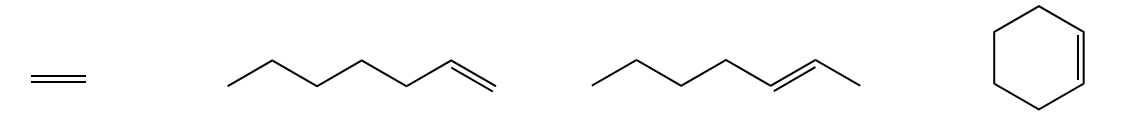
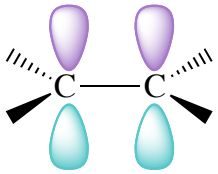
Lecture Notes
Chem 51B
S. King

Chapter 10 Alkenes

I. Introduction: Alkenes are hydrocarbons with carbon-carbon double bonds.

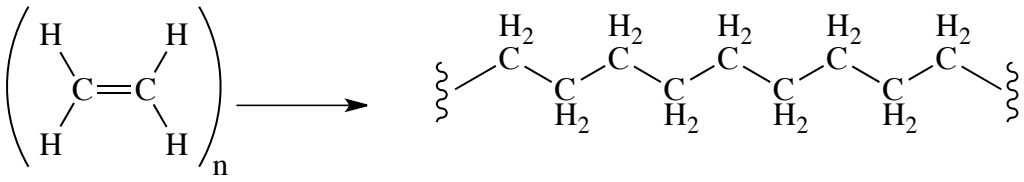


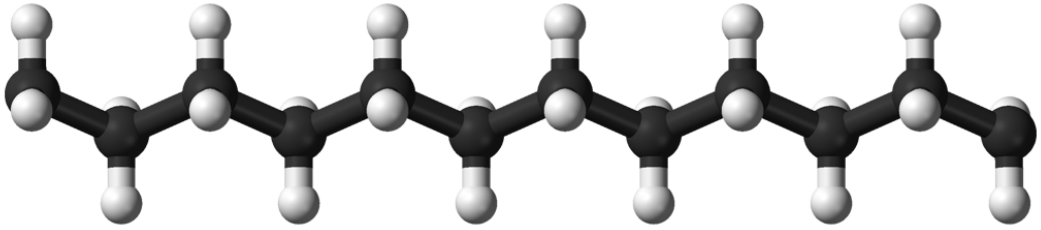
ethylene terminal alkene internal alkene cycloalkene



❖ The C—C double bond is easily converted to other functional groups. Because of this, alkenes are important as intermediates in the synthesis of drugs, pesticides and other valuable chemicals. This, however, accounts for only a small fraction of the billions of pounds of alkenes used annually to make polymers.

Example: Polyethylene (PE):





II. Molecular Formula and Degree of Unsaturation

Alkenes are ***unsaturated*** hydrocarbons because they have fewer than the maximum number of hydrogen atoms per carbon:

General formula for a noncyclic alkane:
General formula for a cyclic alkane:
General formula for an alkene:
General formula for a cyclic alkene:

The general formula for a hydrocarbon is C_nH_{2n+2}, minus two hydrogens for every π-bond and/or ring in the molecule.

- ☛ *The total number of π-bonds and rings in a molecule gives the degree of unsaturation (or units of unsaturation)*

Given the molecular formula, we can tell the degree of unsaturation:

Example: For a compound with molecular formula C_5H_8, give the degrees of unsaturation and draw possible structures for this compound.

This process can be extended to molecules that contain heteroatoms such as O, N, and the halogens.

For O, N and halogens:

- **ignore O**
- **replace each halogen with a H**
- **subtract one H for each nitrogen**

Examples:

C_5H_8O

$C_6H_{11}Cl$

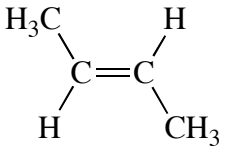
C_8H_9NO

III. Nomenclature of Alkenes:

A. Simple alkenes are named much like alkanes, except the ending is changed from -**ane** to -**ene**.

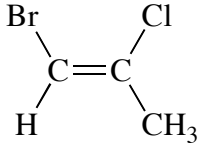
$H_2C{=}CH_2$

- Number the chain from the *end closest to the double bond*. Indicate the position of the double bond by using the number of the first atom of the double bond as a prefix. For more than one double bond, use diene or triene, etc. and indicate the position of the double bonds.
- Substituents are named as they are in alkanes.
- Assign configuration of simple alkenes by using the prefix *cis* or *trans*. This nomenclature can be used when *each carbon of the alkene is bonded to only one substituent*



- Assign configuration to more complex alkenes use the ***E, Z system of nomenclature.***

Example:



Z (zusamen = together): two groups of higher priority on same side