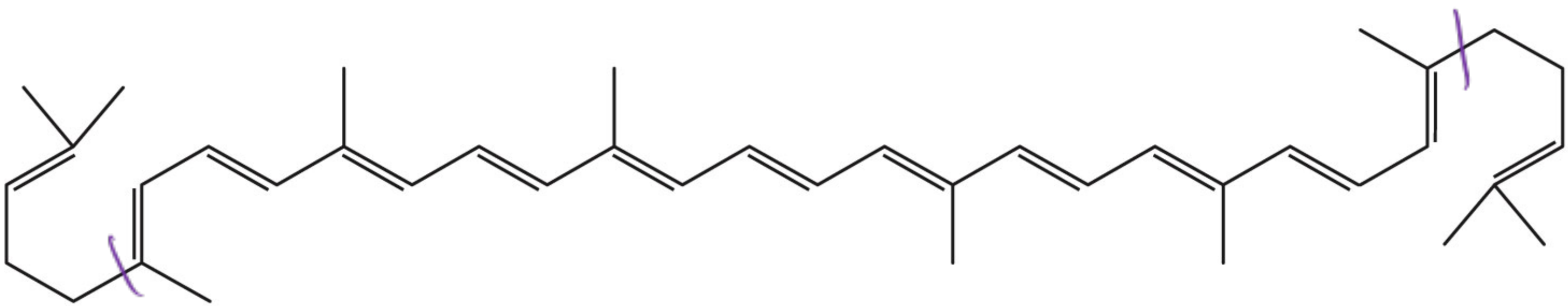
Chapter 3: Alkenes and Alkynes



lycopene

Conjugation
(alternating double bonds)

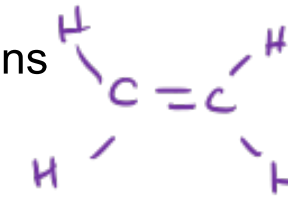
Hydrogenation of Alkenes and Alkynes

Hydrocarbons that have carbon-carbon double bond are called alkenes; those with a carbon-carbon triple bond are alkynes

open chain cyclic

Their general formulas are CnH2n alkenes and CnH2n-2 alkynes

Both alkenes and alkynes are unsaturated hydrocarbons



C_2H_4

ethene [Ethylene]

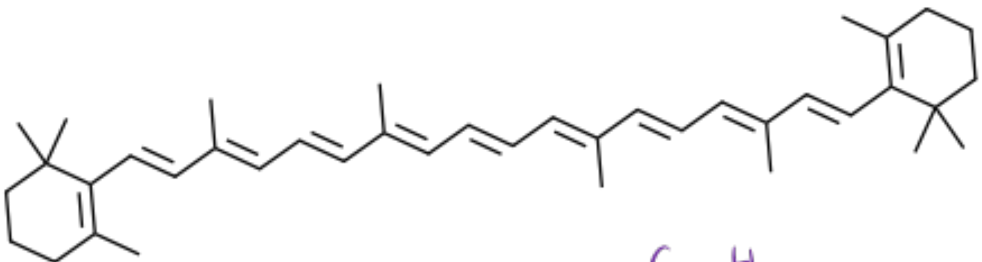
$$\underset{\text{alkene}}{RCH{=}CHR} \xrightarrow[\text{catalyst}]{H_2} \underset{\text{alkane}}{RCH_2CH_2R}$$

$$\underset{\text{alkyne}}{RC{\equiv}CR} \xrightarrow[\text{catalyst}]{2H_2} \underset{\text{alkane}}{RCH_2CH_2R}$$

$H-C\equiv C-H$

0 C_2H_2

Compounds with more than one double or triple bonds exist. Multiple double bonds may lead to dienes, trienes, tetraenes and polyenes. β-carotene and lycopene are examples of polyenes



$C_{40}H_{56}$

11 C-C double bonds

When two or more multiple bonds re present in a molecule, they can be classified depending on the relative positions of the bonds

sp

$C{=}C{=}C$

sp

$C{=}C{=}C{=}C$

sp²

cumulated

ملتزقات ببعضهم — متراكمة

$C{=}C{-}C{=}C$ ✓

$C\overset{\pi}{\underset{\sigma}{=}}C{-}C\overset{2\pi}{\underset{\sigma}{\equiv}}C$ ✓

conjugated

رابطة بتفصل بينهم

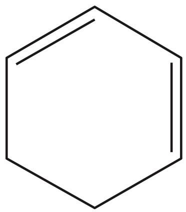
sp² sp³ sp

$C{=}C{-}C{-}C{=}C$

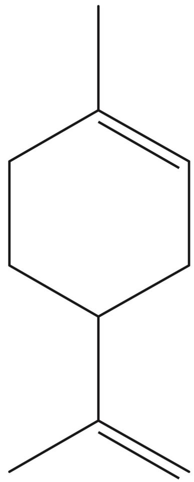
$C{\equiv}C{-}C{-}C{-}C{\equiv}C$

nonconjugated (isolated)

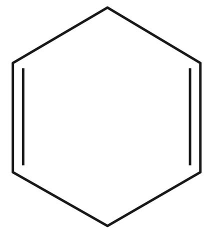
Which of the following compounds have conjugated multiple bonds?



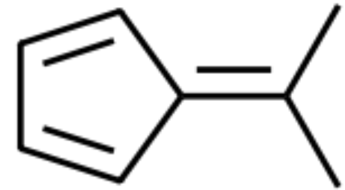
Conjugated



No



NO

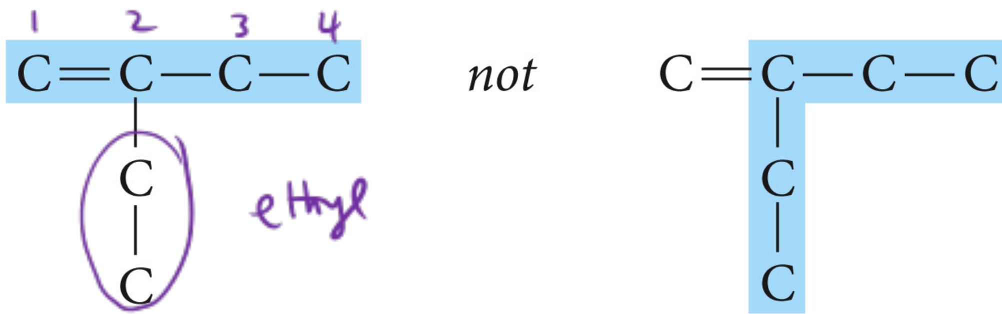


yes

Nomenclature

The ending *–ene* is used to designate carbon-carbon double bond. When more than one double bond is present, the ending is *–diene, triene, tetraene* and so on. The ending –yne is used for triple carbon-carbon bond.

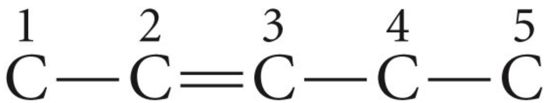
Select the longest chain that includes both carbons of the double bond or triple bond.



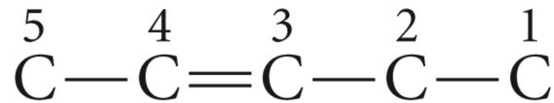
named as a butene, not as a pentene

2-ethyl-1-butene

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

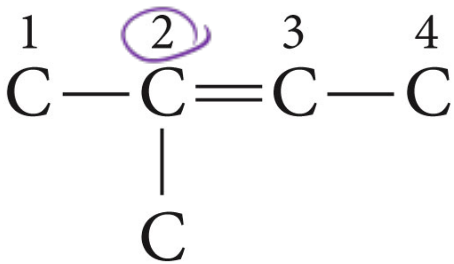


not

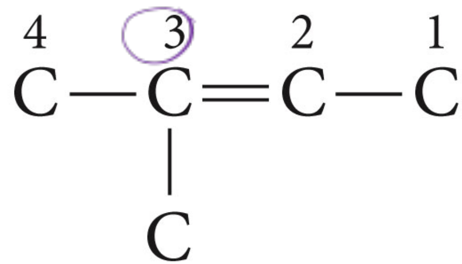


متساوي البعد

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



not



2-methyl-2-butene

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

$$\overset{1}{CH_2}{=}\overset{2}{C}H\overset{3}{C}H_2\overset{4}{C}H_3$$

1-butene, *not* 2-butene

If more than one multiple bond is present, number the chain from the end nearest the first multiple bond.

$$\overset{1}{C}{=}\overset{2}{C}{-}\overset{3}{C}{=}\overset{4}{C}{-}\overset{5}{C} \quad \textit{not} \quad \overset{5}{C}{=}\overset{4}{C}{-}\overset{3}{C}{=}\overset{2}{C}{-}\overset{1}{C}$$

1,3- pintadiene

= END =

If the double bond and the triple bond are equidistant from the end of the chain, the double bond receives the lowest number.

اذا كان متساويين وفيه ثنائية وواحدة ثلاثية

بنرقم من عند الاقرب لطرف السلسلة اذا كانت ثلاثية او ثنائية

alkene takes priority over alkyne

$$\overset{1}{C}=\overset{2}{C}-\overset{3}{C}\equiv\overset{4}{C} \quad \textit{not} \quad \overset{4}{C}=\overset{3}{C}-\overset{2}{C}\equiv\overset{1}{C}$$

✓ ✗

اذا كانوا نفس البعد من الطرفين برقم من عند الثنائية

The root name is from the longest carbon chain containing the multiple bond

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 ✓

$CH_3CH_2CH_2CH_3$

$CH_2=CHCH_2CH_3$ 1-butene

$CH_3-CH=CHCH_3$ 2-butene

so are 1-butyne and 2-butyne

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

1-butene

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

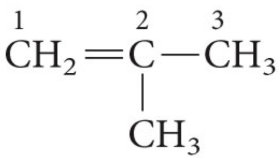
2-butene

$H\overset{1}{C}\equiv\overset{2}{C}\overset{3}{CH_2}\overset{4}{CH_3}$

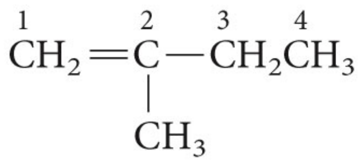
1-butyne

$\overset{1}{CH_3}\overset{2}{C}\equiv\overset{3}{C}\overset{4}{CH_3}$

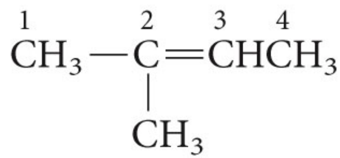
2-butyne



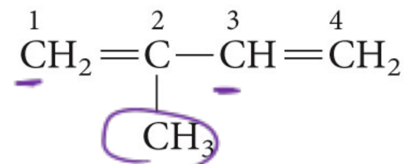
methylpropene
(isobutylene)



2-methyl-1-butene



2-methyl-2-butene



2-methyl-1,3-butadiene
(isoprene)

The numbering rules applied

$$\underset{5}{\overset{1}{CH_3}}-\underset{4}{\overset{2}{CH}}=\underset{3}{\overset{3}{CH}}-\underset{2}{\overset{4}{\underset{CH_3}{\underset{|}{CH}}}}-\underset{1}{\overset{5}{CH_3}}$$

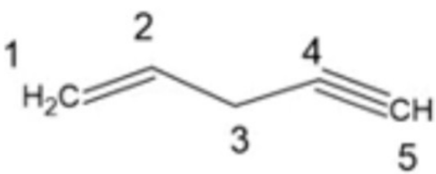
4-methyl-2-pentene
(*Not* 2-methyl-3-pentene; the chain is numbered so that the double bond gets the lower number.)

$$\overset{1}{CH_2}=\overset{2}{\underset{CH_2CH_3}{\underset{|}{C}}}-\overset{3}{CH_2}\overset{4}{CH_3}$$

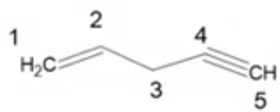
2-ethyl-1-butene
(Named this way, even though there is a five-carbon chain present, because that chain does not include both carbons of the double bond.)

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

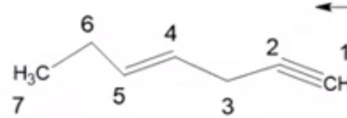
1,3-butadiene
(Note the *a* inserted in the name, to help in pronunciation.)



1-penten-4-yne



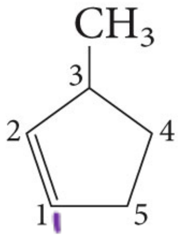
1-penten-4-yne



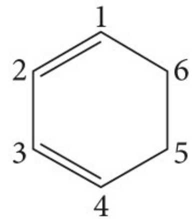
4-hepten-1-yne

With the cyclic hydrocarbons, we start numbering the ring with the carbons of the multiple bond.

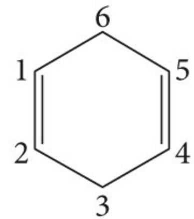
cyclopentene
(No number is necessary, because there is only one possible structure.)



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



1,3-cyclohexadiene



1,4-cyclohexadiene

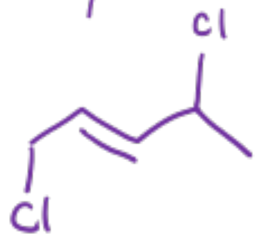
Write the structural formula for

بيلس دا اخر ؟

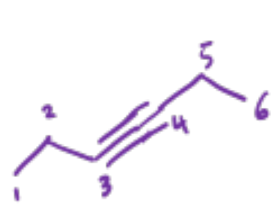
3-methyl-2-pentene

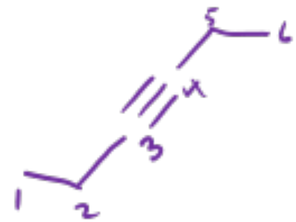
$-C \equiv C-$

1,4-dichloro-2-pentene



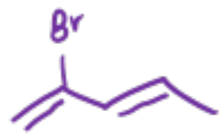
3-hexyne





1,2-dimethylcyclobutene

2-bromo-1,3-pentadiene

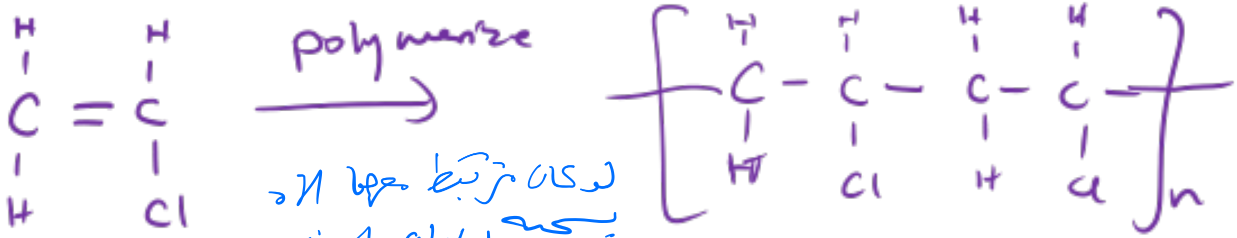


Some Common names

$CH_2{=}CH_2$	$HC{\equiv}CH$	$CH_3CH{=}CH_2$
ethylene	acetylene	propylene
(ethene)	(ethyne)	(propene)

common name

غاز يشتعل
حرارته عالية
ال مصدر حرارة غاز
الطبخ



لو كان مرتبط معها OH
يسمى vinyl alcohol

$CH_2{=}CH{-}$
vinyl
(ethenyl)

$CH_2{=}CHCl$
vinyl chloride
(chloroethene)

allyl alchohol

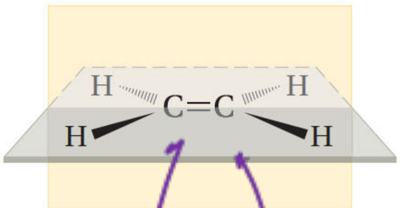
$CH_2{=}CH{-}CH_2{-}$
allyl
(2-propenyl)

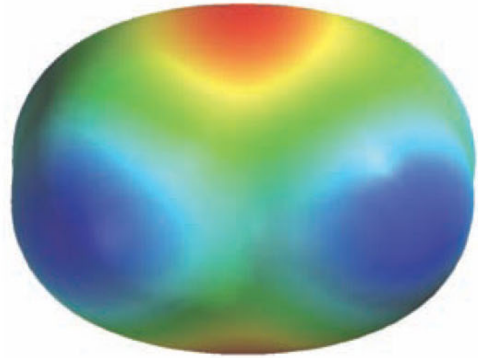
$CH_2{=}CH{-}CH_2Cl$
allyl chloride
(3-chloropropene)

allylic position carbon

0

Some Facts about Double Bonds





التهجين الي حكينا عنه بشكل
اذا كان الـ bond
حول الكربون يكون
تهجينه sp^3 والشكل
tetrahydral
ودرجة الزاوية 109.5

sp^2 sp^2

trigonal planar
120°

$C \overset{\pi}{\underset{\sigma}{=}} C$

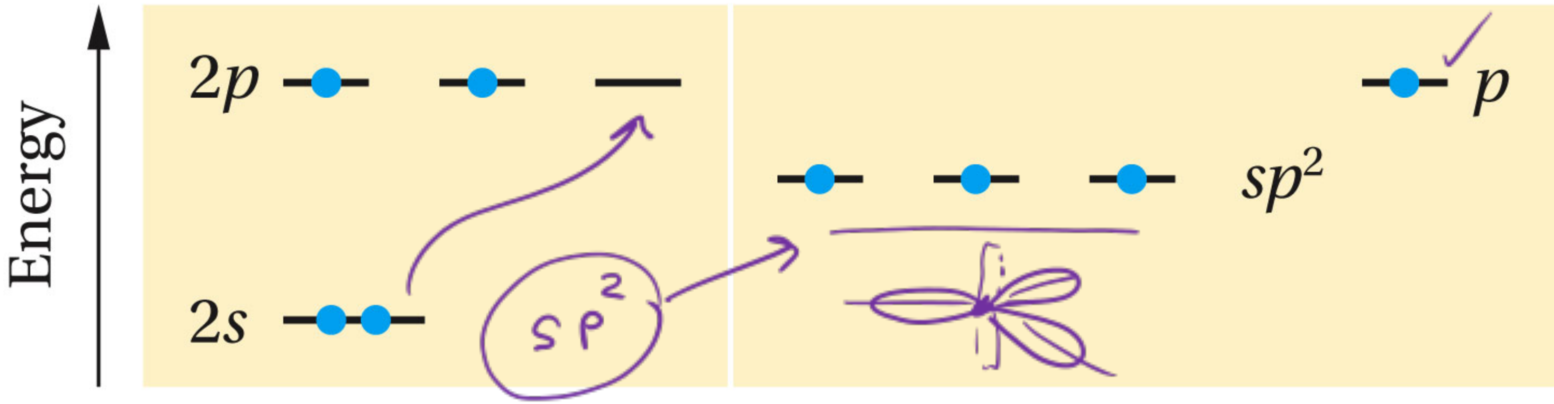
والكربون double يكون التهجين sp^2
والشكل planer والزاوية 120.

= END =

TABLE 3.1 Comparison of C—C and C═C Bonds

Property	C—C	C═C
1. Number of atoms attached to a carbon	4 (tetrahedral)	3 (trigonal)
2. Rotation	relatively free	restricted
3. Geometry	many conformations are possible; staggered is preferred	planar
4. Bond angle	109.5°	120°
5. Bond length	1.54 Å	1.34 Å

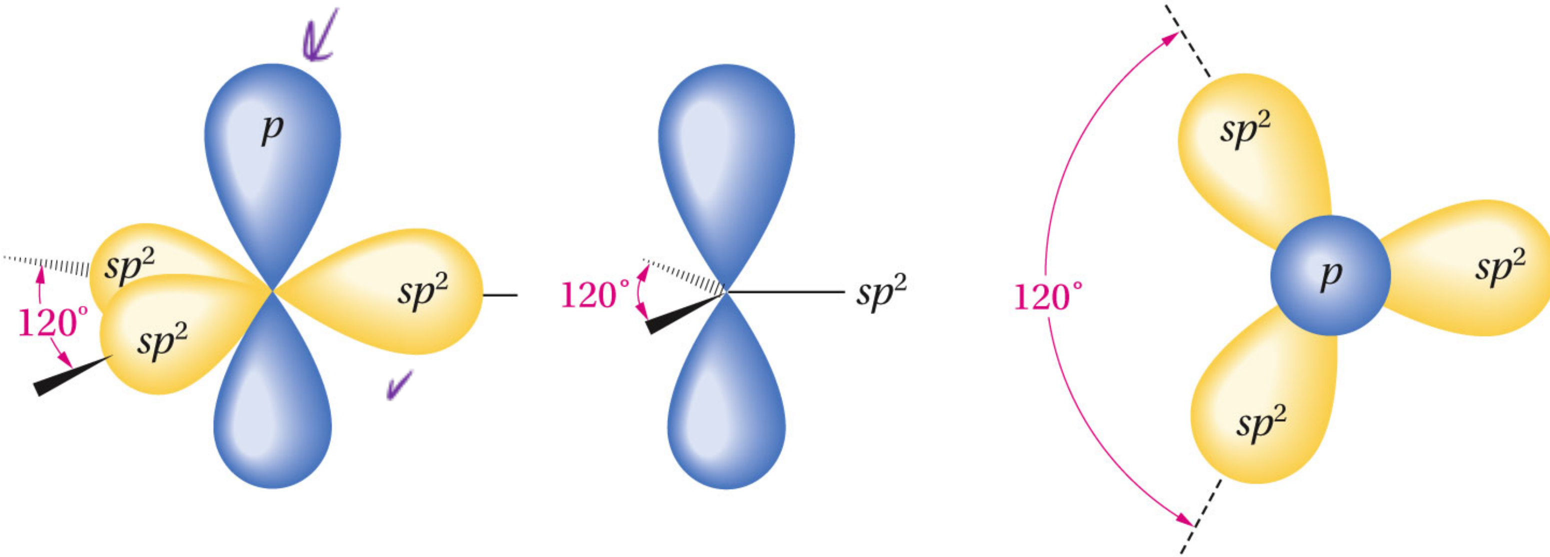
The Orbital Model of a Double Bond; the pi Bond



Atomic orbitals of carbon

The 2*s* and two 2*p* orbitals are combined to form three hybrid sp^2 orbitals, leaving one electron still in a *p* orbital.

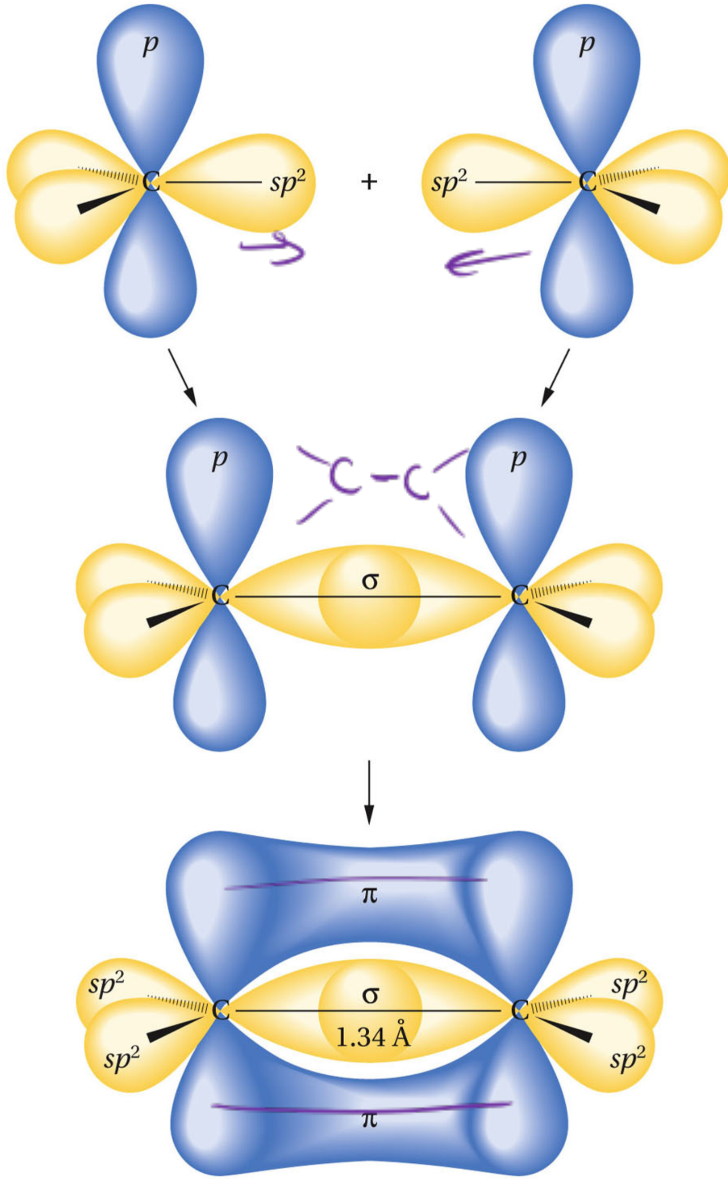
6
C
$1s^2, 2s^2 2p^2$



side view

side view with
the sp^2 orbitals
represented by lines

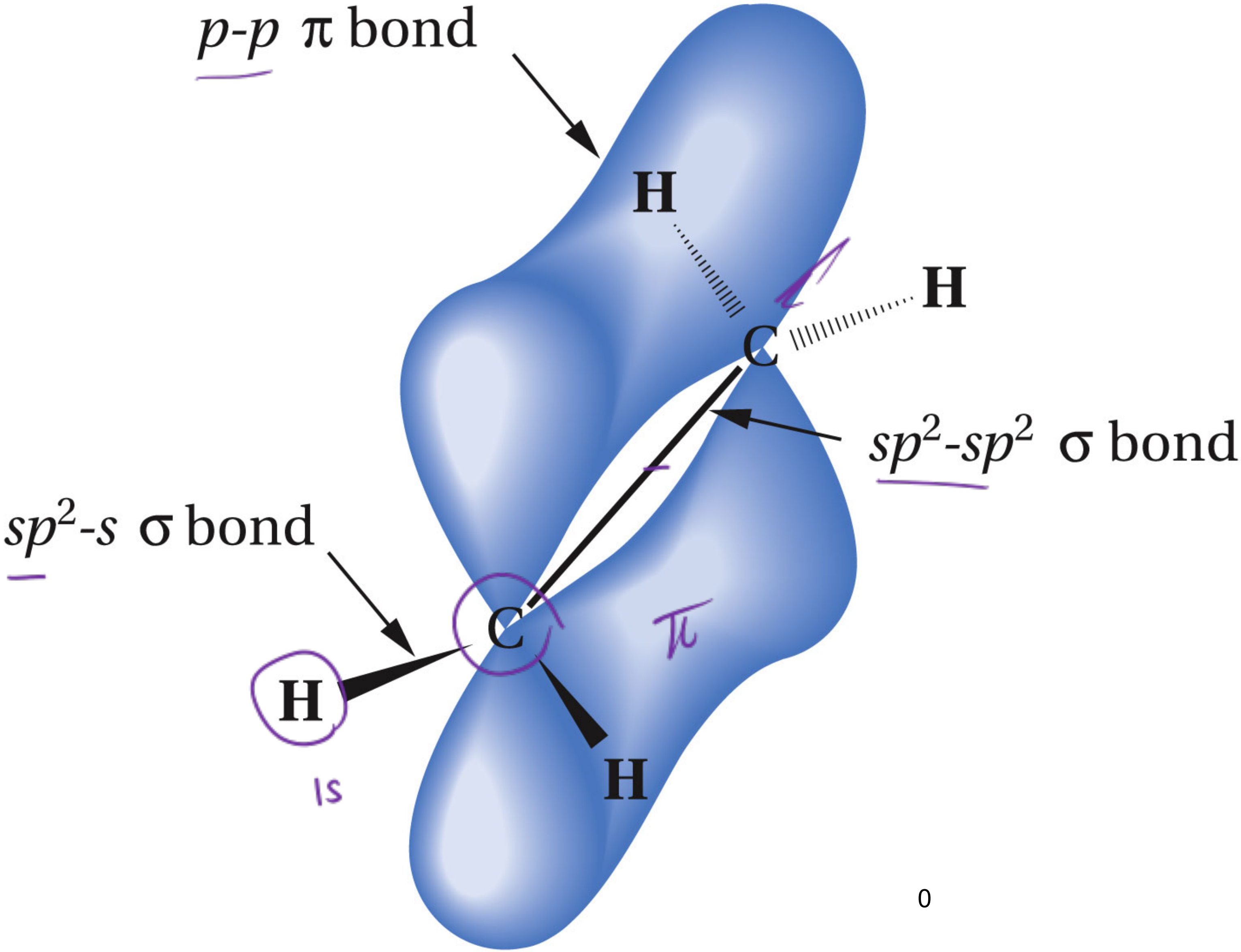
top view



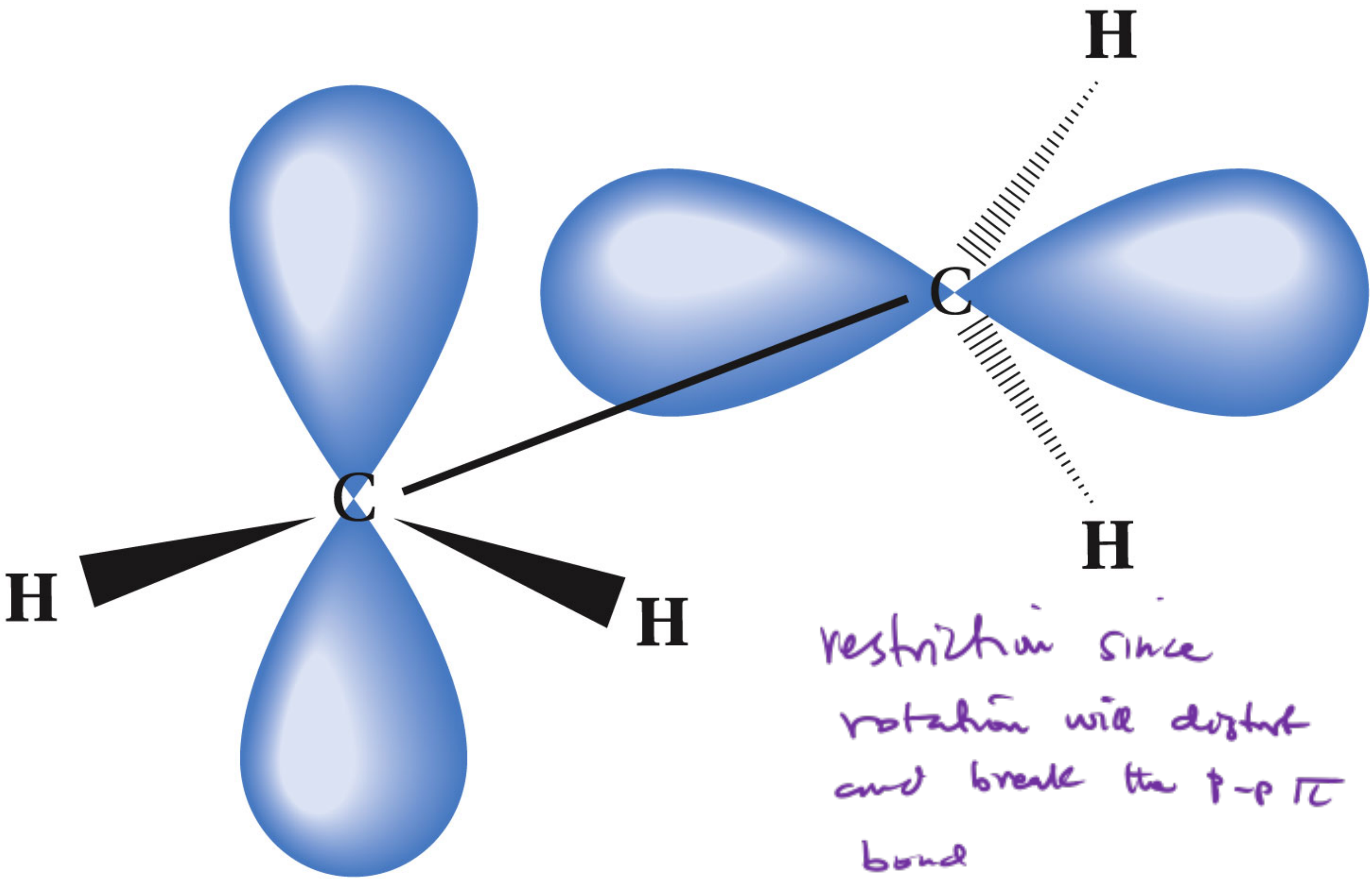
two sp^2-hybridized carbons with *p* orbitals parallel

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

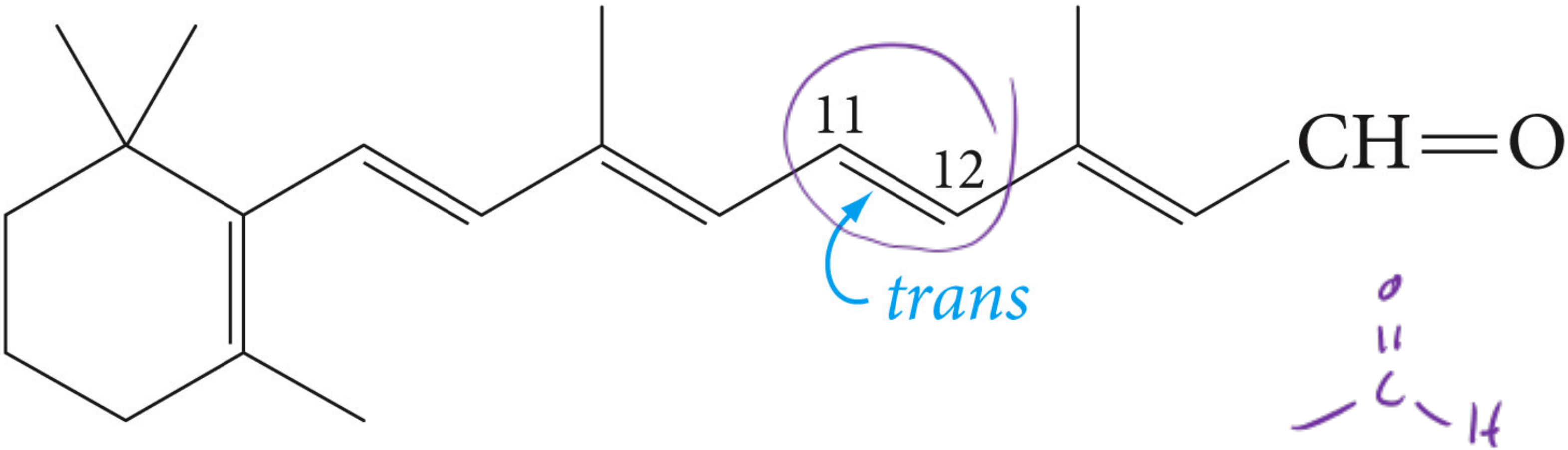
the π bond is formed by two electrons in overlapping parallel *p* orbitals



p-p π bond
H
H
C
sp²-sp² σ bond
sp²-s σ bond
C
π
H
1s
H

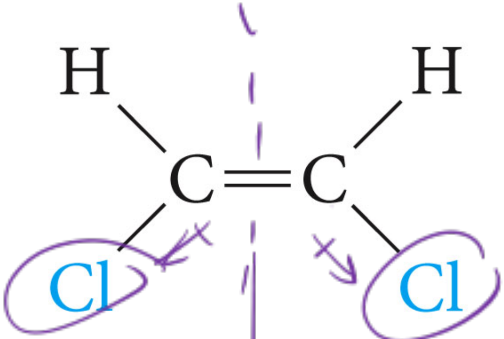


restriction since rotation will distort and break the p-p π bond



trans-retinal

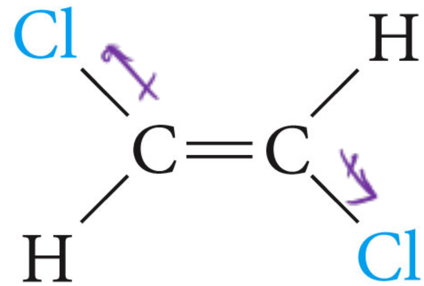
Cis-Trans Isomerism in Alkenes



cis-1,2-dichloroethene

bp 60°C, mp −80°C

polar



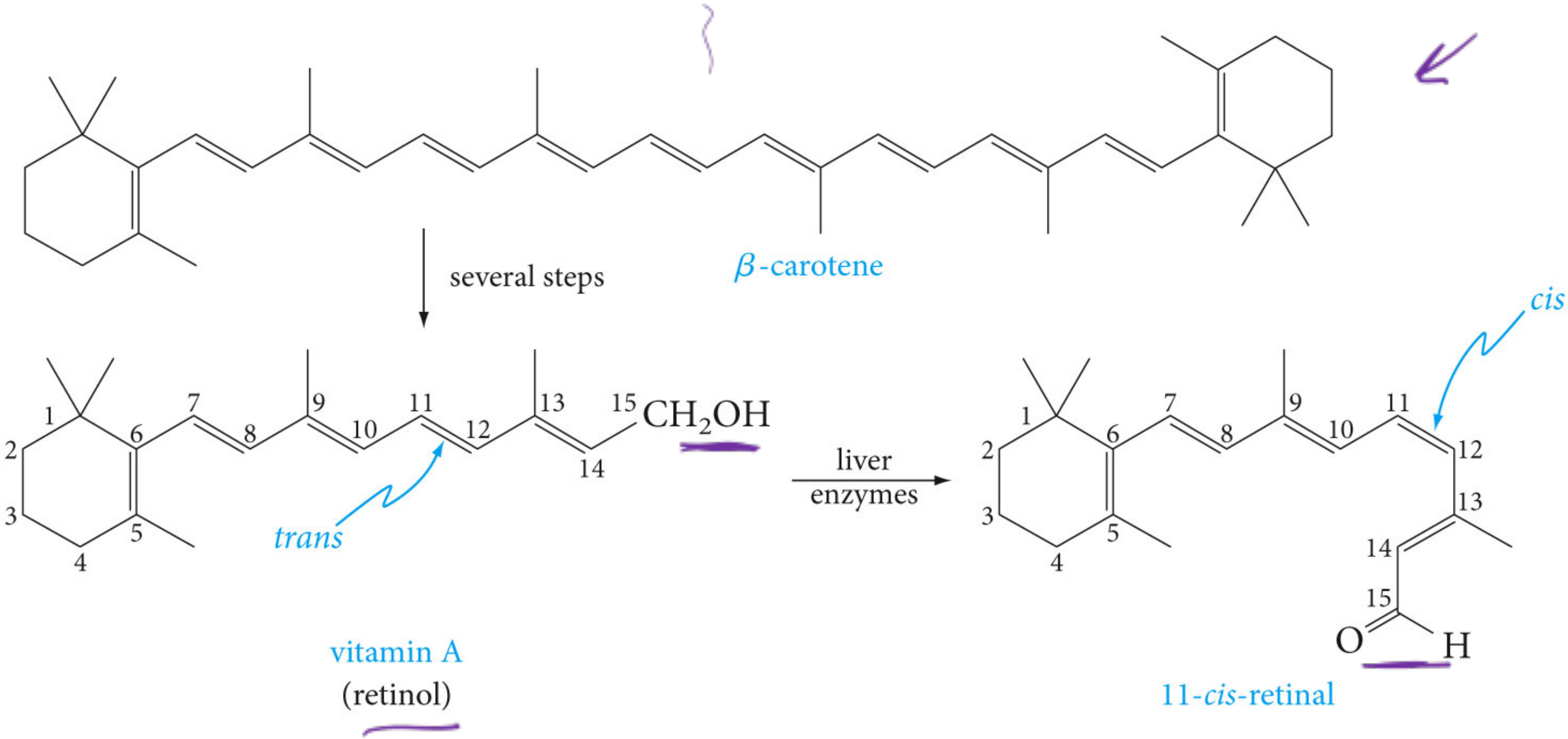
trans-1,2-dichloroethene

bp 47°C, mp −50°C

not polar

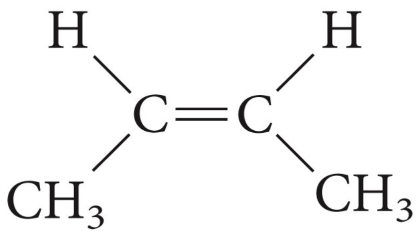
The Chemistry of Vision

$$\begin{tikzcd}[column sep=huge, row sep=huge]
\text{rhodopsin} \arrow[r, "\text{light}", "\text{energy}"'] \arrow[d, shift left] & \text{metarhodopsin-II} \atop \text{(+ nerve impulse)} \arrow[d, shift left] \\
\text{opsin} + \text{11-}\textit{cis}\text{-retinal} \arrow[u, shift left] & \textit{trans}\text{-retinal} \atop \text{+ opsin} \arrow[l, "\text{retinal isomerase}"', "\text{+ light}"] \arrow[u, shift left]
\end{tikzcd}$$



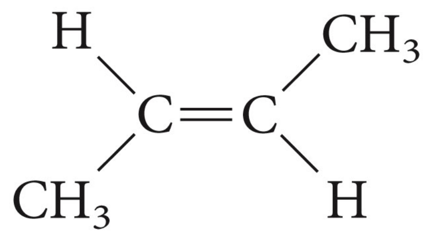
β-carotene
several steps
CH2OH
trans
vitamin A
(retinol)
liver
enzymes
cis
11-cis-retinal

Are cis-trans isomers possible for 1-butene and 2-butene?



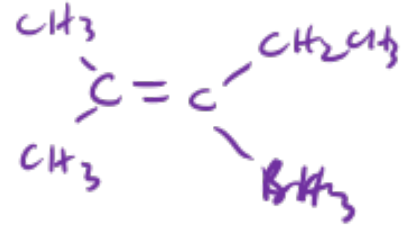
cis-2-butene

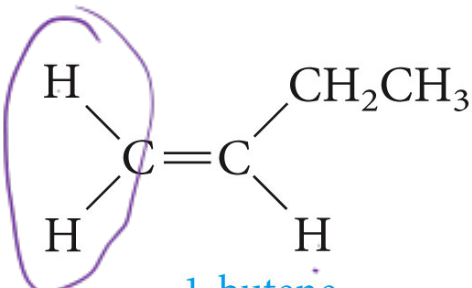
bp 3.7°C, mp −139°C



trans-2-butene

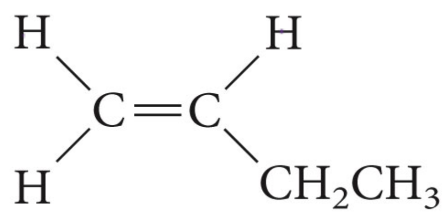
bp 0.3°C, mp −106°C





1-butene

is identical to



1-butene

ما في cis, ولا ترانس

Whenever you have identical grps of cis/trans on one of the C=C bond, 0 ⇒ NO possibili

[illegible] الطرفين cis, trans

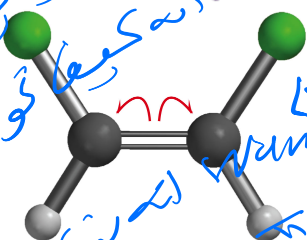
السه يكون كل طرف من طرفين الـ double bond يحمل
مجموعتين مختلفتين اما اذا وجد احد الطرفين يحمل مجموعتين متشابهتين زي الهيدروجين فما بنقدر نحكي عن cis و trans

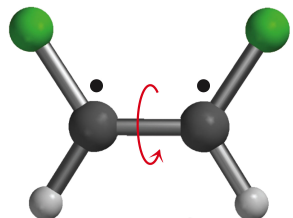
Geometric isomers of alkenes can be interconverted if sufficient energy is supplied to break the pi bond and allow rotation about the remaining sigma bond.

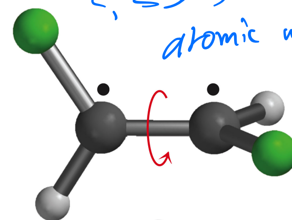
متى بحكم اذا كان المركب cis ولا trans?
بطلع ع الاولوية في كل مجموعة من المجموعات ع طرفي الرابطة الثنائية
كيف بدي احدد الاولوية؟
حسب الـ atomic number
فمثلا الميثيل اله اعلى اولوية من الـ H

هاي الصيغة بتحكي انه cis
homolytic cleavage

Rotation

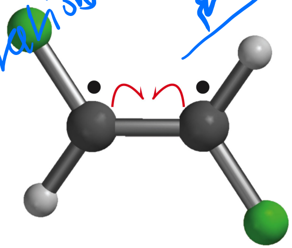


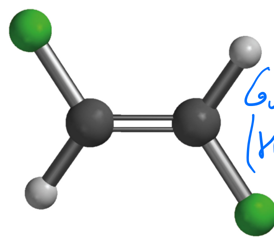




trans
rotation

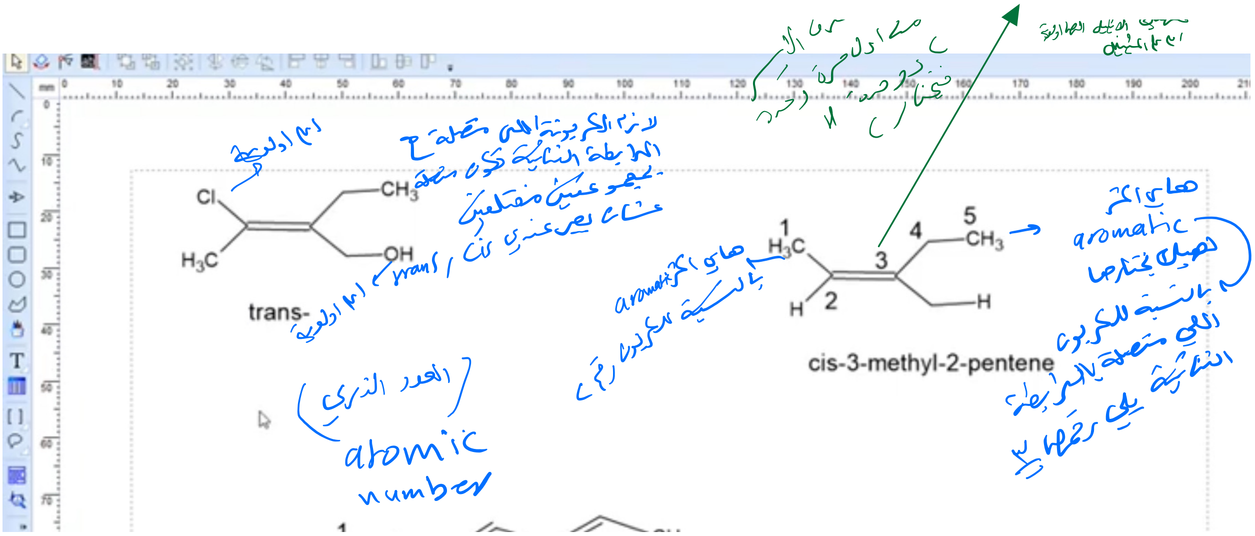
إذا بشوف اشي هو الي اله اعلى اولوية و بشوف الثانية اذا كانوا عنفس الطرف بيكون cis واذا كانوا مختلفة بكون trans



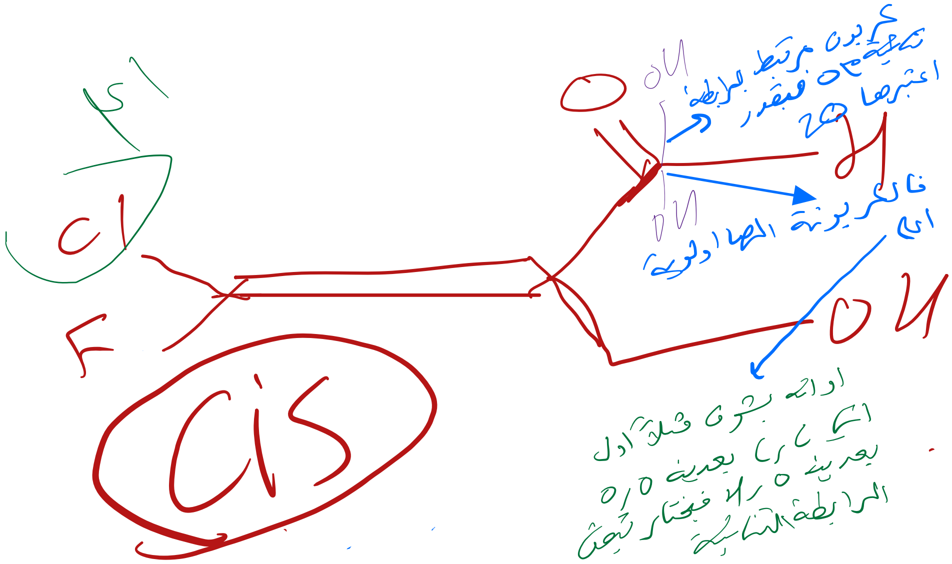


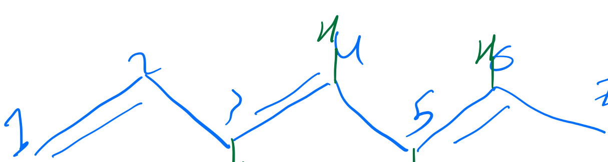
reformation of the π-bond

بطلع ع اول وحدة مرتبطة مع الرابطة الثنائية



الاولوية كم الأليل لا للمثيل بشارك
atomic number

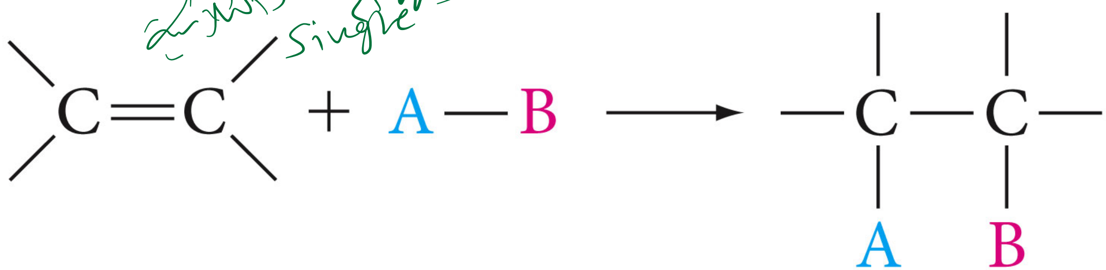




1,3,5- hexatriene

كل رابطة ثنائية عشان نحدد
trans cis

Addition and Substitution Reactions Compared



Addition of halogens X2 (Br_2, Cl_2, $\cancel{I_2}$, $\cancel{F_2}$)

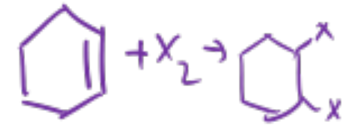
$$CH_3CH{=}CHCH_3 + Cl_2 \longrightarrow CH_3CH(Cl){-}CH(Cl)CH_3$$

semetrical allkene

2-butene
bp 1–4°C

2,3-dichlorobutane
bp 117–119°C

 $+ X_2 \Rightarrow$ Do not undergo addition ryn



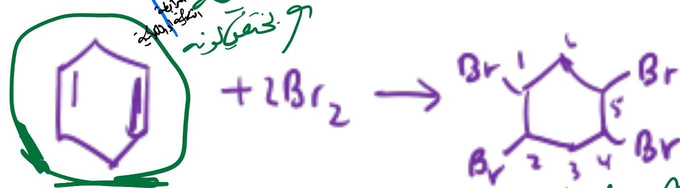
$$CH_2{=}CH{-}CH_2{-}CH{=}CH_2 + \underline{2\,Br_2} \longrightarrow \underset{Br}{CH_2}{-}\underset{Br}{CH}{-}CH_2{-}\underset{Br}{CH}{-}\underset{Br}{CH_2}$$

1,4-pentadiene
bp 26.0°C

1,2,4,5-tetrabromopentane
mp 85 – 86°C

بستخدمه عشان نكشف عن ال unsaturated cc
ال test اذا كانت ارتباطات ثنائية او ثلاثية

ادا لونه احمر بحكي انه ضيفه ال CCl4 بختفي لونه



1,2,4,5 – tetrabromocyclohexane

Addition of Water (Hydration)

semetrical — unsemetrical

$$\underline{CH_2{=}CH_2} + \underset{A\,-\,B}{H{-}OH} \xrightarrow{H^+} \underset{H}{CH_2}{-}\underset{OH}{CH_2} \quad (\text{or } CH_3CH_2OH)$$

عامل مساعد

ethanol

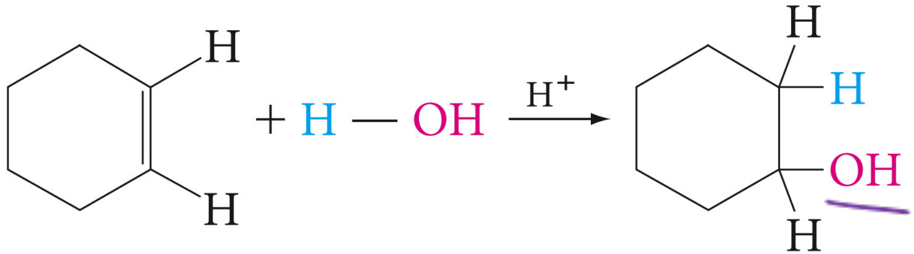
ما بقدر اضيف الماء بدون عامل مساعد
acid catalyst مثل H_2SO_4 ، H_3PO_4

بدون وجود acid catalyst لو اعطيتني ...

ما يكون مهم الأول امه المتفاعلين
semetrical ما يكون فيه مشكلة
المشكلة بتكون ما يكونوا الثنتين

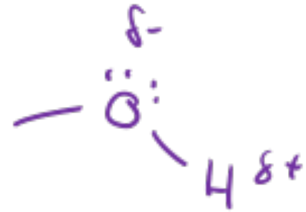
اذا عطاني سؤال بدون H^+ وسألني عن ال product
no product

unsemetrical



cyclohexene
bp 83.0°C

cyclohexanol
bp 161.1°C



Unsaturated cycloalkene

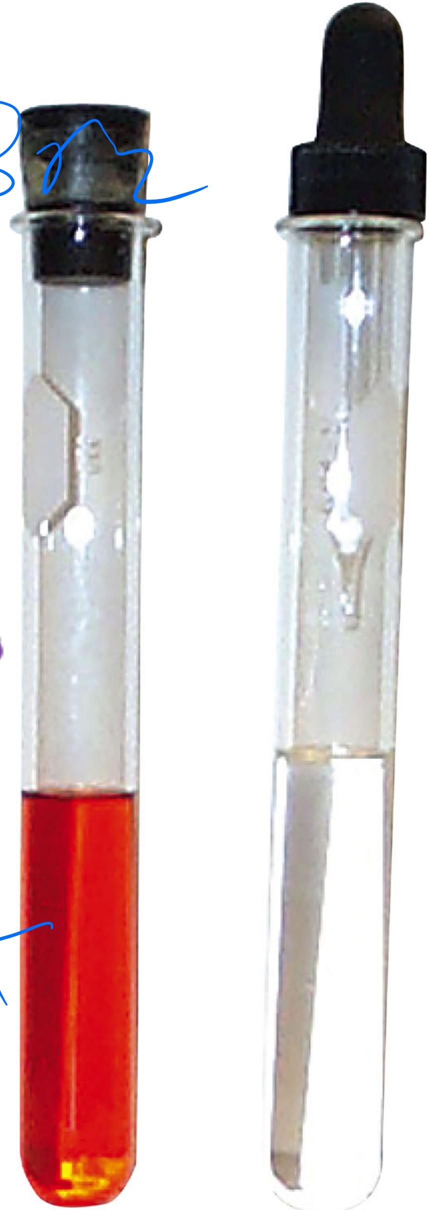
non polar

alcohol

polar ⇒ hydrogen bonding

Test Br_2

Bromine added to saturated



$\leftarrow$ Br_2 to unsaturated Hydrocarbons

alkene

alkyne

$$>C=C< + Br_2 \rightarrow -\underset{|}{\overset{Br}{\overset{|}{C}}}-\underset{|}{\overset{Br}{\overset{|}{C}}}-$$

[illegible]

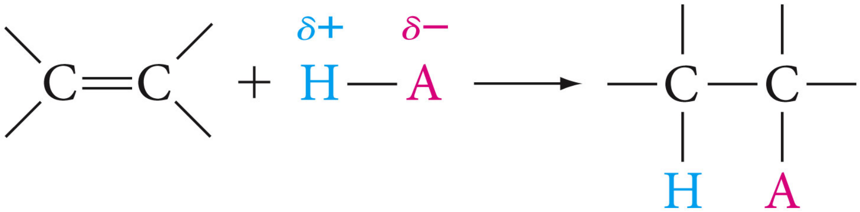
- END -

0

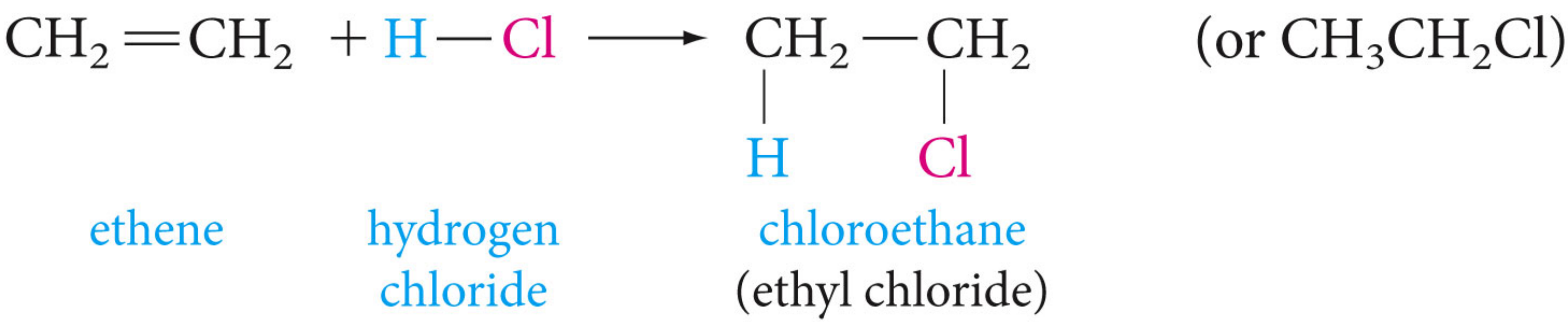
Addition of Acids

ممكن اضيف H_2SO_4

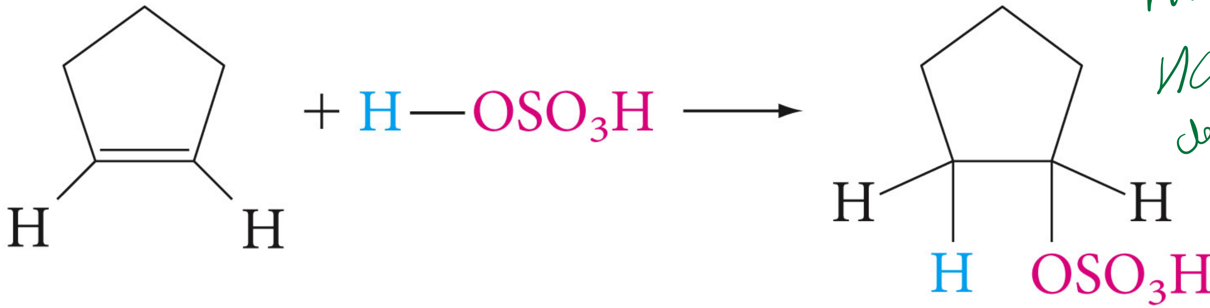
H, HSO_4



Acids that add this way are the hydrogen halides (H-F, H-Cl, H-Br, H-I) and sulfuric acid (H-OSO3H)



acid → H + بروتون



cyclopentene   sulfuric acid   cyclopentyl hydrogen sulfate

HBr ، H_2SO_4
Br_2
HCl ، ما الهم عوامل
مساعدة هما عوامل
مساعدة كالكم

CCl_4
مذيب في حال
ساكن
شان اخفف شوي
لانه يكون مركز
بس في حال ساكن

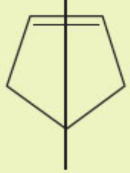
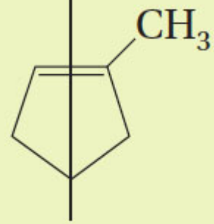
Write the equation for each of the following reactions

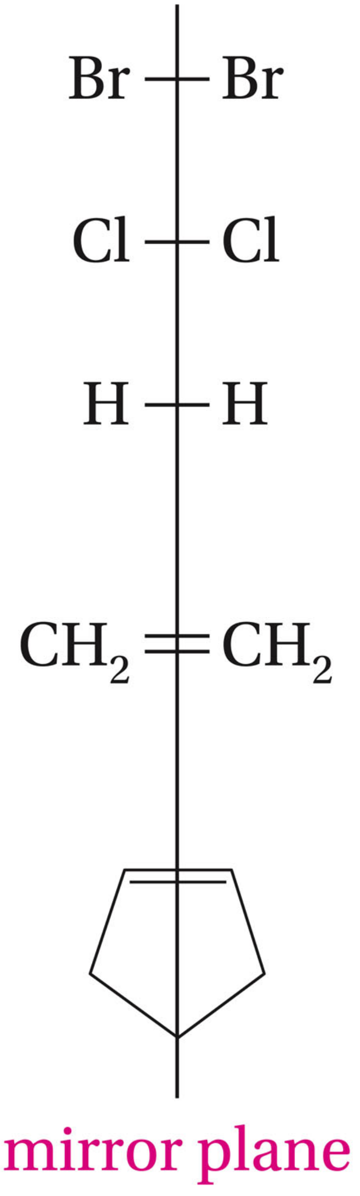
a)2-butene + HCl

b)3-Hexene + HI

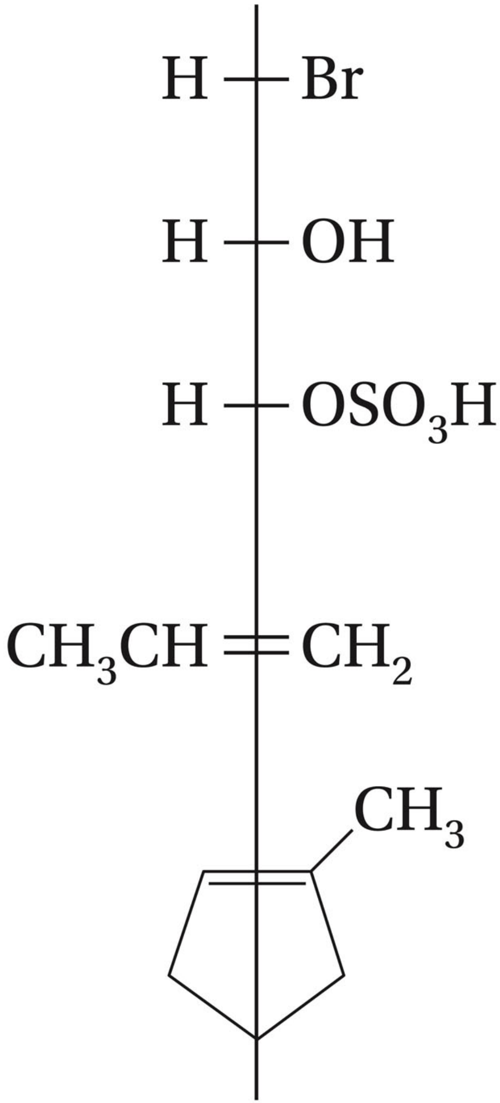
c)4-methylcyclopentene + HBr

Table 3.2 Classification of Reagents and Alkenes by Symmetry with Regard to Addition Reactions

	Symmetric	Unsymmetric
Reagents	Br—Br	H—Br
	Cl—Cl	H—OH
	H—H	H—OSO_3H
Alkenes	$CH_2=CH_2$	$CH_3CH=CH_2$
		
	mirror plane	not a mirror plane

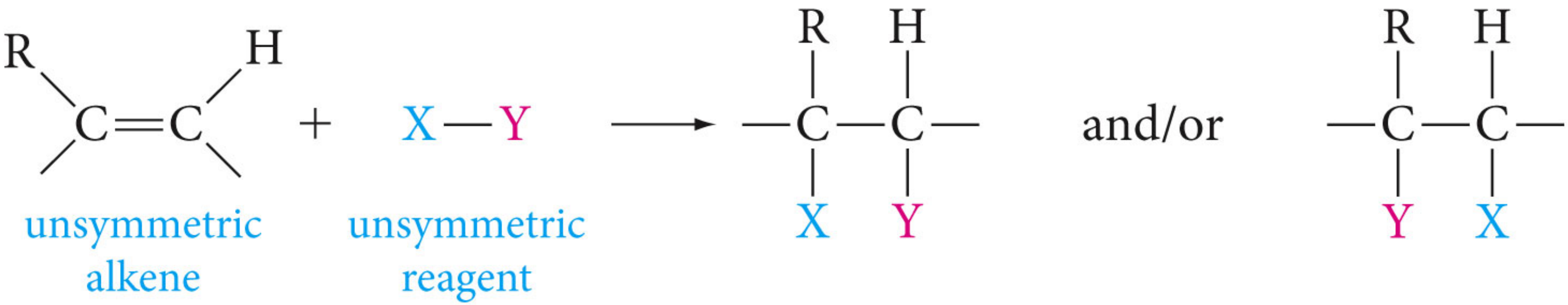


0

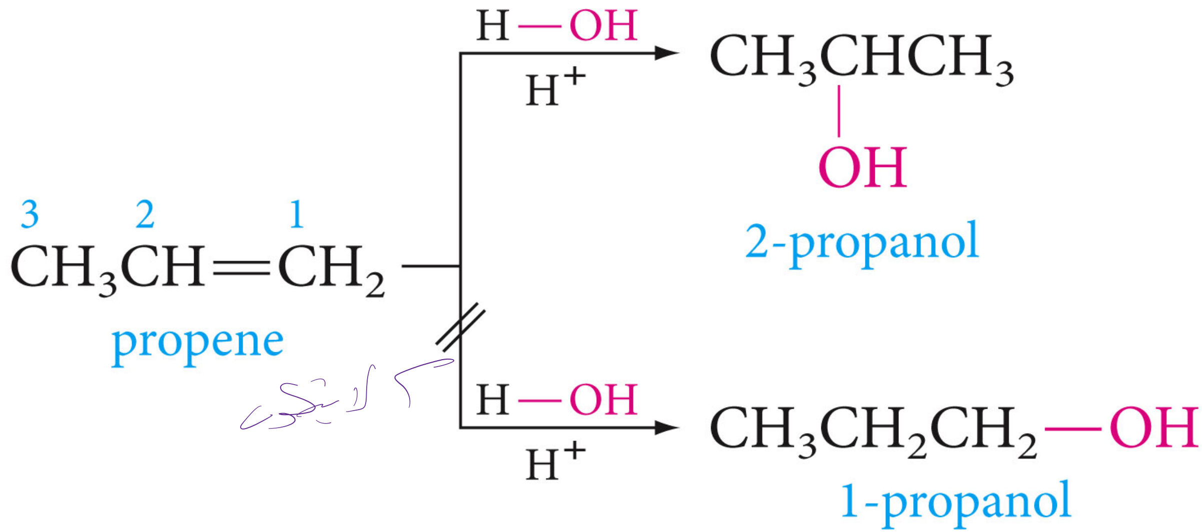


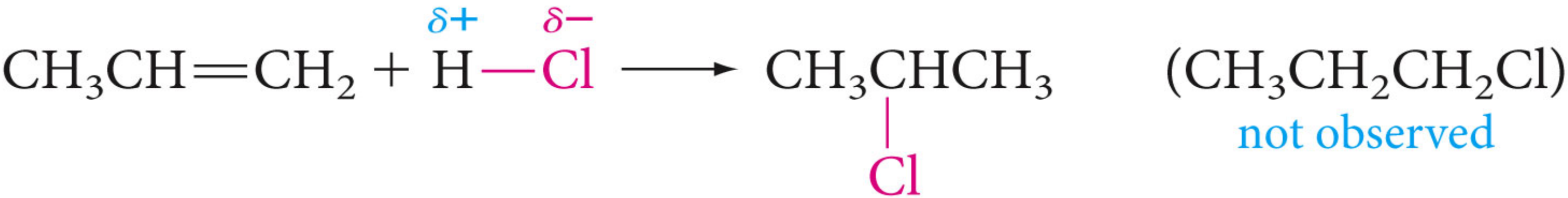
not a mirror plane

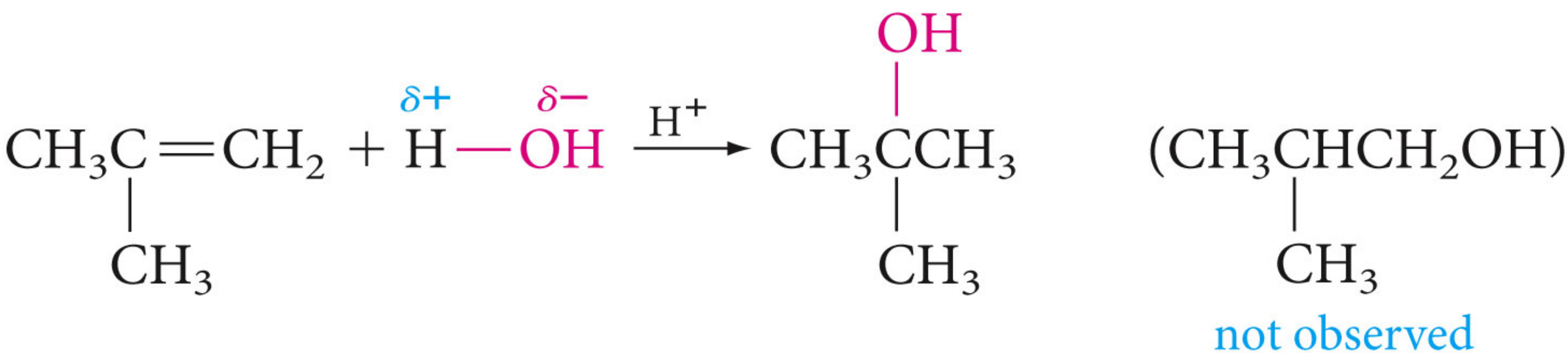
Addition of Unsymmetric Reagents to Unsymmetric Alkenes; Markovnikov's Rule

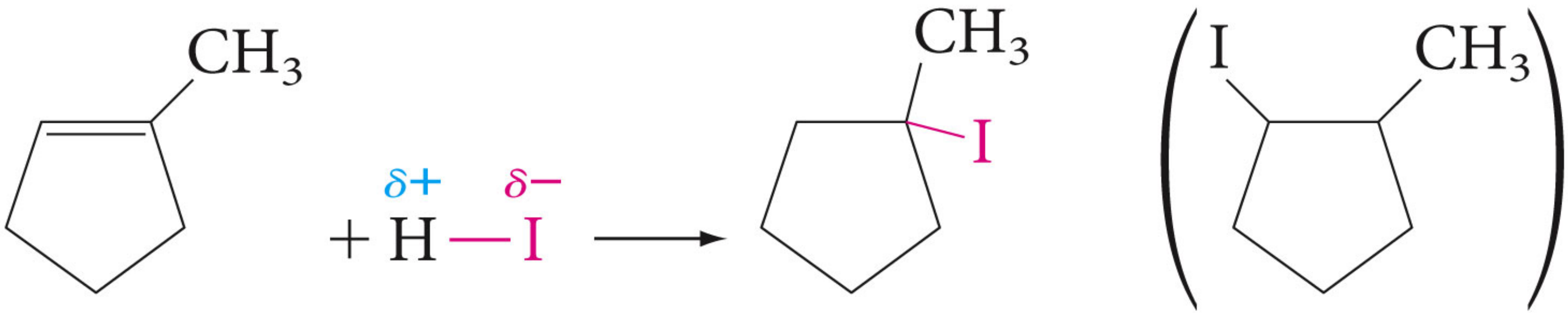


الشق السالب يروح ع C اللي عليه اقل H




δ+
δ−
not observed


δ+
δ−
H+
not observed



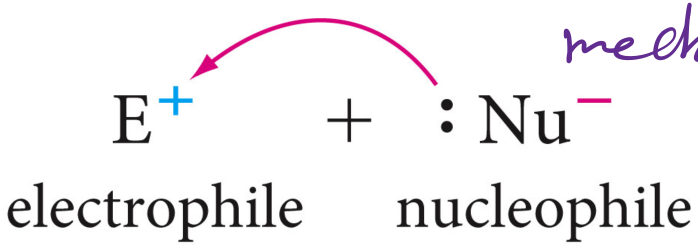
not observed

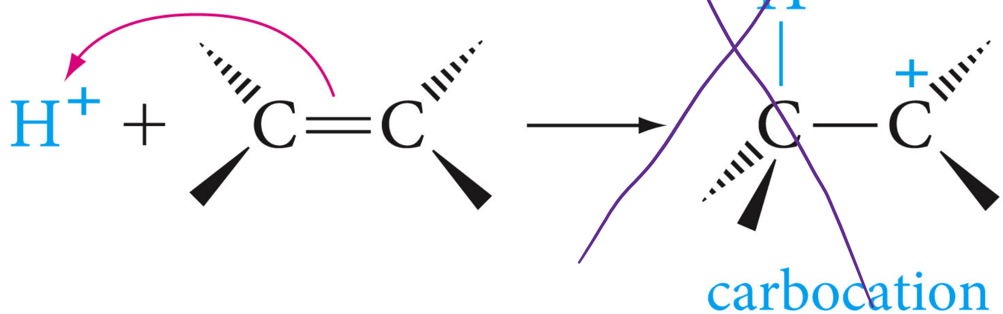
الناتج التاني مش
فقط لـ اوضح
التطبيق
لـ نفهم اله unsemetrical مع وحدة زيادة
بردو الشق السالب يرتبط مع الاقل

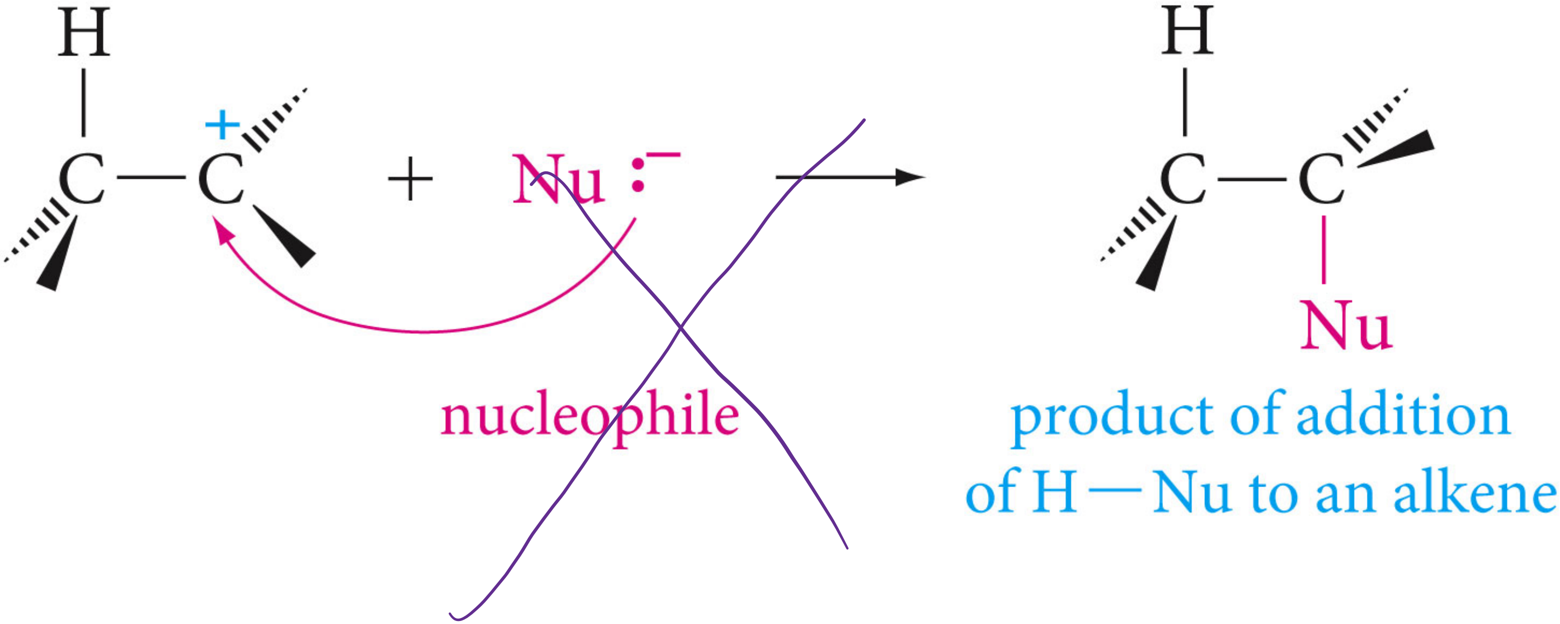
Mechanism of Electrophilic Addition to Alkenes

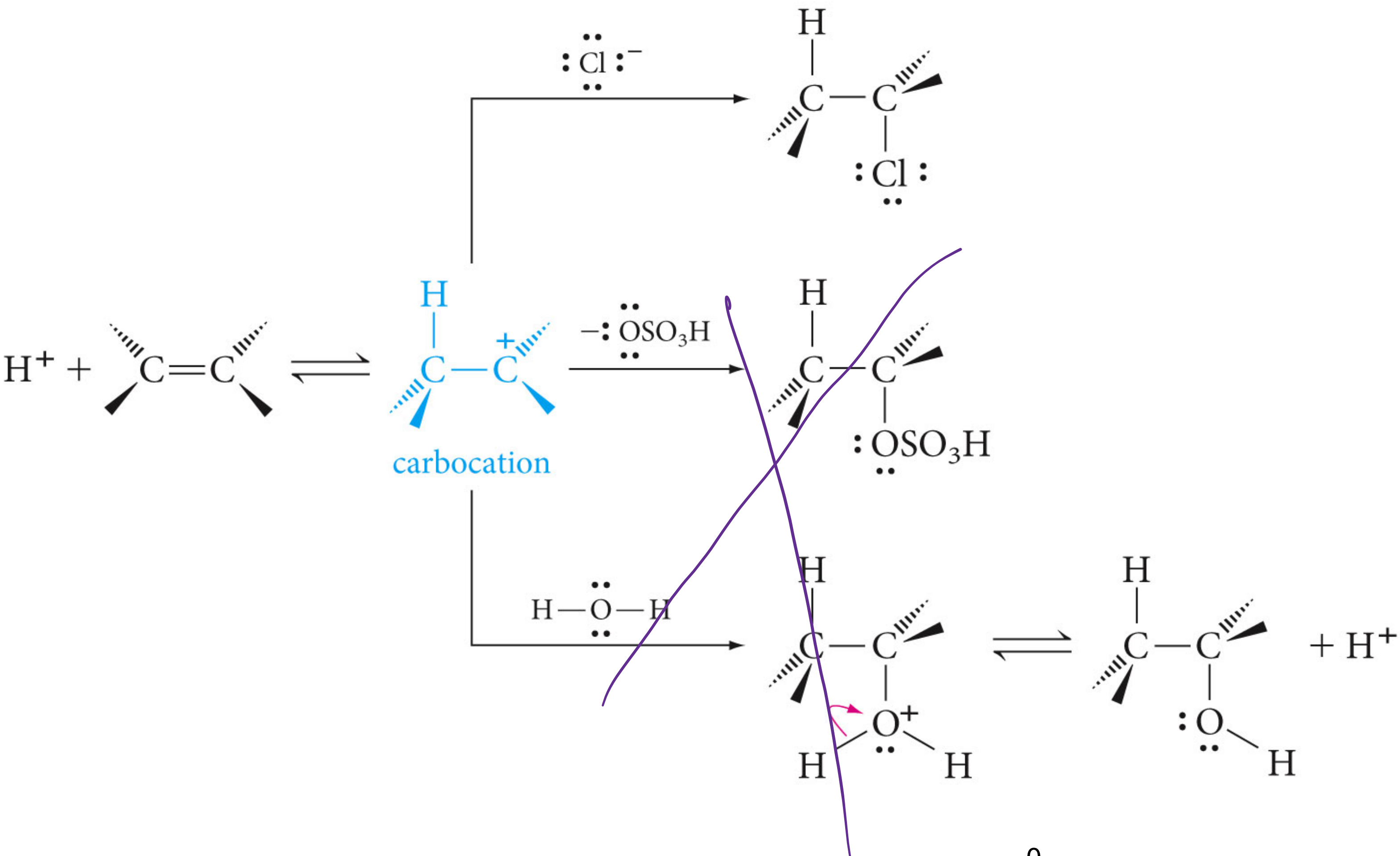
شو مطالبين

بال mechanism



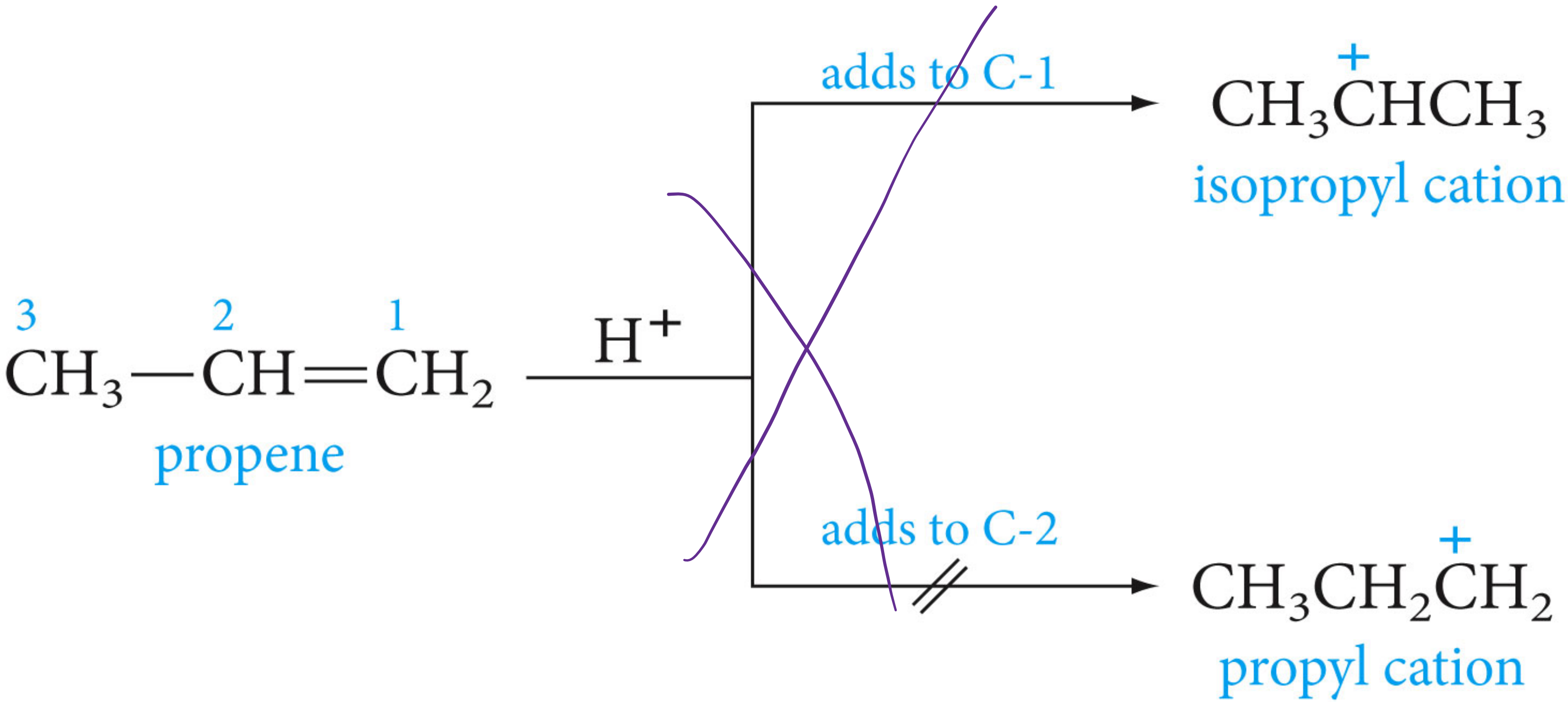


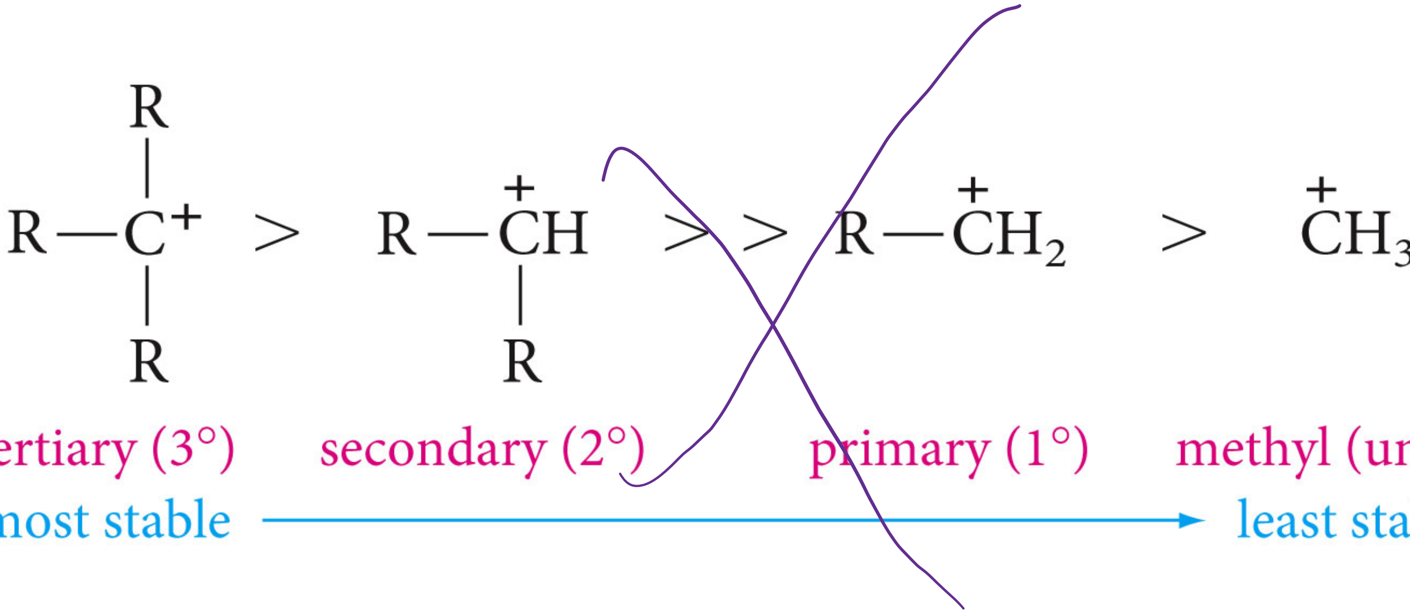

H
C
C
+
Nu
nucleophile
H
C
C
Nu
product of addition
of H — Nu to an alkene



0

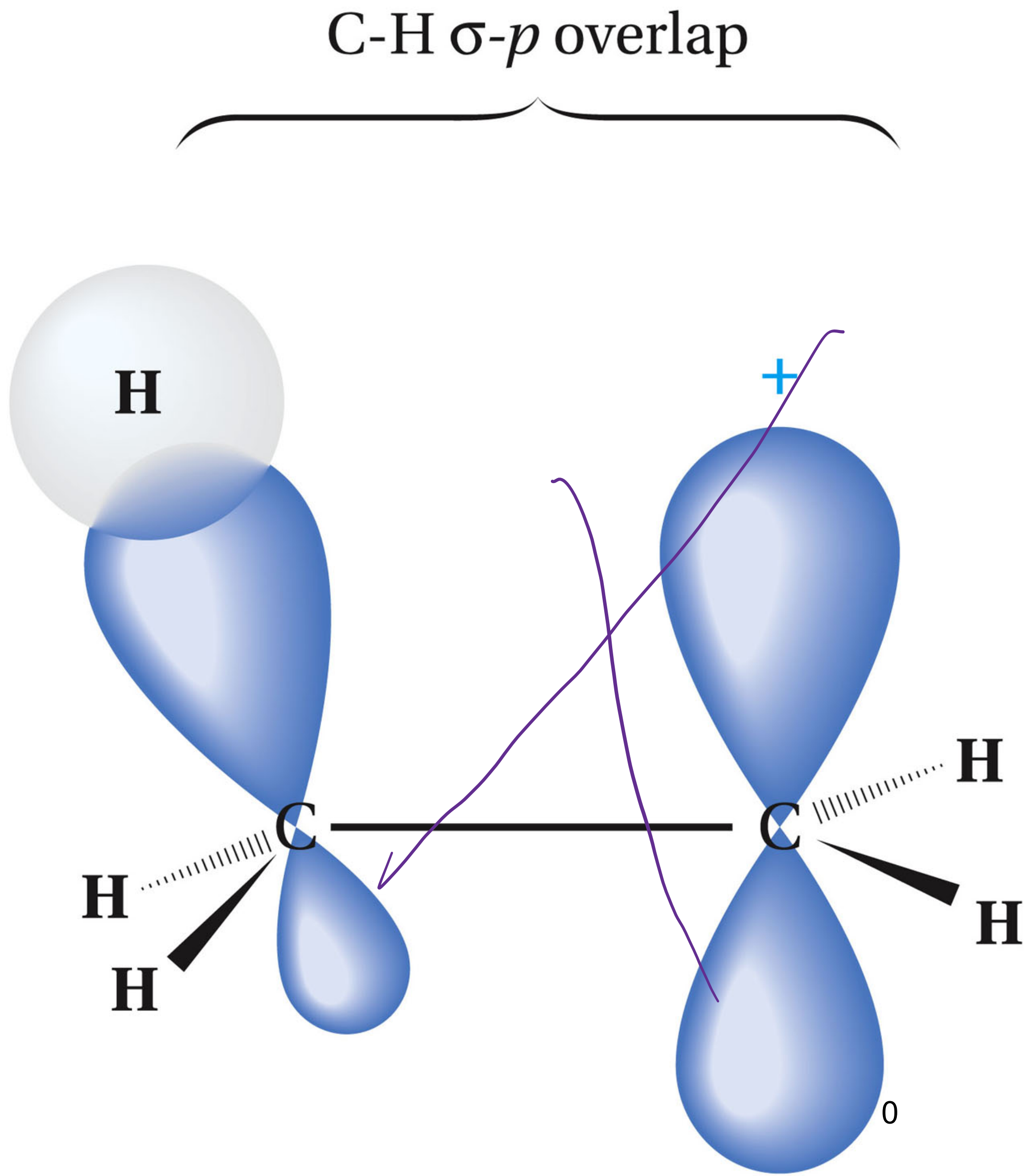
Markovnokov's Rule Explained



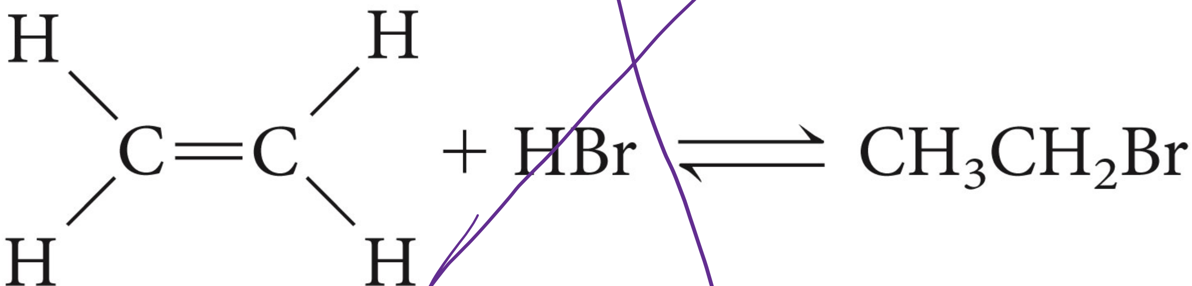


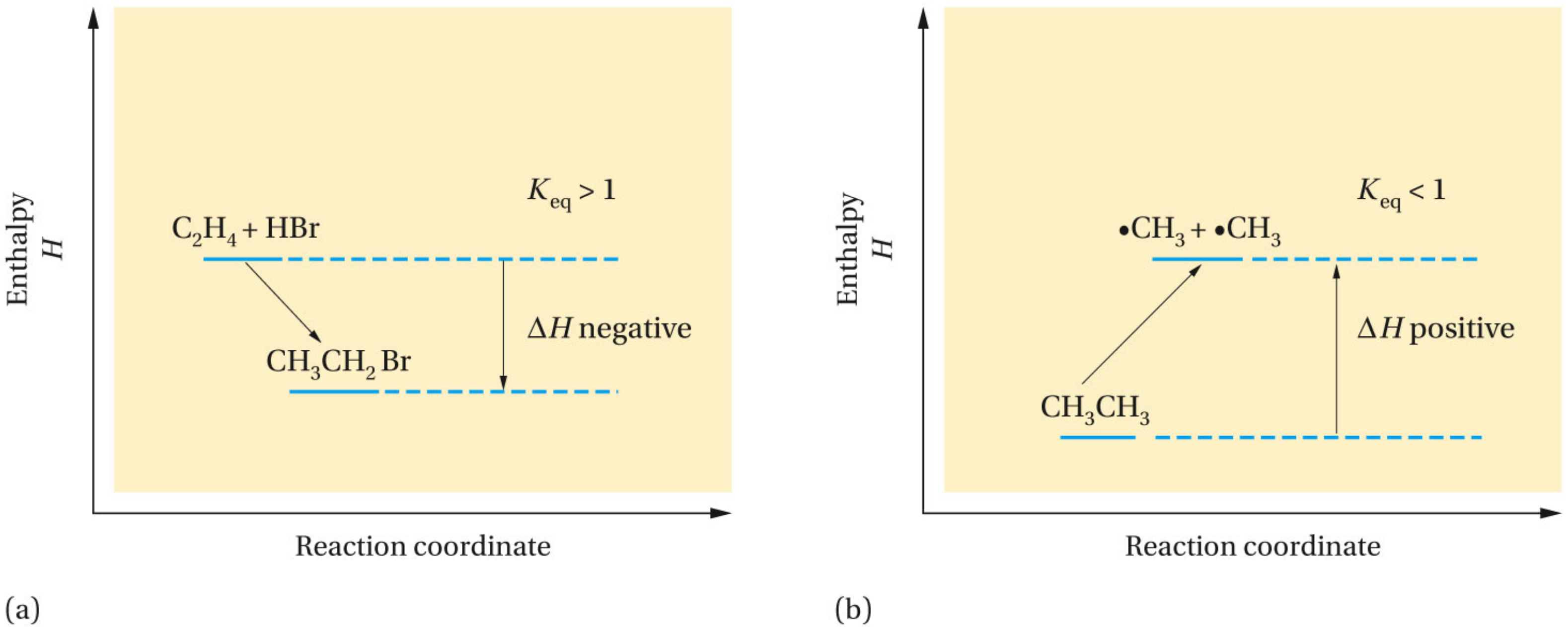
tertiary (3°) secondary (2°) primary (1°) methyl (unique)

most stable $\longrightarrow$ least stable


C-H σ-p overlap
H
+
H
C
C
H
H
H
H
0

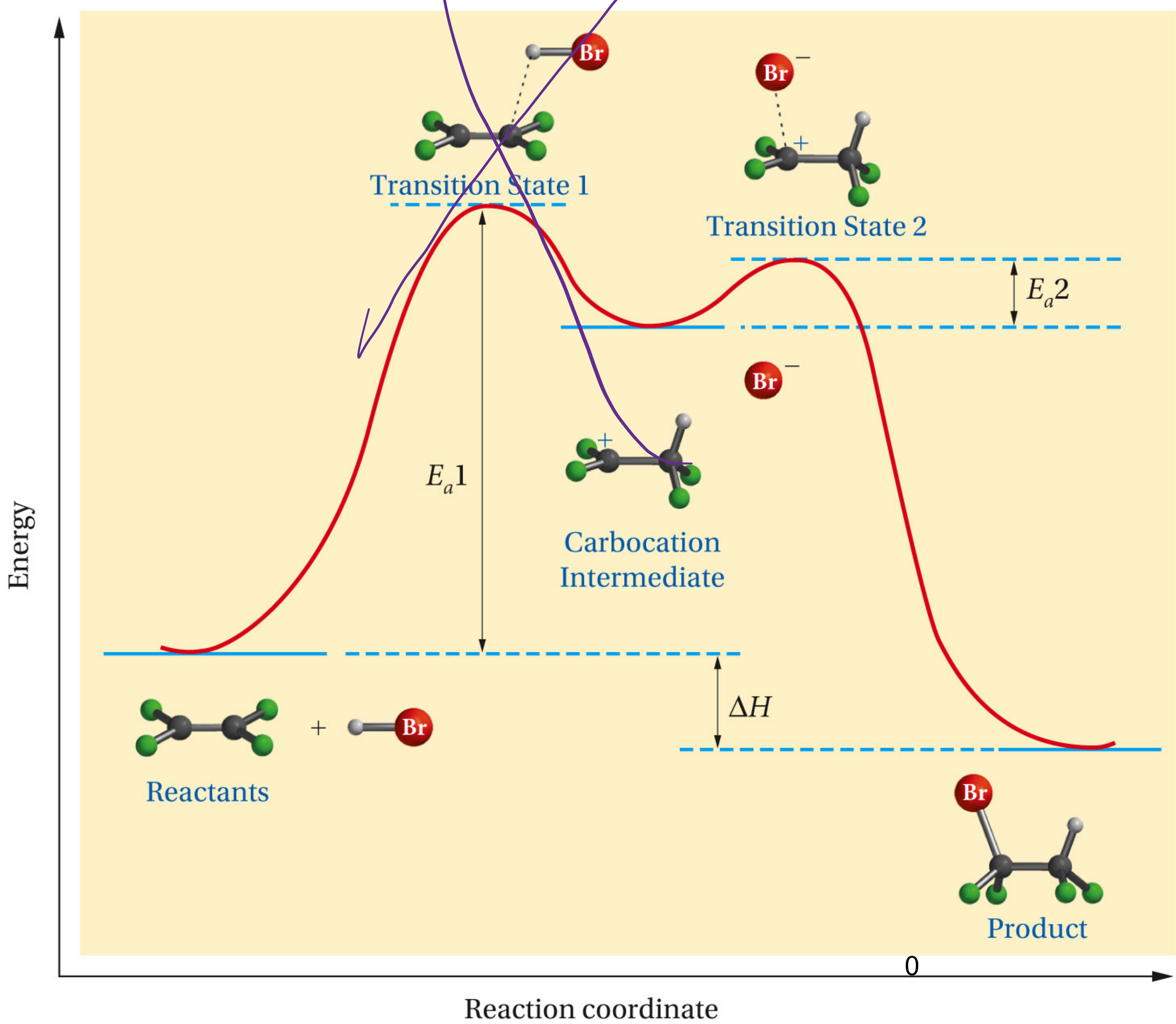
Reaction Equilibrium

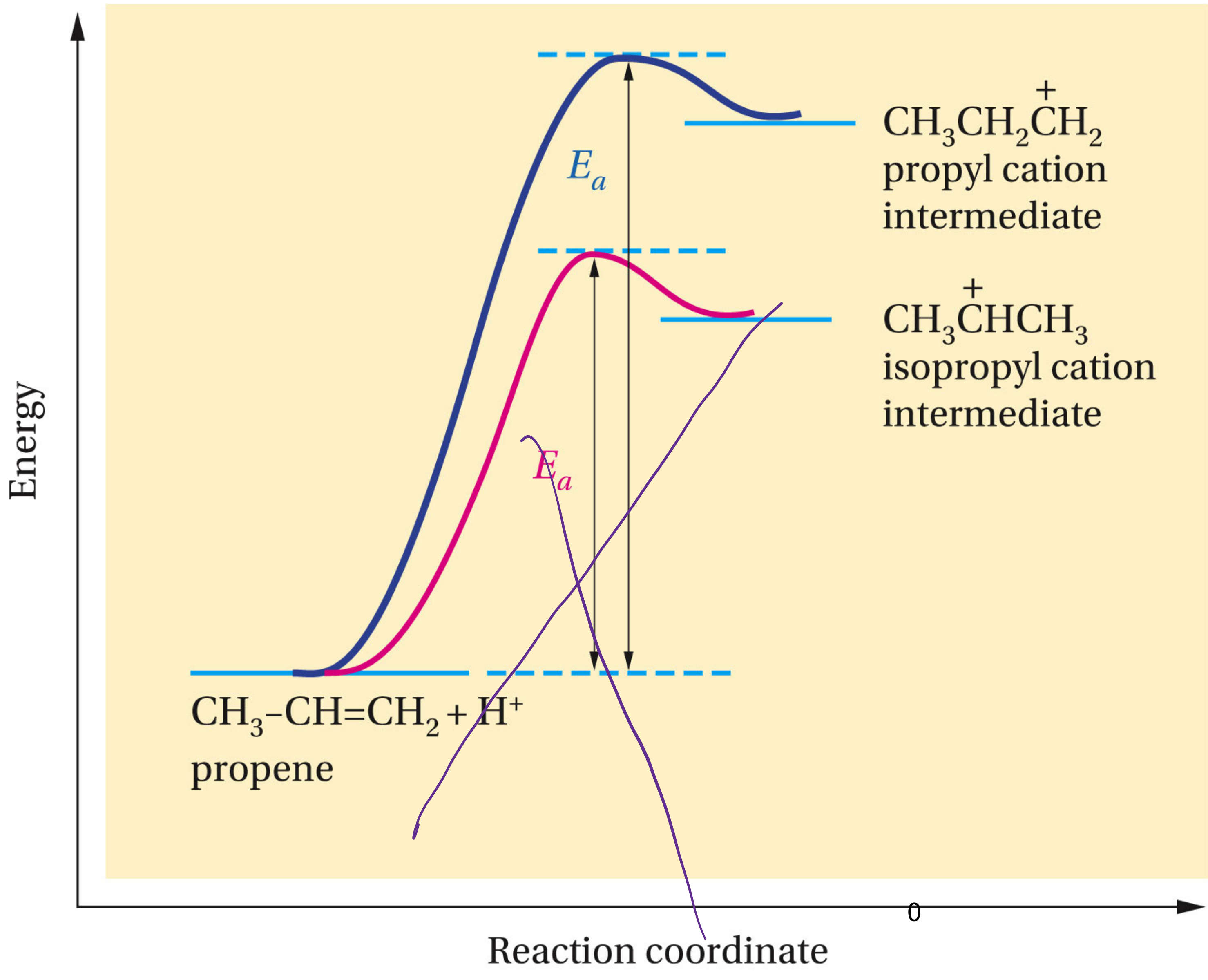




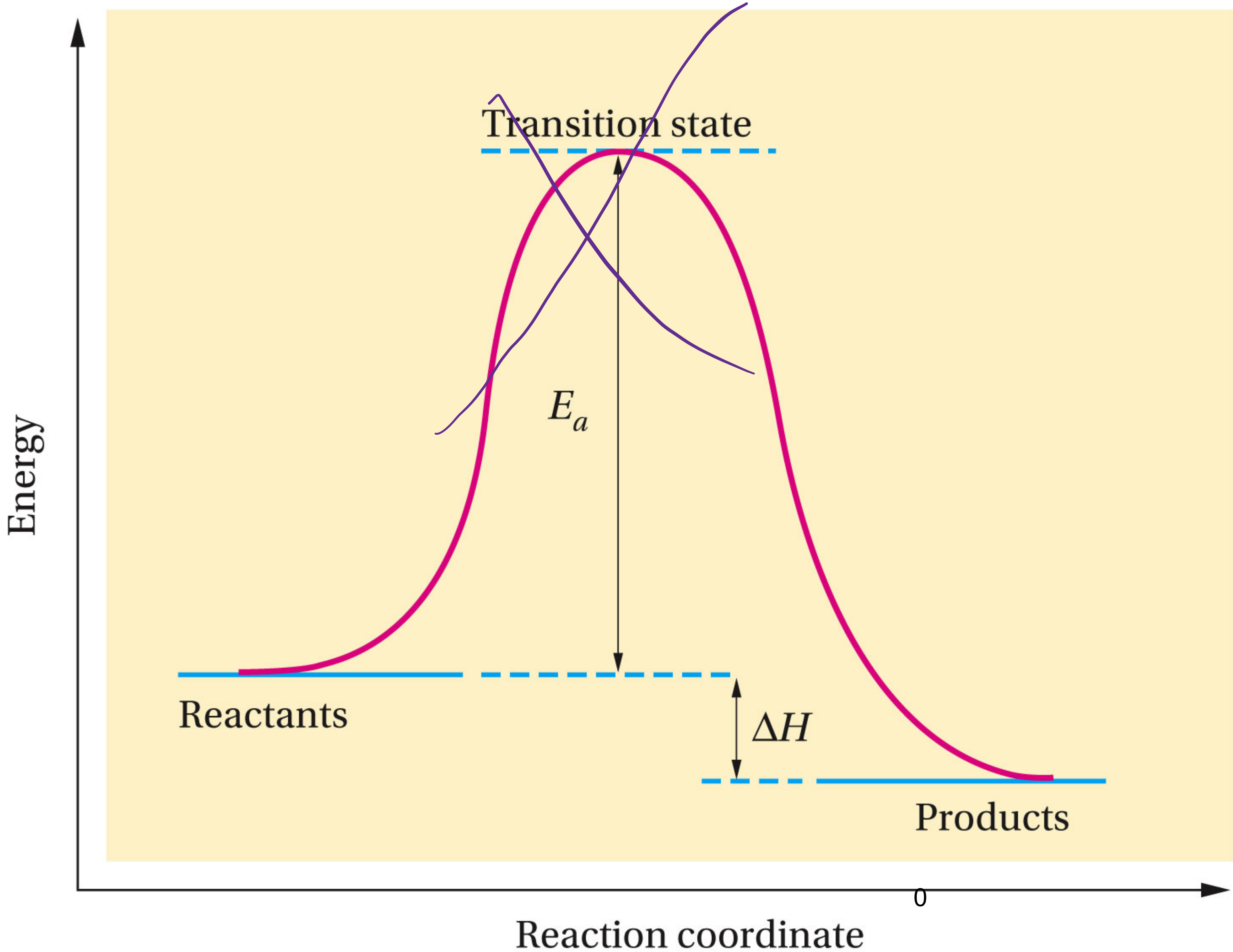
Enthalpy
H
$K_{eq} > 1$
$C_2H_4 + HBr$
ΔH negative
CH_3CH_2Br
Reaction coordinate
(a)
Enthalpy
H
$K_{eq} < 1$
$\bullet CH_3 + \bullet CH_3$
ΔH positive
CH_3CH_3
Reaction coordinate
(b)

0


Transition State 1
Transition State 2
E_a2
E_a1
Carbocation Intermediate
ΔH
Reactants
Product
Energy
Reaction coordinate
0
Br



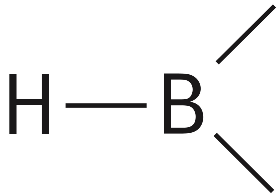
$CH_3CH_2\overset{+}{C}H_2$
propyl cation
intermediate
$CH_3\overset{+}{C}HCH_3$
isopropyl cation
intermediate
E_a
E_a
$CH_3{-}CH{=}CH_2 + H^+$
propene
Energy
Reaction coordinate
0



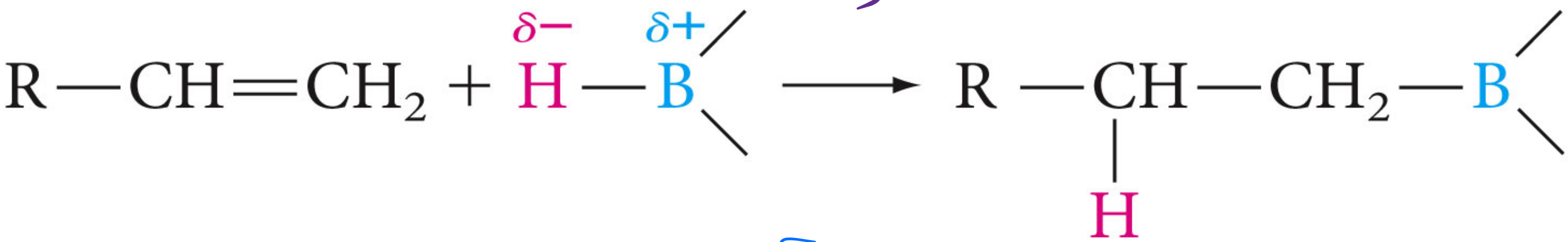
Energy
Transition state
E_a
Reactants
ΔH
Products
0
Reaction coordinate

Hydroboration of Alkenes

oxidation

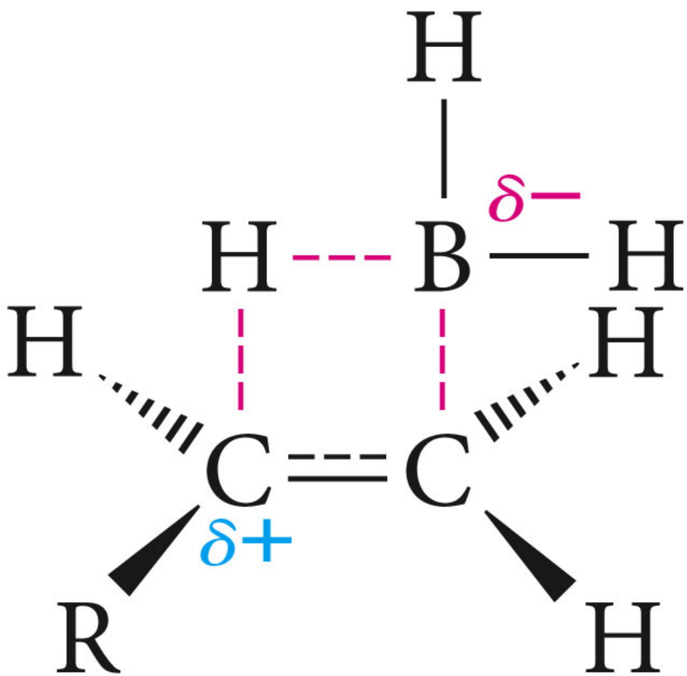


خطوتين بتصير الخطوة
الأولى وبعدين بيصير الخطوة
الثانية اللي نتجت من الخطوة
الأولى وناتجها تكون الكحول



عكس قاعدة
ماركوفنيكوف
لانه الشق السالب
يرتبط بالطرف اللي عليه اكثر H

0



transition state
for hydroboration

$$3\,CH_3CH{=}CH_2 + BH_3 \longrightarrow CH_3CH_2CH_2{-}B\begin{matrix} \diagup CH_2CH_2CH_3 \\ \diagdown CH_2CH_2CH_3 \end{matrix}$$

propene borane tri-*n*-propylborane

مادة فعالة جدا

الخطوة ١

$$(CH_3CH_2CH_2)_3B + 3\,H_2O_2 + 3\,NaOH \longrightarrow$$

tri-*n*-propylborane

$$3\,CH_3CH_2CH_2OH + Na_3BO_3 + 3\,H_2O$$

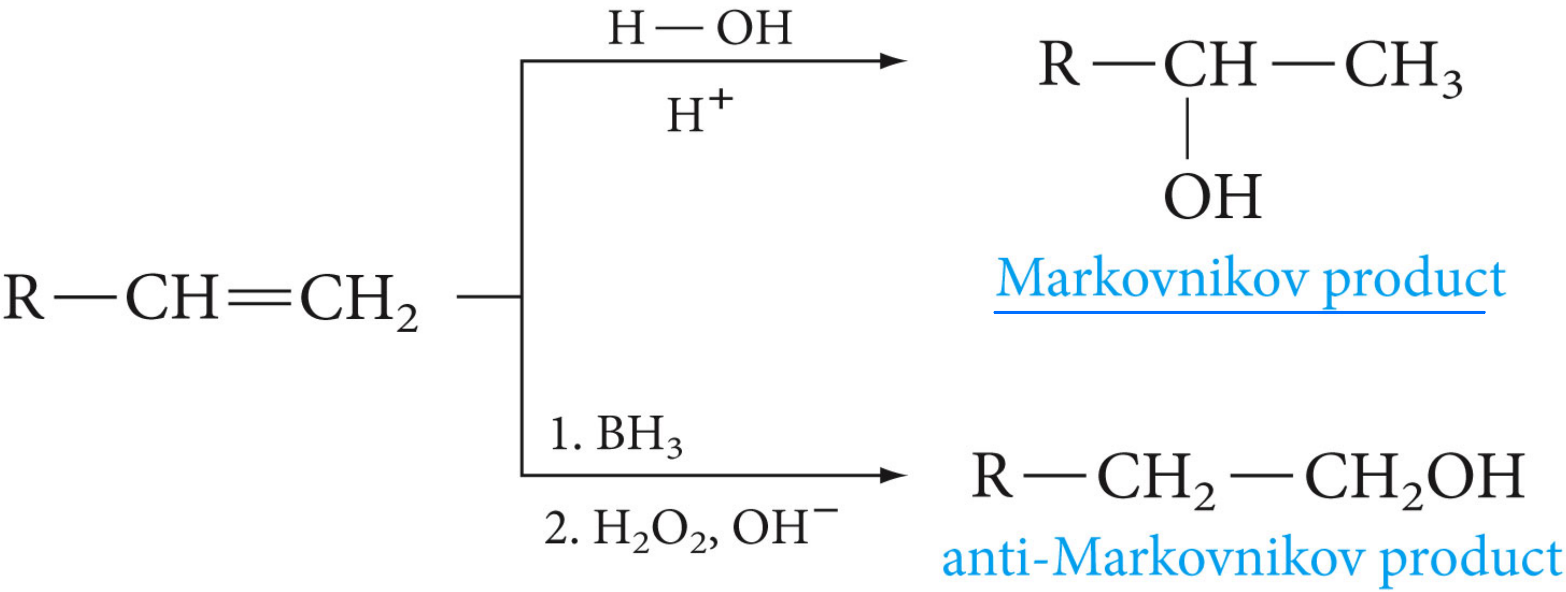
n-propyl alcohol sodium borate

hydration reaction

بيتحول للكحول

OH ترتبط بالكربون اللي فيه

H الأكثر


R—CH=CH2
H—OH
H+
1. BH3
2. H2O2, OH−
R—CH—CH3
OH
Markovnikov product
R—CH2—CH2OH
anti-Markovnikov product

$$\begin{array}{c} CH_3 \\ | \\ CH_3-C=CH_2 \end{array} \xrightarrow{BH_3} \xrightarrow[OH^-]{H_2O_2} \begin{array}{c} CH_3 \\ | \\ CH_3\,CH\,CH_2OH \end{array}$$

$$3\,CH_3-\overset{\displaystyle CH_3}{\overset{|}{C}}=CH_2 \xrightarrow{BH_3} (CH_3-\overset{\displaystyle CH_3}{\overset{|}{C}H}-CH_2)_3B \xrightarrow[OH^-]{H_2O_2} 3\,CH_3-\overset{\displaystyle CH_3}{\overset{|}{C}H}-CH_2OH$$

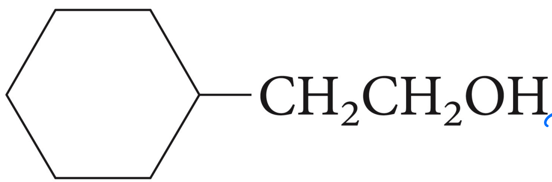
الفرق الي بين

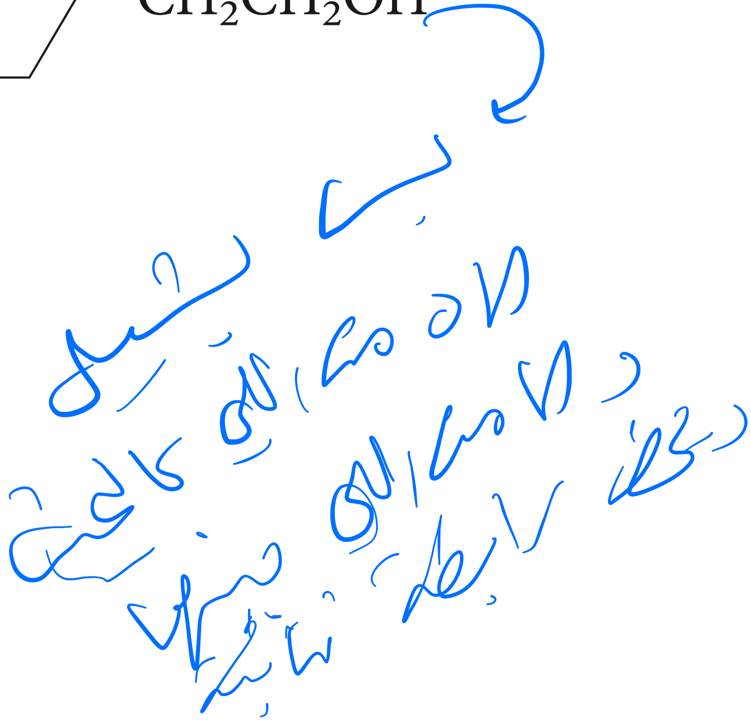
انه اول كان

يطلع عكس هلا صار

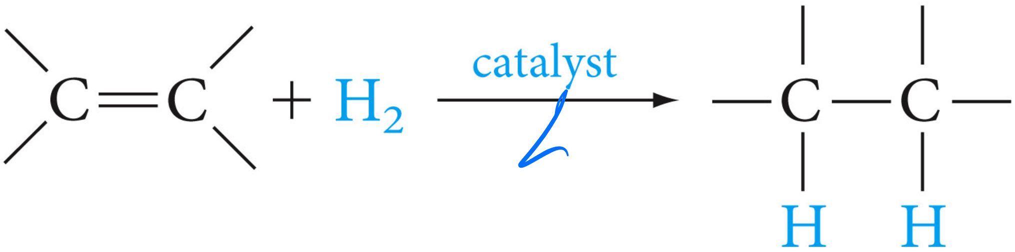
دوج

What alkene is needed to obtain he alcohol below via hydroboration-oxidation sequence, what product would this alkene give with acid-catalyzed hydration.





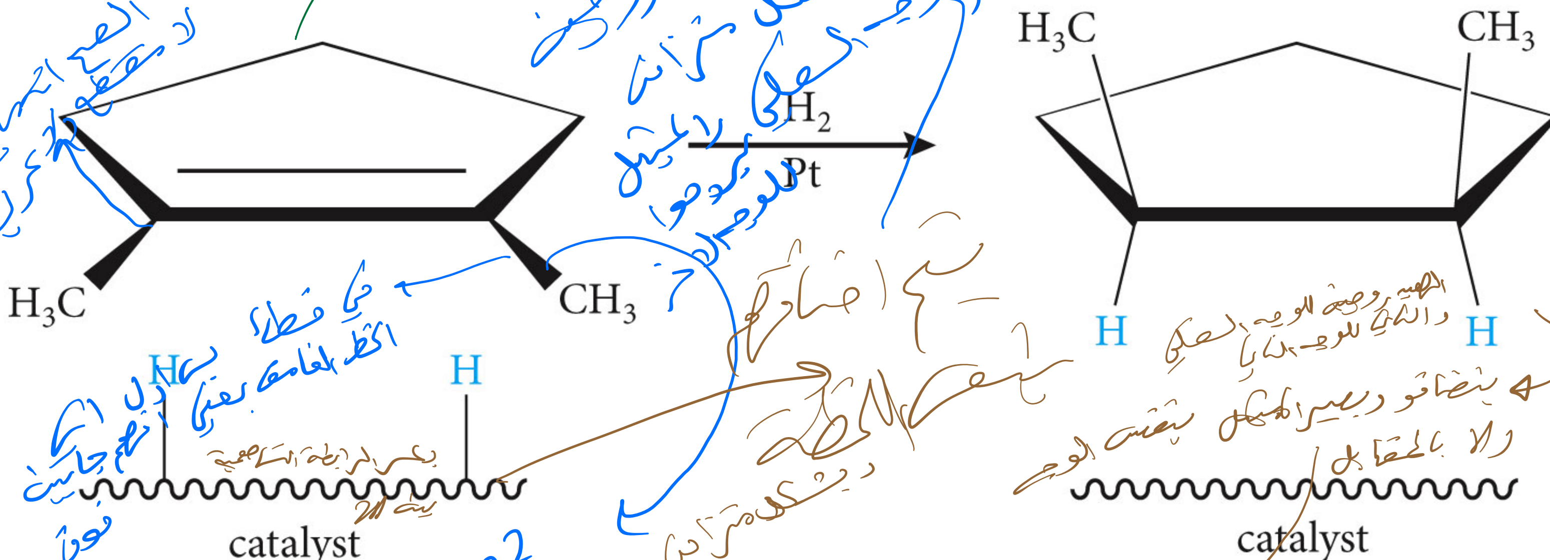
Addition of Hydrogen



Ni

Pt

cis لازم التعامل بكل
لا trans بدل ما
planer



cis الهيدروجين يشكل متوازي على الوجه السفلي
ثم اضافة H للوجه

ثم اضافة
يصير الرابطة
يشكل متوازي

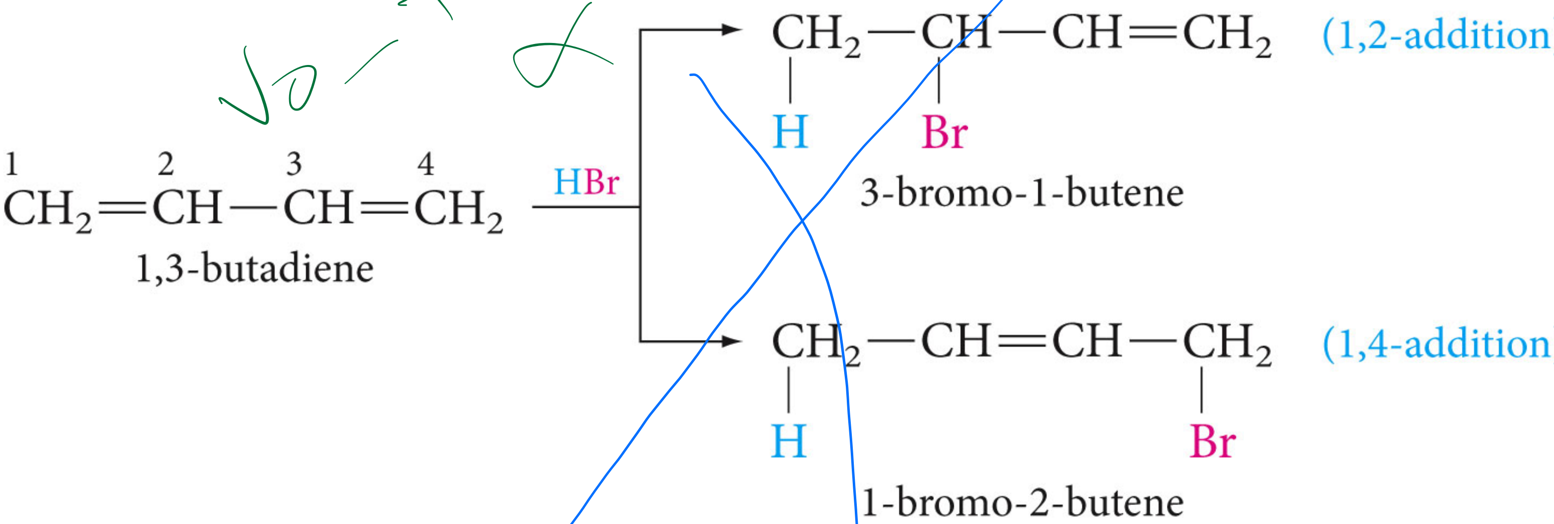
الهيدروجين للوجه السفلي
بيتضاف ويصير الكل بنفس الوجه

cis يعني التأثير
cyclic طبعاً بيشتغل ب
اما open chain ما بيشتغل

ring le planer sp2
لازم تكون بنفس plane
plane

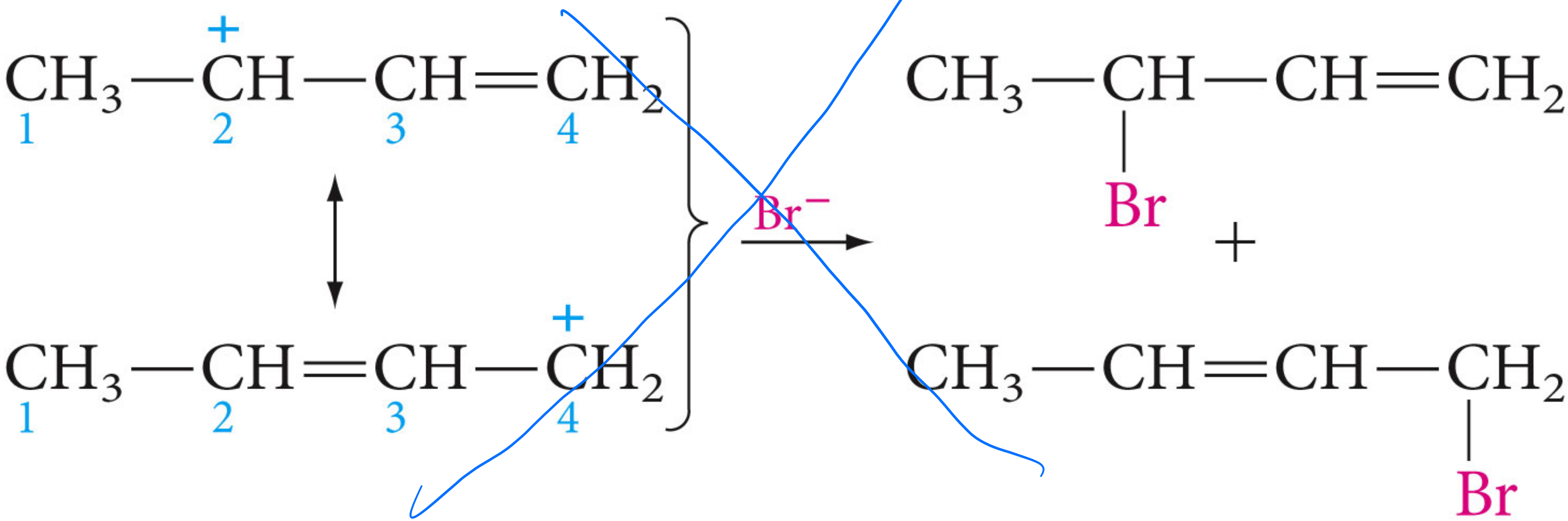
0

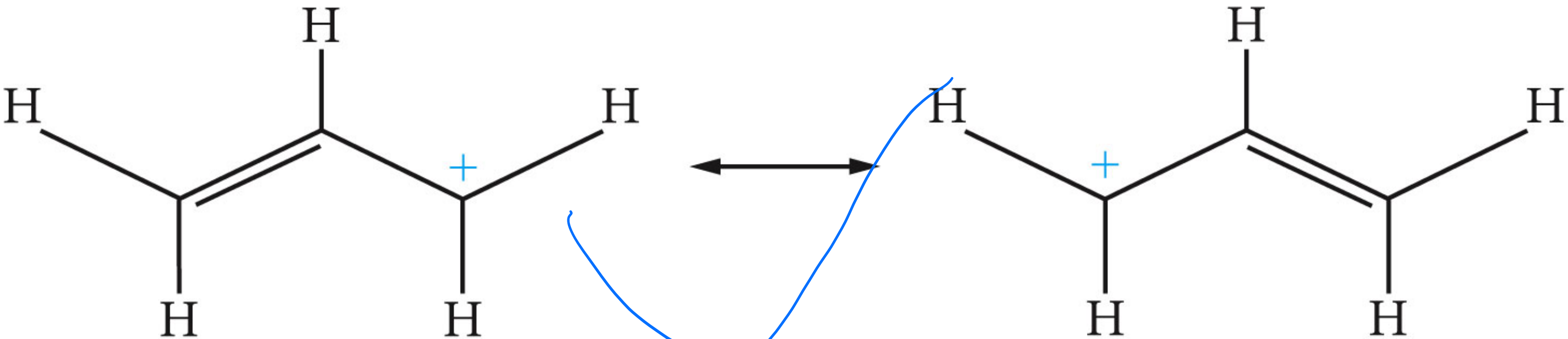
Addition to Conjugated Systems



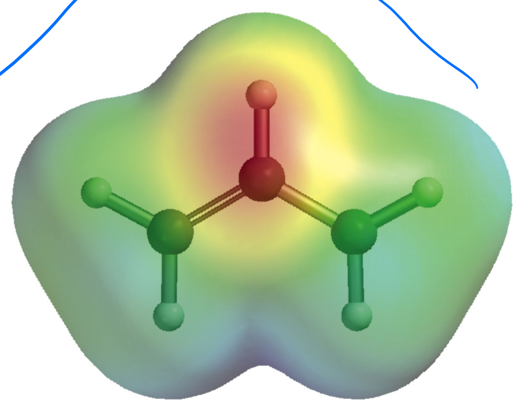
$$\mathrm{H^{+} + CH_2{=}CH{-}CH{=}CH_2 \longrightarrow CH_3{-}\overset{+}{C}H{-}CH{=}CH_2}$$

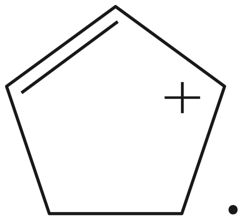
$$\mathrm{[CH_3{-}\overset{+}{C}H{-}CH{=}CH_2 \longleftrightarrow CH_3{-}CH{=}CH{-}\overset{+}{C}H_2]}$$





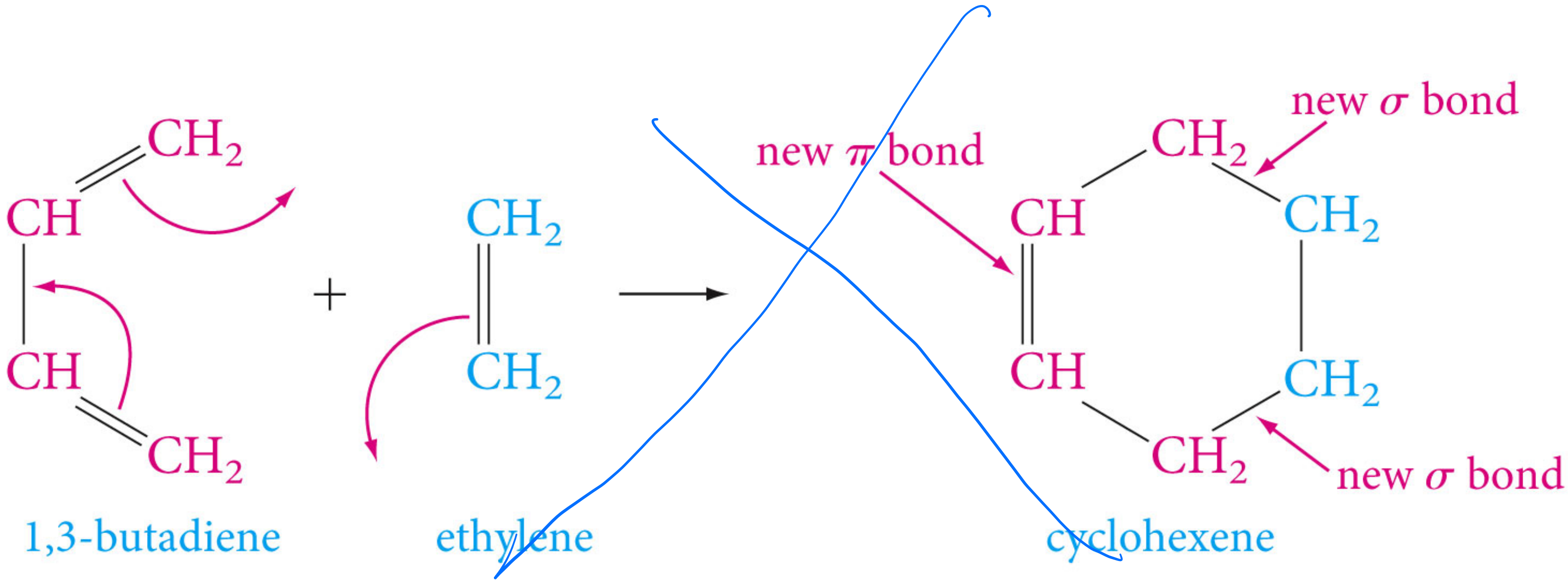
~~the allyl carbocation~~

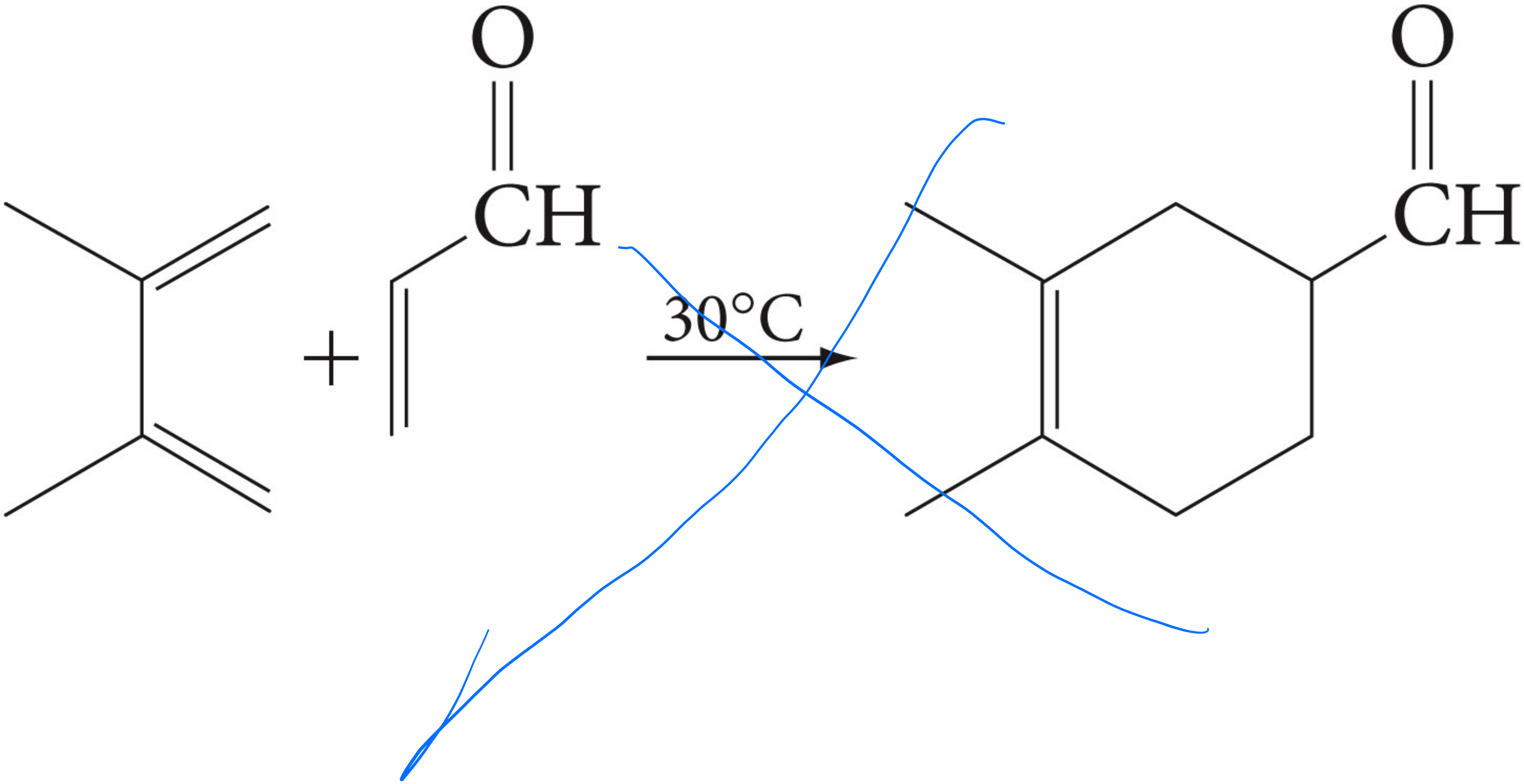




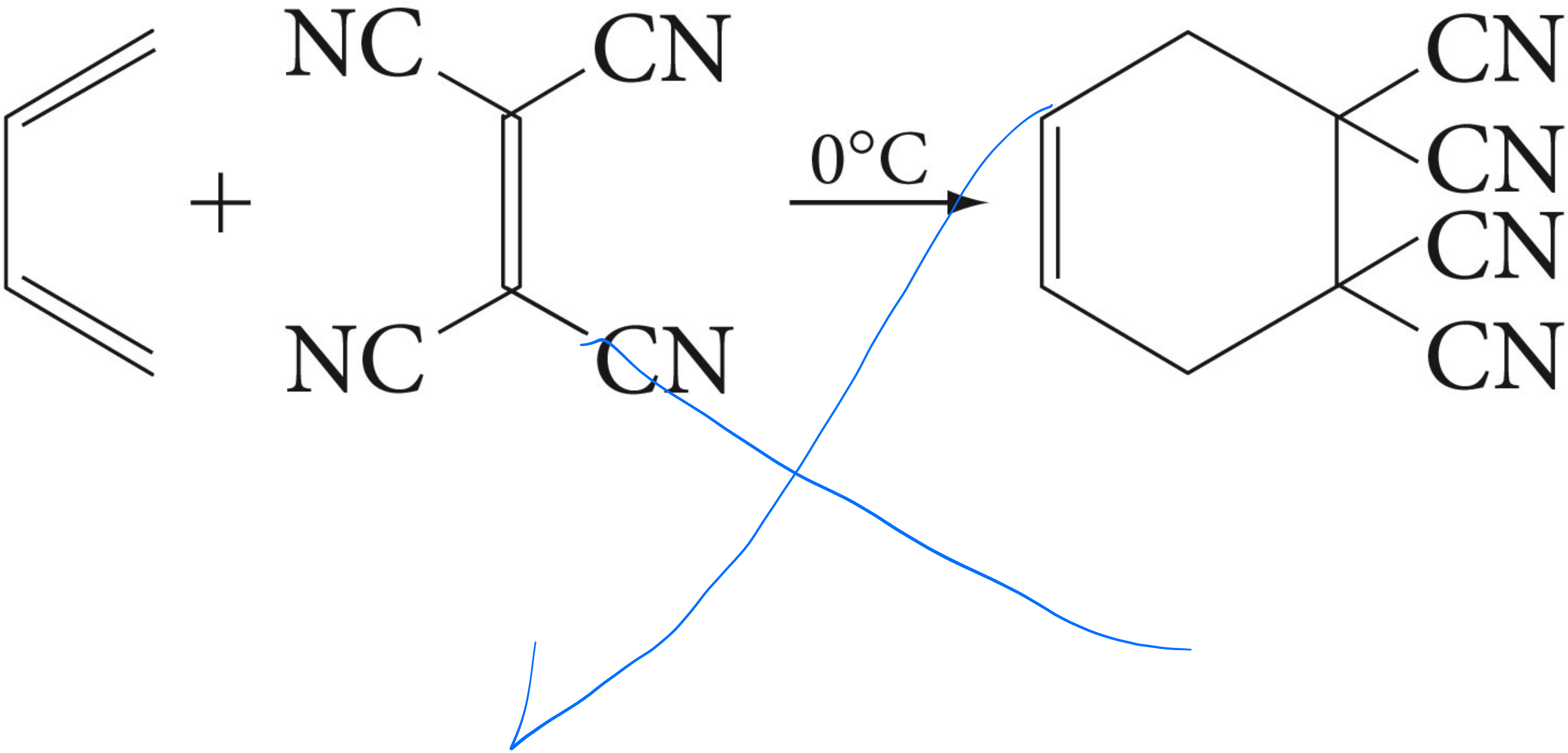
0

Cycloaddition to Conjugated Dienes: Diels-Alder Reaction

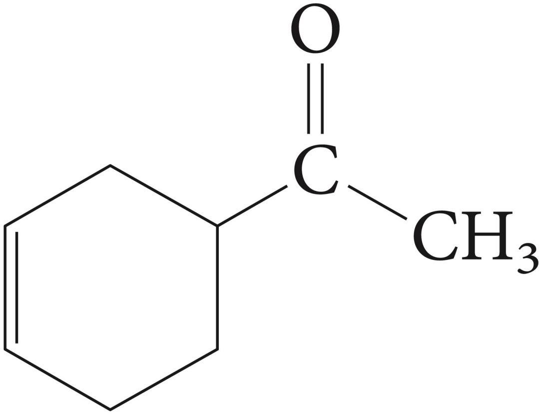




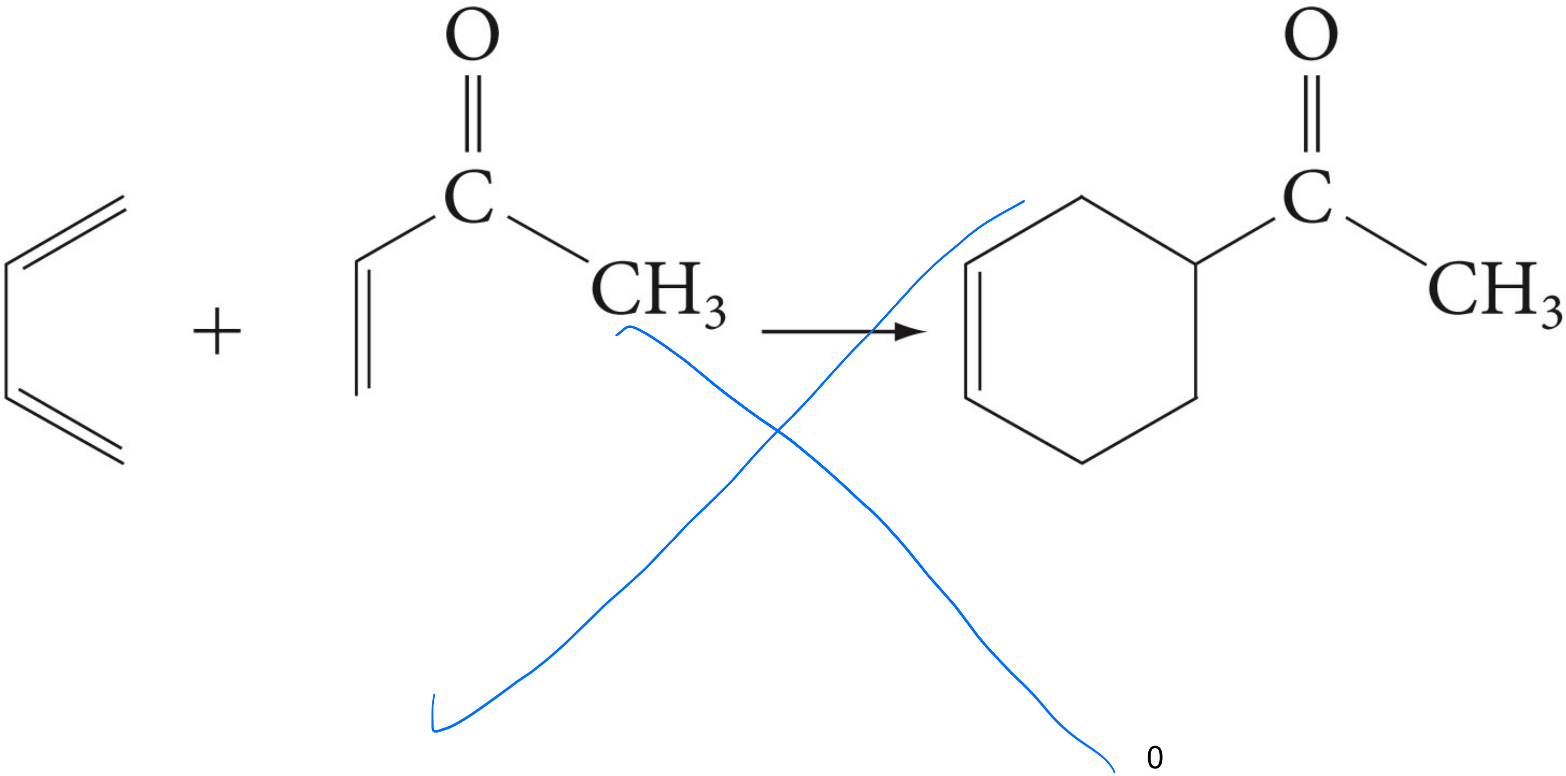
0



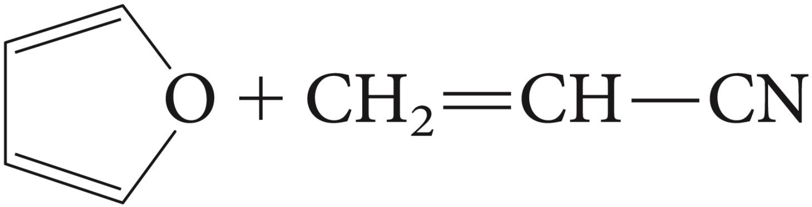
0



0



0



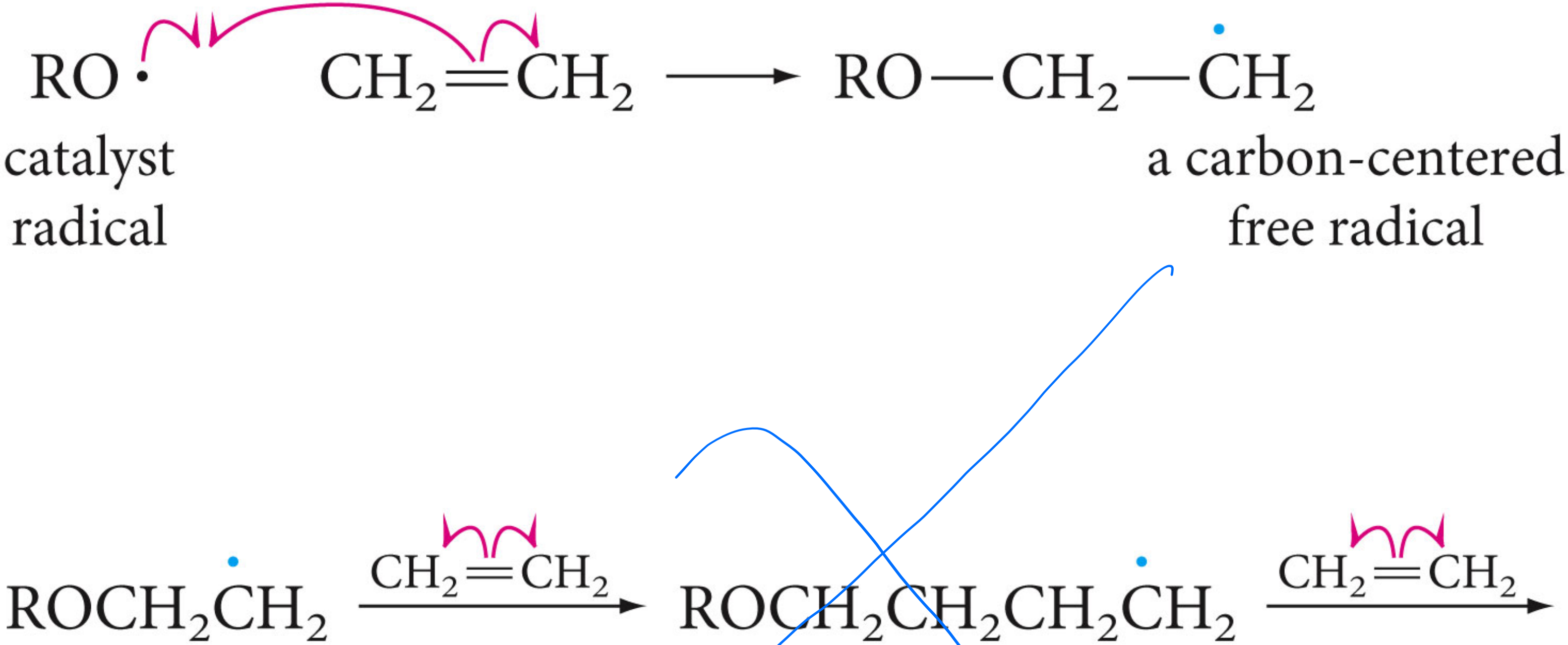
0

Free-Radical Additions; Polyethene

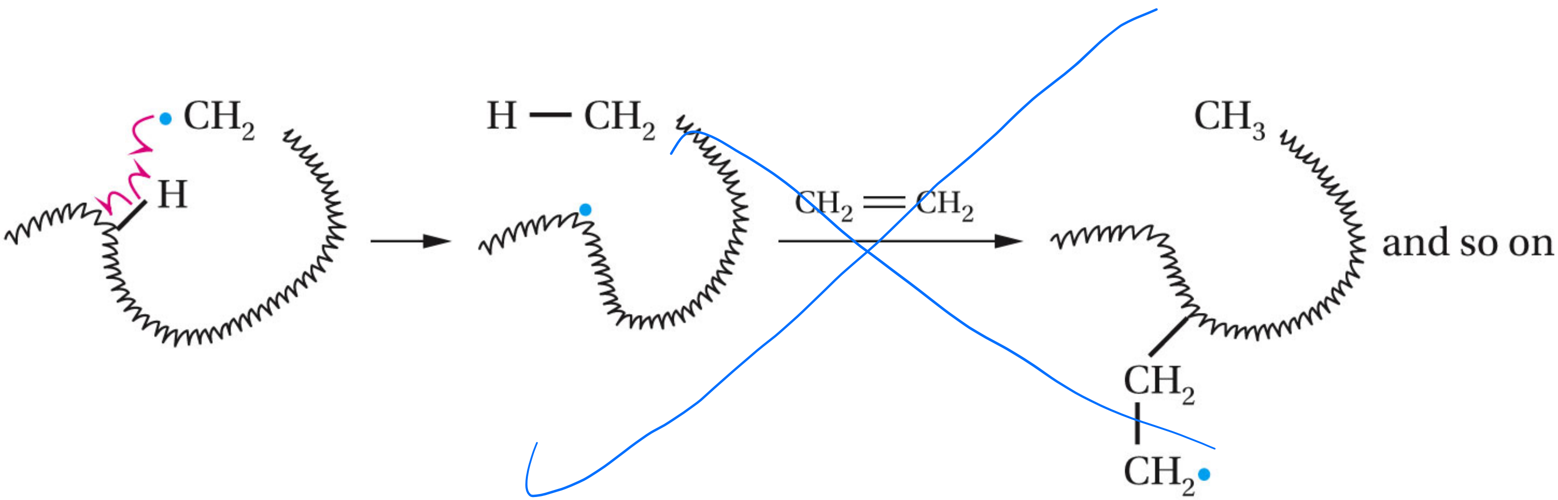
$$\underset{\text{ethylene}}{CH_2{=}CH_2} \xrightarrow[\text{1000 atm, }>100^\circ\text{C}]{\text{ROOR}} \underset{\text{polyethylene}}{\left(CH_2-CH_2 \right)_n}$$

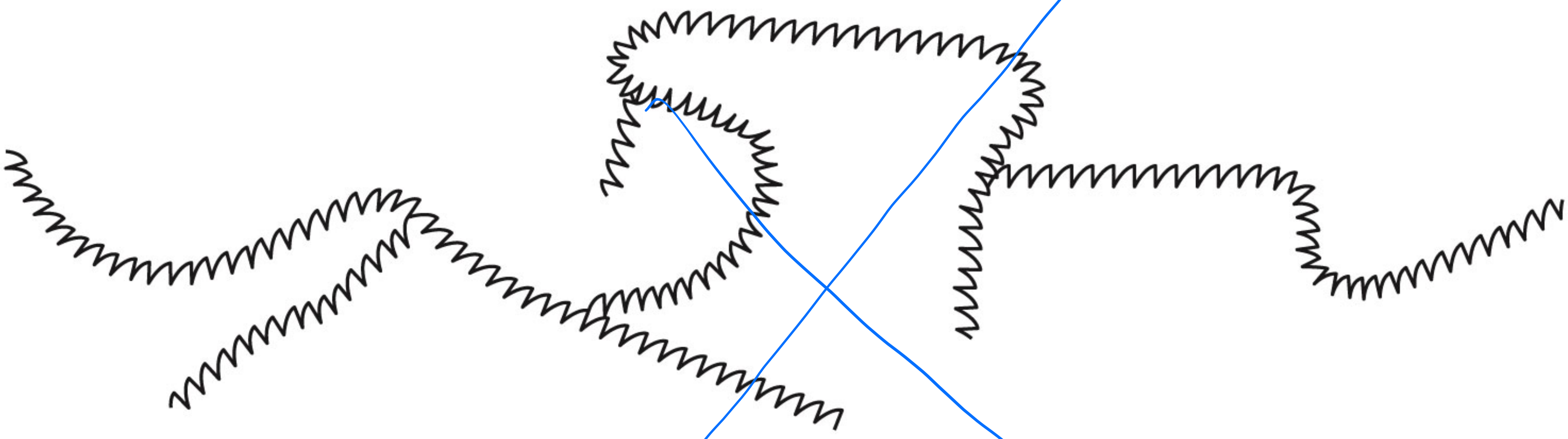
(n = several thousand)

$$\underset{\text{organic peroxide}}{R-O-O-R} \xrightarrow{\text{heat}} \underset{\text{two radicals}}{2\,R-O\cdot}$$


catalyst
radical
a carbon-centered
free radical

$$ROCH_2\dot{C}H_2 \xrightarrow{CH_2=CH_2} ROCH_2CH_2CH_2\dot{C}H_2 \xrightarrow{CH_2=CH_2} ROCH_2CH_2CH_2CH_2CH_2\dot{C}H_2$$ and so on





branched polyethylene

Oxidation with permanganate; a Chemical Test

ويعتبر اضافة addition oxidation addition reaction

يعتبر تفاعل اضافة
ويتم ازالة π بوند واضافة مجموعة للرابطة الثنائية

purpul لونه

المركبات المتجاورة

ويعتبر oxidation لانه زاد عدد ذرات O

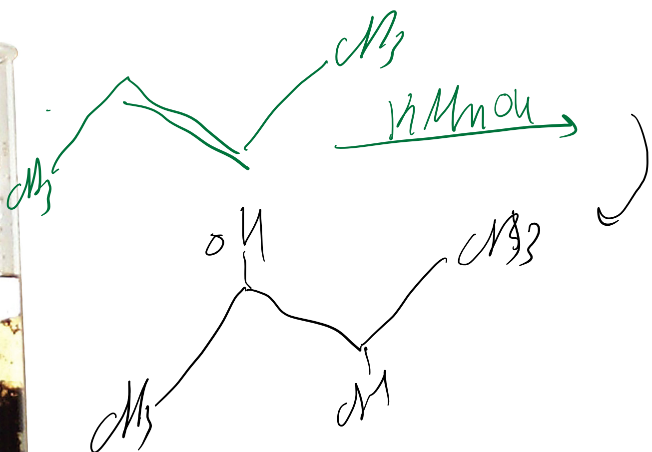
$$3\ \rangle C{=}C\langle\ + 2\,K^+MnO_4^- + 4\,H_2O \longrightarrow 3\ {-}\underset{OH}{\overset{|}{C}}{-}\underset{OH}{\overset{|}{C}}{-}\ +\ 2\,MnO_2\ +\ 2\,K^+OH^-$$

alkene	potassium permanganate (purple)	a glycol	manganese ~~dioxide~~ (brown-black)

diol

1,2 diol

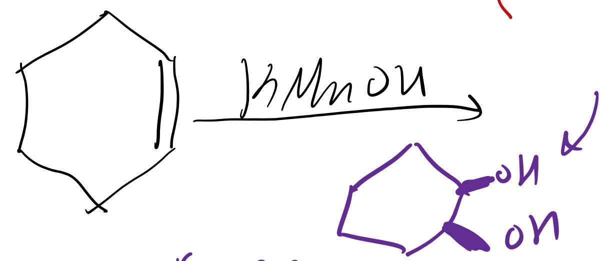
راسب بني اسود



كشف مخبري للكشف عن الالكين

0

Ozonolysis of Alkenes

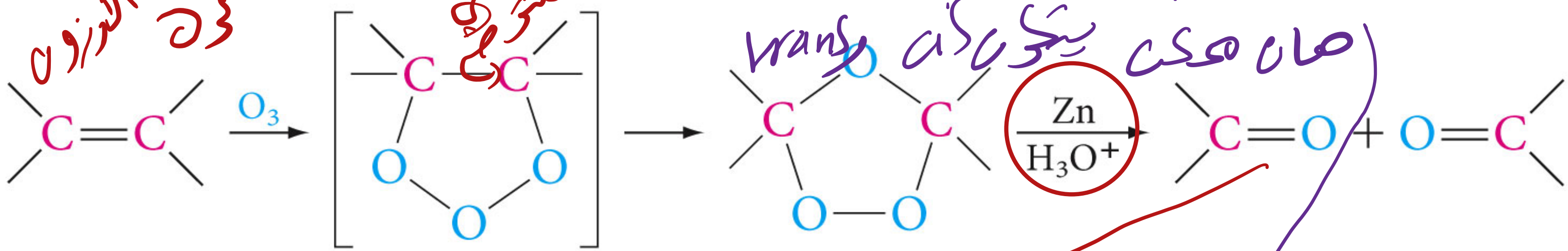


تعامل مع الاوزون
O_3

صار وسطي

trans او cis يتكون

cis صار هيك



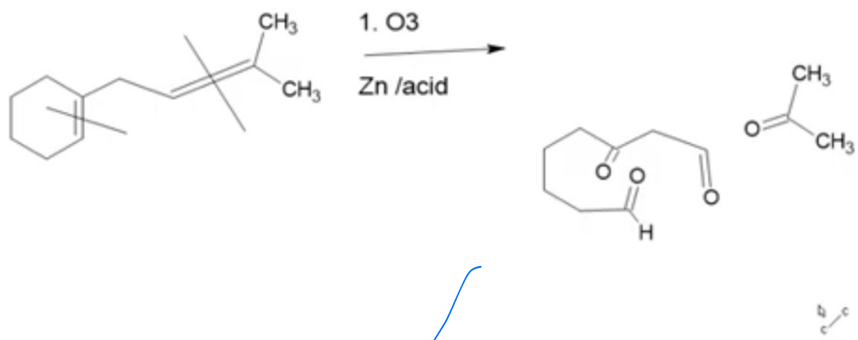
alkene | molozonide | ozonide | two carbonyl groups

انكسر ال π والسيقما وانفصلت ذرات الكربون تبعا للرابطة الثنائية كل كربون ترتبط بذرة اكسجين بجو الحمضي الحيوي

ال OH يتكون cis

cis

cyclic ال KMnO4 عملية يتكون عندي cis (trans)


CH3
CH3
1. O3
Zn /acid
CH3
O
CH3
O
O
H
O

حطه على انه دكور الدهايد او كيتون او كلاهما انه حسب على ما حوط الكربون

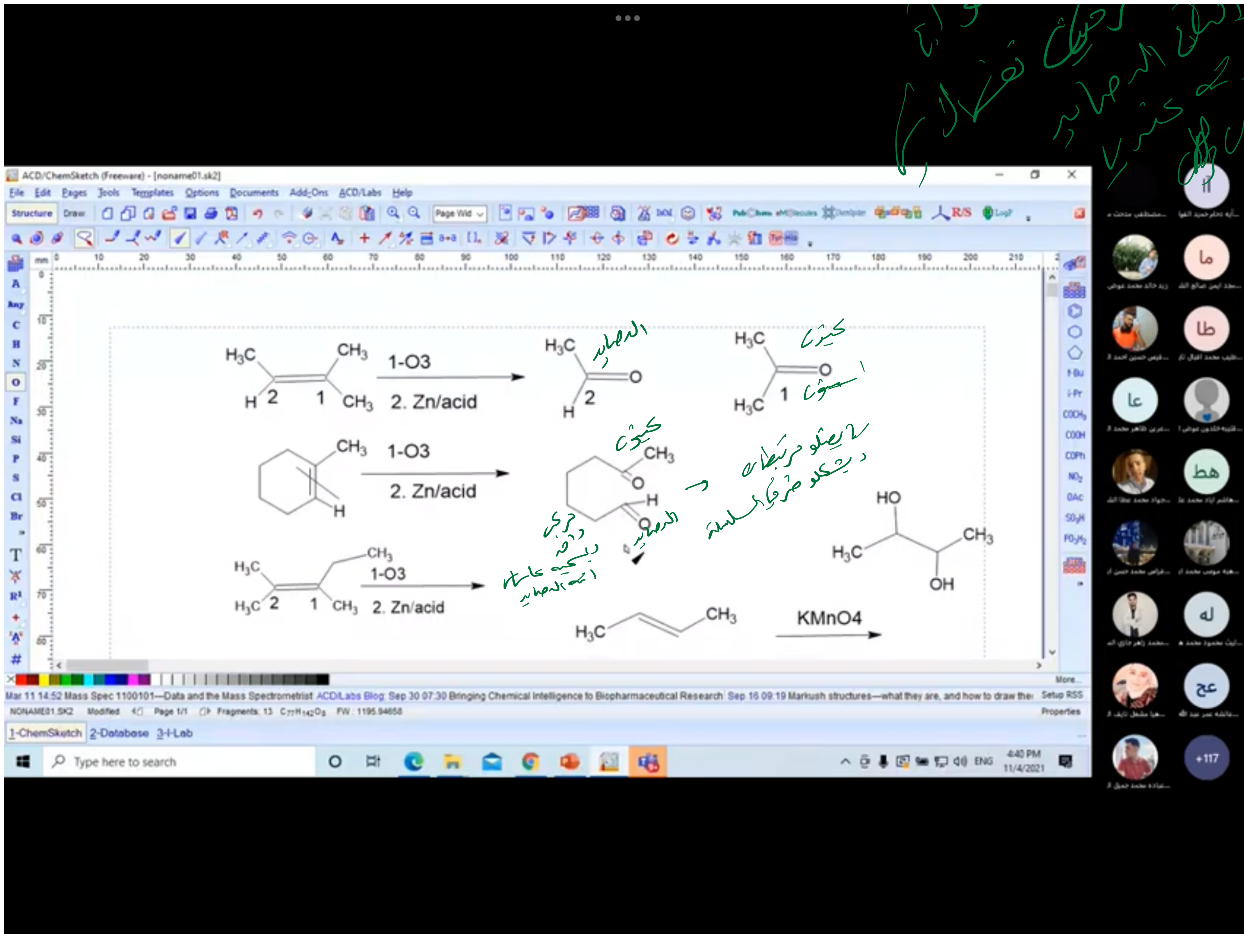
$$\underset{\text{1-butene}}{CH_2{=}CHCH_2CH_3} \xrightarrow[\text{2. Zn, } H^+]{\text{1. } O_3} \underset{\text{formaldehyde}}{CH_2{=}O} \quad \underset{\text{propanal}}{O{=}CHCH_2CH_3}$$

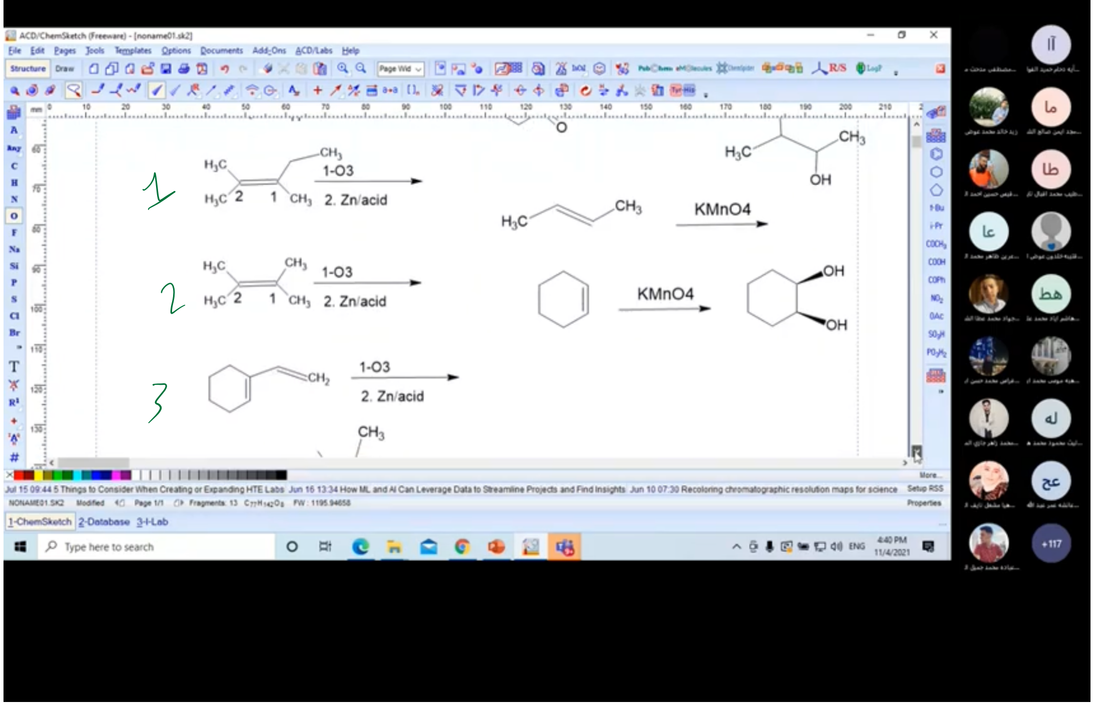
كل الرابطة الثنائية اكسر

$$\underset{\text{2-butene}}{CH_3CH{=}CHCH_3} \xrightarrow[\text{2. Zn, } H^+]{\text{1. } O_3} 2\ \underset{\text{ethanal}}{CH_3CH{=}O}$$

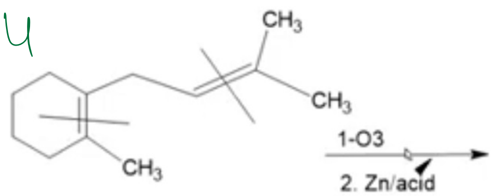
ثنتين راحو ها للسطر

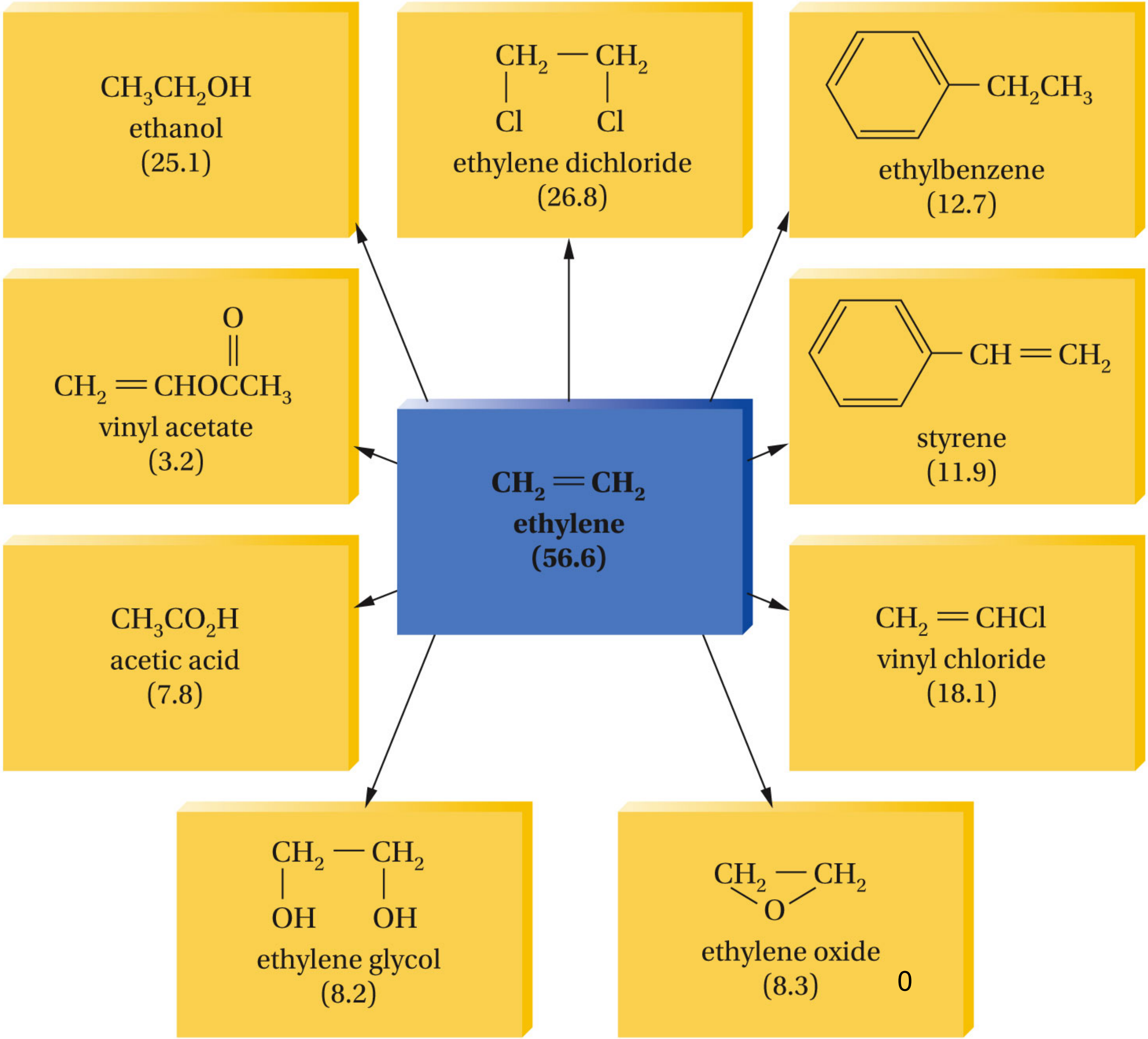
0


ACD/ChemSketch (Freeware) - [noname01.sk2]
1-O3
2. Zn/acid
KMnO4

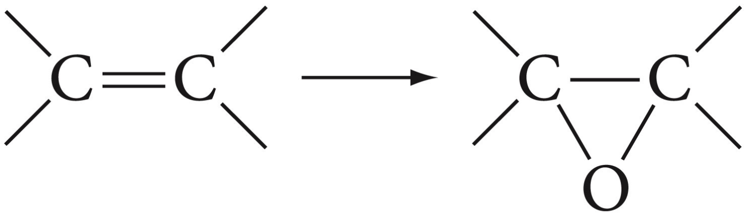

ACD/ChemSketch (Freeware) - [noname01.sk2]
1
2
3
1-O3
2. Zn/acid
KMnO4

4




CH3CH2OH
ethanol
(25.1)
CH2 — CH2
Cl Cl
ethylene dichloride
(26.8)
CH2CH3
ethylbenzene
(12.7)
O
CH2 = CHOCCH3
vinyl acetate
(3.2)
CH = CH2
styrene
(11.9)
CH2 = CH2
ethylene
(56.6)
CH3CO2H
acetic acid
(7.8)
CH2 = CHCl
vinyl chloride
(18.1)
CH2 — CH2
OH OH
ethylene glycol
(8.2)
CH2 — CH2
O
ethylene oxide
(8.3)

Other Alkene Oxidations



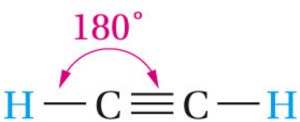
alkene　　　　　epoxide

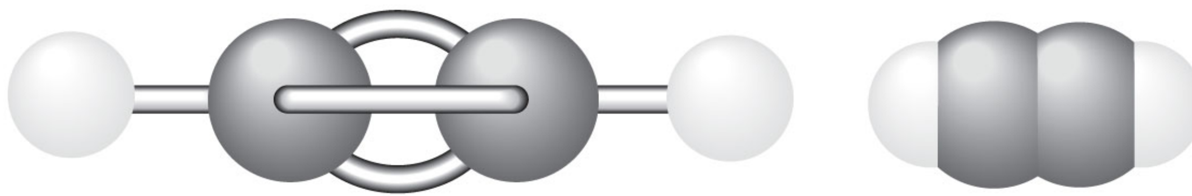
بنوضحه دلعا نوضحه

الإيثر

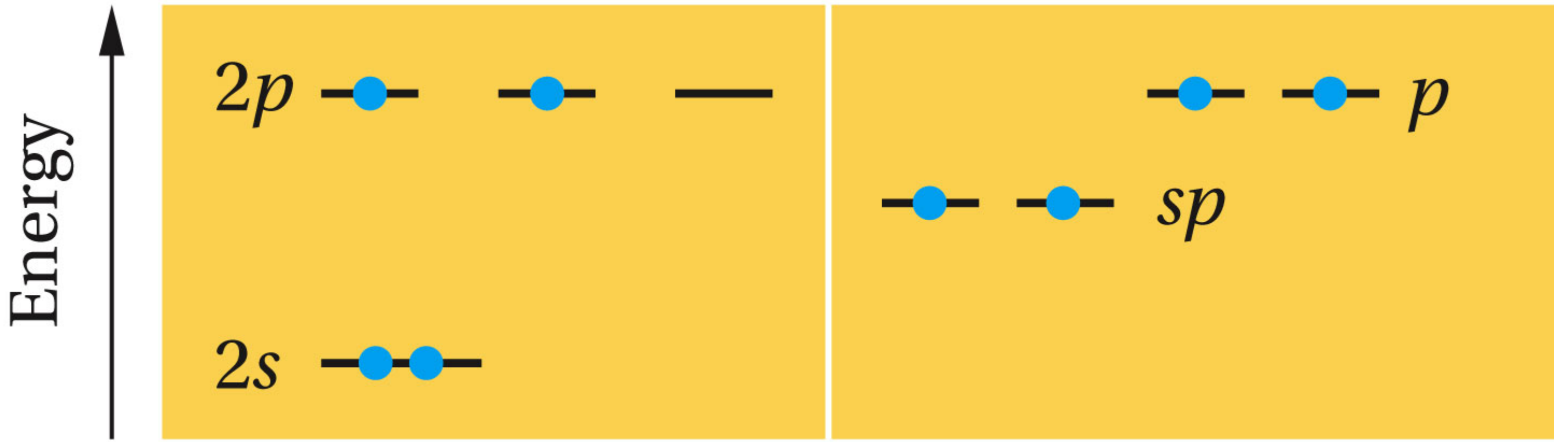
$$C_nH_{2n} + \frac{3n}{2}\,O_2 \longrightarrow n\,CO_2 + n\,H_2O$$

مش مطلوب منه



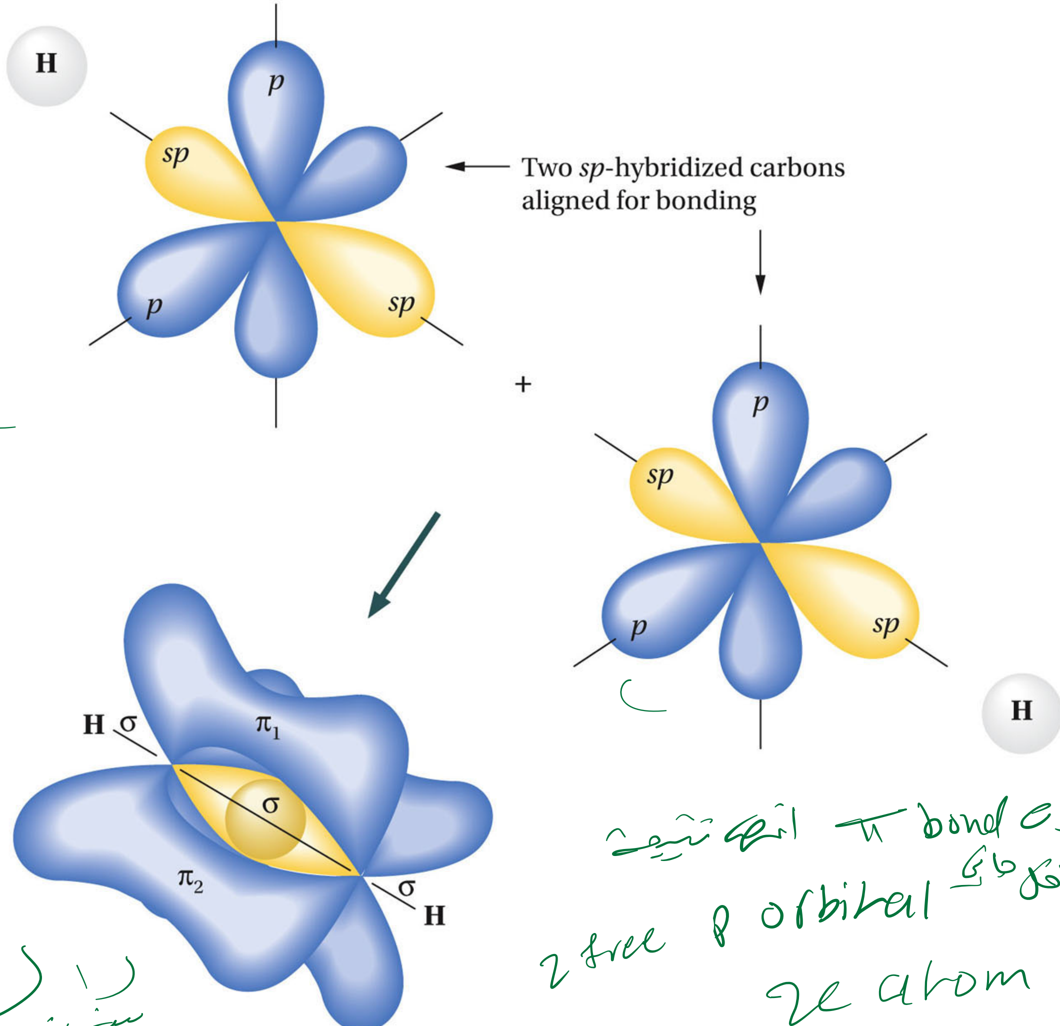


sp
linear



Atomic orbitals of carbon

The 2*s* and one 2*p* orbital are combined to form two hybrid *sp* orbitals, leaving one electron in each of two *p* orbitals.



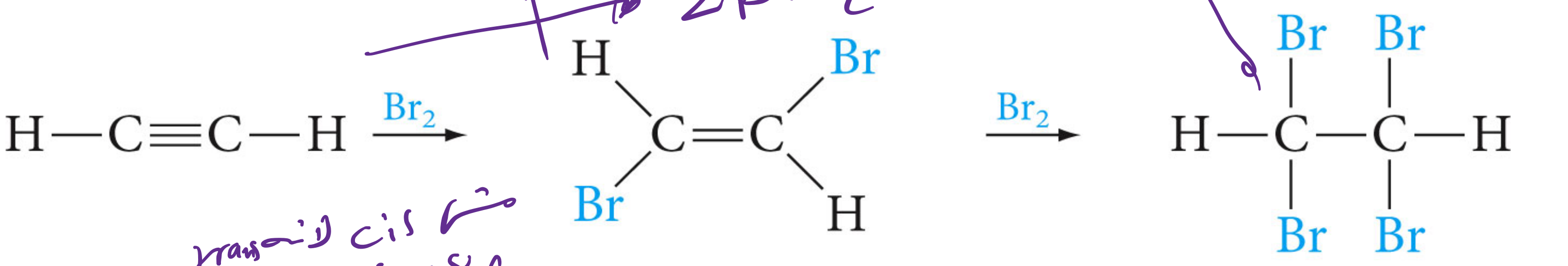
The resulting carbon–carbon triple bond, with a hydrogen atom attached to each remaining *sp* bond. (The orbitals involved in the C—H bonds are omitted for clarity.)

تكون π bond انها تشبه
تداخل جانبي 2 free p orbital
مع 2e atom
اذا كانت 2π
كل C يتضمن 2 free p orbital

اذا سمعتها تشبه تداخل بين افلاك
عجيبة sp orbital
head-head

addition of halogen

$+ 2Br_2$



ethyne   *trans*-1,2-dibromoethene   1,1,2,2-tetrabromoethane

مش cis لانو trans
بكون الو stability اكبر
بعاد عن بعض وبيصير فراغات فالتنافر اقل
بيصير واكثر استقرار

properetes → خصائصها زي الالكين تقريبا

١- درجة الغليان الها اعلى من other compound
زي الكحول والهاليد

٢- تزداد درجة الغليان بزيادة عدد ذرات C
وزيادة الوزن الجزيئي

٣- كلما زادت التفرع تقل درجة الغليان

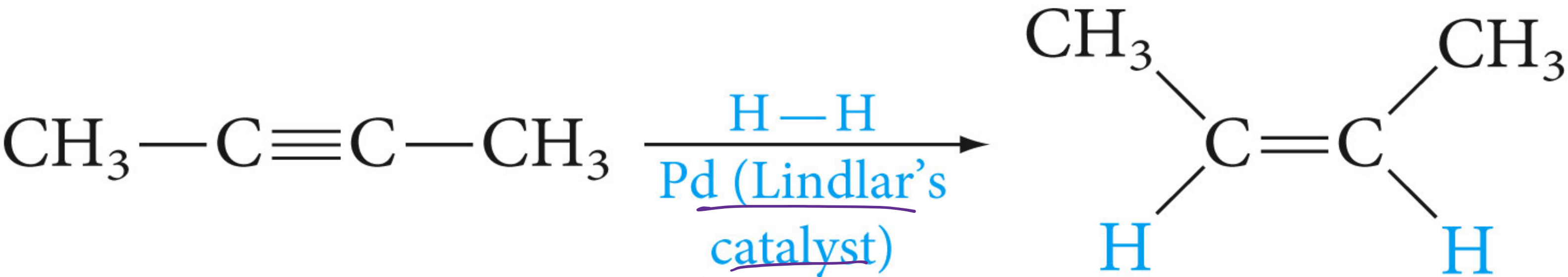
بالنسبة للنشاط الكيميائي الالكين والالكاين انشط من الالكان

تشابه في من حيث الكثافة ودرجة الغليان وغيرها

0

Table 3.3 Common Petroleum Fractions

Boiling range, °C	Name	Range of carbon atoms per molecule	Use
<20	gases	C_1 to C_4	heating, cooking, petrochemical raw material
20–200	naphtha; straight-run gasoline	C_5 to C_{12}	fuel; lighter fractions (such as petroleum ether, bp 30°C–60°C) also used as laboratory solvents
200–300	kerosene	C_{12} to C_{15}	fuel
300–400	fuel oil	C_{15} to C_{18}	heating homes, diesel fuel
>400		over C_{18}	lubricating oil, greases, paraffin waxes, asphalt



2-butyne

bp 27°C

cis-2-butene

bp 3.7°C

partial reduction

شي cis صار trans الجو بجهاز التفاعل . بوجود السائل صار

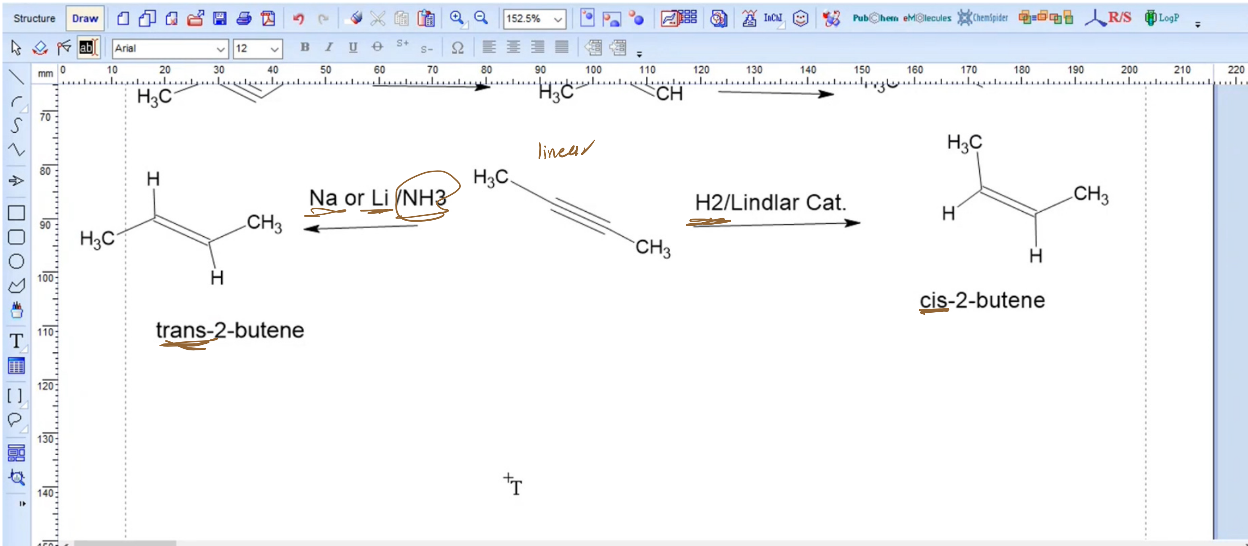
يحصل لـ trans مختلفة فلو انه يكون العامل مختلف

Condition, trans

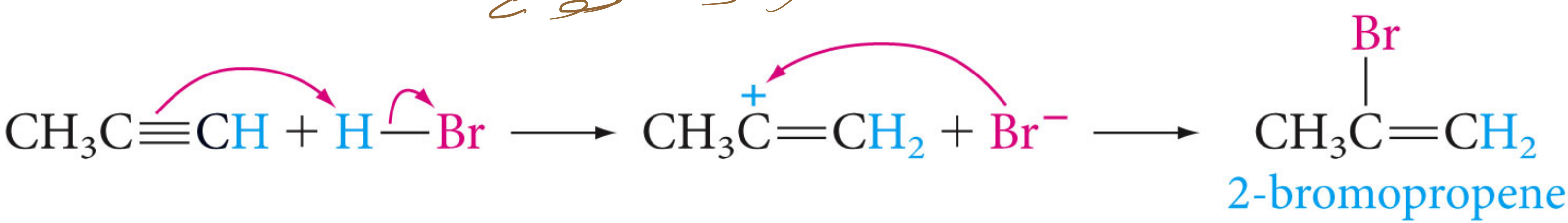
موجود

Condition حسب ال

trans و

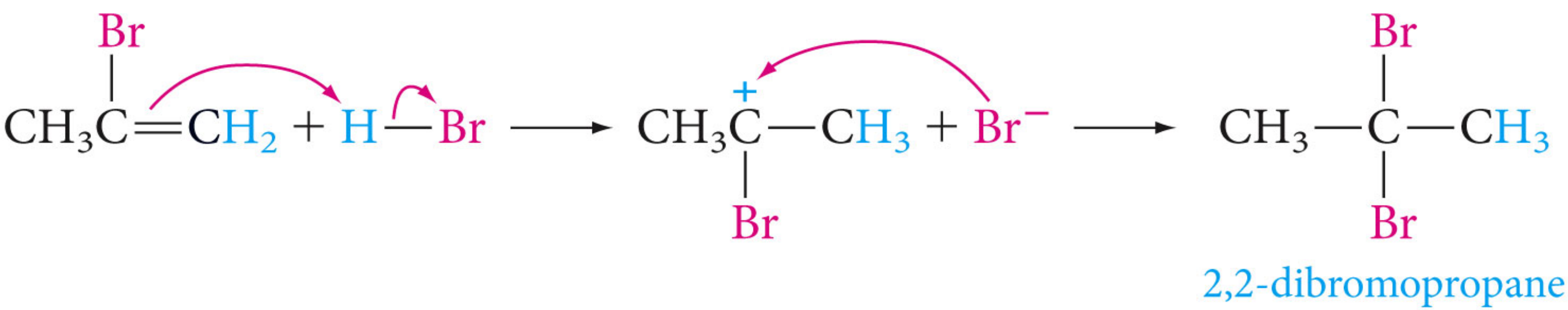

linear
Na or Li /NH3
H2/Lindlar Cat.
trans-2-butene
cis-2-butene

مارکوفنیکوف



2HBr

اضافه بر H Br



terminal alkyne → الكاربون بالأقل احد طرفي الرابطة الثلاثية مرتبطة بـ H بشكل مباشر

terminal alkyne

$$R-C\equiv C-H + Na^{+}NH_2^{-} \xrightarrow{\text{liquid } NH_3} R-C\equiv C{:}^{-}Na^{+} + NH_3$$

sodium amide

a sodium acetylide

this hydrogen is weakly acidic

weakly acidic

لكن باستخدام قاعدة قوية مثل $NaNH_2^-$ قادرة ع نزع H على شكل H^+

بتصير شحنة الـ C سالبة وبتكون استيلايد

هيك اخصص

$$R-C\equiv CH + H-OH \xrightarrow[HgSO_4]{H^+} \left[R-\overset{\overset{HO}{|}}{C}=\overset{\overset{H}{|}}{C}-H \right] \longrightarrow R-\overset{\overset{O}{\|}}{C}-CH_3$$

a vinyl alcohol, or enol

a methyl ketone

عدد الـ H ع طرفي الرابطة الثلاثية مختلف فبيتكون عندي one product of alketon

لانه الشق اللي الو الـ H الأكثر يرتبط بـ OH وبالتالي ما ...

غير قادر ع استقبال جزيء H_2O ...

ene ← الكين

ol ← الكحول

لانه بيصير اله عملية reorgnization ترتيب الروابط بتتكسر الرابطة بين H و O والكترونات الرابطة بتكون رابطة π بين C و O

التهجين ما يتكون الا شكل واحد للكيتون

وال٢ فيه ٢ شكل

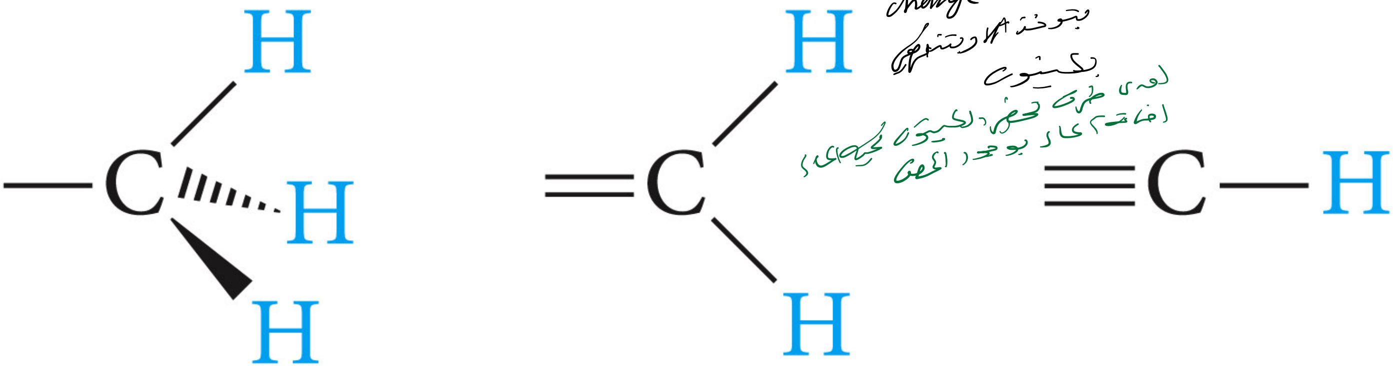
ح ر ح بتقلب وبتصير

full negative charge

بتوخذ H وبتتحول بكيتون

لهيك طرق تحضير الكيتون كثيرة

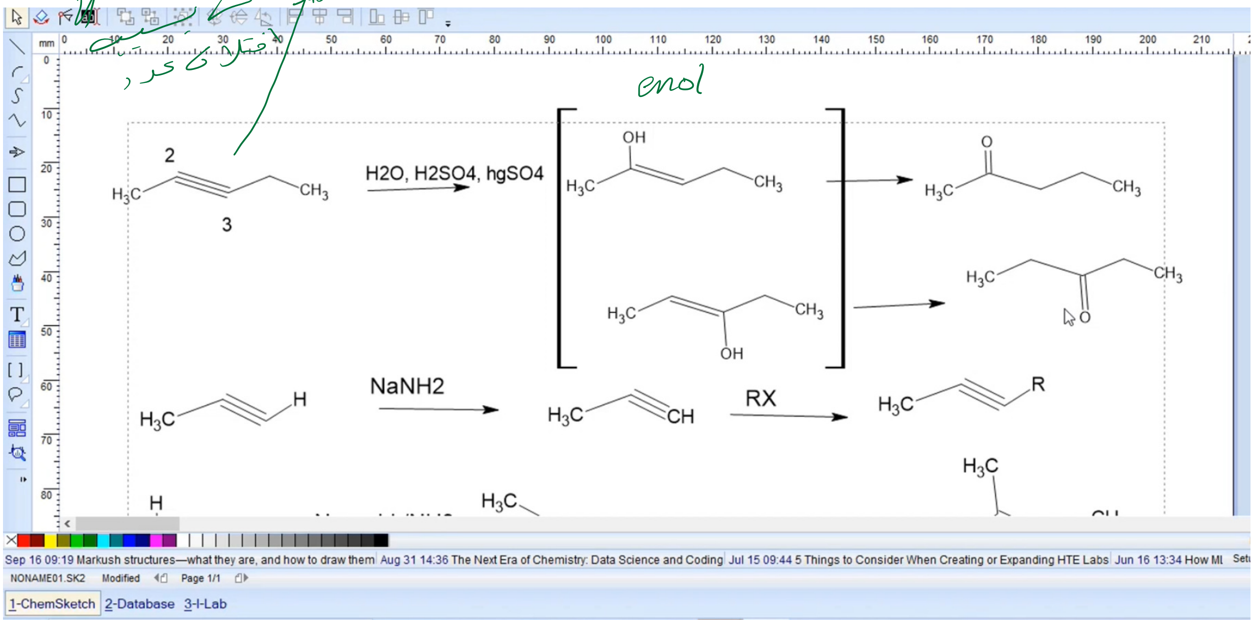
اما ال٢ ... لا يوجد الحمض



sp^3	sp^2	sp
25% *s*,	33⅓% *s*,	50% *s*,
75% *p*	66⅔% *p*	50% *p*

increasing acidity →

الالكاين unsymmetrical نتيجة نفحة اكثر
طبيعة ال substituent
بسبب اختلاف عدد

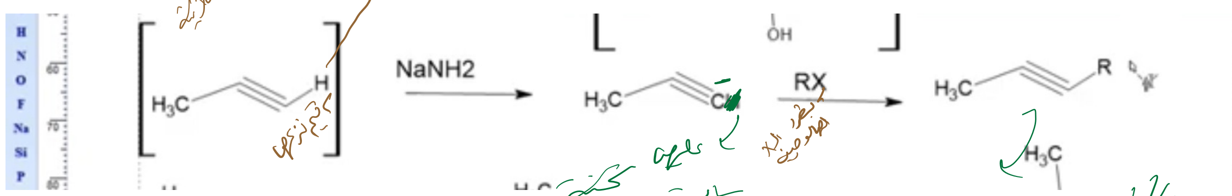


اذا كان unsymmetrical نتيجة اختلاف عدد لا ينتج كيتون واحد
واذا كان نتيجة اختلاف الطبيعة بيكون عندنا 2 كيتون

H مربوطة مباشرة بالرابطة الثلاثية

بتكون الـ acidic hydrogen

بتكون حمضي



بتحطه عليها شحنة سالبة

بنطرد الـ X الهالوجين

higher alkynes

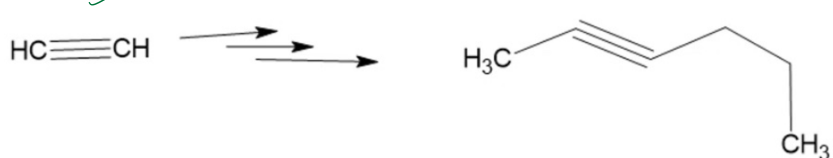
الي ازيد عدد ذرات الكربون

فيها بسلسلة الالكاين

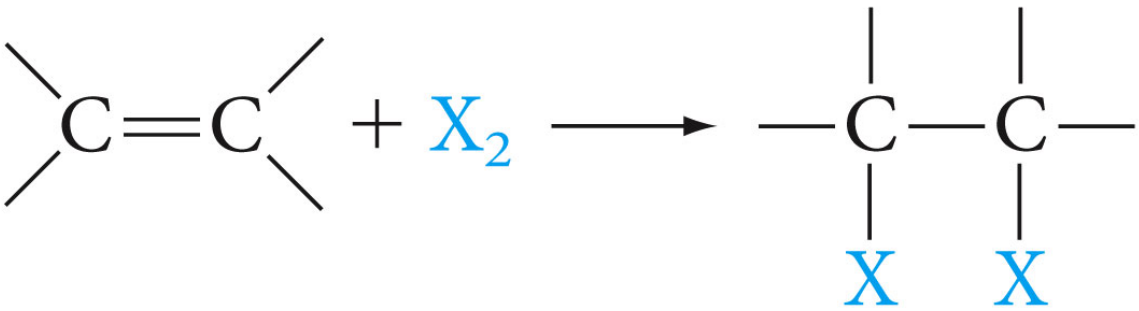
بنعمل مرتين اول مرة

بنزلة الـ H باستخدام NaNH2 وبعدها للهالوجين

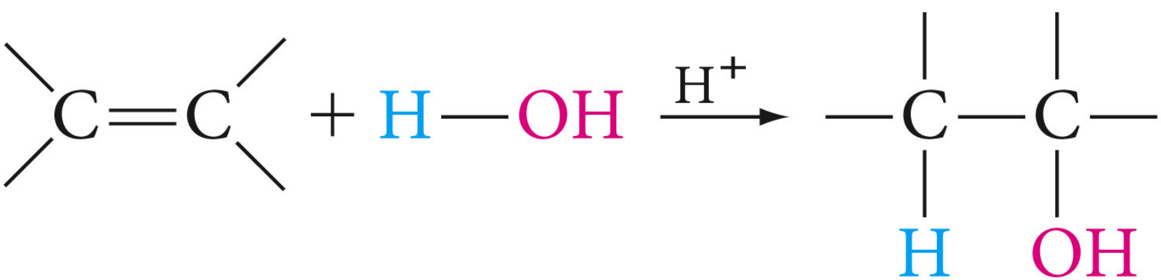
n-propen وباخذ الفرع وبضيف الـ الكحول

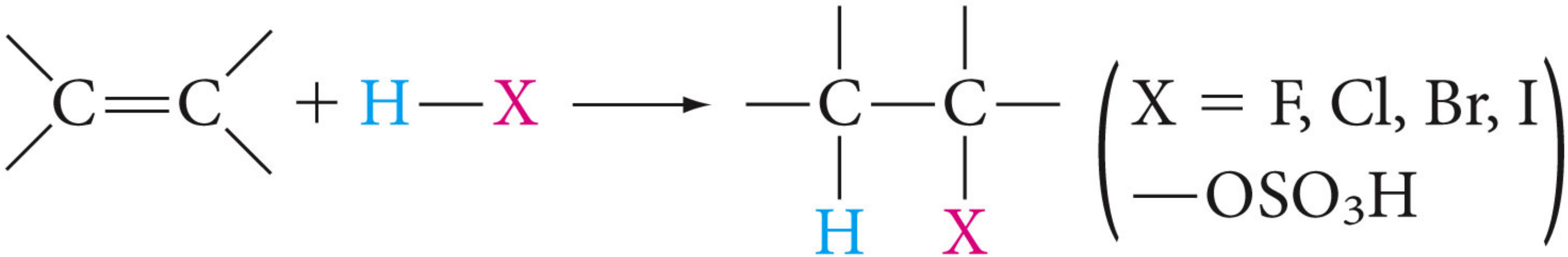


REACTIONS SUMMARY

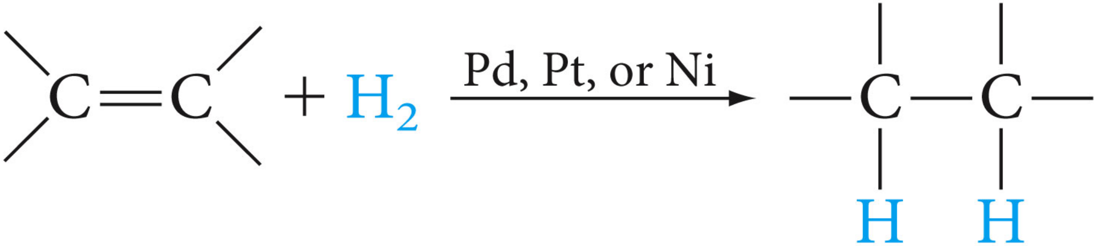


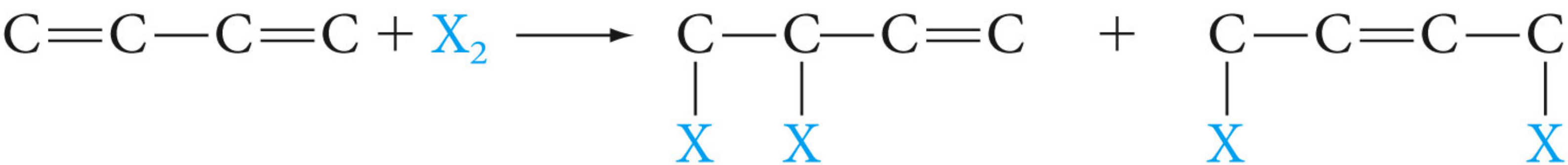
(X = Cl, Br)



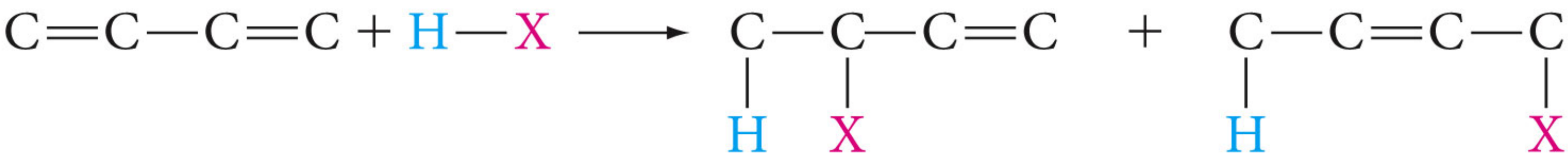


$$3\ \mathrm{RCH{=}CH_2} \xrightarrow{\mathrm{BH_3}} \mathrm{(RCH_2CH_2)_3B} \xrightarrow[\mathrm{HO^-}]{\mathrm{H_2O_2}} 3\ \mathrm{RCH_2CH_2OH}$$

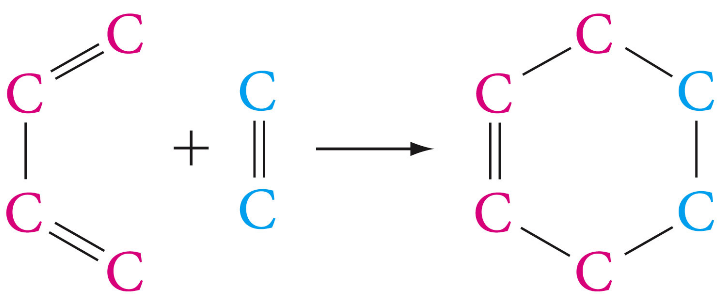




1,2-addition　　1,4-addition

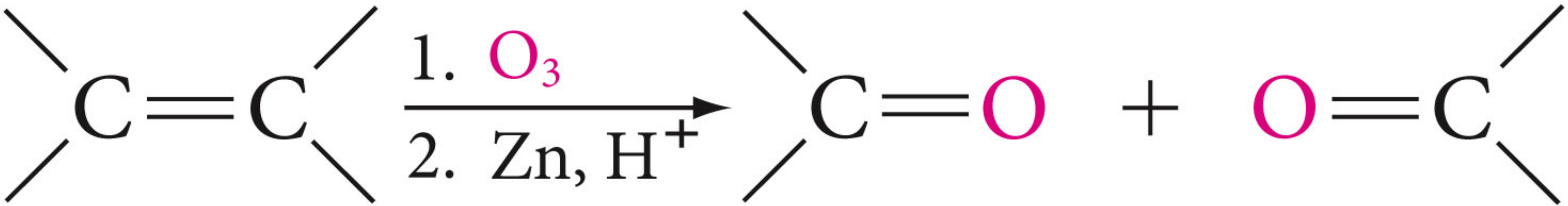


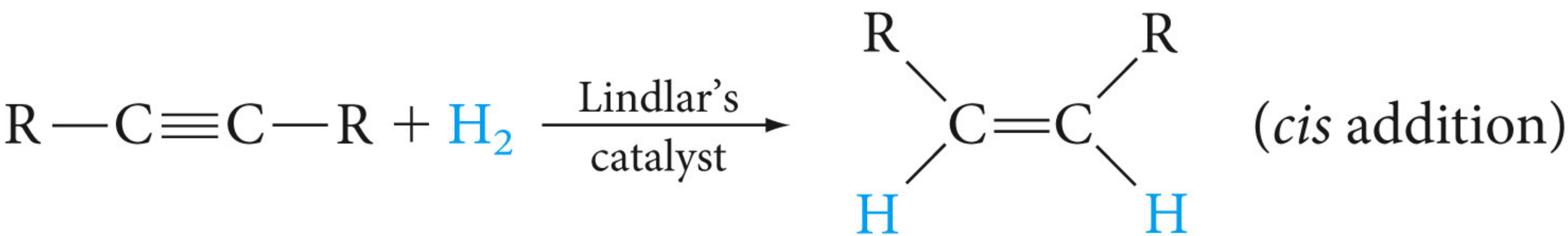
(X = Cl, Br) 1,2-addition 1,4-addition

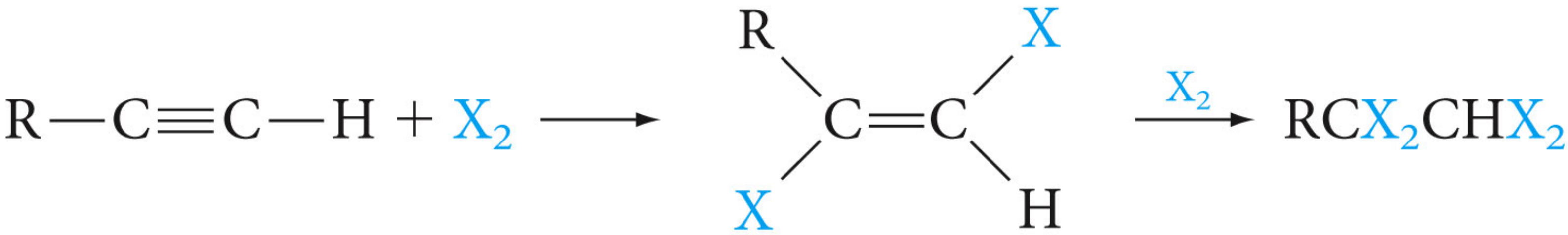


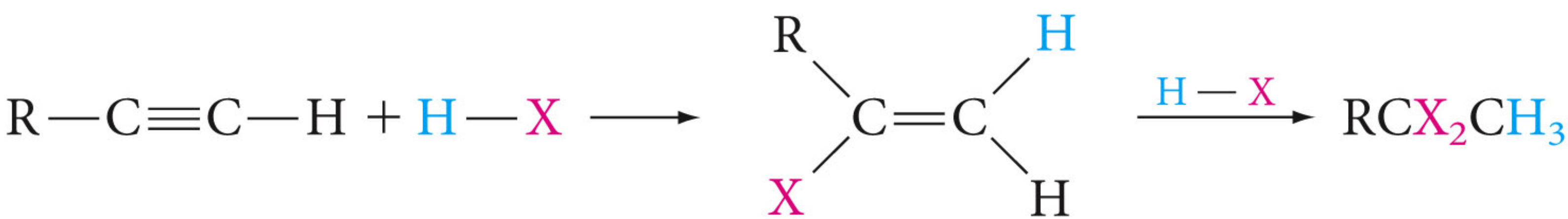
$$n\,H_2C{=}CH_2 \xrightarrow{\text{catalyst}} \left(\!-CH_2{-}CH_2-\!\right)_n$$

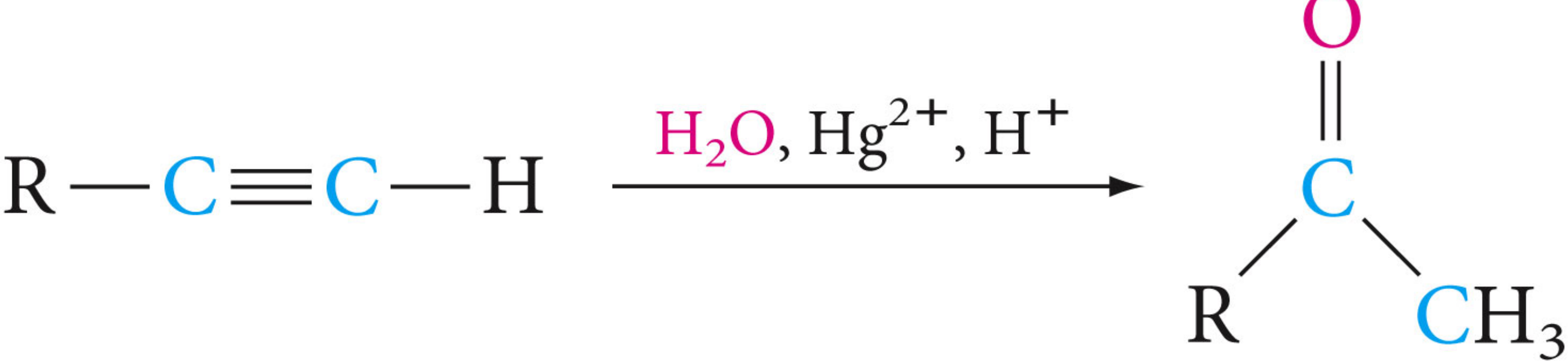
$$RCH{=}CHR \xrightarrow{KMnO_4} \begin{array}{c} RCH - CHR \\ \;|\qquad\quad| \\ OH\qquad OH \end{array} + MnO_2$$


1. O3
2. Zn, H+

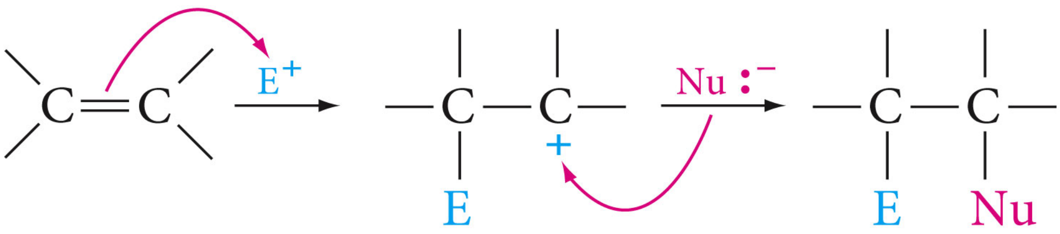

Lindlar's catalyst
(cis addition)


R—C≡C—H + X2
X2
RCX2CHX2

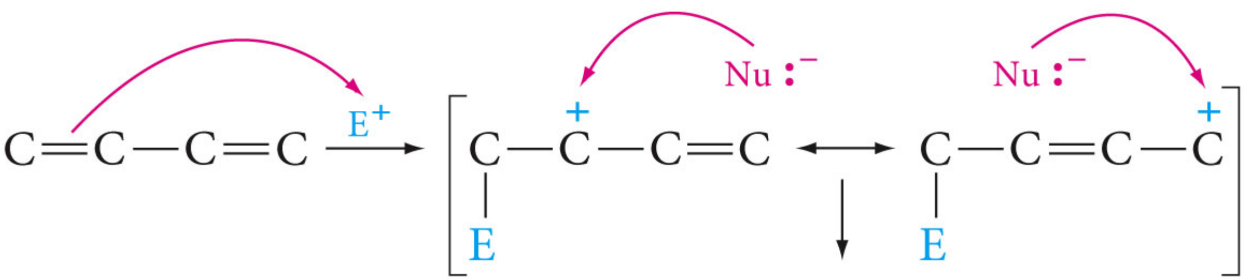

R—C≡C—H + H—X
H — X
RCX2CH3



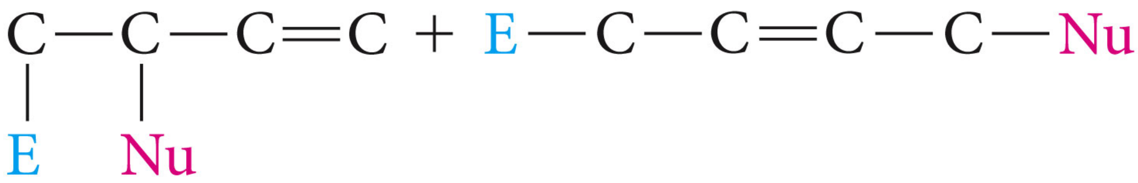
$$R-C\equiv C-H + Na^+\,NH_2^- \xrightarrow{NH_3} R-C\equiv C{:}^-\,Na^+ + NH_3$$



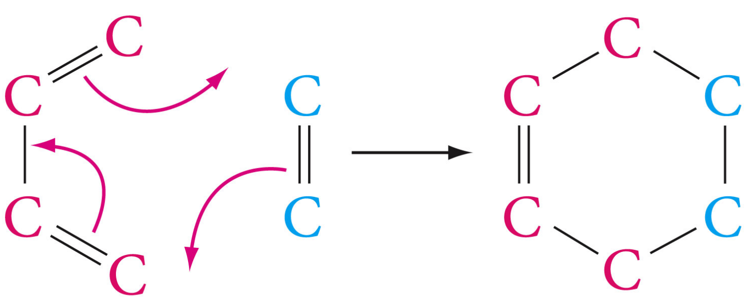
carbocation

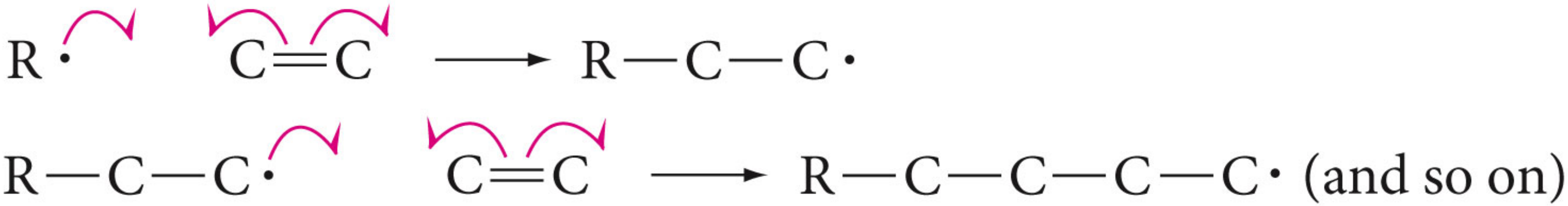


allyl carbocation



1,2-product 1,4-product




(and so on)