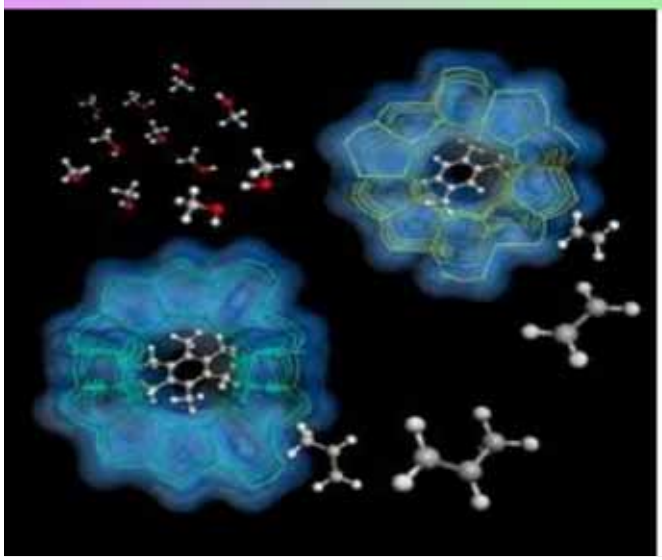
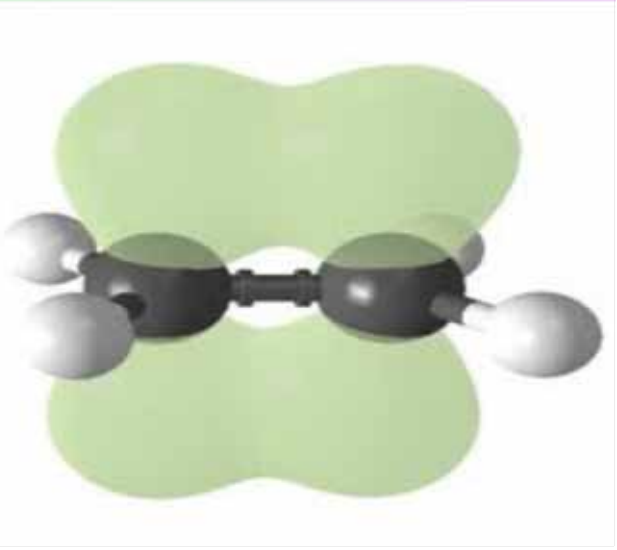
Chemistry of Alkenes





Learning Outcomes

Students will be able to:

1. describe alkenes as unsaturated hydrocarbons;
2. describe the plane and angles formed by carbon atoms in alkene molecules;
3. show the preparation of alkenes from alcohols and alkyl halides.

n = No. of Carbons

C_nH_{2n+2} Alkane

C_nH_{2n} Alkene

C_nH_{2n-2} Alkyne.

① C_3H_8

② C_3H_6

C_3H_6

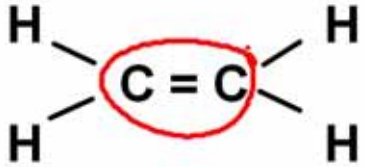
$n = 3$

Alkenes as Unsaturated Hydrocarbons:

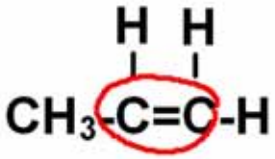
Alkenes are hydrocarbons that contain a carbon-carbon double bond (C=C) in their molecules. They have the general formula C_nH_{2n} (n=number of C atoms). Alkenes contain two hydrogen atoms less than alkanes and are thus designated as *unsaturated hydrocarbons*.

As a class, alkenes are commonly known as Olefins (Latin, *olefiant = oil forming*) because the lower members form 'oily' products on treatment with chlorine or bromine.

Since, there can be no alkene with one carbon, the first member of the series (putting n=2 in C_nH_{2n}) has the molecular formula C_2H_4 and is commonly known as *ethylene*. The second member of the family has the molecular formula C_3H_6 (n=3) and is commonly called propylene. Ethylene and propylene may be represented by the following structures.

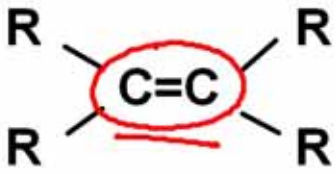


ethylene (C_2H_4)

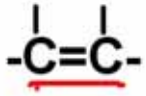


propylene (C_3H_6)

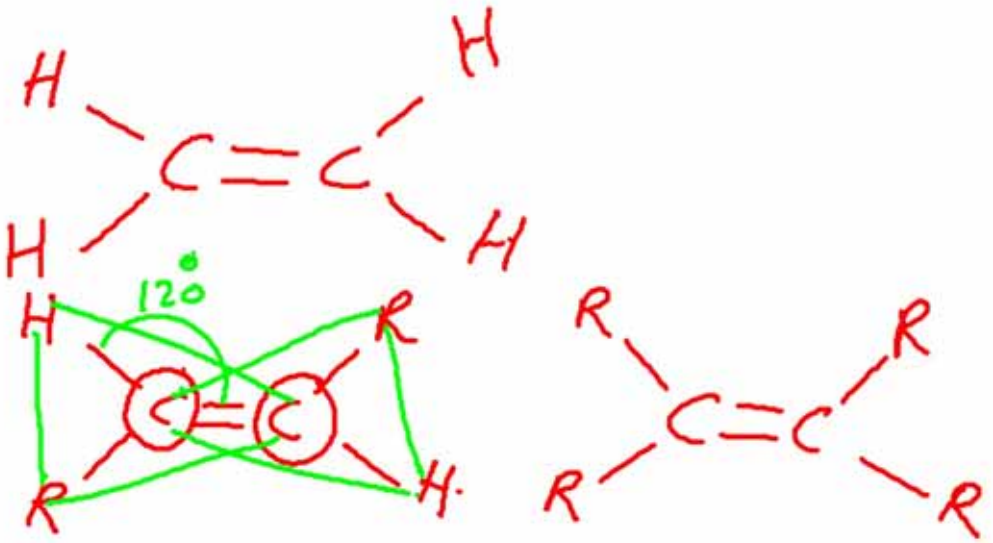
In general, alkenes can be represented by the following formula:



The adjacent carbon atoms are joint together by two covalent bonds that largely determines the chemical behaviour of alkenes.

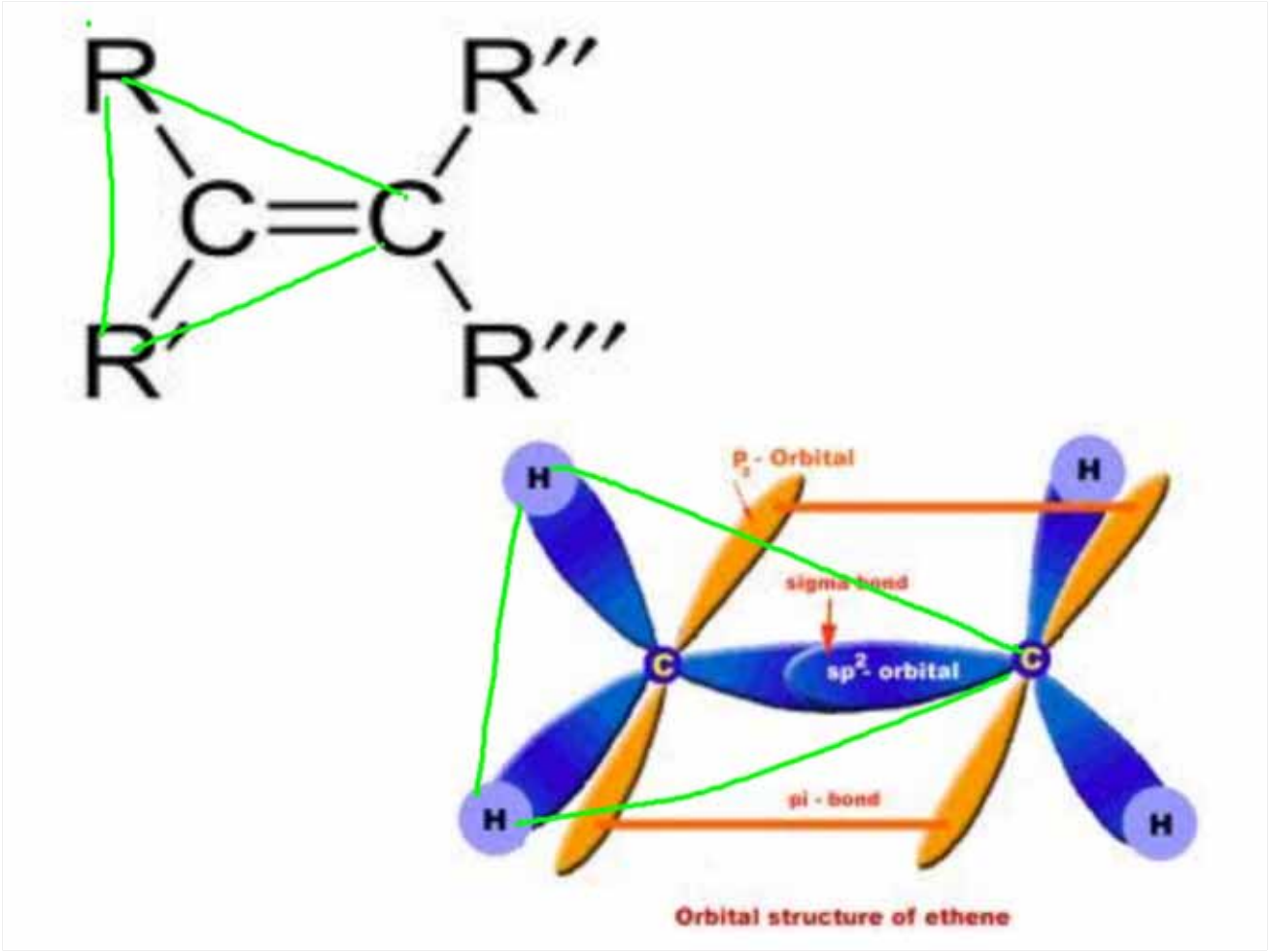


It is commonly referred to as the *Olefinic bond* or *Ethylenic bond*.

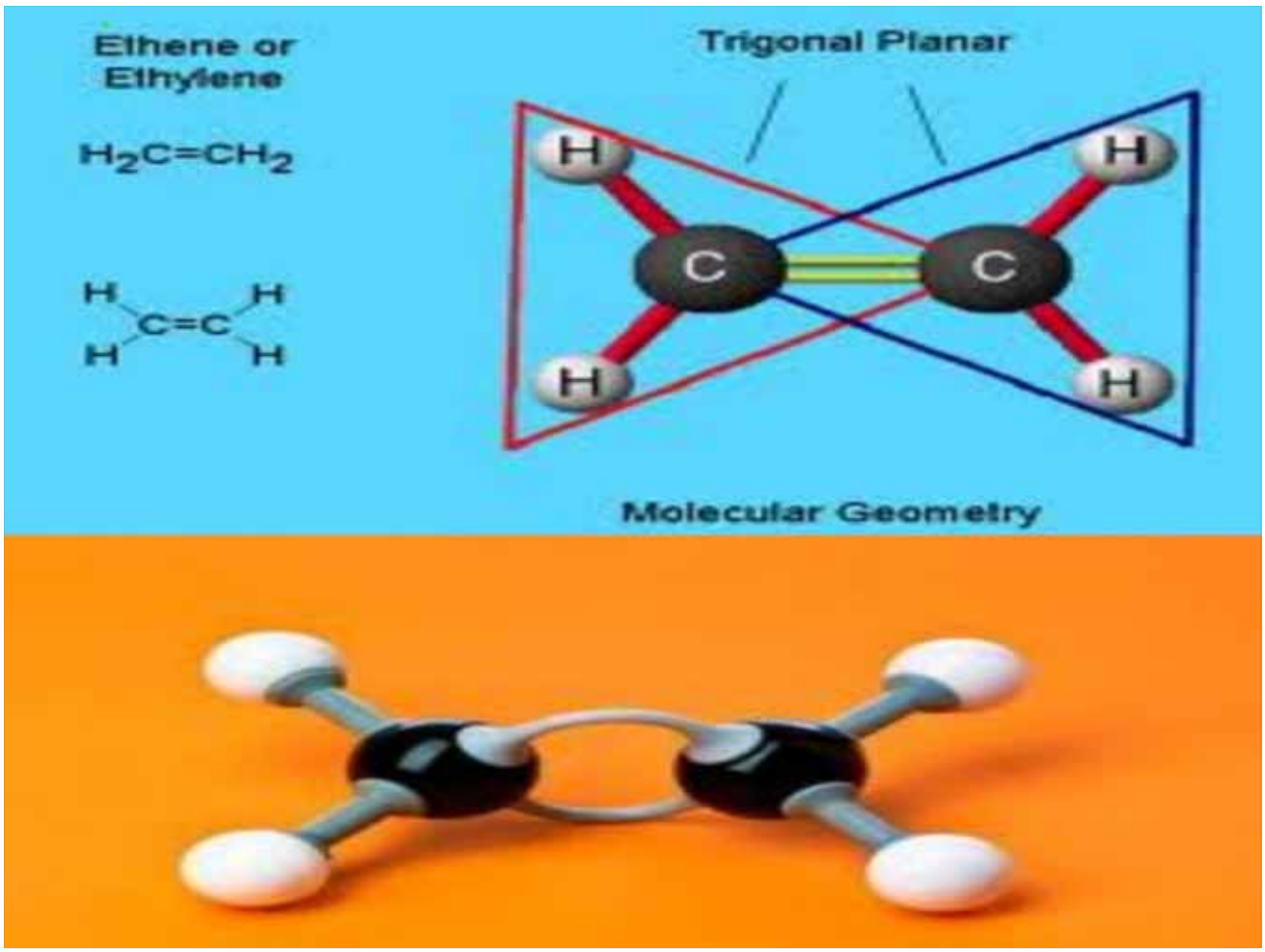

H
H
C
C
H
H
120
H
R
C
C
R
H
R
R
R
C
C
R
R
R

Plane and angles formed by carbon atoms in alkene molecules:

In alkenes, each double bonded carbon atom is surrounded by two hydrogen atoms or one hydrogen and one alkyl group or two alkyl groups. This arrangement of atoms or group of atoms gives each double bonded carbon a planar trigonal geometry with the bond angles of 120°. The Lewis structure of an alkene molecule shows that there are three active electron pairs surrounding each central carbon atom. These electron pairs must be arranged as far apart as possible to minimize the repulsion, it is achieved by placing three atoms or group of atoms around the central atom, at the three corners of an equilateral triangle in which each angle is of 120°.



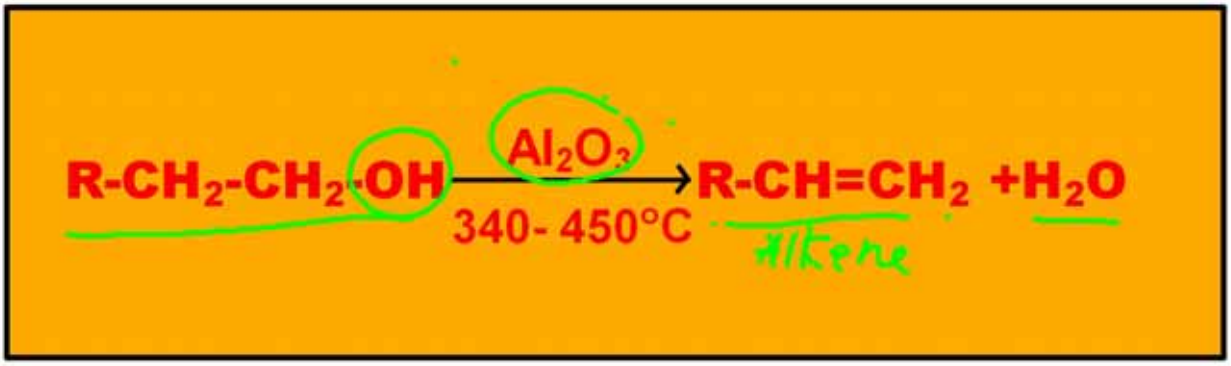
Orbital structure of ethene


Ethene or
Ethylene
$H_2C=CH_2$
H
C=C
H
H
Trigonal Planar
H
H
C
C
H
H
Molecular Geometry

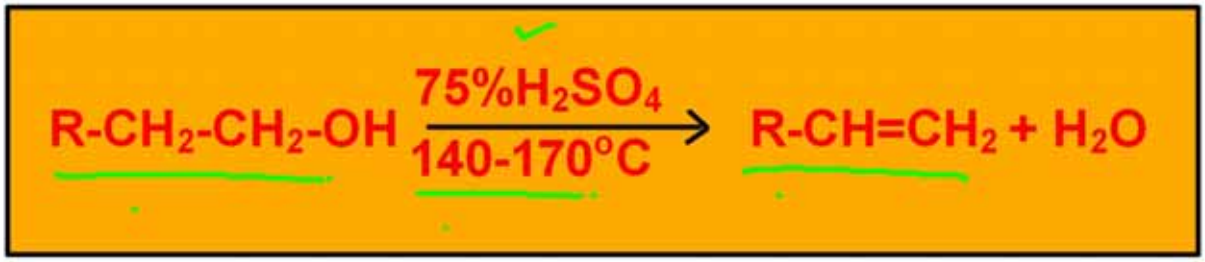
Preparation of Alkenes:

1. Dehydration of alcohols:

Alcohols when dehydrated in the presence of a catalyst give alkenes. The best procedure is to pass vapours of alcohol over heated alumina.

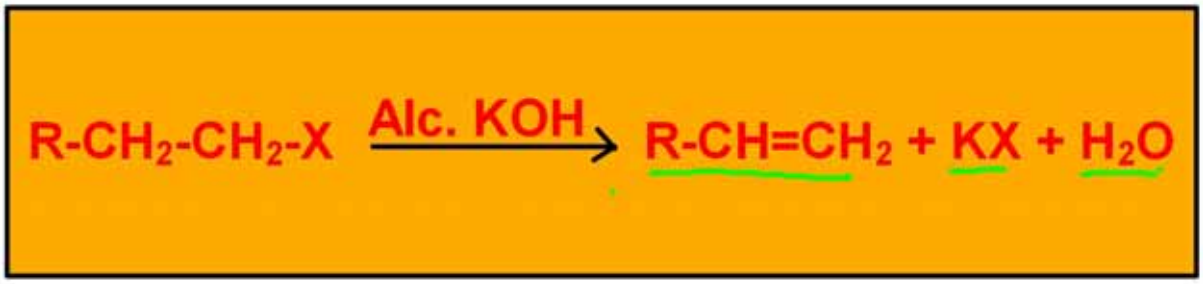


Concentrated H_2SO_4 is also used for the dehydration of alcohols.

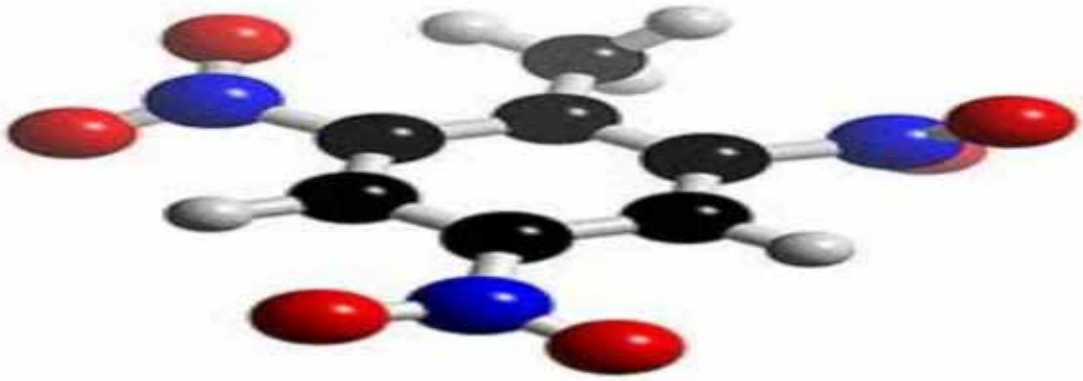


2. Dehydrohalogenation of Alkyl Halides:

Alkyl halides on heating with alcoholic potassium hydroxide undergo dehydrohalogenation i.e. elimination of a halogen atom together with a hydrogen atom from adjacent carbon atoms.


R-CH2-CH2-X
Alc. KOH
R-CH=CH2 + KX + H2O

Multiple Choice Questions



1. Aliphatic hydrocarbons with a double bond in their structures are called

A. alkanes.
B. alkenes.
C. alkynes.
D. cycloalkanes.

2. Which of the following shows a planar trigonal geometry?

A. Methane
B. Ethane
C. Ethene
D. Ethyne

3. Dehydrohalogenation of chloroethane produces

A. chloroethene.
B. ethene.
C. chloroethyne.
D. ethyne.