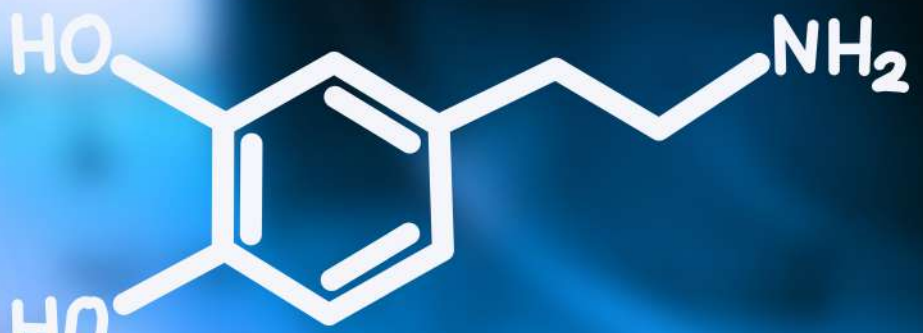
Organic 1

لجان الدُّفعات

DOPAMINE ACADEMY

Subject: Lecture 5



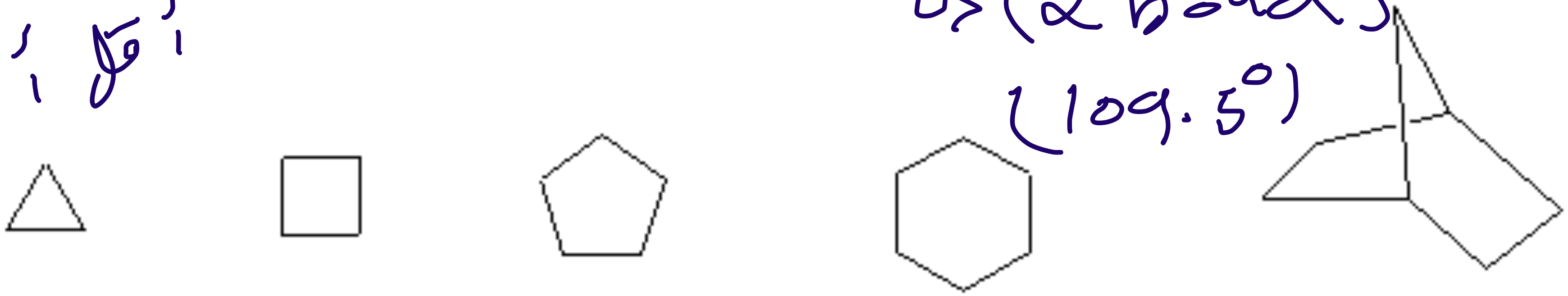
Dopamine

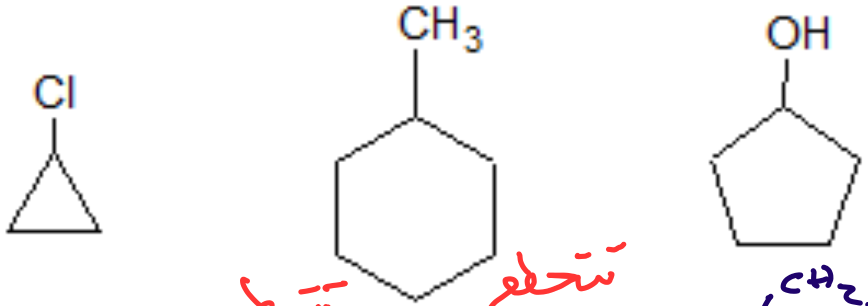
Student Name: Otba Khalid

25-7-2024

2-Alicyclic Alkanes

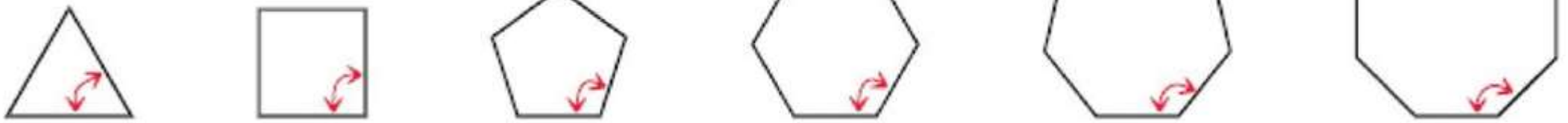
Cycloalkanes: C_nH_{2n} (*contain carbon-carbon single bond in a single ring*)





Cyclic Alkanes

- Carbon atoms in alkanes are sp^3 hybridized

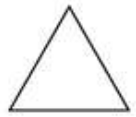


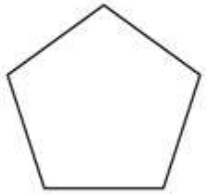
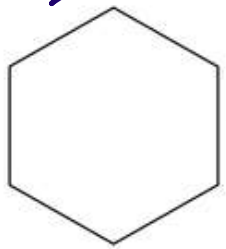
- To optimize the bond angles, most cycloalkanes are NOT flat in their most stable conformation

Nomenclature

Cycloalkanes

- Alkanes with closed ring(s) of C atoms
- General formula: C_nH_{2n} (C_3H_6, C_4H_8, C_5H_{10}, etc.)
- Naming: use cyclo- prefix before alkane name

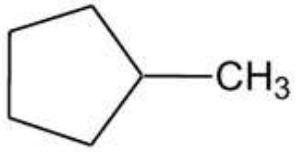


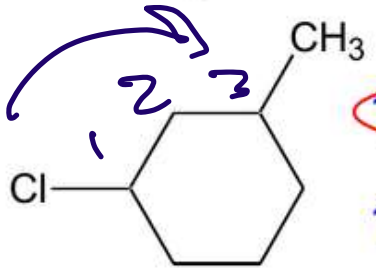
cyclopropane	cyclobutane	cyclopentane	cyclohexane
n = 3	n = 4	n = 5	n = 6
C_3H_6	C_4H_8	C_5H_{10}	C_6H_{12}

Naming substituted cycloalkanes:

- 1 substituent: no numbering necessary
- 2 or more substituents: highest alpha priority on C #1



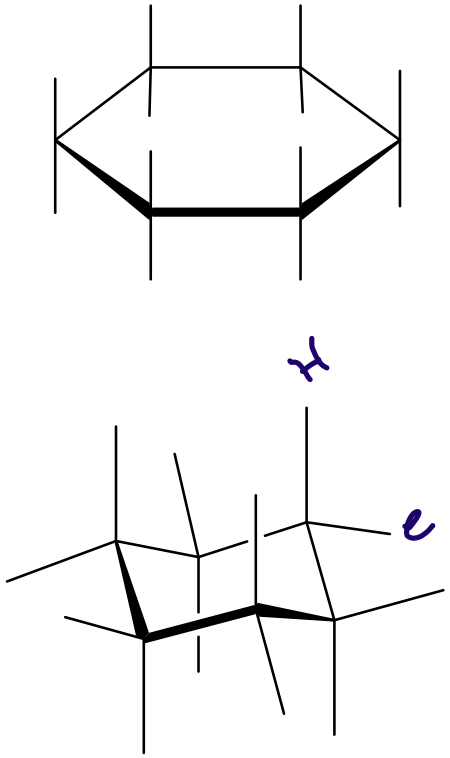
methylcyclopentane



1-chloro-5-methylcyclohexane

1-chloro-3-methylcyclohexane

Conformations of Cyclohexane

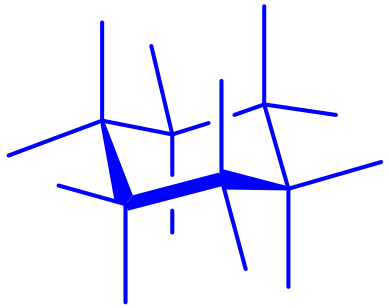


Cyclohexane does not have any angle strain! It isn't a flat molecule. By rotating about the carbon-carbon bonds, it can achieve 109.5° bond angles.

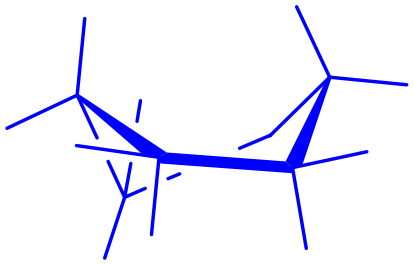
(the form is unless diverse)

conformations of cyclohexane

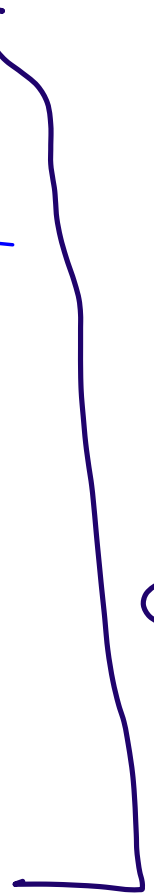
more stable



chair



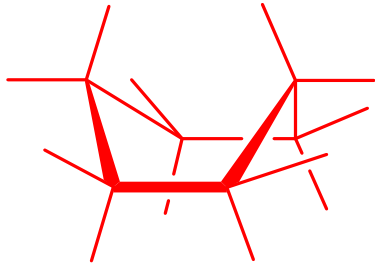
twist boat



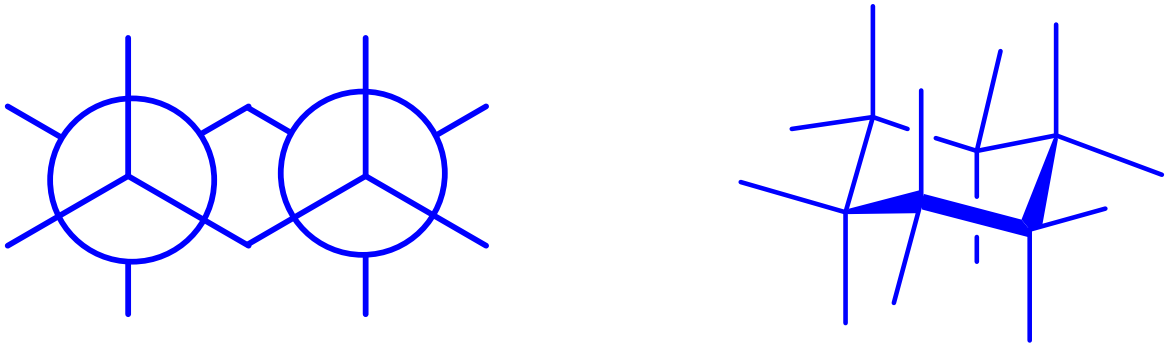
* العلاقة بينهما

conformation

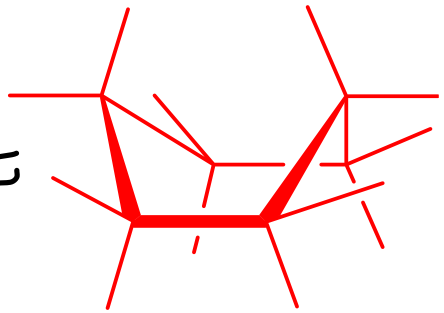
less stable

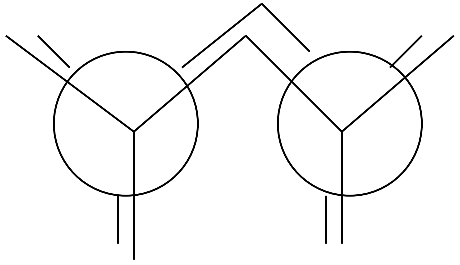


boat

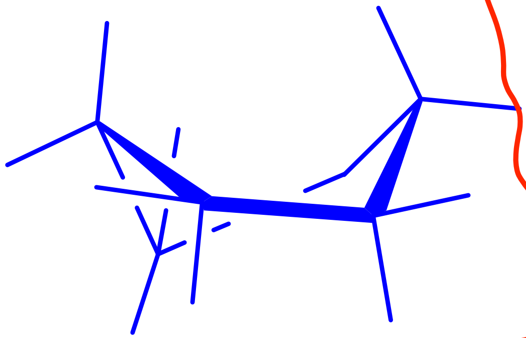


The **chair** conformation of cyclohexane is free of both angle strain and torsional strain (deviation from staggered). This is the **most** stable conformation.

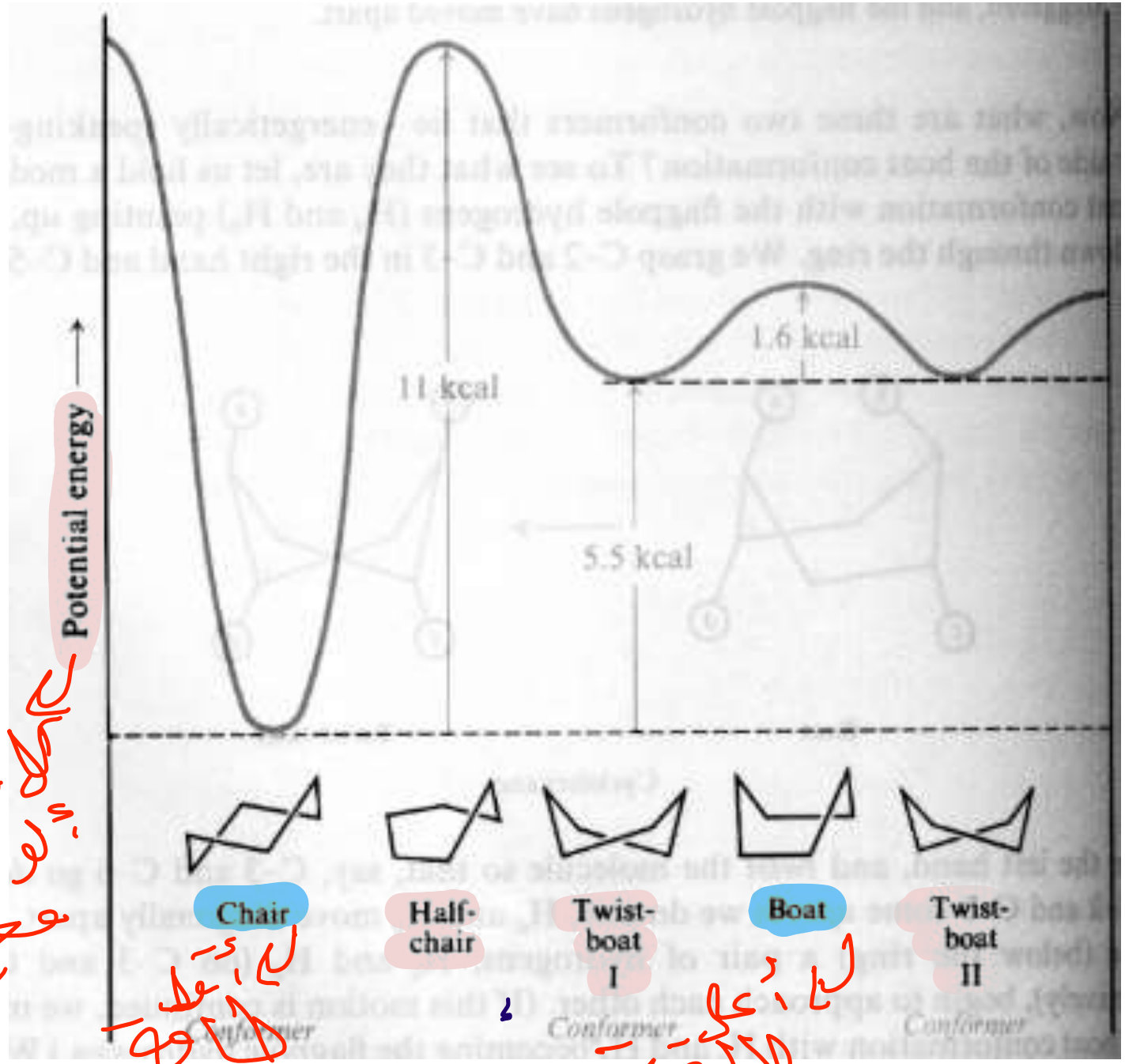




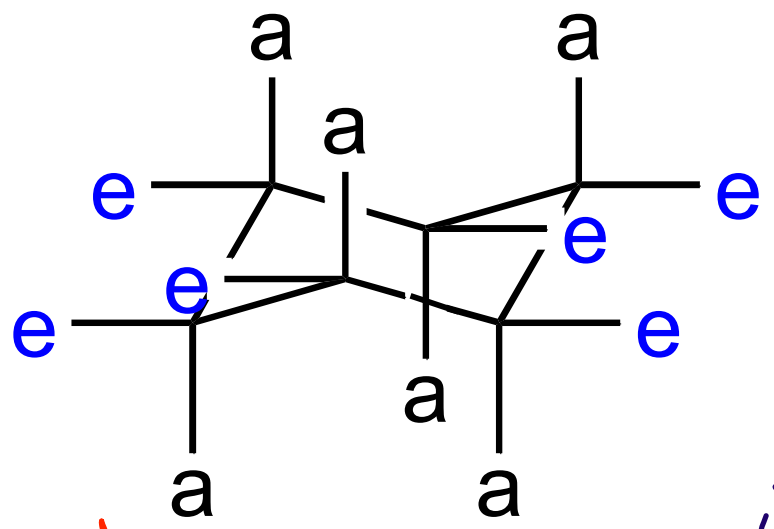
The boat conformation is free of angle strain, but has a great deal of torsional strain (eclipsed). To relieve the strain, it twists slightly to form the twist boat:



conformations of cyclohexane



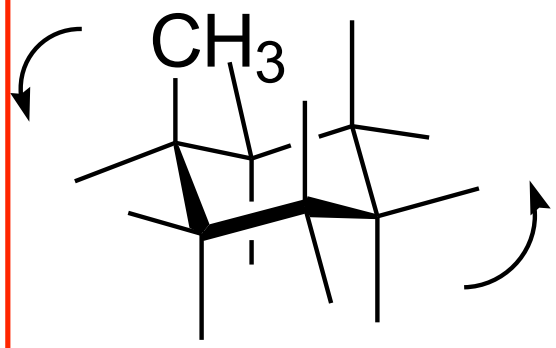
* the most stable or the least energ

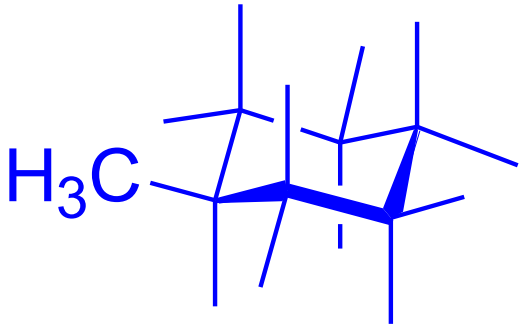


a = axial positions in the chair conformation

e = equatorial positions

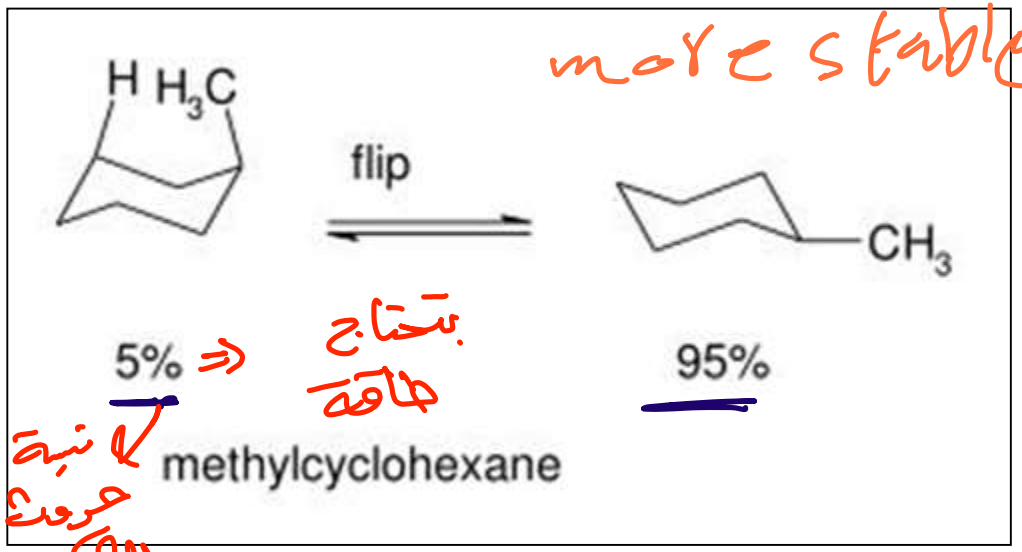
التفرع يكون الأفضل عند equatorial

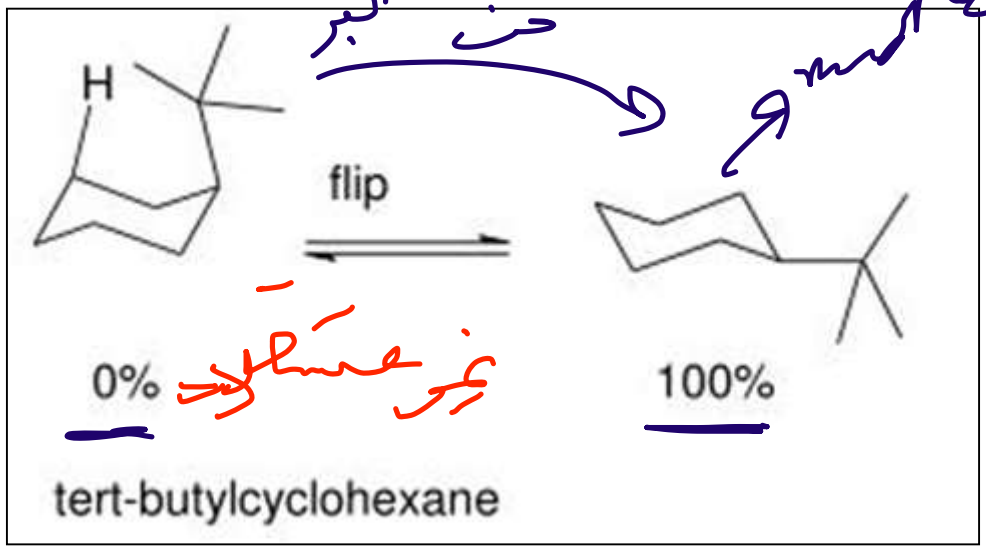




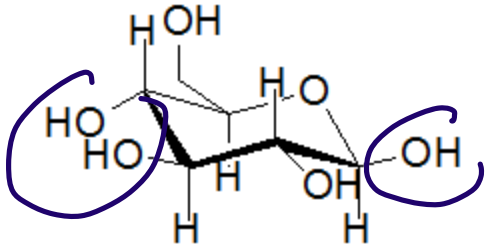
CH_3 in axial position

CH_3 in equatorial position is more stable





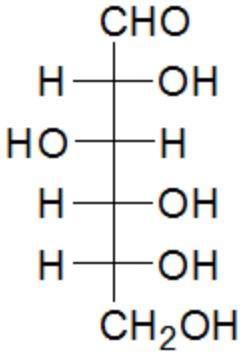
Glucose molecule

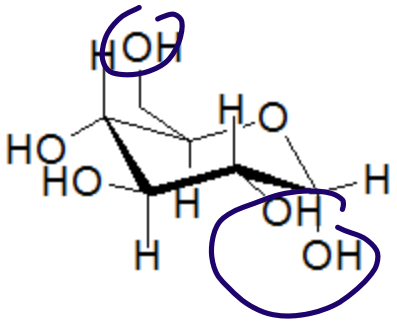


beta-D-glucose

all OH groups equatorial

more stable





alpha-D-glucose

one group forced to be axial

equatorial الباقي

2. ALKENES

The Structure of Alkenes

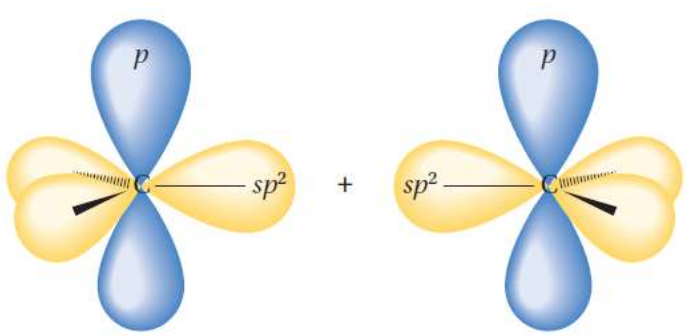
- Alkenes are hydrocarbons that contain a *carbon–carbon double bond*.
- Alkenes are also *Olefins*.
- General formula is C_nH_{2n}
- The simplest members of the Alkenes series are C_2 & C_3

	$CH_2=CH_2$	$H_3C-CH=CH_2$
Common name:	Ethylene	Propylene
IUPAC name:	Ethene	Propene

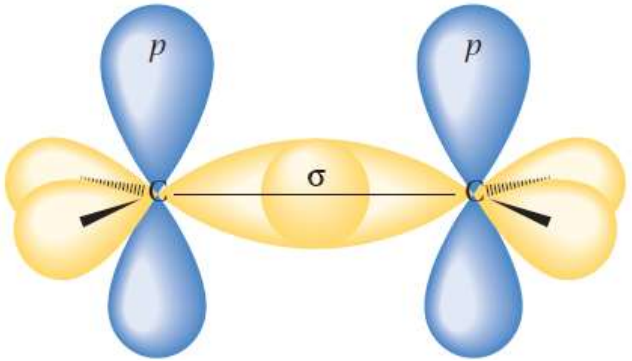
The Structure of Alkenes

- Hybridization; sp^2-hybridized orbitals
- The angle between them is 120° and bond length C=C (1.34 Å).
- A trigonal planar. ⇒ مستوي الشكل

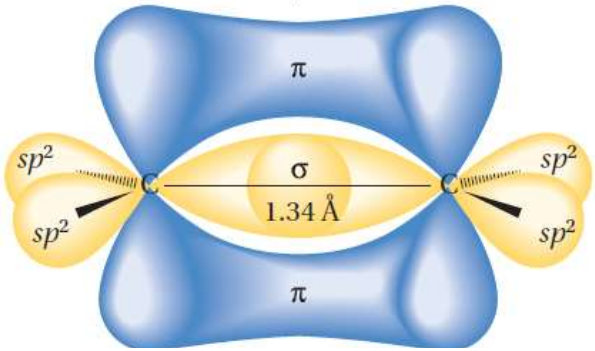
كلما زاد عدد الروابط
قل طول الرابطة ⇐



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

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

$CH_2=CH_2$ ethylene (ethene)

$CH_3CH=CH_2$ propylene (propene)

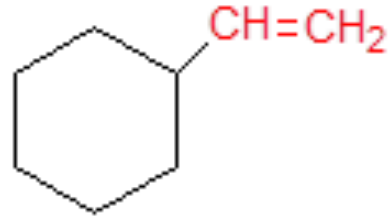
- Two important groups also have common names; They are the vinyl and allyl groups.
- These groups are used in common names.

$CH_2=CH-$ vinyl (ethenyl)

$CH_2=CHCl$ vinyl chloride (chloroethene)

$CH_2=CH-CH_2-$ allyl (2-propenyl)

$CH_2=CH-CH_2Cl$ allyl chloride (3-chloropropene)



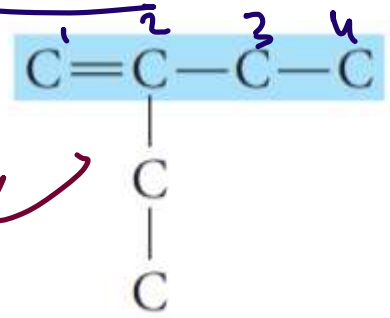
Common name: Vinyl cyclohexane
IUPAC name: Cyclohexylethene

Nomenclature of Alkenes

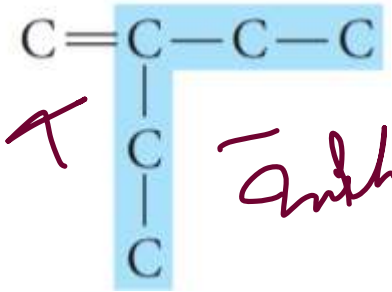
The IUPAC Rules

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.

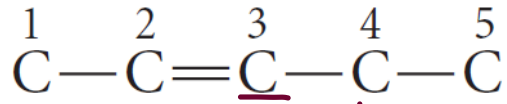
1. The ending **-ene** is used to designate a carbon–carbon double bond.
2. Select the **longest chain that includes *both* carbons of the double bond**.



not



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



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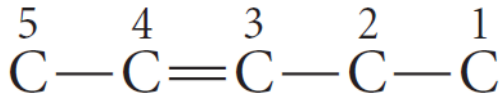
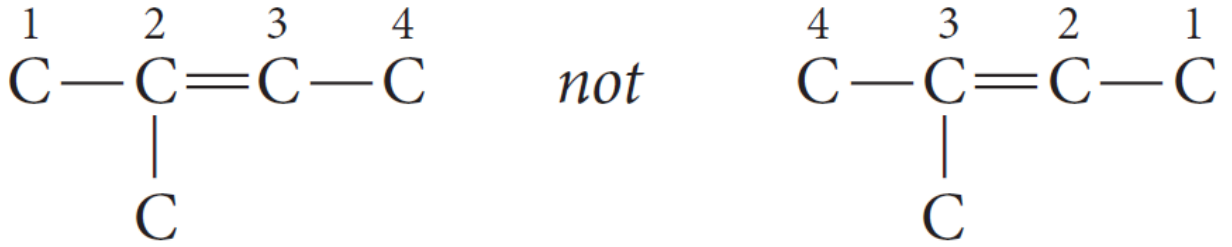


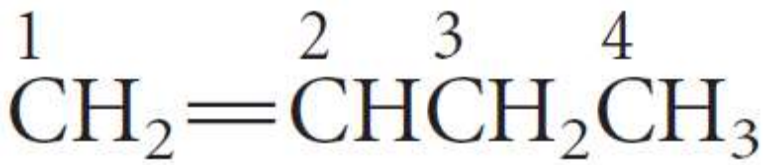
Nomenclature of Alkenes

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

* إذا نفس المسافة (C=C) بالجي من الطرف الأقل رقم



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



1-butene, *not* 2-butene

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.

CH_3CH_3 ethane	$CH_2{=}CH_2$ ethene	$HC{\equiv}CH$ ethyne
$CH_3CH_2CH_3$ propane	$CH_2{=}CHCH_3$ propene	$HC{\equiv}CCH_3$ propyne

⇒ identical

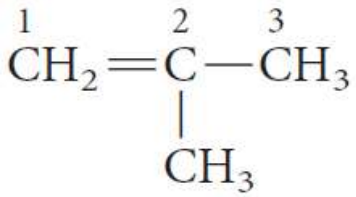
With four carbons, a number is necessary to locate the double bond.

$\overset{1}{CH_2}{=}\overset{2}{CH}\overset{3}{CH_2}\overset{4}{CH_3}$ 1-butene

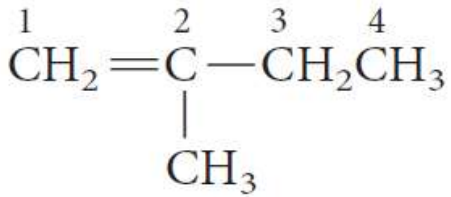
$\overset{1}{CH_3}\overset{2}{CH}{=}\overset{3}{CH}\overset{4}{CH_3}$ 2-butene

Nomenclature of Alkenes

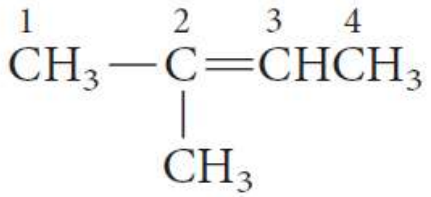
- Branches are named in the usual way.



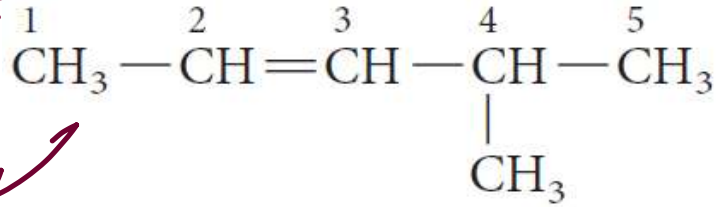
methylpropene
(isobutylene)



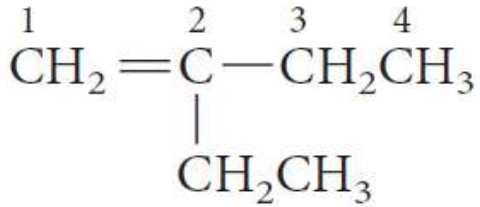
2-methyl-1-butene



2-methyl-2-butene



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

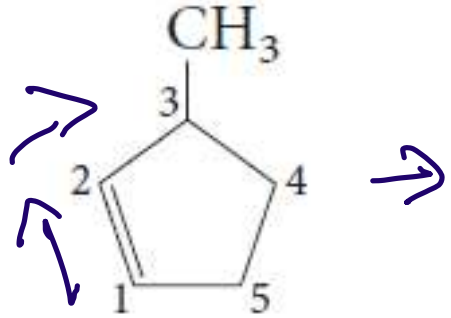


2-ethyl-1-butene
(Named this way, even though there is a five-carbon chain present, because that chain does not include both carbons of the double bond.)

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.)



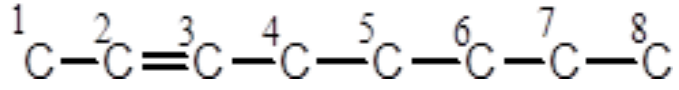
3-methylcyclopentene
(Start numbering at, and number through the double bond; 5-methylcyclopentene and 1-methyl-2-cyclopentene are incorrect names.)

Nomenclature of Alkenes

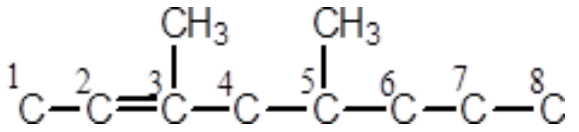
Example: Write the structural formula of 4-Isopropyl-3,5-dimethyl-2-octene.

1) The parent carbon chain is an Octene.

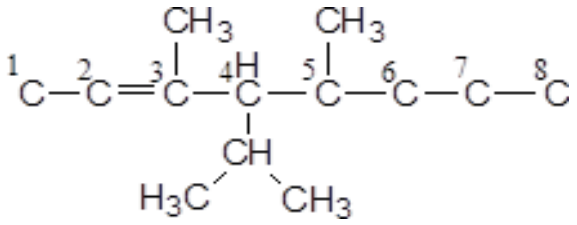
The double bond is located between the 2nd and 3rd carbons.



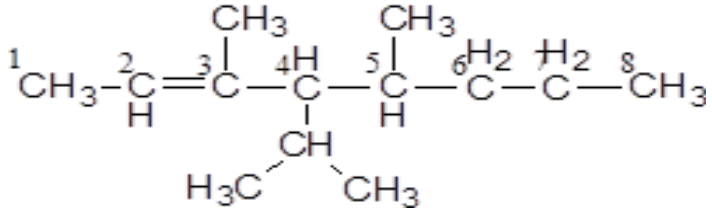
2) Two methyl groups are attached on the parent carbon chain, one on carbon 3 and the other on carbon 5.



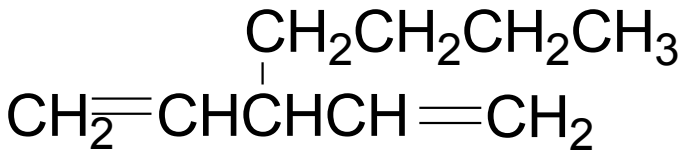
3) An isopropyl group is attached on carbon 4.



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

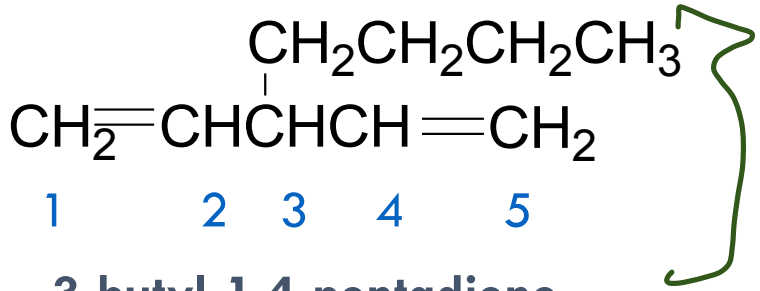


Diene compounds: are alkenes with two π bonds



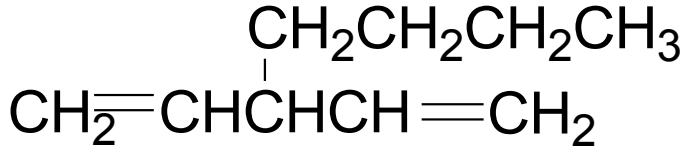
Nomenclature of Dienes

1. Find the longest chain containing both double bonds



3-butyl-1,4-pentadiene

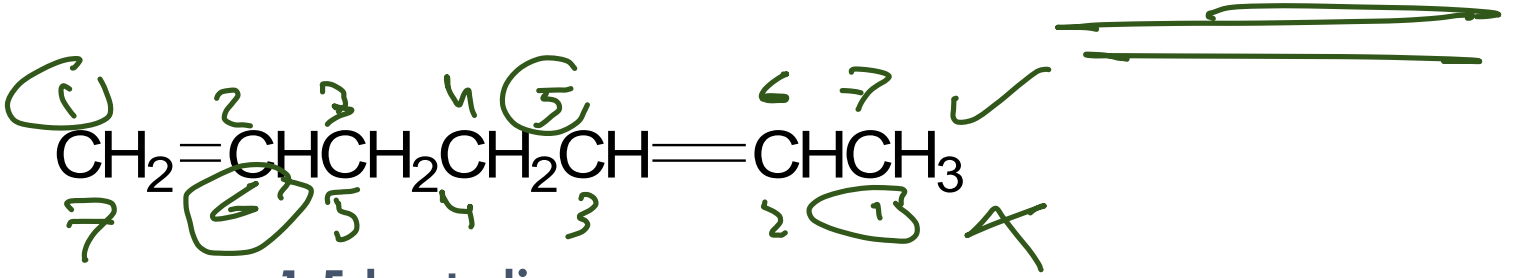
2. Use corresponding alkane name but replace the "*ne*" ending with "*diene*"



3-butyl-1,4-pentadiene

"pentane" changed to "pentadiene"

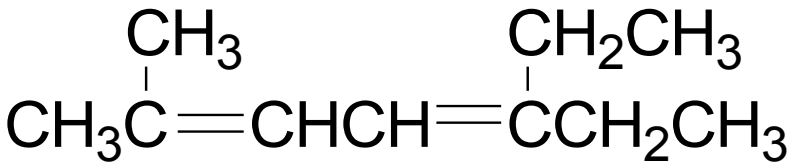
3. Number in the direction that gives the lowest number to a double bond



1,5-heptadiene

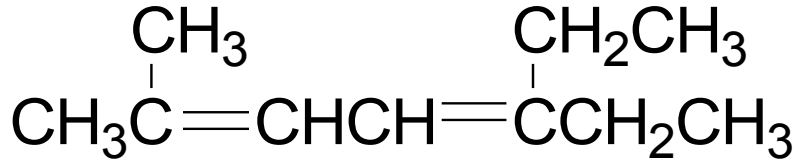
not 2,6-heptadiene

4. List substituents in alphabetical order



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

5. 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



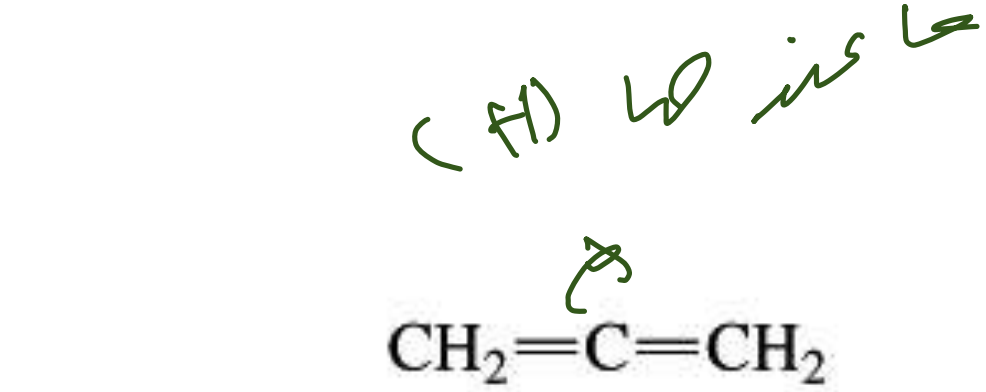
5-ethyl-2-methyl-2,4-heptadiene

or 5-ethyl-2-methyl-hepta-2,4,-diene

أنتبه لا (د) (-)

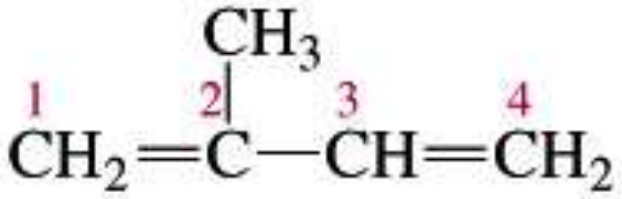
* ممكن يجي سؤال نفس الخيارات بس الاختلاف في الفاصلة (و) أو (-)

Example:



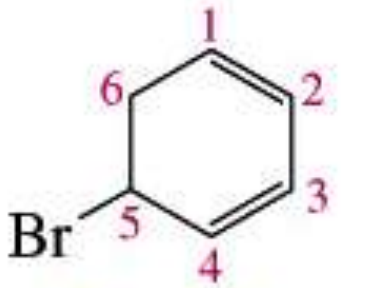
systematic: propadiene

common: allene



2-methyl-1,3-butadiene

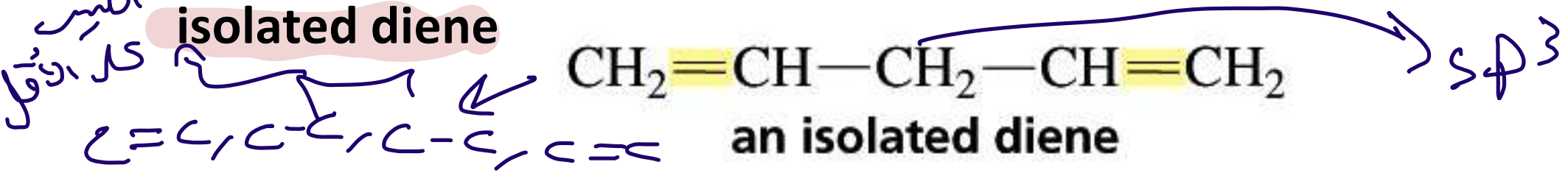
isoprene



5-bromo-1,3-cyclohexadiene

Types of Dienes

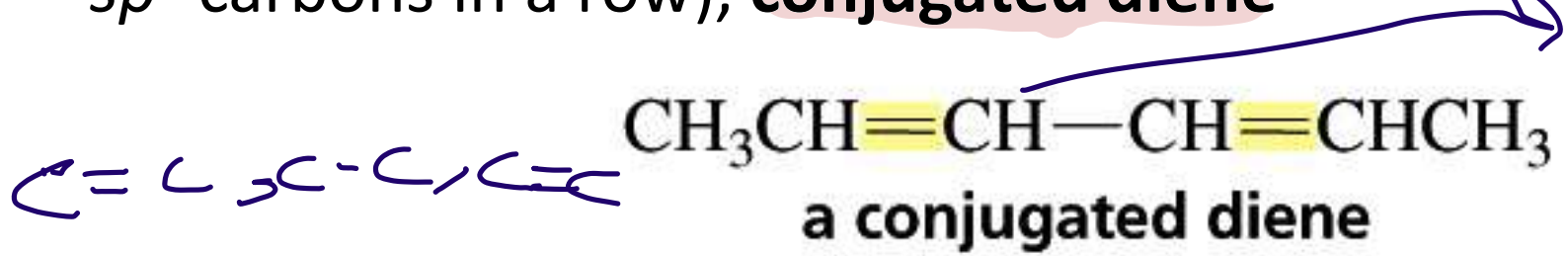
- When double bonds are separated by at least one sp^3 carbon, **isolated diene**



$CH_2{=}CH{-}CH_2{-}CH{=}CH_2$

an isolated diene

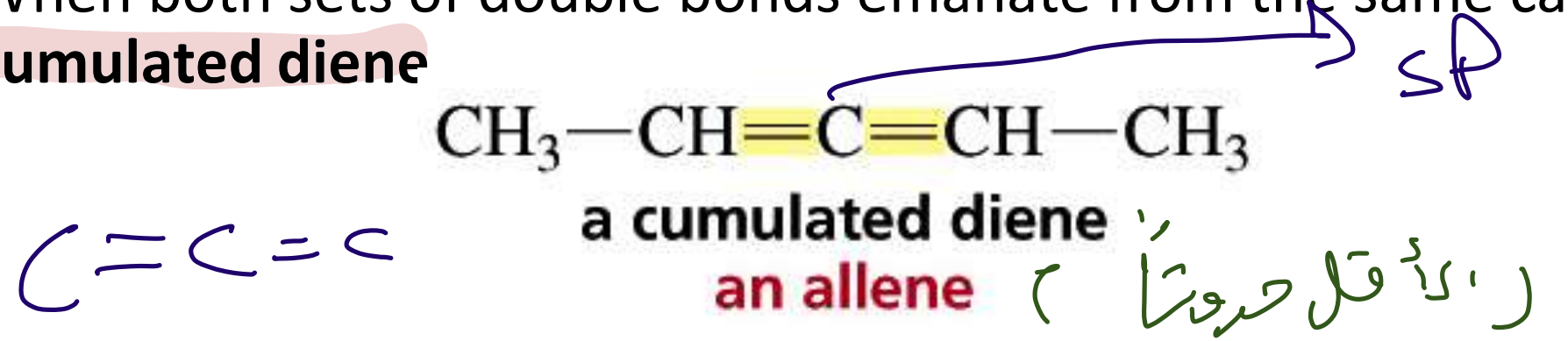
- When double bonds are separated by only one single bond (i.e. four sp^2 carbons in a row), **conjugated diene**



$CH_3CH{=}CH{-}CH{=}CHCH_3$

a conjugated diene

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



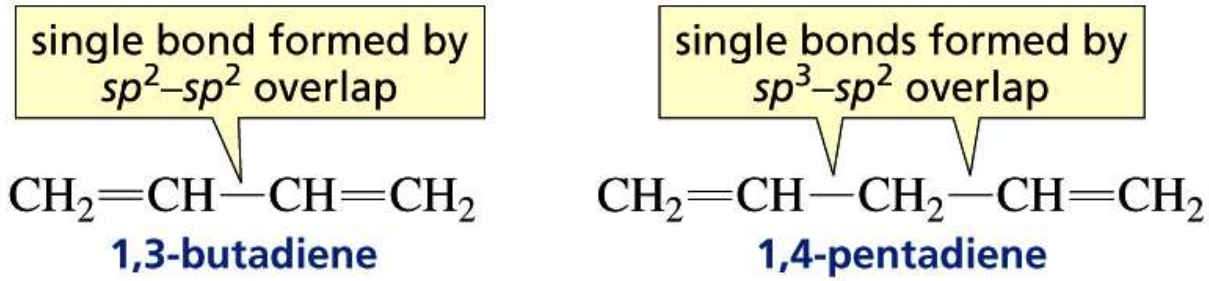
$CH_3{-}CH{=}C{=}CH{-}CH_3$

a cumulated diene

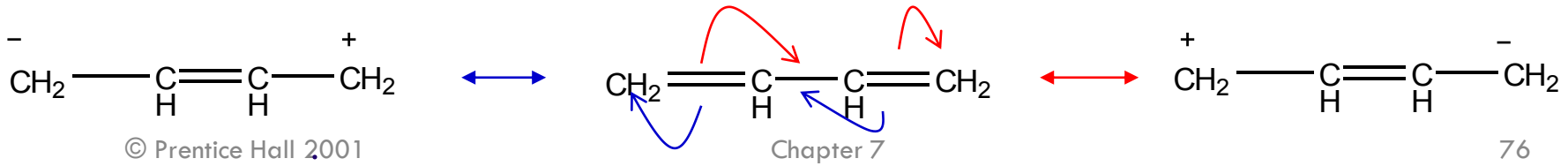
an allene

Relative Stabilities of Dienes

- 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

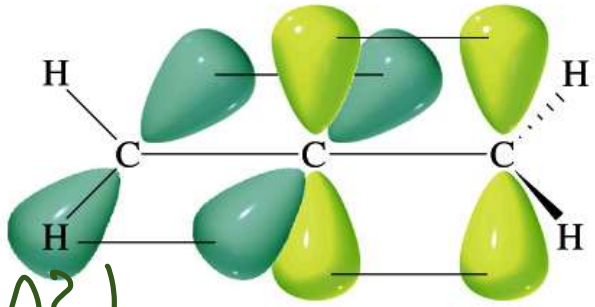


- Resonance also stabilizes the conjugated diene

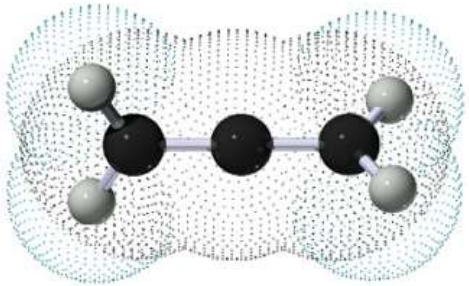


Relative Stabilities of Dienes

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



(a)



(b)

⇒ linear compound

(sp²-sp²) (sp²-sp²)

(sp-sp) (s-s)

(sp-s)

* ترتيب حسب العقول والقوة

s-s > sp-s > sp-sp > sp²-sp² > sp³-sp³

لي جواب