

Date:

1/11/2023



لجان الرِّفعات



تفريغ عضويه 1

Chapter (2) : موضوع المحاضرة

(5) : رقم المحاضرة

Gufran Khaseeb : إعداد الصيدلانيه

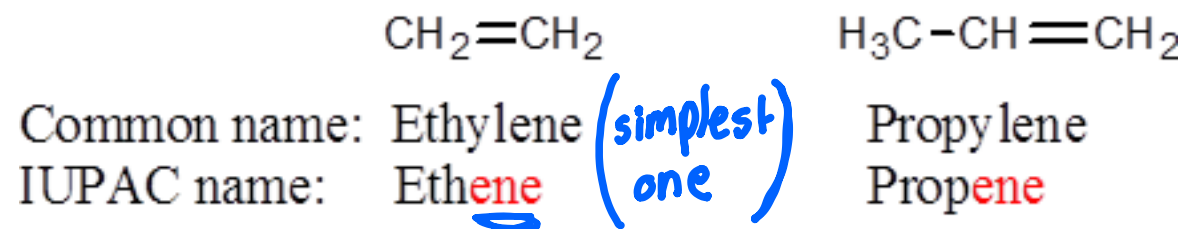




2. ALKENES

The Structure of Alkenes

- **Alkenes** are hydrocarbons that contain a **carbon-carbon double bond**.
- **Alkenes** are also **Olefins**. →
- General formula is **C_nH_{2n}** (the same of cycloalkane)
- The simplest members of the **Alkenes** series are **C_2 & C_3** (there is No C_1)

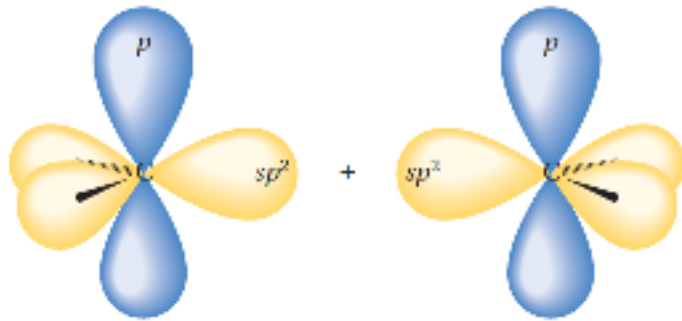


(simplest one)

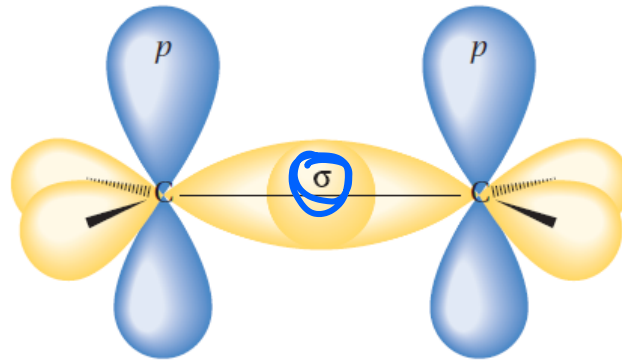
The Structure of Alkenes

- Hybridization: sp^2 hybridized orbitals
- The angle between them is 120° and bond length C=C ($1.34 \text{ \AA}$).
- A trigonal planar.

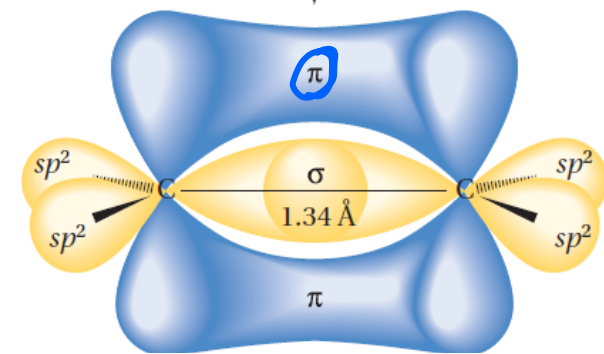
لما زاد عدد الروابط
قل طول الرابطة



two sp^2 -hybridized
carbons with p
orbitals parallel



the σ bond is formed by
two electrons in
overlapping sp^2 orbitals



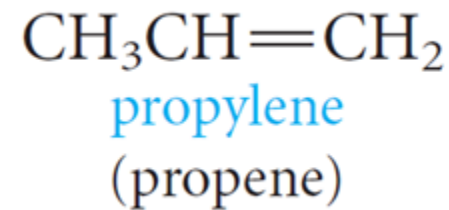
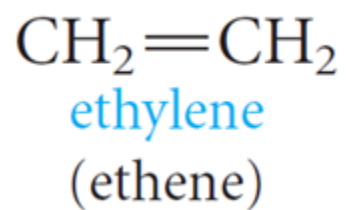
the π bond is formed by
two electrons in
overlapping parallel
 p orbitals

Nomenclature of Alkenes

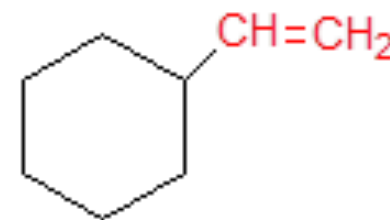
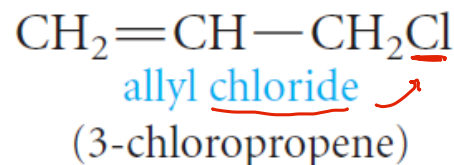
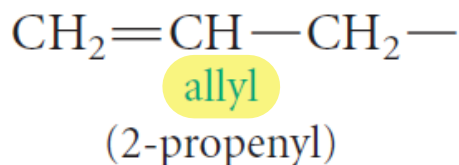
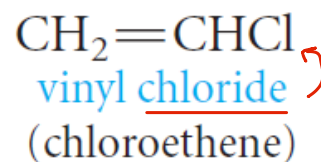
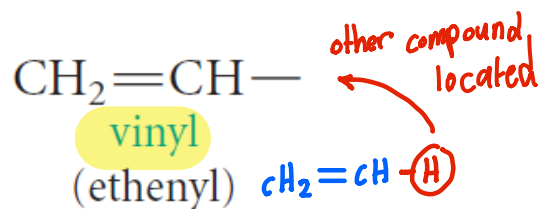
Common Names

→ more common for the small compounds

- The simplest members of the alkene series are frequently referred to by their older common names, **ethylene**, and **propylene**.



- Two important groups also have common names; They are the **vinyl** and **allyl** groups.
- These groups are used in common names.



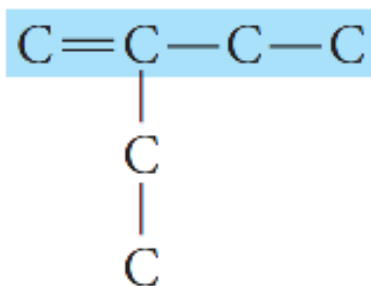
Common name: **Vinyl** cyclohexane
IUPAC name: Cyclohexylethene

The IUPAC Rules

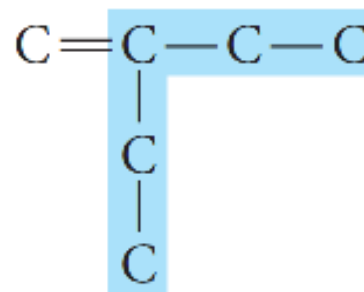
Nomenclature of Alkenes

The IUPAC rules for naming alkenes are similar to those for alkanes, but a few rules must be added for naming and locating the multiple bonds.

1. The ending **-ene** is used to designate a carbon-carbon double bond.
2. Select the **longest chain that includes both carbons of the double bond**.

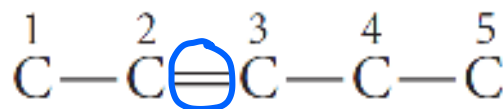


not

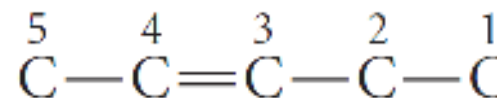


إذا مثل فـهـو جـزء مـن
parent
group

3. **Number the chain from the end nearest the double bond** so that the carbon atoms in that bond have the lowest possible numbers.

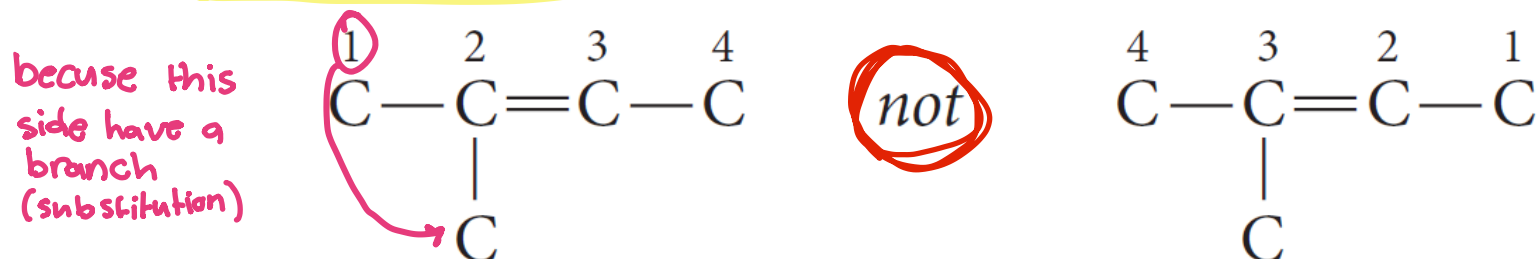


not

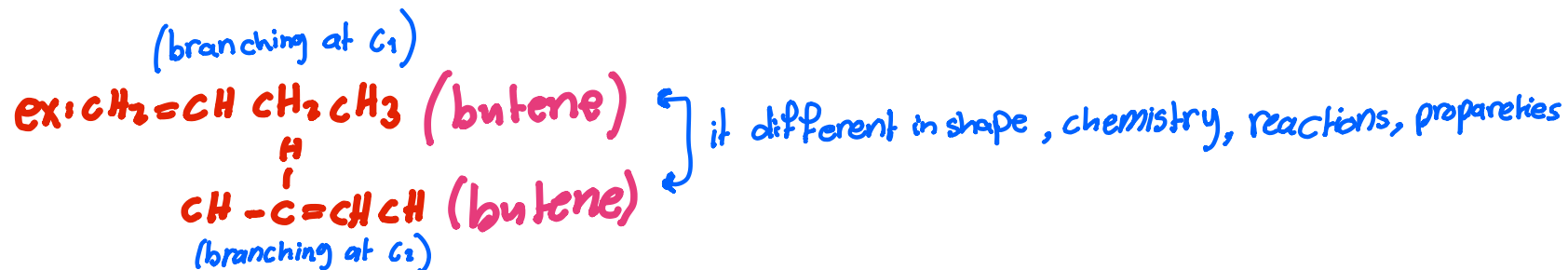


Nomenclature of Alkenes

If the multiple bond is equidistant from both ends of the chain, number the chain from the end nearest the first branch point.



4. Indicate the **position of the multiple bond using the lower numbered carbon atom** of that bond.

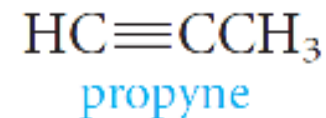
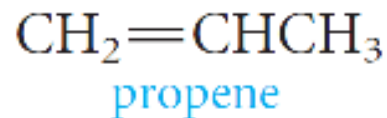
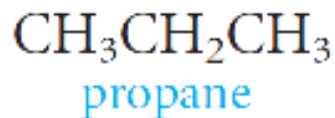
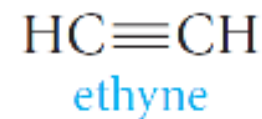
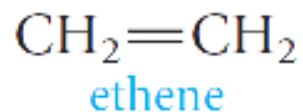


Nomenclature of Alkenes

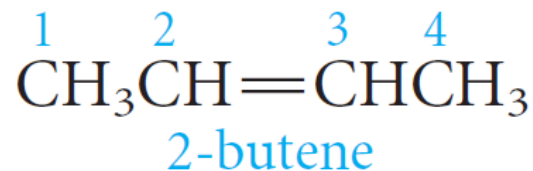
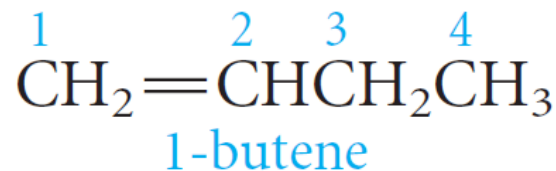
NOTES

The root of the name (*eth-* or *prop-*) tells us the number of carbons, and the ending (*-ane*, *-ene*, or *-yne*) tells us whether the bonds are single, double, or triple.

No number is necessary in these cases, because in each instance, only one structure is possible. (identical)

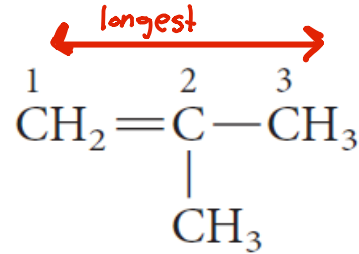


With four carbons, a number is necessary to locate the double bond.

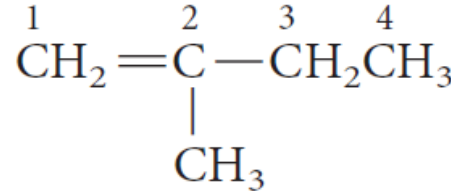


Nomenclature of Alkenes

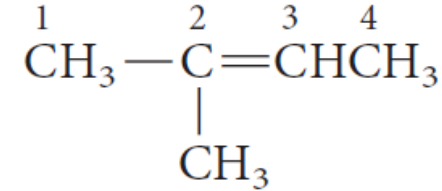
0 Branches are named in the usual way.



methylpropene
(isobutylene)

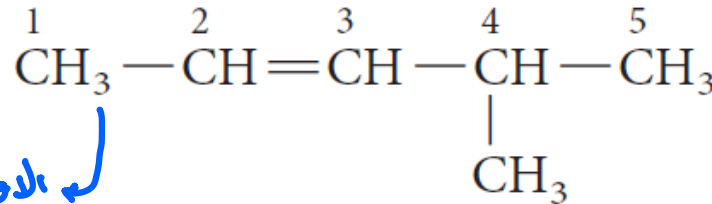


2-methyl-1-butene



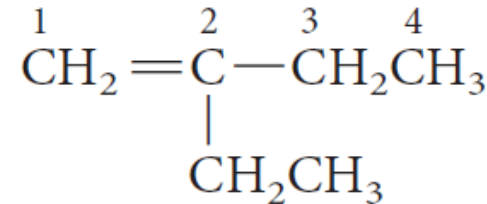
2-methyl-2-butene

the branching from middle



الأولوية لأقرب
double bond
branching

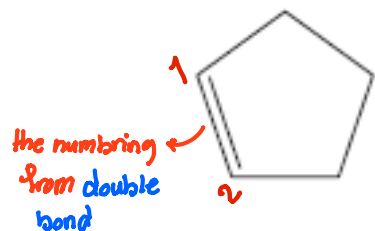
4-methyl-2-pentene
(Not 2-methyl-3-pentene;
the chain is numbered so
that the double bond gets
the lower number.)



2-ethyl-1-butene
(Named this way,
even though there
is a five-carbon
chain present,
because that chain
does not include
both carbons of the
double bond.)

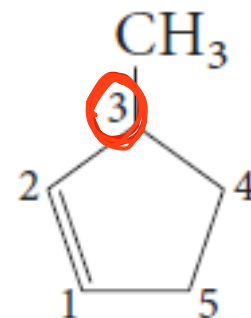
Nomenclature of Alkenes

- With **cyclic hydrocarbons**, we start numbering the ring with the carbons of the double bond.



cyclopentene

(No number is necessary, because there is only one possible structure.)



3-methylcyclopentene

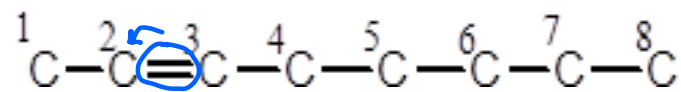
(Start numbering at, and number through the double bond; 5-methylcyclopentene and 1-methyl-2-cyclopentene are incorrect names.)

Nomenclature of Alkenes

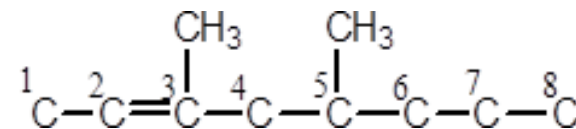
Example: Write the structural formula of **4-Isopropyl-3,5-dimethyl-2-octene**.

1) The parent carbon chain is an **Octene**.

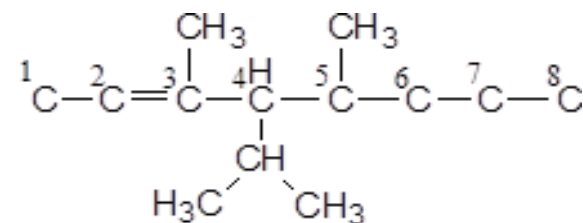
The double bond is located between the 2nd and 3rd carbons.



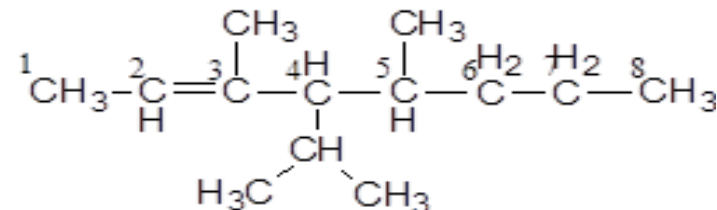
2) Two **methyl groups** are attached on the parent carbon chain, one on **carbon 3** and the other on **carbon 5**.



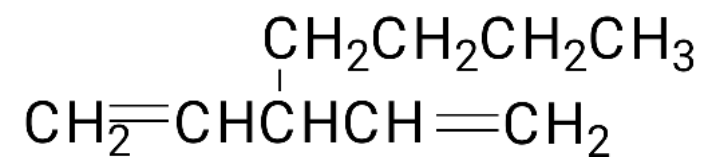
3) An **isopropyl group** is attached on **carbon 4**.



4) Put the missing hydrogens to get the correct structure.

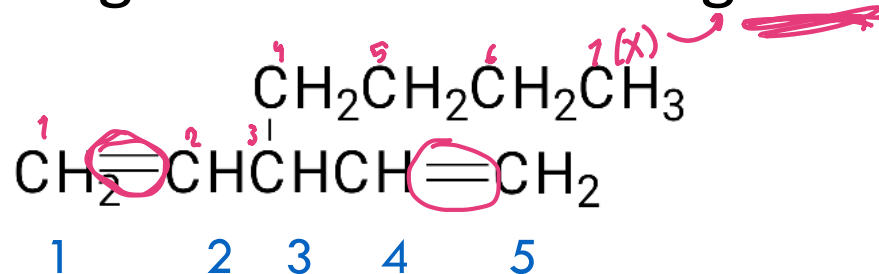


Diene compounds: are alkenes with two π bonds



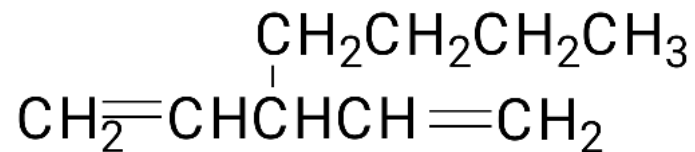
Nomenclature of Dienes

1. Find the longest chain containing both double bonds



3-butyl-1,4-pentadiene

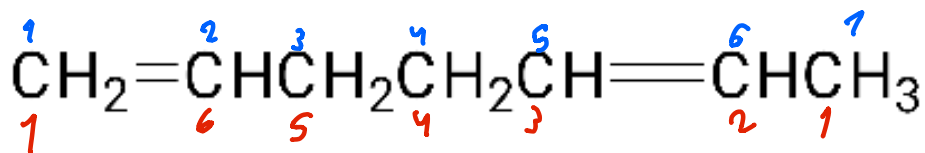
2. Use corresponding alkane name but replace the “ne” ending with “diene”



3-butyl-1,4-pentadiene

“pentane” changed to “pentadiene”

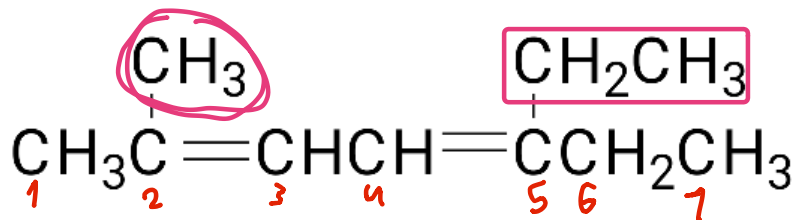
3. Number in the direction that gives the lowest number to a double bond



1,5-heptadiene

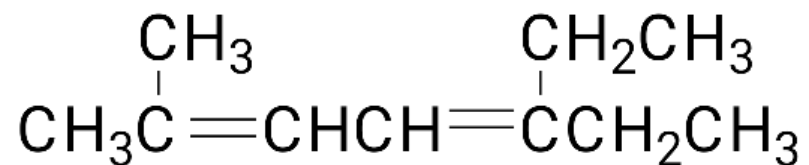
not 2,6-heptadiene

4. List substituents in alphabetical order



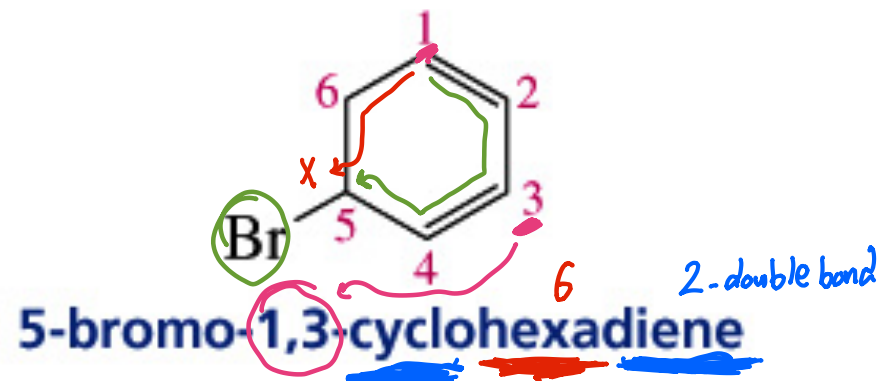
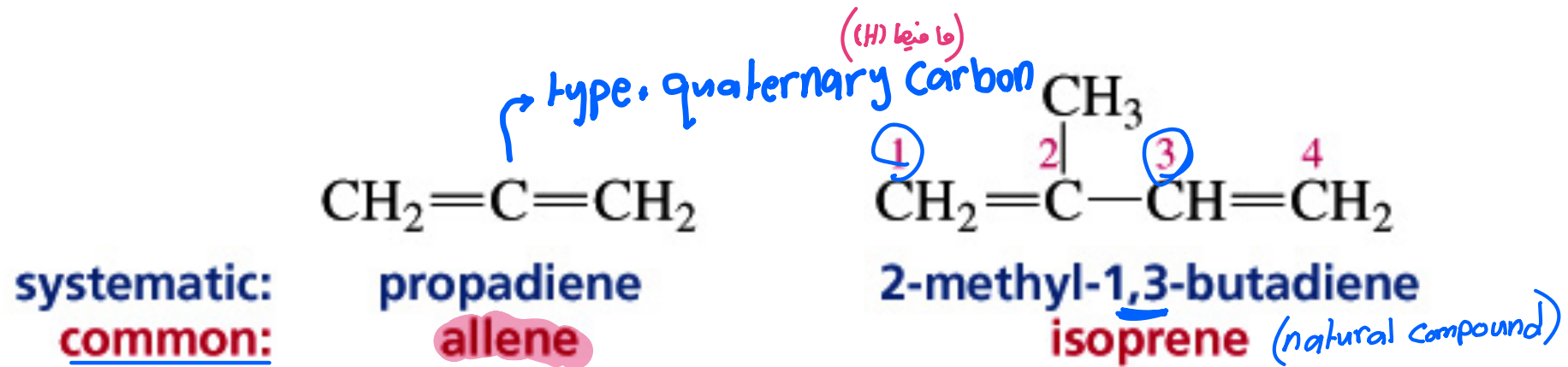
5-ethyl-2-methyl-2,4-heptadiene

- Place numbers indicating the double bond positions either in front of the parent compound or in the middle of the name immediately before the *diene* suffix



5-ethyl-2-methyl-2,4-heptadiene  have two ways
or 5-ethyl-2-methyl-hepta-2,4,-diene

Example:



Types of Dienes

- When double bonds are separated by at least one sp^3 carbon, **isolated diene**



an isolated diene

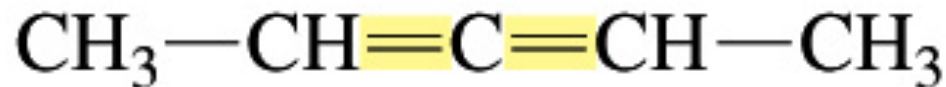
مفصولين

- When double bonds are separated by only one single bond (i.e. four sp^2 carbons in a row), **conjugated diene** (rich in electrons)



a conjugated diene

- When both sets of double bonds emanate from the same carbon, **cumulated diene**



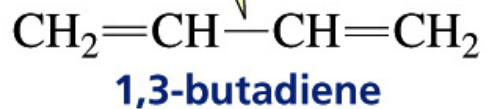
a cumulated diene

an allene (الاقطع هرونا)

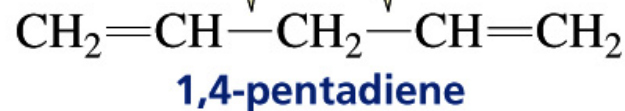
Relative Stabilities of Dienes

- most stable**
 Conjugated dienes are more stable than isolated dienes because
 - An sp^2-sp^2 single bond is shorter and stronger than a sp^3-sp^2 single bond

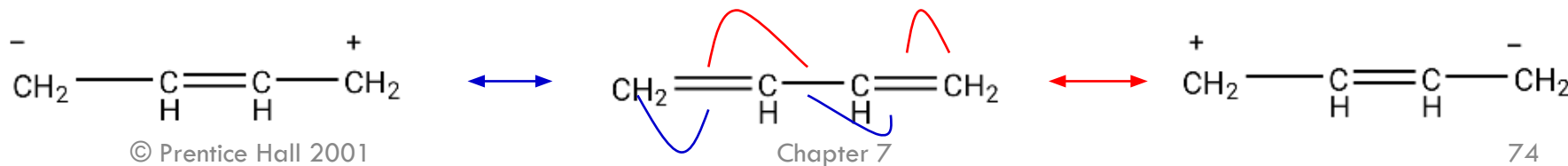
single bond formed by
 sp^2-sp^2 overlap



single bonds formed by
 sp^3-sp^2 overlap

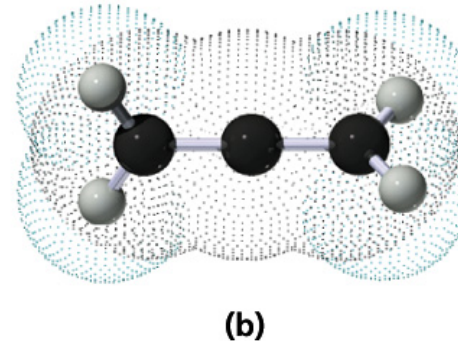
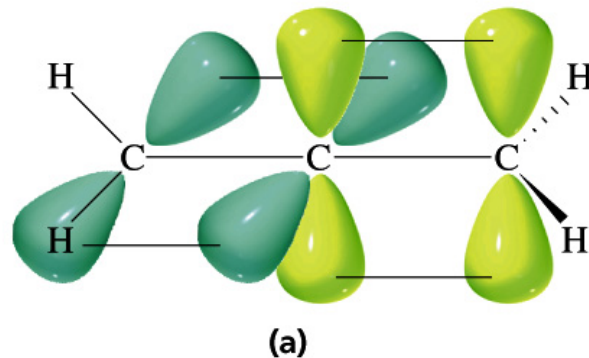


- Resonance also stabilizes the conjugated diene



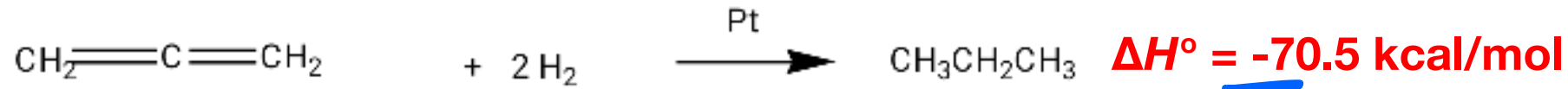
Relative Stabilities of Dienes

- Doubly-bonded carbons in isolated and conjugated dienes all are sp^2 hybridized
- The central carbon in a cumulated diene is sp hybridized



(it become a
linear compound)

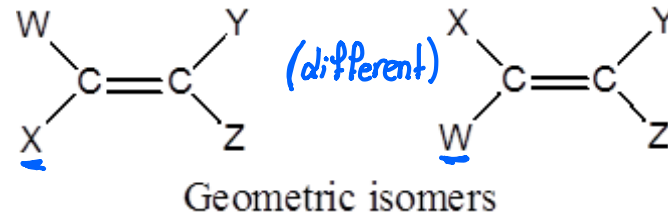
Relative Stabilities of Dienes



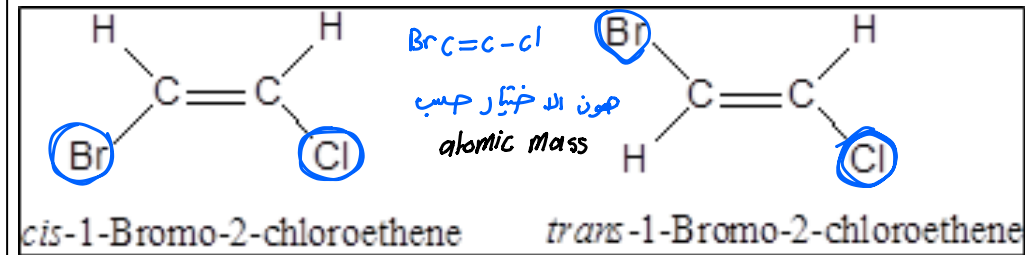
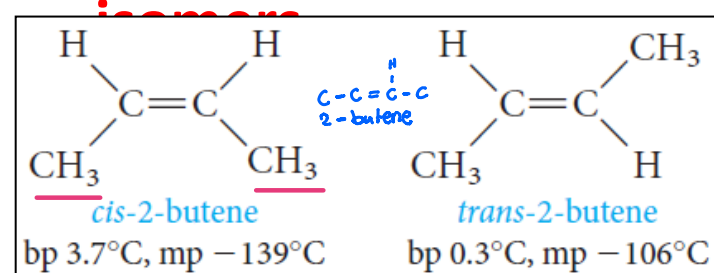
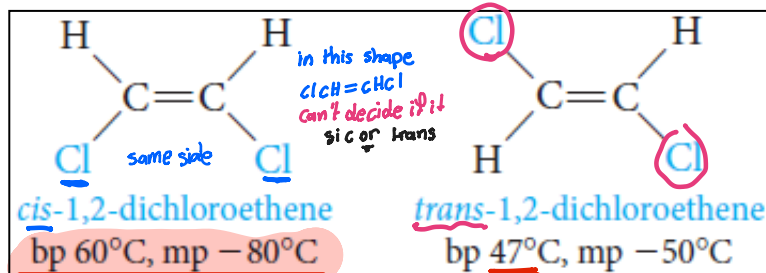
- The heat of hydrogenation of allene is similar to that of 1-butyne; both have at least one *sp* carbon
- Additional reactivity of cumulated dienes will not be considered in this course

Geometric Isomerism in Alkenes

- In **alkenes**, **geometric isomerism** is **due** to **restricted rotation** about the carbon - carbon double bond.



A) when **W** differs from **X** and **Y** from **Z**, Alkenes exist as **geometric**



- cis isomer**; when two similar groups are on the **same side** of the double bond.
- trans isomer**; when two similar groups are on the **opposite sides** of the double bond.
- They have **different physical properties** and can be separated by fractional crystallization or distillation.