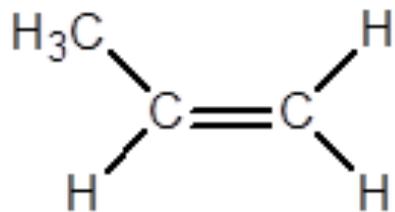
1-butene

is identical to

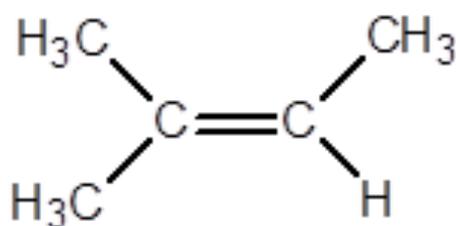


1-butene

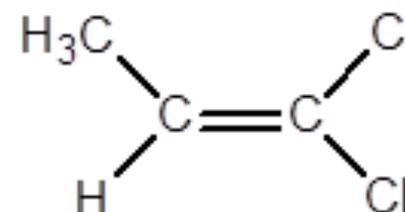
Q: which of the following alkenes do not have geometrical isomers?



Propene



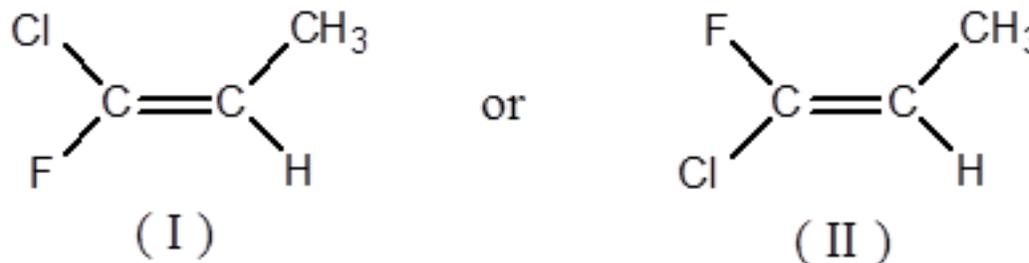
2-Methyl-2-butene



1,1-Dichloropropene

Geometric Isomerism in Alkenes

- For alkenes with four different substituent such as



Another system, the **E, Z** system,

- Basically, **the E,Z system** works as follows;

Arrange the groups on each carbon of the C=C bond in order of priority

- **The priority depends on atomic number:**

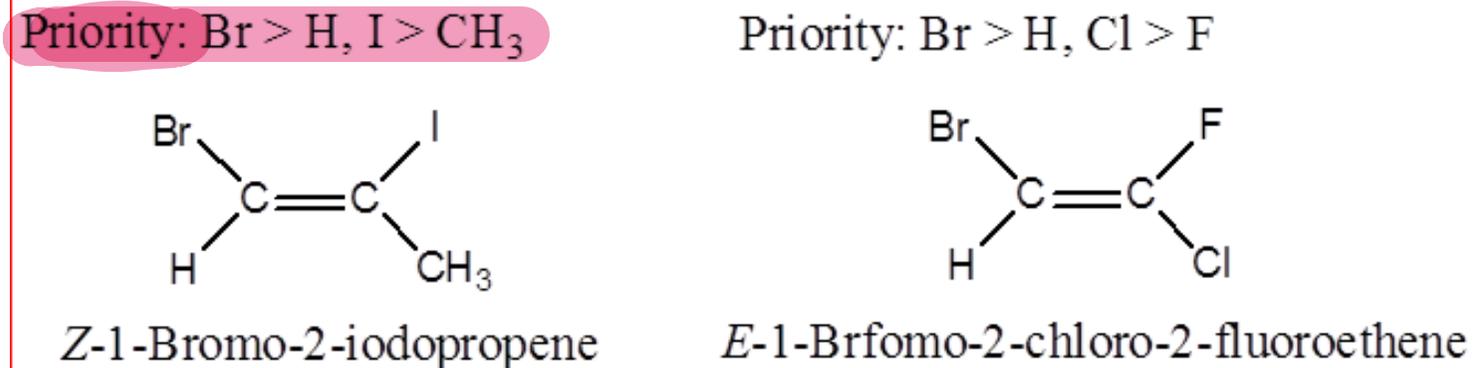
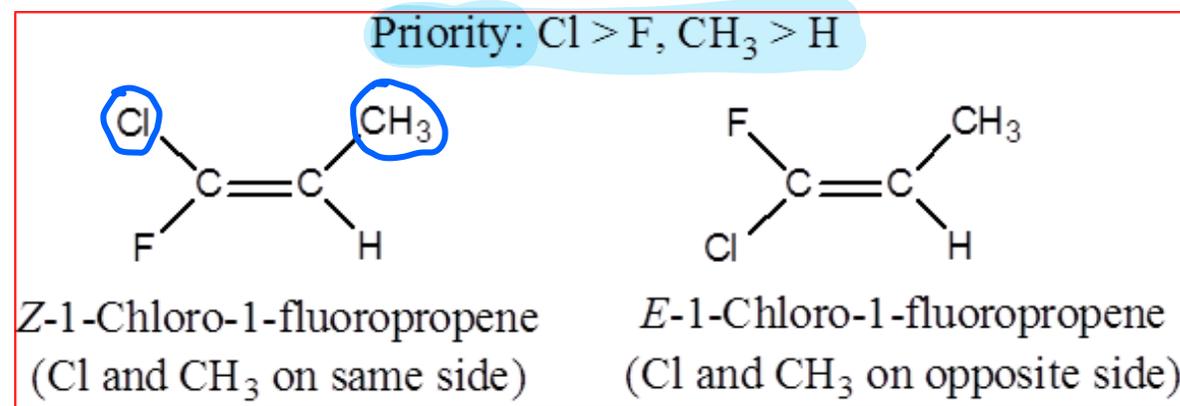
*The **higher the atomic number** of the atom directly attached to the double-bonded carbon, **the higher the priority**.*

Thus, in structure (I),

Cl > F, and CH₃ > H.

Geometric Isomerism in Alkenes

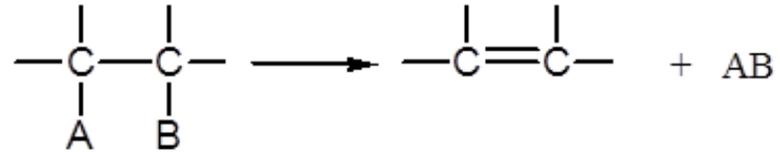
- If the two groups of **higher priority** are on the **same side** of the C=C plane, The isomer is labeled **Z**; (from the German *zusammen*, together).
- If the two groups of higher priority are on **opposite sides** of the C=C plane, The isomer is labeled **E**; (from the German *entgegen*, opposite).



Preparation of Alkenes

- Alkenes are prepared by Elimination of an atom or group of atoms from adjacent carbons to form carbon-carbon double bond.

the reason: the double bond



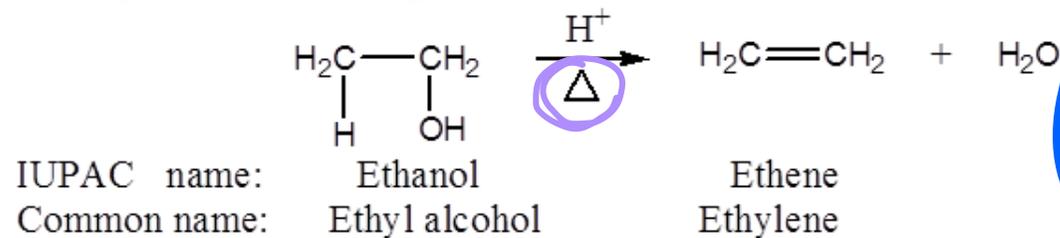
(A=H or halogen;
B=OH or halogen)

الزائد H_2O

1) Dehydration of Alcohols

have hydroxy group (OH)

- When an alcohol is heated in the presence of a mineral acid catalyst, it readily loses a molecule of water to give an alkene.



(at the primary group)

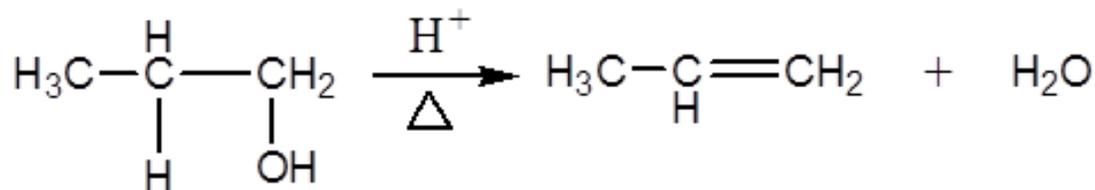
- The acid catalysts most commonly used are sulfuric acid, H_2SO_4 , and phosphoric acid, H_3PO_4 .

mineral

Preparation of Alkenes

1) Dehydration of Alcohols

Removal of OH group and a proton from two adjacent carbon atoms using mineral acids such as H_2SO_4 or H_3PO_4

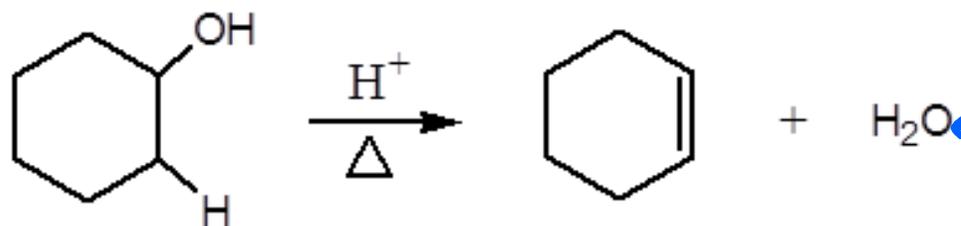


IUPAC name: 1-Propanol

Common name: *n*-Propyl alcohol

Propene

Propylene



IUPAC name: Cyclohexanol

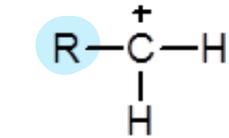
Common name: Cyclohexyl alcohol

Cyclohexene

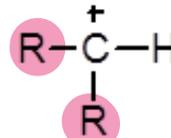
at the
primary
group

1) Dehydration of Alcohols

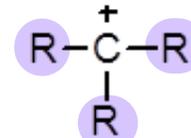
o Classes of Carbocations *lack in carbons*



1° carbocation
primary



2° carbocation
secondary

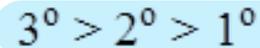


3° carbocation
tertiary

*(R group) عدد ربيط ←
↳ the carbocation more stable*

according to the number of carbon atoms attached to the positively charged carbon.

The ease of formation and the stabilities of carbocations follow the order



← Ease of formation and stabilities of carbocations

*note: more (R group)
more stable
(carbocation)*

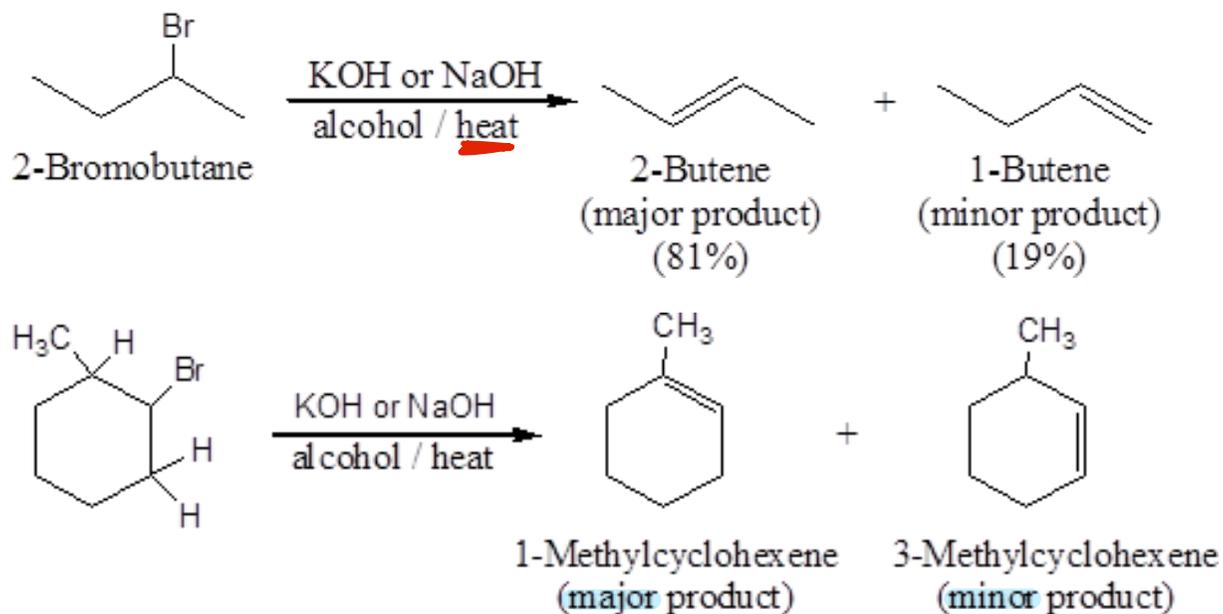
o Generally

1. The dehydration of alcohols requires an **acid catalyst**.
2. The predominant alkene formed follows **Saytzeffs rule**.
3. The reaction proceeds *via* a **carbocation intermediate**.
4. The stabilities of carbocations and the ease of dehydration of alcohols follows the order **3° > 2° > 1°**.

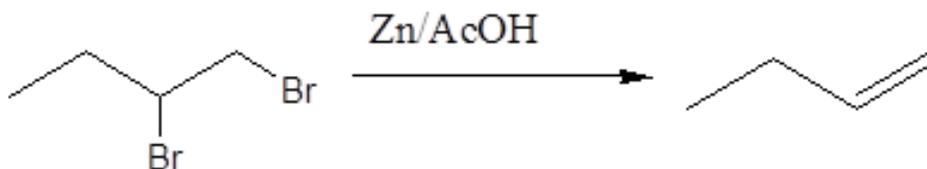
2) Dehydrohalogenation of Alkyl Halides

Alkenes can also be prepared under alkaline conditions.

heating an alkyl halide with a solution of KOH or NaOH in alcohol, yields an alkene.



3) Dehalogenation of Vicinal Dibromides



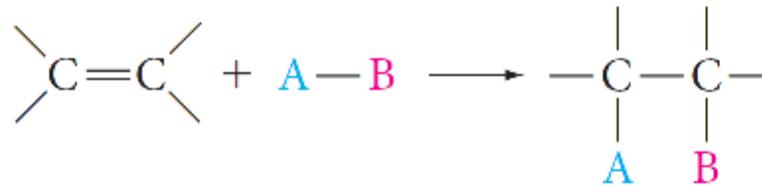
Reactions of Alkenes

o The chemistry of alkenes can be divided into two general types of reactions:

(1) Electrophilic Addition Reactions

ما يتخير عدد Carbons

↳ lack electrons
for atoms/molecules
(have +ve charge)



Addition of Symmetric and Unsymmetric Reagents to symmetric Alkenes.

1. Addition of Hydrogen: Catalytic Hydrogenation
2. Addition of Halogens: Halogenation

Addition of Unsymmetric Reagents to Unsymmetric Alkenes; Markovnikov's

- Rule.
1. Addition of Hydrogen Halides
 2. Addition of Sulfuric Acid
 3. Addition of Water: Hydration
 4. Addition of HOX: Halohydrin Formation

note + the alkenes → rich electrons
(p) orbitals → it's the target
for any lack electrons compounds.

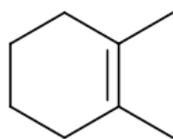
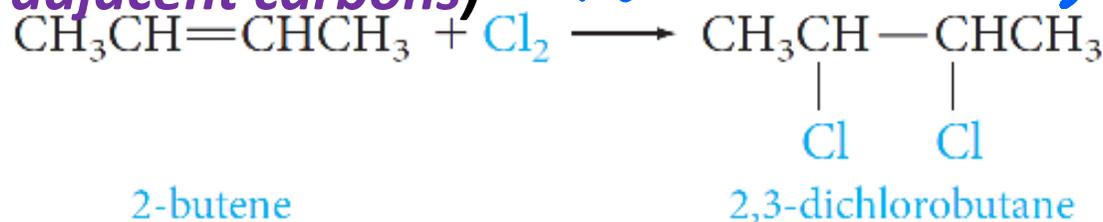
(2) Oxidation Reactions

1. Ozonolysis
2. Oxidation Using KMnO_4

Electrophilic Addition Reactions

2. Addition of Halogen: Halogenation

When an **alkene** is treated at room temperature with a solution of **bromine** or **chlorine** in **carbon tetrachloride** to give the corresponding **vicinal dihalide** (two halogens attached to adjacent carbons) *the solvent (non polar)*



1,2-Dimethyl-cyclohexene



trans-1,2-Dibromo-1,2-dimethyl-cyclohexane

تجانس برفه

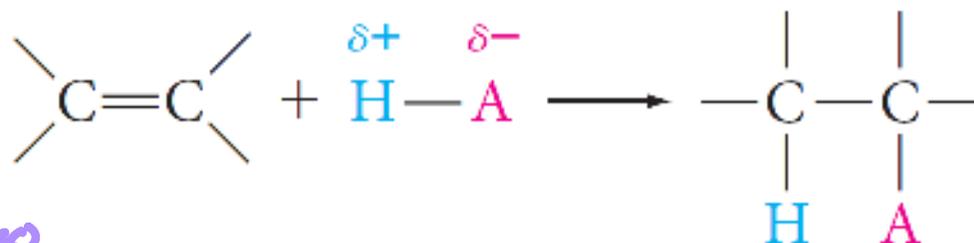
- **Iodine** is **too unreactive** and will not add to the double bond.
- **Fluorine** is **too reactive** and reacts explosively with an alkene.

Electrophilic Addition Reactions

3. Addition of Acids

- A variety of acids add to the double bond of alkenes.

The hydrogen ion (or proton) adds to one carbon of the double bond, and the remainder of the acid becomes connected to the other carbon.



→ compound from two parts

- Acids that add in this way are the **hydrogen halides** (H-F, H-Cl, H-Br, H-I), and **water** (H-OH).

Note that

- Any electron-deficient species is called an **electrophile**.
- Any electron-rich species is called a **nucleophile**.

Electrophilic Addition Reactions

Examples of Electrophile:

- i) **Positive reagents:** protons (H^+), alkyl group R^+ , nitronium ion (NO_2^+), etc....
- ii) **Neutral reagents having positively polarized centers:** HCl , bromine (because it can be polarized so that one end is positive).
- iii) **Lewis acids:** molecules or ions that can accept an electron pair $\Rightarrow \text{BF}_3$ and AlCl_3 .
- iv) **Metal ions that contain vacant orbitals:** the silver ion (Ag^+), the mercuric ion (Hg^{2+}), and the platinum ion (Pt^{2+}).

Examples of Nucleophile:

a) Negative ions

e.g. $\text{H}\ddot{\text{O}}^-$: Hydroxide ion, $\text{H}\ddot{\text{S}}^-$: Hydrosulphide ion, $\text{R}\ddot{\text{O}}^-$: Alkoxide ions,

$:\text{N}\equiv\text{C}^-$: Cyanide ion, $:\ddot{\text{X}}^-$: Halide ions, ...etc.

b) Neutral molecules

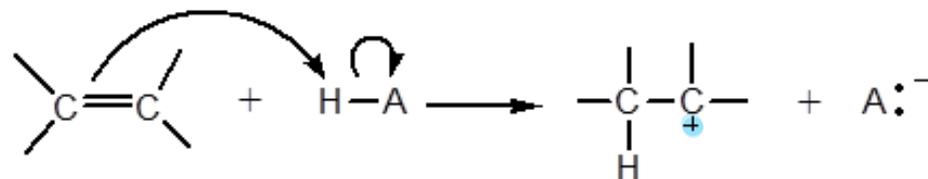
e.g. $\text{H}_2\ddot{\text{O}}$, $\text{R}-\ddot{\text{O}}-\text{H}$, $\text{R}-\ddot{\text{O}}-\text{R}$, $\text{H}_3\ddot{\text{N}}$, $\text{R}_3\ddot{\text{N}}$, ...etc.

Electrophilic Addition Reactions

3. Addition of Acids

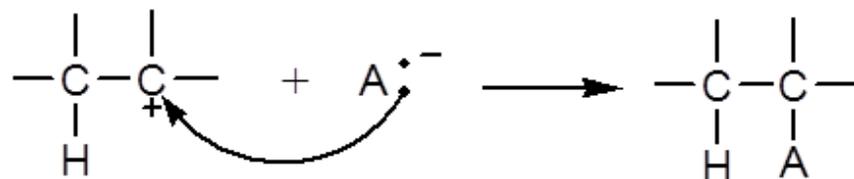
The addition of H—A to an alkene is believed to be a **two-step process**.

Step 1. The hydrogen ion (**the electrophile**) attacks the Π -electrons of the alkene, forming a C—H bond and a **carbocation**.



rich in electrons

Step 2. The negatively charged species A: - (**a nucleophile**) attacks the carbocation and forms a new C—A bond.



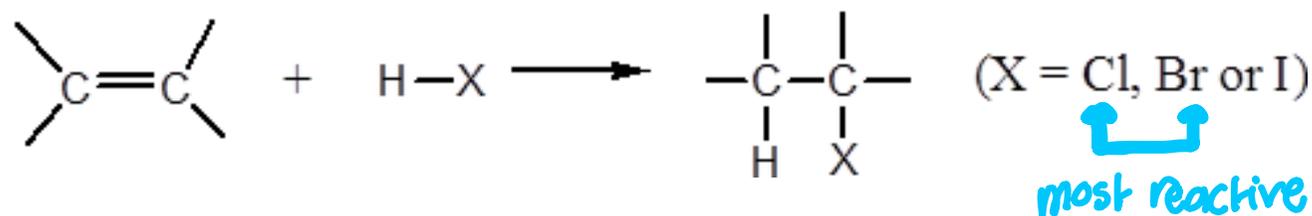
The attack by an electrophilic reagent on the Π -electrons, falls in a general category called **electrophilic addition reactions**.

Electrophilic Addition Reactions

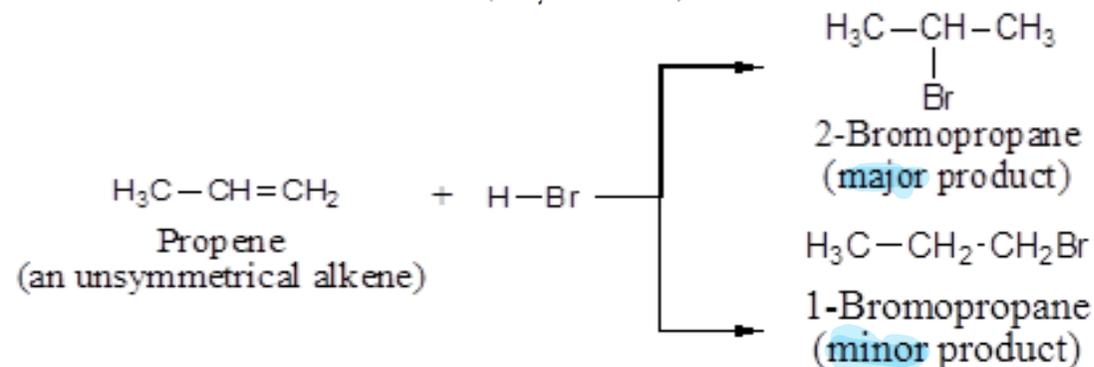
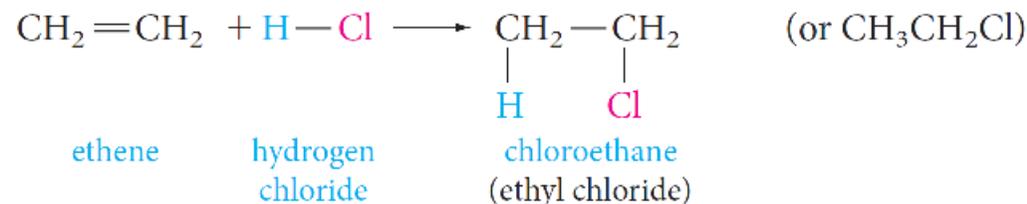
3.1. Addition of Hydrogen Halide

Alkenes react with hydrogen chloride, HCl, hydrogen bromide, HBr and hydrogen iodide, HI, to form alkyl halides, RX.

General equation



Examples;



Electrophilic Addition Reactions

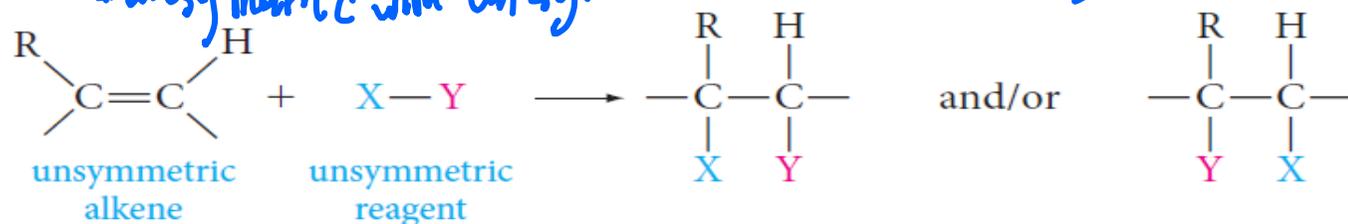
O Reagents and alkenes can be classified as either **symmetric** or **unsymmetric** with respect to addition reactions.

□ If a reagent and/or an alkene is symmetric, only one addition product is possible.

□ But if both the reagent and the alkene are *unsymmetric*, two products are, in principle, possible.

- symmetric with symmetric (one probability?) (the major one)

- unsymmetric with unsymmetric (two probability)



* symmetric with symmetric (one probability)

* unsymmetric with unsymmetric (two probability)

Table 3.2 Classification of Reagents and Alkenes by Symmetry with Regard to Addition Reactions

	Symmetric	Unsymmetric
Reagents	$ \begin{array}{c} \text{Br} - \text{Br} \\ \quad \\ \text{Cl} - \text{Cl} \\ \quad \\ \text{H} - \text{H} \end{array} $	$ \begin{array}{c} \text{H} - \text{Br} \\ \quad \\ \text{H} - \text{OH} \\ \quad \\ \text{H} - \text{OSO}_3\text{H} \end{array} $
Alkenes	$ \begin{array}{c} \text{CH}_2 = \text{CH}_2 \\ \\ \text{Cyclopentene} \end{array} $ <p style="text-align: center;">mirror plane</p>	$ \begin{array}{c} \text{CH}_3\text{CH} = \text{CH}_2 \\ \\ \text{Cyclopentene} \end{array} $ <p style="text-align: center;">not a mirror plane</p>