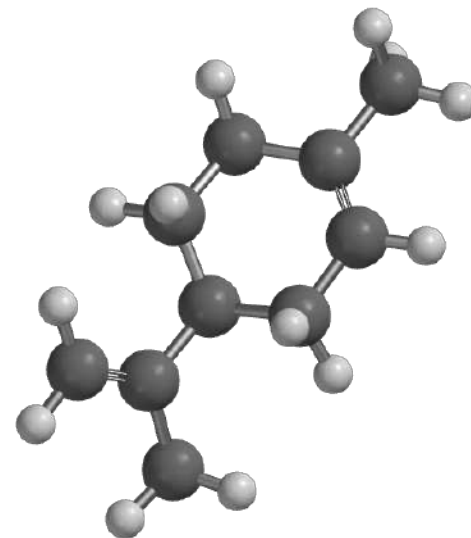
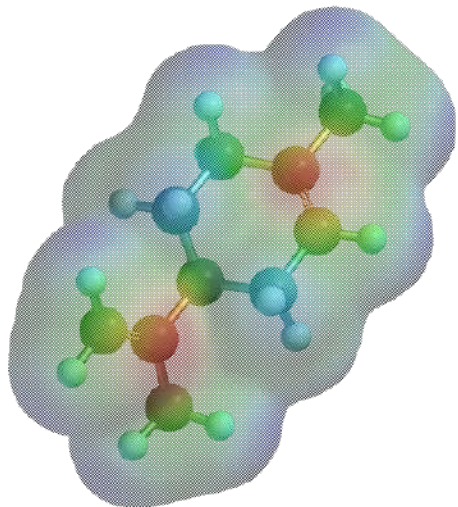




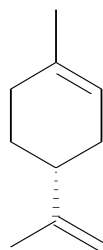
# Organic chemistry

Lec: 7

Done by: Dema Alhussine



# *Chapter 3: Alkenes and Alkynes*

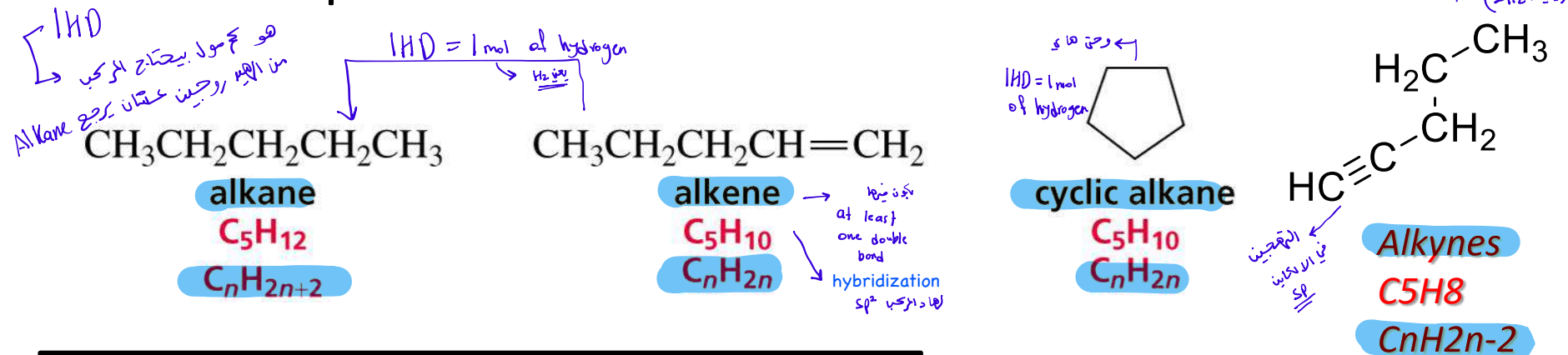


**Endorse**

# General Properties

Alkenes contain double bonds and alkynes triple bonds. Both classes of compounds are hydrocarbons, containing only C and H atoms.

- a double bond consists of 1  $\sigma$  and 1  $\pi$  bond,
- a triple bond consists of 1  $\sigma$  and 2  $\pi$  bonds.



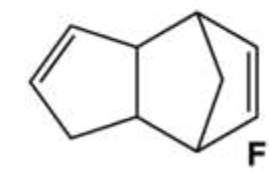
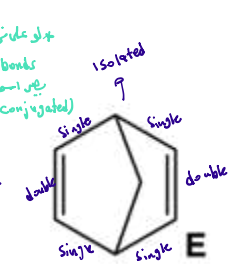
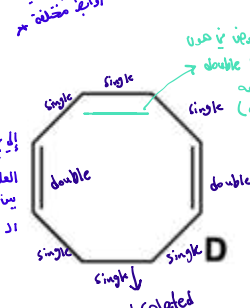
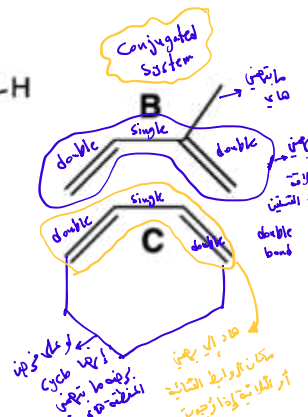
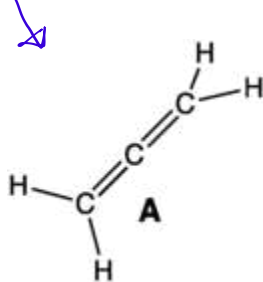
Every  $\pi$  bond results in the loss of a pair of H atoms.

# General Properties (cont'd)

The Index of Hydrogen Deficiency (IHD) can give an idea of possible structures based on the ratio of C to H. This is a count of the number of H<sub>2</sub> molecules needed to obtain the corresponding saturated acyclic structure. The IHD is also equal to the number of rings and  $\pi$  bonds in the molecule.

With multiple double (or triple) bonds three possible arrangements arise: cumulated, conjugated or isolated (non-conjugated). Conjugated are especially important as the  $\pi$  bonds can interact.

Cumulated	Conjugated	Isolated (Nonconjugated system)
$C=C=C$	$C=C-C=C$	$C=C-C-C=C$
$C=C=C=C$	$C\equiv C-C\equiv C$	$C\equiv C-C-C-C\equiv C$



الفكرة هون إنه يكون  
تبعدين ي روارج multiple  
↓  
double or triple  
ربيعهم أحسن من رابطة single

double bonds  
مربيعين

multiple bonds  
بعض double  
بعض triple

reasoner system  
لا

المثلثة لا  
! conjugation  
? reasoner  
ملا

multiple single  
multiple

بما يعني الترتيب  
المهم إنه فيه  
اولاين مختلفة

double bonds  
بعض اسمه  
(conjugated)

isolated

single  
double  
single  
isolated

single  
double  
single  
isolated

# • IUPAC Nomenclature of alkenes

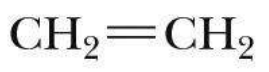
- Use the Suffix **-ene** to show the presence of a carbon-carbon double bond.
- Number the parent chain to give the 1<sup>st</sup> carbon of the double bond the lower number.
- Follow IUPAC rules for numbering and naming substituents.
- For a cycloalkene, the numbering of the atoms of the ring the must begin with the two carbons of the double bond.

double bond ← هذا اختيار أطول سلسلة لازم تحتوي على  
Functional group ← هنا لازم تاخذ أقل رقم

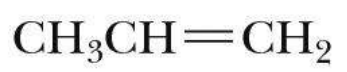
prefix + root + suffix  
Substituent ←  
Parent name (سلسلة) ←  
Functional group (مجموعة وظيفية) ←

- Some alkenes, particularly low-molecular-weight ones, are known almost exclusively by their common names.

علمها  
التركيب  
IUPAC name:  
Common name:  
لزم نونم

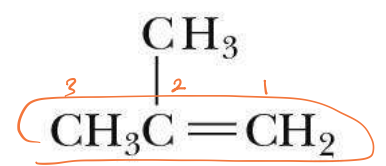


Ethene  
Ethylene



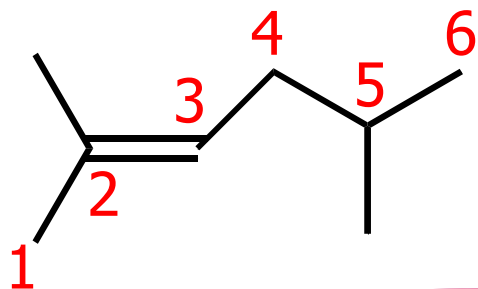
Propene  
Propylene

في حالة الـ ethene و propene  
ما نجا داي نونم الكربون الـ 1 عتفا  
double bond  
ليست؟ لانه في الحالة هـ رتفا 1  
الركبان بعد الـ propene  
يعني بعد المركب المكون من (3C)  
لزم نونم



2-Methylpropene  
Isobutylene

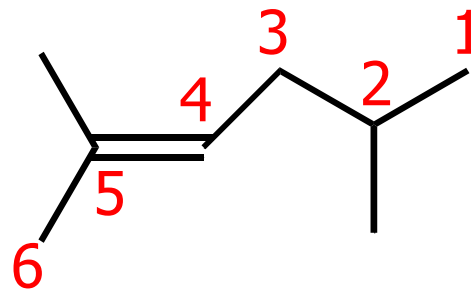
Number the chain in the direction that gives the functional group the lowest number.



**2,5-Dimethyl-2-hexene**

6c

**NOT**



**2,5-Dimethyl-4-hexene**

يمكن في بعض المراجع يكونوا كالتين

hex-2-ene هيكل  
برفقه مع ✓

بين هياك  
بنتكيب  
يا الغالب

في خطا يمكن تقع فيه لورقمنا بشكل (فقري)

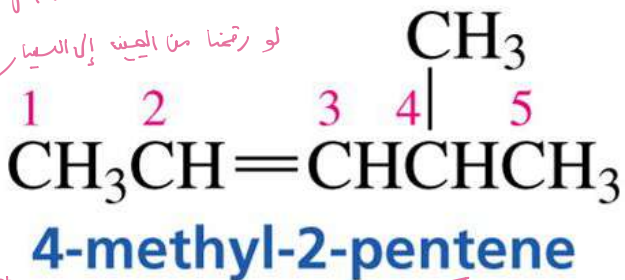
2 بلع 6 وهو مش longest chain.

\* نركز على اى خطا

double bond ← اتل ترتيب

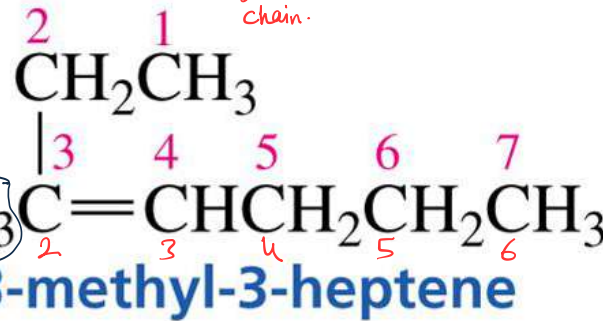
لو رقمنا من اليمين إلى اليسار

CH<sub>3</sub>  
حفاظا 2  
وال double bond 3



5c

substituent

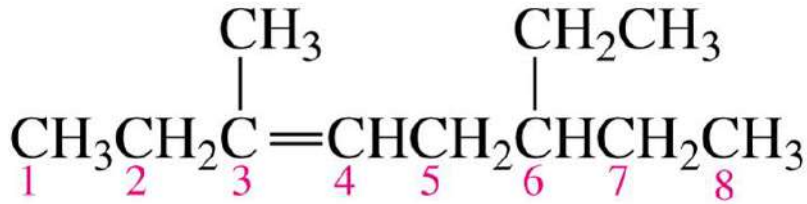


← الترتيب هياك خطا

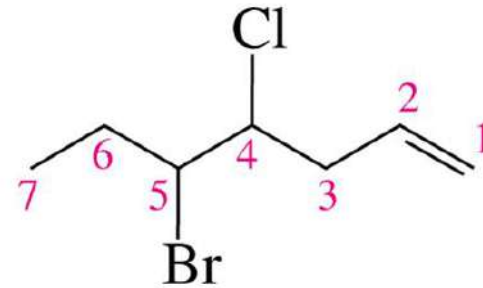
\* نهون لازم  
لترتيب من اليسار  
إلى اليمين



Substituents are stated in alphabetical order.



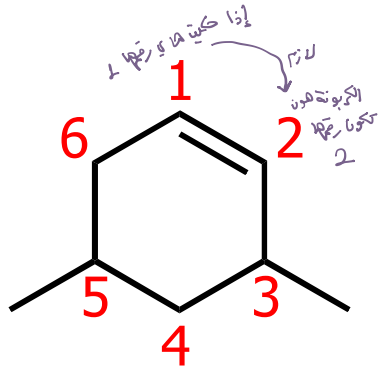
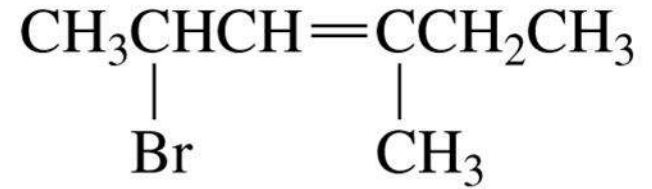
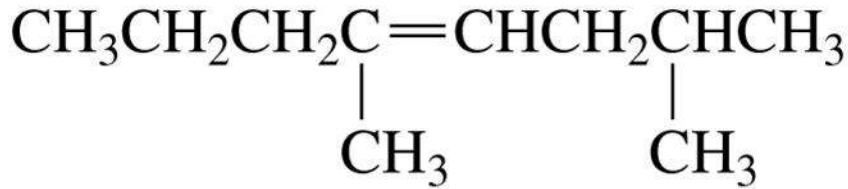
6-ethyl-3-methyl-3-octene



5-bromo-4-chloro-1-heptene

ما ننصاه

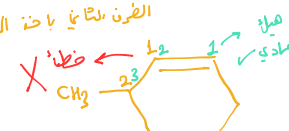
Hw:



3,5-Dimethylcyclohexene

ما ننصاه

كل عمادي ينجر مع عقارب الساعة ونبعد عكس عقارب الساعة  
بسن الفكرة إنه 1=2  
2=1  
يعني طرف من double bond  
الطرف الثاني باخذ الرقم 2



NOT

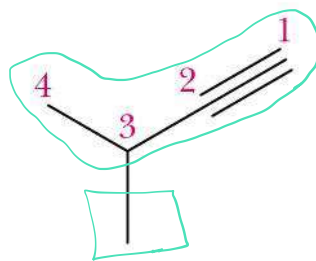
4,6-Dimethylcyclohexene

double bond ← cyclo  
داخلاً 1  
Substituent  
من داخل الحلقة ال double bond  
وهي اسماها بغير انتم  
من باخذ الرقم إلى بسيط كل الأحوال طبقاً  
رقم واحد ال double bond + انتم ال Substituent

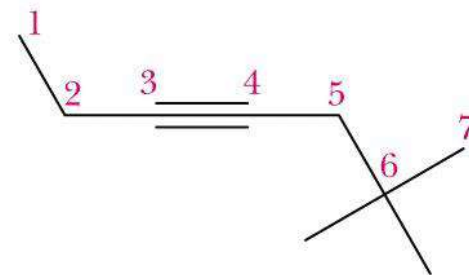
# • IUPAC nomenclature of alkynes

نفس القواعد  
تأخذ الـ  
Alkyne  
الرقم لأنه يشبه  
Alkyne

- Use the infix **-yne** to show the presence of a carbon-carbon triple bond.
- Number the parent chain to give the 1<sup>st</sup> carbon of the triple bond the lower number.
- Follow IUPAC rules for numbering and naming substituents.



3-Methyl-1-butyne



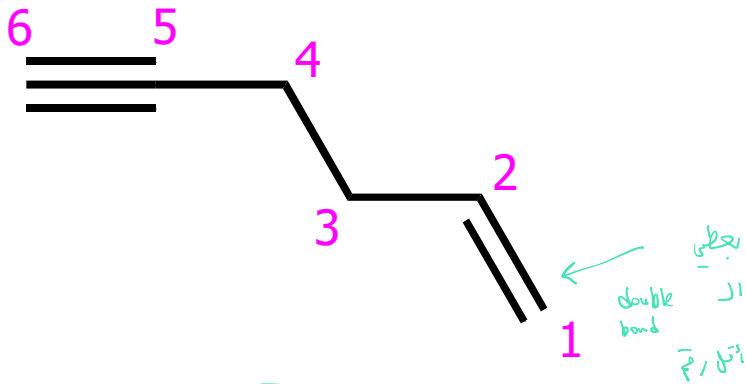
6,6-Dimethyl-3-heptyne

- Common Name:

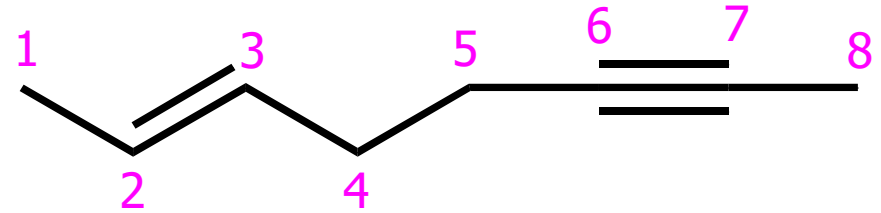


→ Common  
name  
for simplest  
Alkyne

طلب شو نعمل لو اجا في نفس المركب رابطة ثنائية وثلاثية مع بعض ؟ الجواب : مطلوب منا حالة وحدة في الكتاب وينلتزم فيها والي هيه لما يكون الهم نفس ال priority



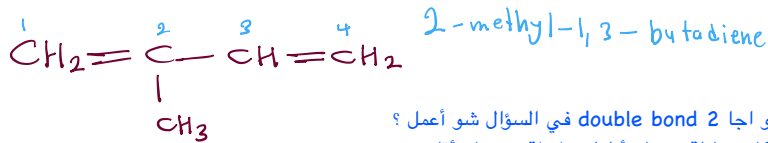
Hex-1-en-5-yne  
6C double bond triple bond



(2E)-Oct-2-en-6-yne  
8C double bond triple bond

انفسها 2 بجطي عنها بجدين

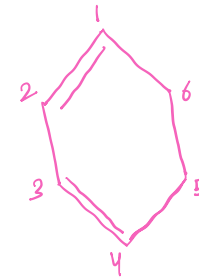
ex:



لو اجا 2 double bond في السؤال شو عمل ؟ بكل بساطة بتختار أطول سلسلة وتختار أقل ترقيم وبتعطي اهتمام لل substituent لكن الشيء الجديد ما بتحكي ene لأنه انت ما عندك بس رابطة ثنائية وحدة بتحط diene

بالتالي بناخذ من البعير ال الين بحيث نكل رقم ال double bond واتنرجح ال substituent

ex:

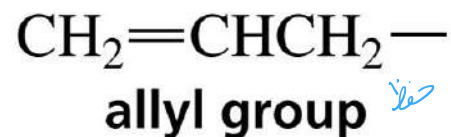
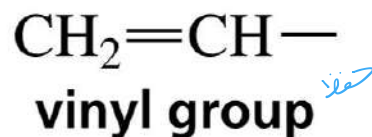


1,3-cyclohexadiene

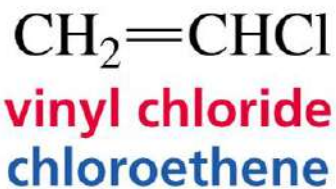
# Vinyl and Allyl Groups

A **vinyl group** is the **smallest group** that contains a **vinyl carbon**.

An **allyl group** is the **smallest group** that contains an **allylic carbon**.



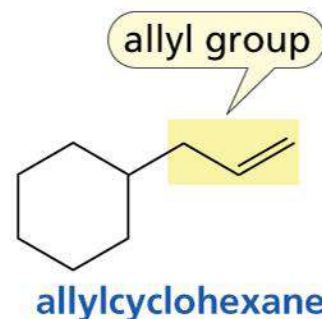
**common name:** vinyl chloride  
**systematic name:** chloroethene



**common name:** allyl bromide  
**systematic name:** 3-bromopropene

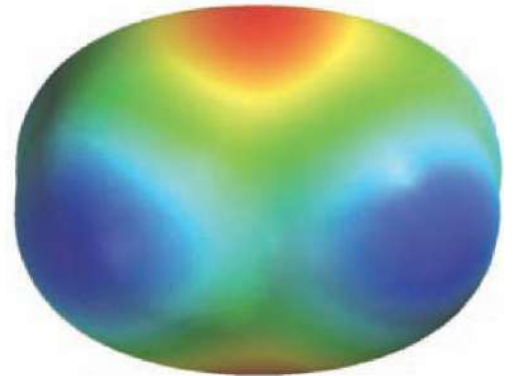
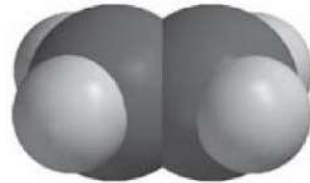
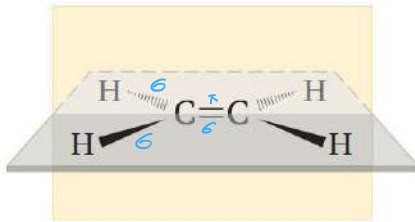


The **substituent** is on the **vinyl** or **allylic** carbon.



# Bonding in Alkenes

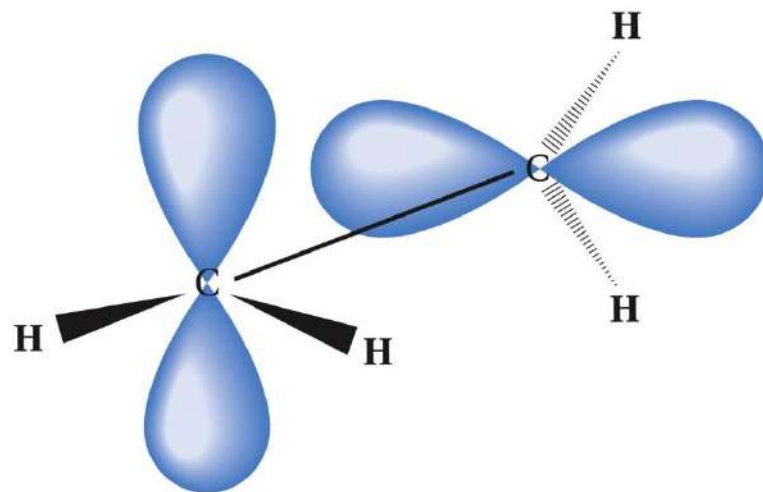
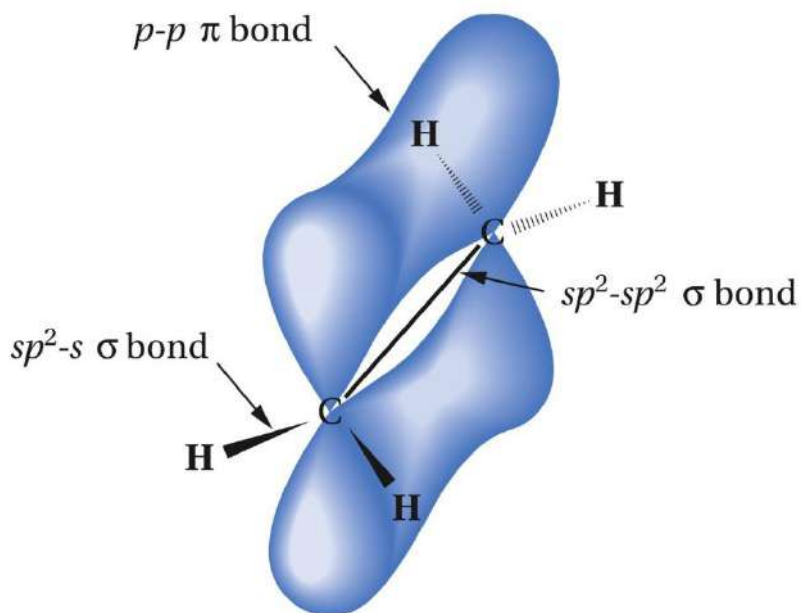
- Alkenes are  $sp^2$  hybridized
- Trigonal planar – bond angle  $\sim 120^\circ$
- 3  $\sigma$  and 1  $\pi$  bond (or 2 single and 1 double)
- C=C double bond  $\sim 1.34 \text{ \AA}$
- The  $\pi$  bond lock the geometry to planar



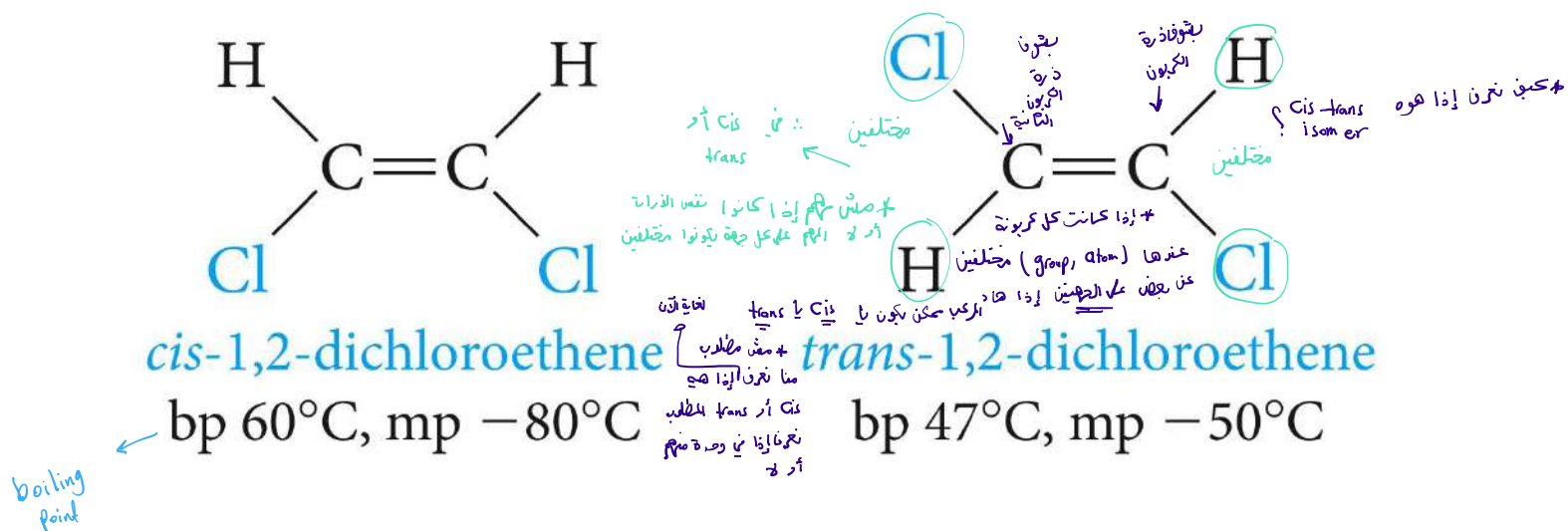
\* الرابطة  $\pi$  ← تضمين الرابطة سجا (single bond)  
\* الرابطة  $\sigma$  ← تأتي من الرابطة سجا (single bond)

# Cis – Trans Isomerism

The double bond in an alkene is rigid, that is it will not rotate freely. Therefore substituents on the carbon atoms will produce geometric isomers the same as on a cycloalkane ring.

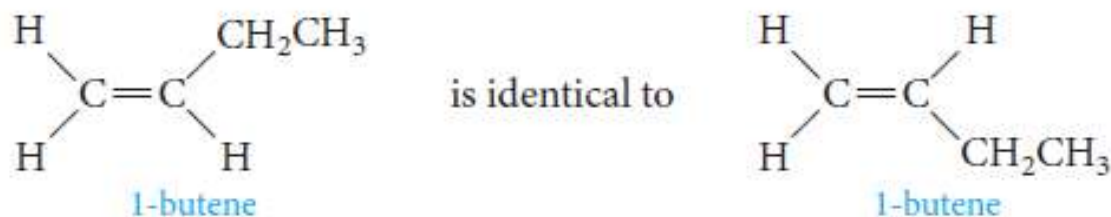


If the two non-hydrogen atoms or groups are on the same side of the double bond it is a *cis*- arrangement, on opposite sides a *trans*- arrangement, i.e.



Note that they have different physical properties, this is because their dipole moments are different.

For *cis-trans* isomerism to occur in alkenes, *each* carbon of the double bond must have two different atoms or groups attached to it.



# Polar reagents can be divided into :

## Nucleophiles

يحبوا  
الاشياء  
الموجبة

A nucleophile has

+ve  
nucleus ← like → to like

(electron rich)

a negative charge,

a lone pair,

or a  $\pi$  bond.



these are nucleophiles because they



have a pair of electrons to share

## Electrophiles

-ve      like

electron poor

positively atom or center

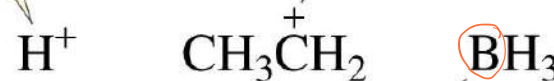
An electrophile has

a positive charge,

a partial positive charge,

or an incomplete octet.

these are electrophiles because they have a positive charge



this is an electrophile because it has an incomplete octet

↳ lone empty orbital

this is an electrophile because it has a partial positive charge

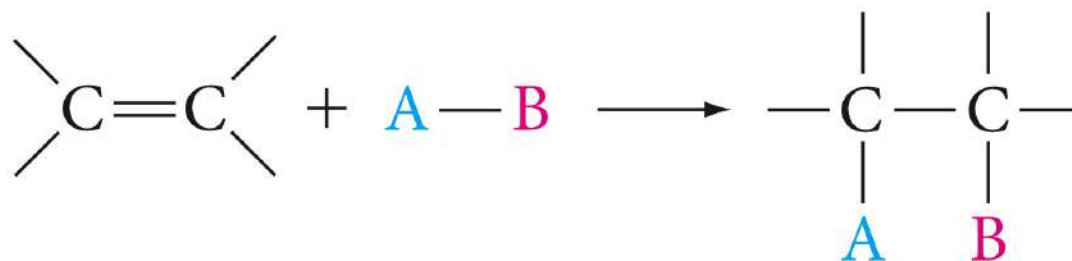
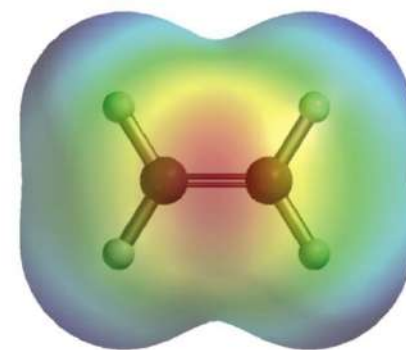




# Chemical Reactivity

The chemical reactivity of alkenes arise from the  $\pi$  electrons. The  $\pi$  bond is weaker than the  $\sigma$  bond so these electron react first. The reagent will add across the double bond so these are

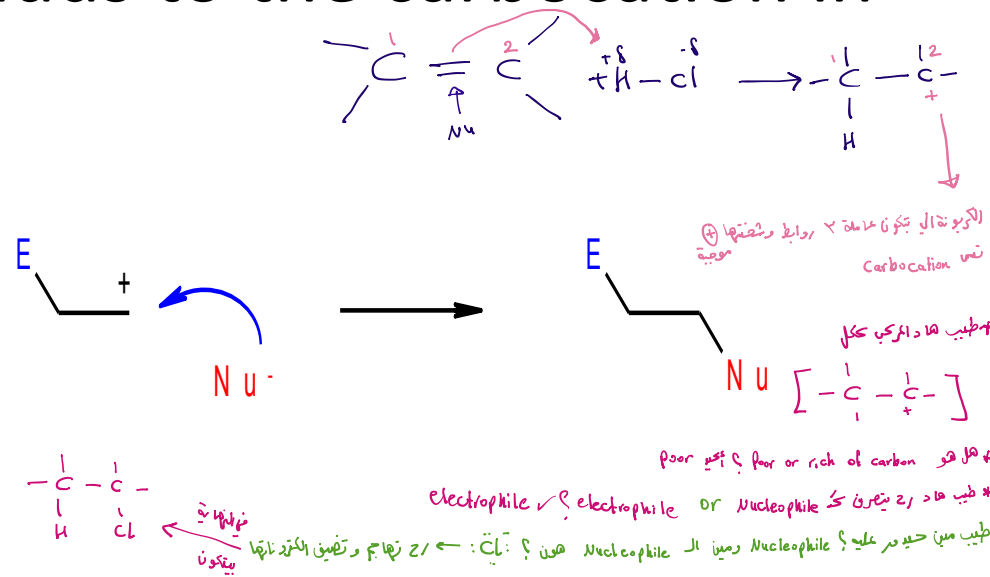
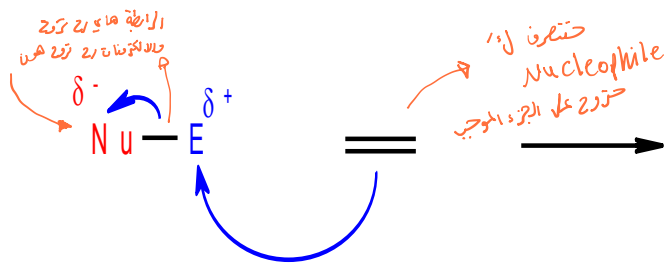
*addition reactions.*

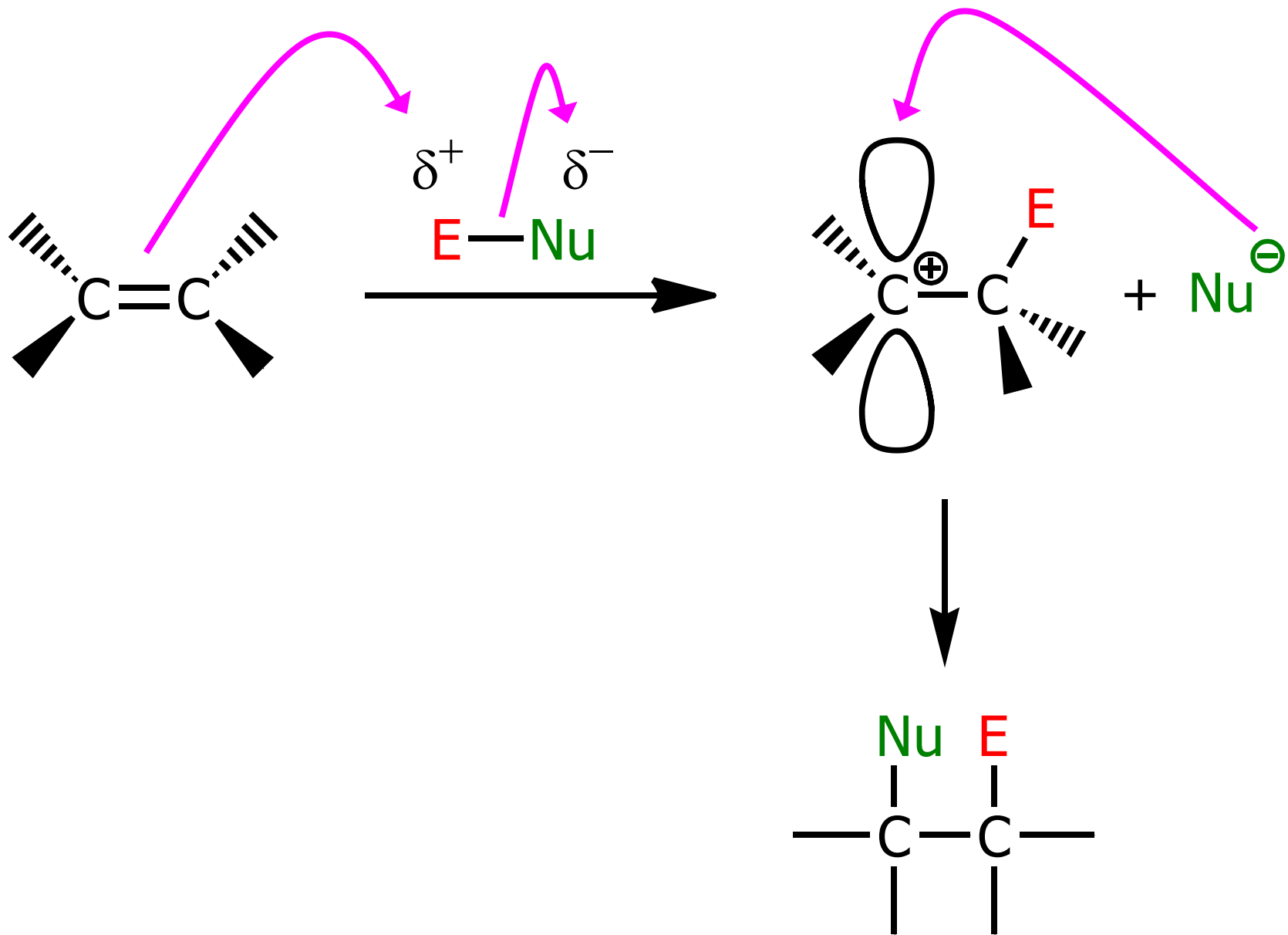


more stable

# Electrophilic Addition Mechanism

The basic mechanism is the same for all reagents, a two step reaction where an electrophile (**E**) add to the  $\pi$  bond in the first step creating a **carbocation** intermediate. A nucleophile (**Nu**) then adds to the carbocation in the second step.





## ❖ Mechanism

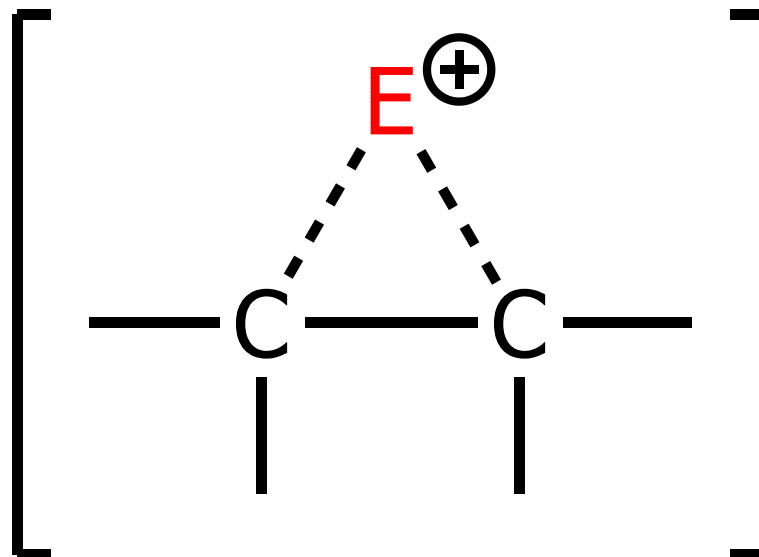
- Sometimes do not go through a “free carbocation”, may go via

في بعض الأحيان

Carbocation ال

يأخذ الشكل ال Bridge

\* نأخذ عنه بعيننا \*



Wednesday

20-3-2024

