

AL- MUSTAQBAL UNIVERSITY

College Of Health And Medical Techniques

Prosthetic Dental Techniques Department

Second Grade

Second Semester



Advanced chemistry

Lecture 11 (The theoretical part)

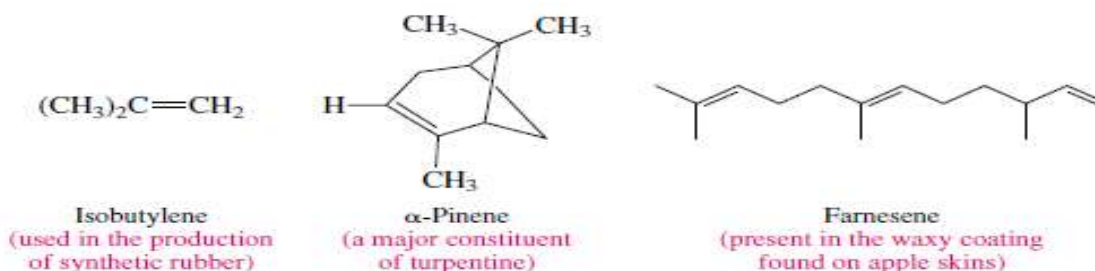
(Organic compounds (ALKENES))

By:

Assist.Prof.Dr.Ahmed A. AL-Khafagi

ALKENES

Alkenes are hydrocarbons that contain a carbon–carbon double bond. A carbon–carbon double bond is both an important structural unit and an important functional group in organic chemistry. The shape of an organic molecule is influenced by the presence of this bond, and the double bond is the site of most of the chemical reactions that alkenes undergo. Some representative alkenes include *isobutylene* (an industrial chemical), *α-pinene* (a fragrant liquid obtained from pine trees), and *farnesene* (a naturally occurring alkene with three double bonds).

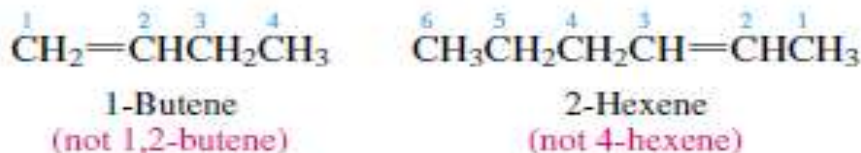


8.2.1. ALKENE NOMENCLATURE

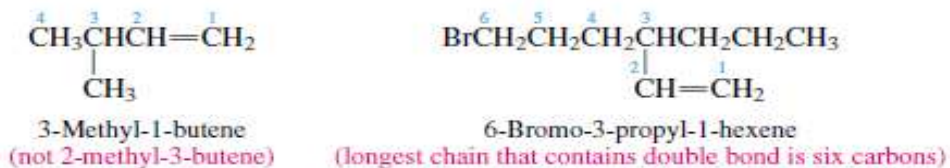
We give alkenes IUPAC names by replacing the *-ane* ending of the corresponding alkane with *-ene*. The two simplest alkenes are **ethene** and **propene**. Both are also well known by their common names *ethylene* and *propylene*.



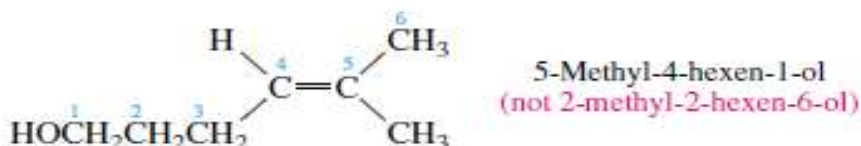
Ethylene is an acceptable synonym for *ethene* in the IUPAC system. *Propylene*, *isobutylene*, and other common names ending in *-ylene* are not acceptable IUPAC names. The longest continuous chain that includes the double bond forms the base name of the alkene, and the chain is numbered in the direction that gives the doubly bonded carbons their lower numbers. The locant (or numerical position) of only one of the doubly bonded carbons is specified in the name; it is understood that the other doubly bonded carbon must follow in sequence.



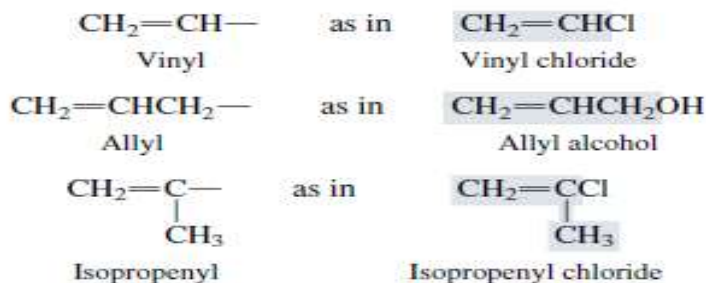
Carbon-carbon double bonds take precedence over alkyl groups and halogens in determining the main carbon chain and the direction in which it is numbered.



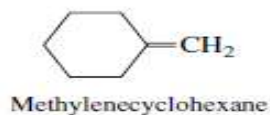
Hydroxyl groups, however, outrank the double bond. Compounds that contain both a double bond and a hydroxyl group use the combined suffix *-en + -ol* to signify that both functional groups are present.



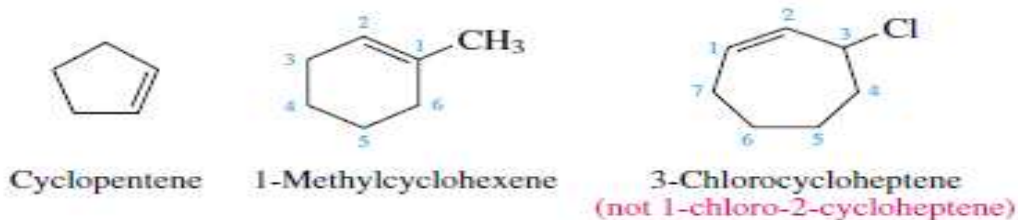
that the common names of certain frequently encountered *alkyl* groups, such as isopropyl and *tert*-butyl, are acceptable in the IUPAC system. Three *alkenyl* groups—**vinyl**, **allyl**, and **isopropenyl**—are treated the same way.



When a CH₂ group is doubly bonded to a ring, the prefix *methylene* is added to the name of the ring.



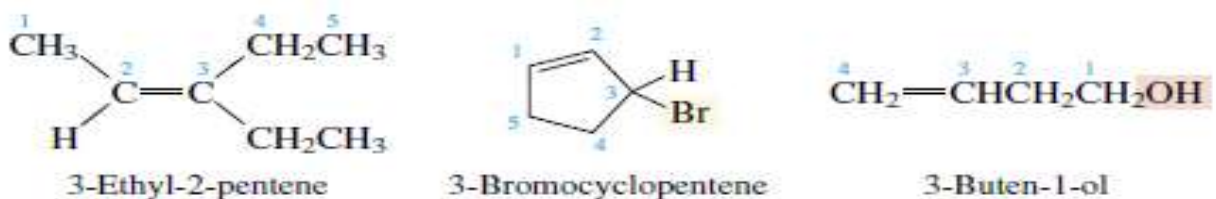
Cycloalkenes and their derivatives are named by adapting cycloalkane terminology to the principles of alkene nomenclature.



No locants are needed in the absence of substituent's; it is understood that the double bond connects C-1 and C-2. Substituted cycloalkenes are numbered beginning with the double bond, proceeding through it, and continuing in sequence around the ring. The direction of numbering is chosen so as to give the lower of two possible locants to the substituent.

8.2.2.SUMMARY

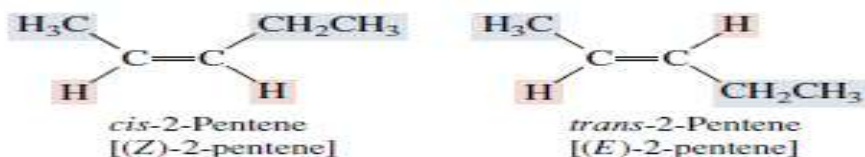
1-Alkenes and cycloalkenes contain carbon-carbon double bonds. According to **IUPAC nomenclature**, alkenes are named by substituting *-ene* for the *-ane* suffix of the alkane that has the same number of carbon atoms as the longest continuous chain that includes the double bond. The chain is numbered in the direction that gives the lower number to the first appearing carbon of the double bond. The double bond takes precedence over alkyl groups and halogens in dictating the direction of numbering, but is outranked by the hydroxyl group.



2-Bonding in alkenes is described according to an sp^2 orbital hybridization model. The double bond unites two sp^2 -hybridized carbon atoms and is made of a σ component and a π component. The σ bond arises by overlap of an sp^2 hybrid orbital on each carbon. The π bond is weaker than the σ bond and results from a side-by-side overlap of p orbitals. Isomeric alkenes may be either **constitutional isomers** or **stereoisomers**.



3-There is a sizable barrier to rotation about a carbon–carbon double bond, which corresponds to the energy required to break the π component of the double bond. Stereoisomeric alkenes are configurationally stable under normal conditions. The **configurations** of stereoisomeric alkenes are described according to two notational systems. One system adds the prefix *cis*- to the name of the alkene when similar substituents are on the same side of the double bond and the prefix *trans*- when they are on opposite sides. The other ranks substituents according to a system of rules based on atomic number. The prefix *Z* is used for alkenes that have higher ranked substituents on the same side of the double bond; the prefix *E* is used when higher ranked substituents are on opposite sides.



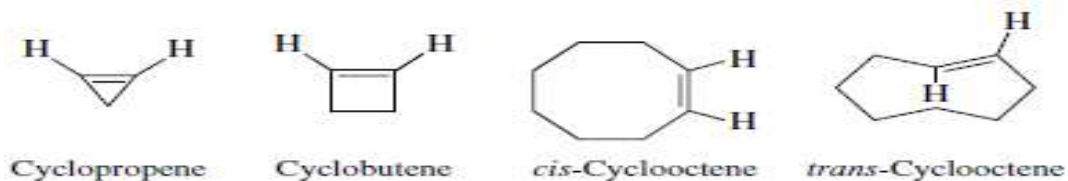
4-Alkenes are relatively nonpolar. Alkyl substituents donate electrons to an *sp*²-hybridized carbon to which they are attached slightly better than hydrogen does.

5-Electron release from alkyl substituents stabilizes a double bond. In general, the order of alkene stability is:

- * Tetrasubstituted alkenes ($\text{R}_2\text{C}=\text{CR}_2$) are the most stable.
- * Trisubstituted alkenes ($\text{R}_2\text{C}=\text{CHR}$) are next.
- * Among disubstituted alkenes, *trans*- $\text{RCH}=\text{CHR}$ is normally more stable than *cis*- $\text{RCH}=\text{CHR}$. Exceptions are cycloalkenes, *cis* cycloalkenes being more stable than *trans* when the ring contains fewer than 11 carbons. Terminally disubstituted alkenes ($\text{R}_2\text{C}=\text{CH}_2$) may be slightly more or less stable than $\text{RCH}=\text{CHR}$, depending on their substituents.
- * Monosubstituted alkenes ($\text{RCH}=\text{CH}_2$) have a more stabilized double bond than ethylene (unsubstituted) but are less stable than disubstituted alkenes. The greater stability of more highly substituted double bonds is an example of an **electronic effect**. The decreased stability that results from van der Waals strain between *cis* substituents is an example of a **steric effect**.

The greater stability of more highly substituted double bonds is an example of an **electronic effect**. The decreased stability that results from vander Waals strain between *cis* substituents is an example of a **steric effect**.

6-Cycloalkenes that have trans double bonds in rings smaller than 12 members are less stable than their cis stereoisomers. *trans*-Cyclooctene can be isolated and stored at room temperature, but *trans*-cycloheptene is not stable above -30°C.



7-Alkenes are prepared by **elimination** of alcohols and alkyl halides. These reactions are summarized with examples in Table 5.2. In both cases, elimination proceeds in the direction that yields the more highly substituted double bond (**Zaitsev's rule**).