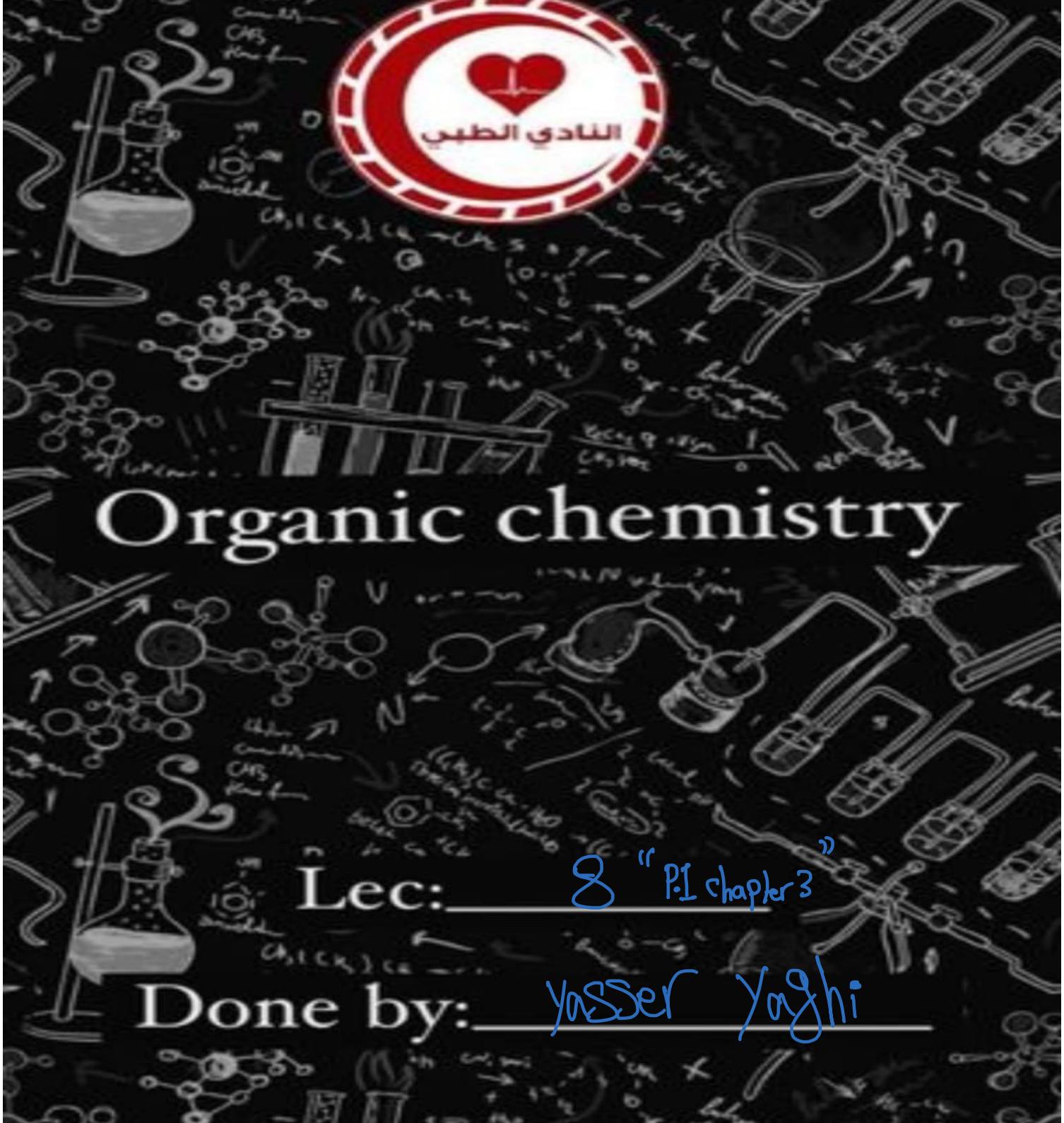
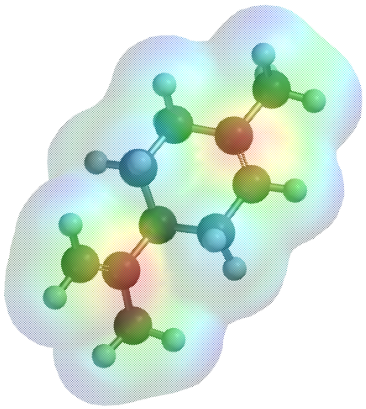
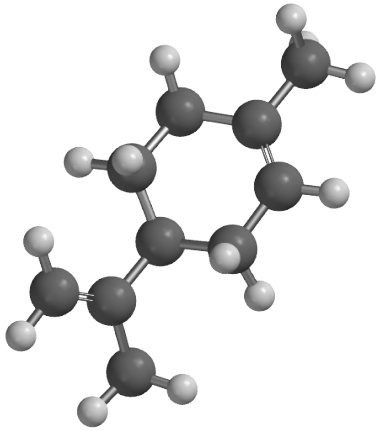

النادي الطبي
Organic chemistry
Lec: 8 "P.1 chapter 3"
Done by: Yasser Yaghi

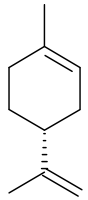




Chapter 3: Alkenes and Alkynes

الألكينات

الألكينات



limonene

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 s and 1 p bond,
- a triple bond consists of 1 s and 2 p bonds.

They are also "unsaturated" as they contain p bonds and are also known as olefins.

General Properties (cont'd)

They contain less H atoms that the corresponding alkane, generic chemical formulas are;

C_nH_{2n+2} alkanes

C_nH_{2n} alkenes

C_nH_{2n-2} alkynes

Every p bond results in the loss of a pair of H atoms.

General Properties (cont'd)

عامل الفقر الهيدروجيني

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 H2 molecules needed to obtain the corresponding saturated acyclic structure. The IHD is also equal to the number of rings and p bonds in the molecule.

الفكرة: كم المركب بنقصه مول من H_2 حتى يصبح مثل الأنكان

IHD for Alkene = 1

IHD for Alkynes = 2

Focus H_2 not H

General Properties (cont'd)

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

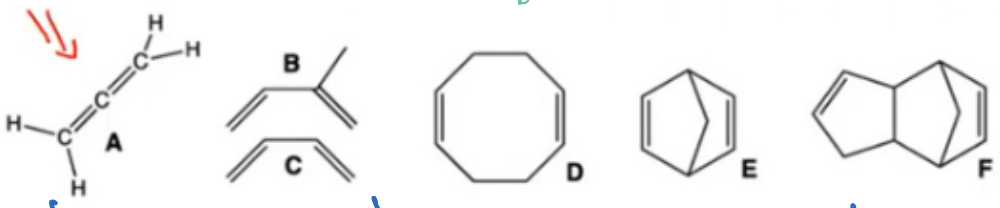
double bonds

Single bond Seperate between two multiple bonds.

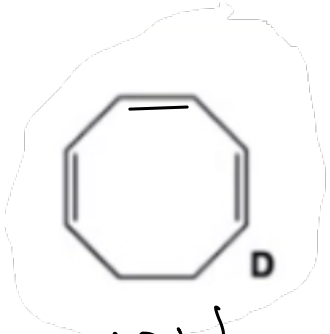
More than one Single bond seperate two multiple bonds.

Cumulated	Conjugated	Isolated
C=C=C	C=C-C=C	C=C-C-C=C
C=C=C=C	C≡C-C≡C	C≡C-C-C-C≡C

multiple bond — Single



Cumulated Conjugated Isolated



Conjugated

ene instead of an

- 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 1st 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.

1- نعوض للمقطع ene في نهاية الاسم بدلاً من ane.
2- نحدد أطول سلسلة كربون ونبدأ بالترقيم من الجهة الأقرب لذرة الكربون الأولى الحاملة الرابطة الثنائية.

في الألكينات الحلقية
خرتي الكربون اللتان تحملان الرابطة الثنائية نعطيها رقم 1 & 2.

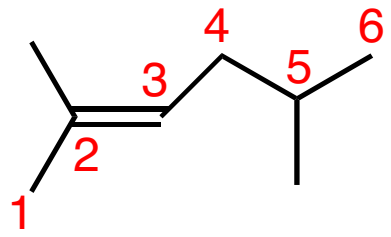
والأمثلة توضح ذلك.

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

	$CH_2=CH_2$	$CH_3CH=CH_2$	$CH_3C(CH_3)=CH_2$
IUPAC name:	Ethene	Propene	2-Methylpropene
Common name:	Ethylene	Propylene	Isobutylene

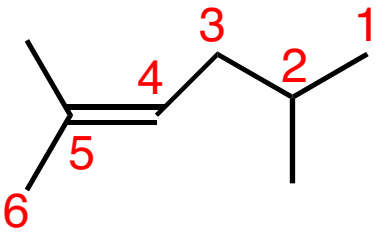
بعض المركبات لها أسماء شائعة والتي اشتهرت بهن قبل وضع النظام العالمي للتسمية IUPAC

ونظرًا لأهميتها في الصناعات تحتفظ بأسمائها الشائعة.



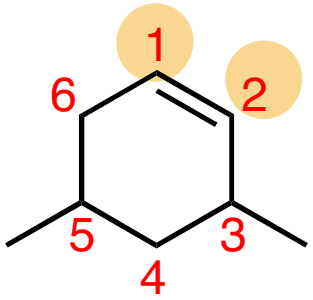
2,5-Dimethyl-2-hexene

NOT



2,5-Dimethyl-4-hexene

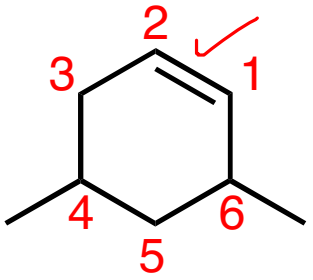
نتفق أننا نبدأ العد دائماً من عندال double bond
ولكن لكي نقرر هل نمشي عكس عقارب الساعة أم مع، نراعي أن يكون مجموع ارقام ذرات الكربون الحاملة للتفرعات اقل ما يمكن



3,5-Dimethylcyclohexene

* لاحظ لا نضع رقم ذرة الكربون الحاملة للرابطة الثنائية في cycloalkene لأنه حتماً رقمها 1 ولا يُكتب بل يُفهم ضمنياً أمّا التفرعات فتكتب وفق قواعد التسمية.

NOT

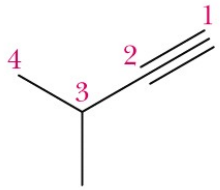


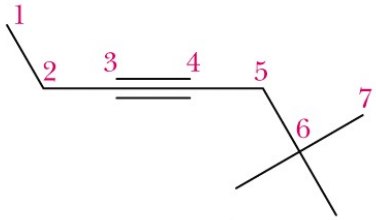
4,6-Dimethylcyclohexene

الألكاينات

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

نفس الخطوات





~~3-Methyl-1-butyne~~

3-Methyl-1-butyne

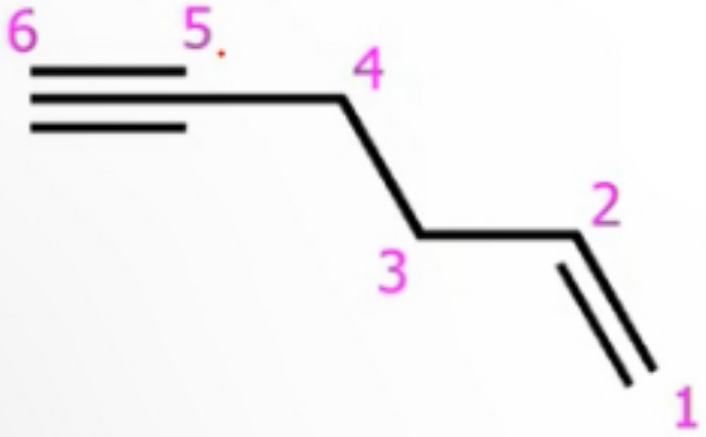
6,6-Dimethyl-3-heptyne

- Common Name:

HC≡CH
acetylene
(ethyne)

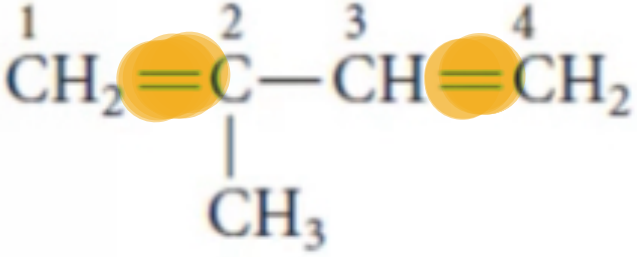
HC≡CH
acetylene

ملحوظة: إذا وُجِد رابطة ثنائية ورابطة ثلاثية في نفس السلسلة فإن الأولية تُعطى للرابطة الثنائية يُبدأ الترقيم من ذرة الكربون الأقرب إلى =

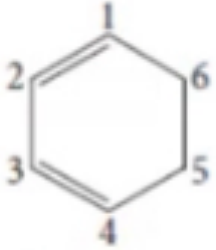


Hex-1-en-5-yne

(2E)-Oct-2-en-6-yne



2-methyl-1,3-butadiene



1,3-cyclohexadiene

* هذا السلايد هكذا موجود في الشيت مع الغرابيش 😄
أحد الطلاب عدّل عليه بالغلط.

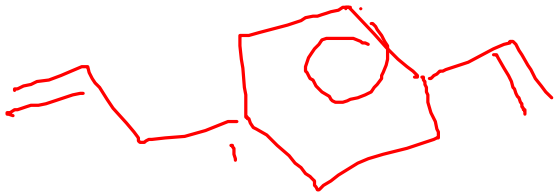
Two important groups also have common names. They are the vinyl and allyl groups (their IUPAC names are in parentheses below), shown on the left. These groups are used in common names, illustrated in the examples on the right.

$CH_2=CH-$
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)



$CH_2=CH-$
vinyl

ذرتان C

$CH_2=CH-CH_2-$
allyl

3 ذرات كربون

تجميع للأسماء الشائعة "التي يجب حفظها"

	$CH_2=CH_2$	$CH_3CH=CH_2$	$CH_3C(CH_3)=CH_2$
Common name:	Ethylene	Propylene	Isobutylene

Alkenes

Alkyne

$HC\equiv CH$

acetylene

Two important groups

$CH_2=CH-$

vinyl

$CH_2=CH-CH_2-$

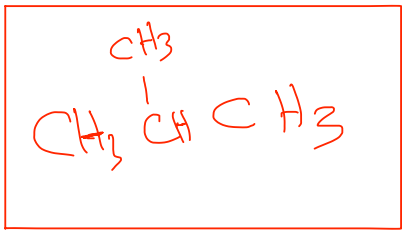
allyl

Test yourself

1. What is the common name for the alkene with the IUPAC name "2-Methylpropenel"?

a) acetylene
b) isobutylene
c) dimethylbutylene
d) isobutane

كل هذا السؤال ترسم امركب

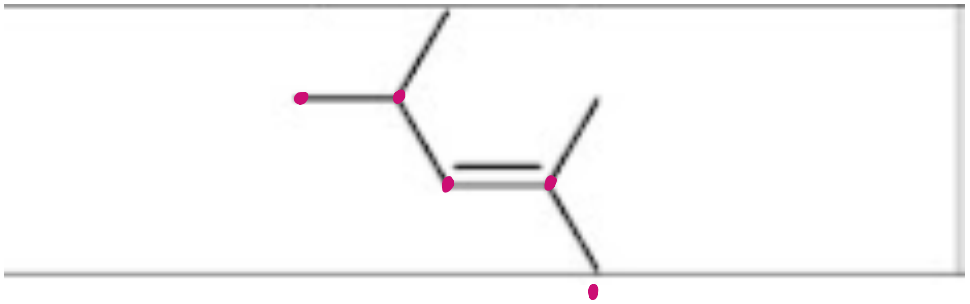


b

وهذه الصيغة البنائية يجب حفظها نفا

isobutylene

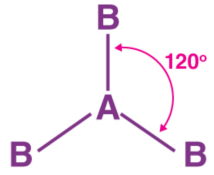
Name this Compound according to IUPAC name:



2,3-di Methyl-2-Pentene

Bonding in Alkenes

- Alkenes are sp2 hybridized
- Trigonal planar – bond angle ~120°
- 3 s and 1 p bond (or 2 single and 1 double)
- C=C double bond ~ 1.34 Å
- The π p bond lock the geometry to planar

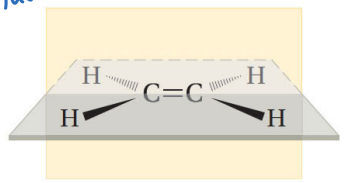


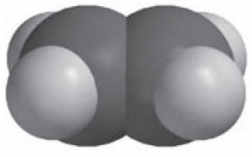
حيث A ذرة كربون C

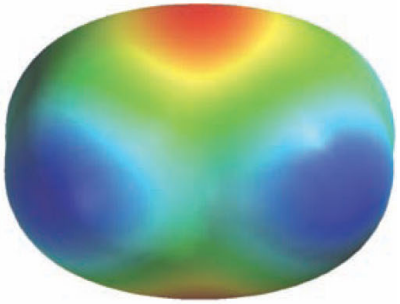
كل ذرة كربون في الرابطة الثنائية تولها 3 أحادية ورابطة ثنائية أي 3σ و 1π

في الألكين 2 faces وجود = يمنع الـ free rotation مايؤدي لك خطوط

upper and lower face







* الرابطة الثنائية أقصر من الأحادية

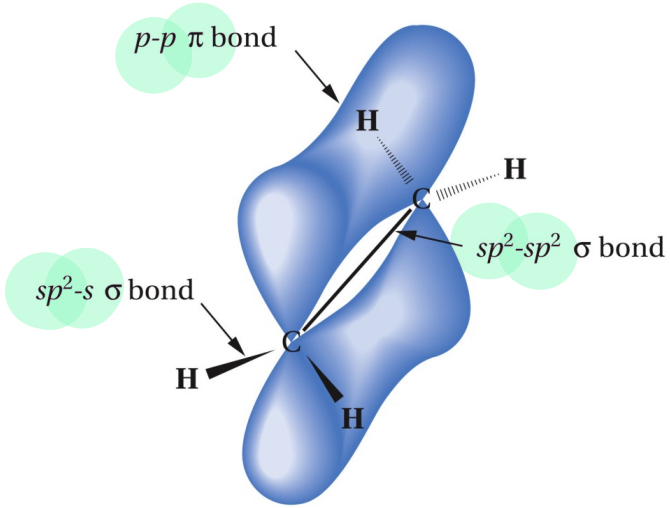
التفسير: بسبب التداخل الأقوى والذي يعمل على قصر الرابطة.

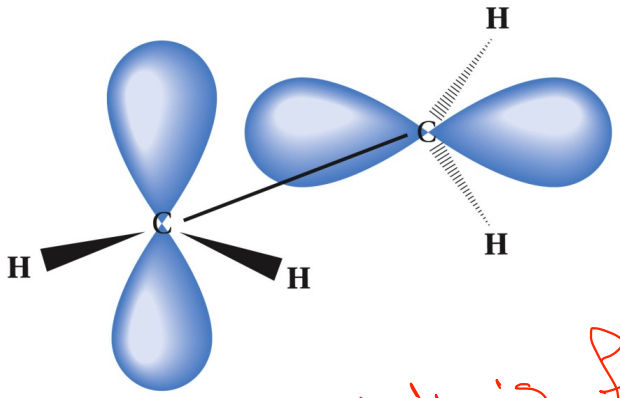
overlap

2,4 di:Methyl-2-Pentene

Cis – Trans Isomerism

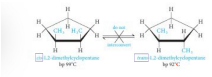
The double bond in an alkene is rigid, that is it will not rotate freely. Therefore substituents on the carbon atoms will produce geometric isomers the same as on a cycloalkane ring.





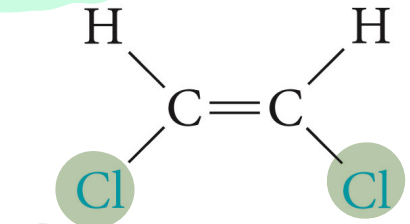
Rotation is forbidden as well as in cycloalkanes.

Cis – Trans Isomerism (cont'd)

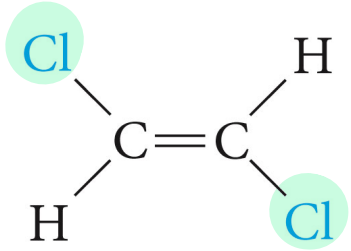


تتكون نفس الفكرة.

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.



cis-1,2-dichloroethene
bp 60°C, mp −80°C



trans-1,2-dichloroethene
bp 47°C, mp −50°C

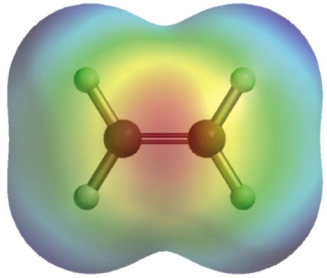
إذا كانت المتفرعات (مثل Cl) في نفس الاتجاه ∴ cis

إذا كانت بعكس الاتجاه trans

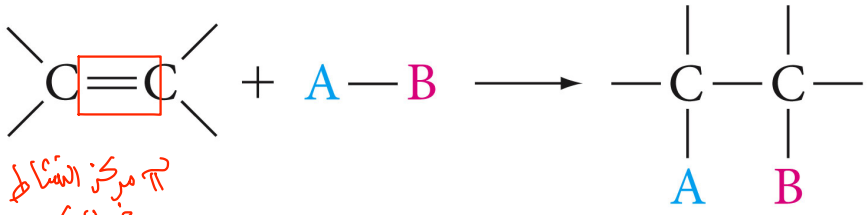
Note that they have different physical properties, this is because their dipole moments are different.

Chemical Reactivity

The chemical reactivity of alkenes arise from the p electrons. The p bond is weaker than the s bond so these electron react first. The reagent will add across the double bond so these are *addition reactions*.



Note: electrophilic addition reaction



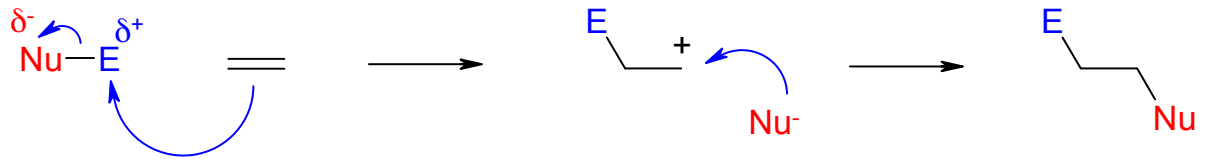
إضافة الكتروفيلية

Electrophilic Addition Mechanism

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

electrophile الطرف الموجب في Reagent

nucleophile الطرف السالب



سُمّيت إضافة الكتروفيلية لأنّ أول من يبدأ التفاعل (ر) هو الطرف الالكتروفيلي ٥ بحيث يهاجم بسوءة الرابطة الثنائية ٢١

Polar reagents can be divided into :

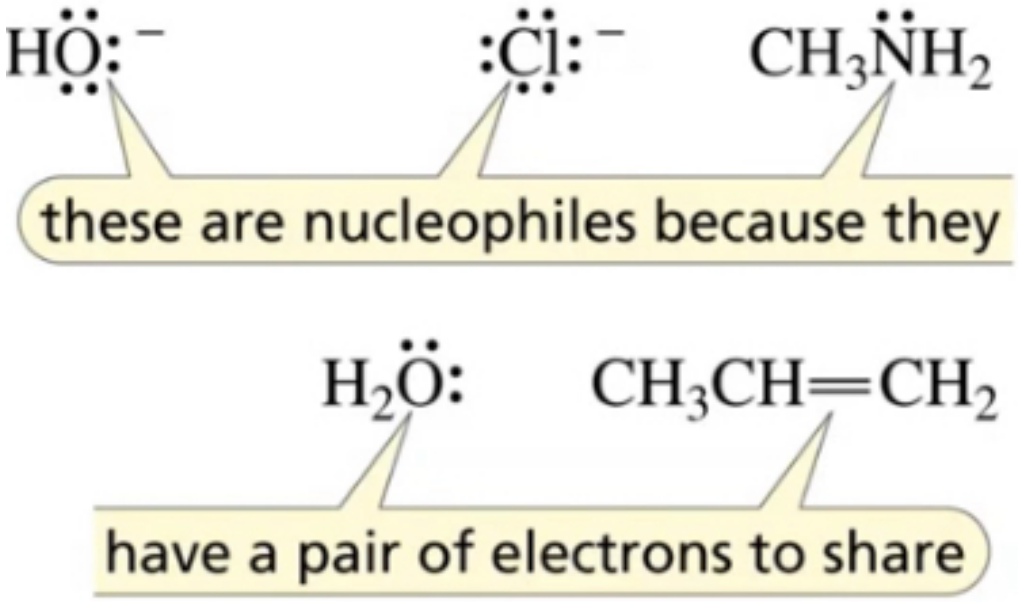
Nucleophiles

A nucleophile has

a negative charge,

a lone pair,

or a π bond.



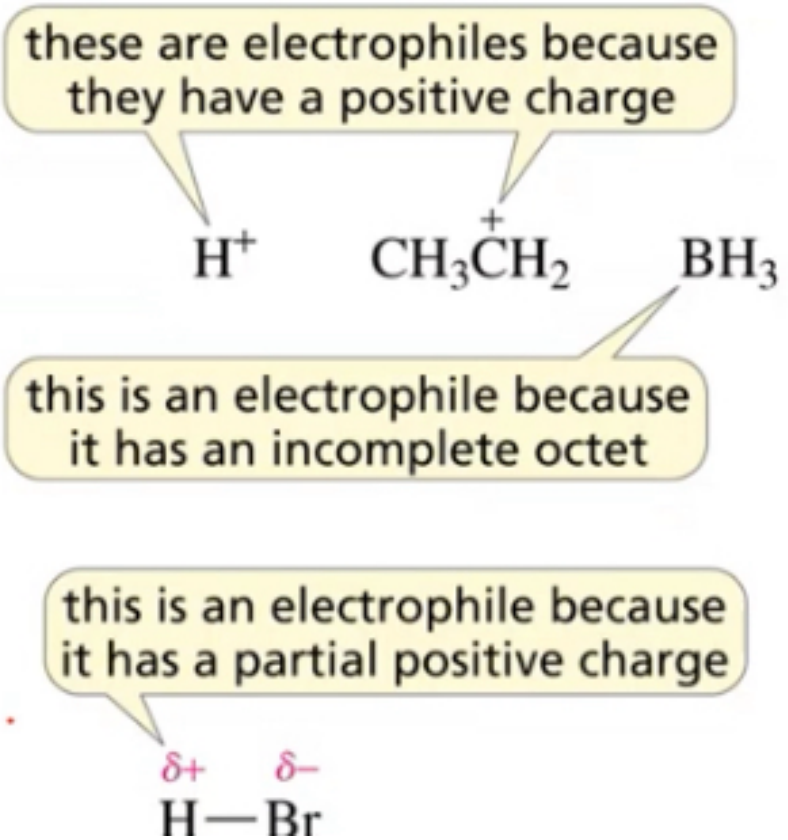
Electrophiles

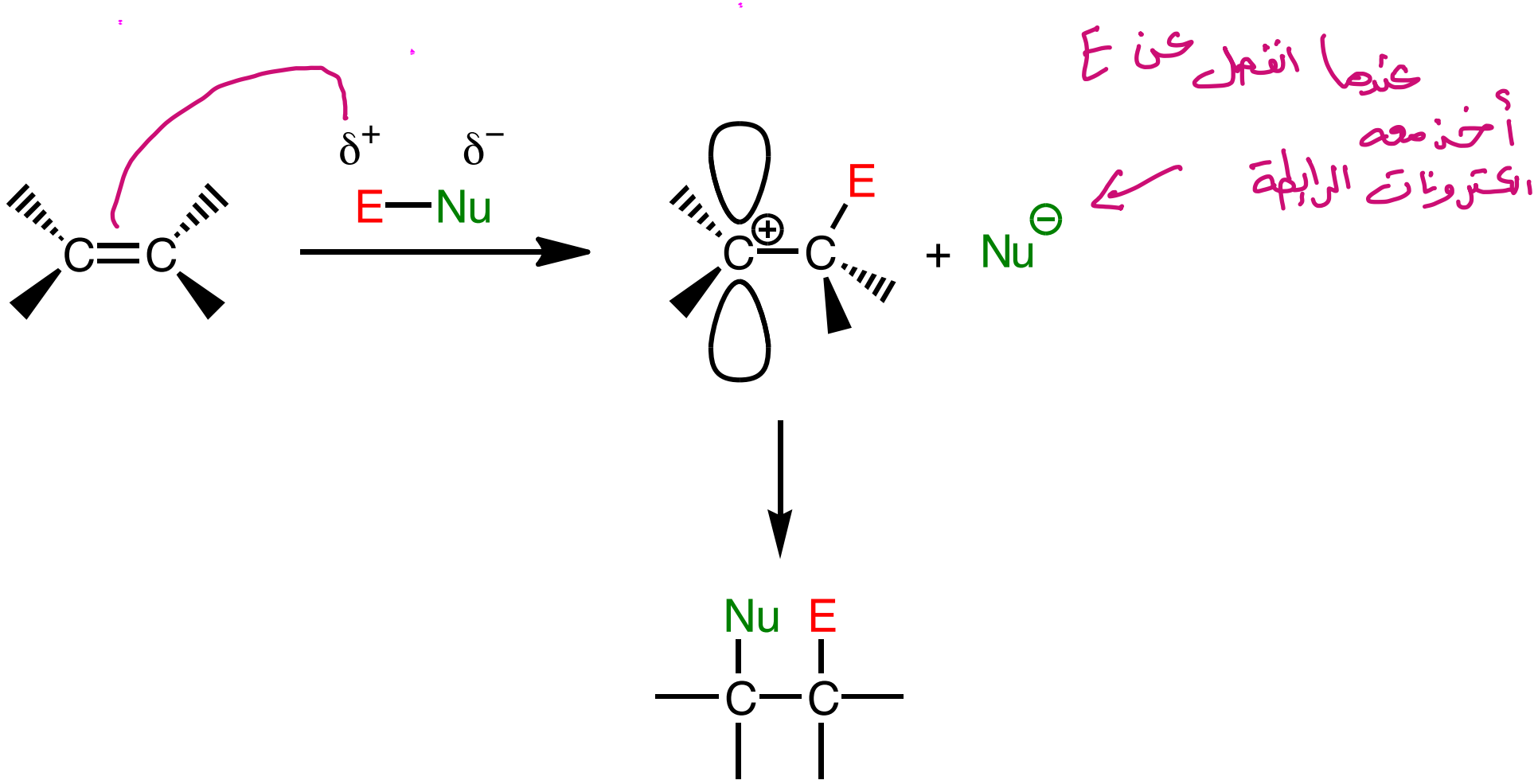
An electrophile has

a positive charge,

a partial positive charge,

or an incomplete octet.




δ+ δ−
E—Nu
C=C
C⊕—C
E
+ Nu⊖
Nu E
—C—C—