SECTION 5 – STRUCTURE AND REACTIVITY OF ALKENES

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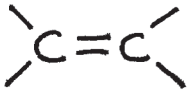
Section 5 = Structure and Reactivity of Alkenes.

- Alkenes ("olefins") = hydrocarbons with one or more double-bonds (d.b.'s).



↝ 1 σ-bond and 1 π-bond

↝ double-bonds are shorter and stronger than single-bonds

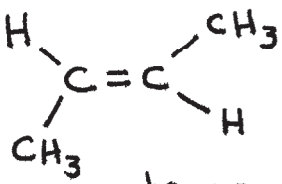
↳ lengths:

d.b. = 1.33 Å
s.b. = 1.54 Å

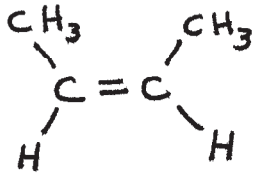
(1 Å = 1×10^{-10} m)

- Strength of a C=C d.b. ⇒ 145-150 kcal/mol (σ and π combined) vs. 80-85 kcal/mol (C-C σ-bond).

⊛ Stereoisomerism:



trans



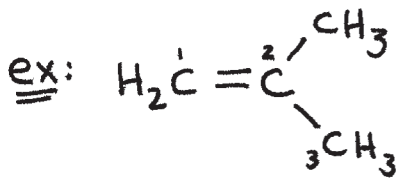
cis

} the energy-barrier (E_a) is too high at room temp. to rotate 1 end by 180°.

⊛ Nomenclature of Alkenes.

↳ name of principal (main) chains or rings contain "-ene" endings.

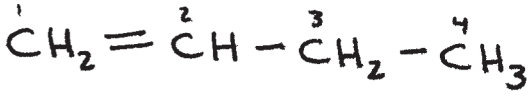
		IUPAC	COMMON NAME
ex:	$H_2C=CH_2$	ethene	ethylene
ex:	$H_2C=CH-CH_3$	propene	propylene

ex: 

IUPAC	COMMON NAME
2-methylpropene	isobutylene

⊛ 6 Rules for Naming Alkenes. ***

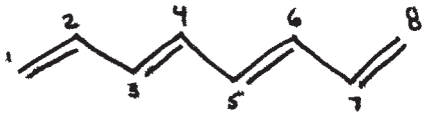
① Chains numbered from an end such that the d.b. gets the lowest locator number, specifying the first carbon of the d.b.

ex:  → **1-butene**

ex:  → **2-butene**

② If 2 or more d.b.'s are present, number the main chain so that the d.b.'s get the lowest #'s overall.

* endings (suffixes) ⇒ -diene, -triene, and -tetraene

ex:  → **1,3,7-octatriene**

(NOT: 1,5,7-octatriene)

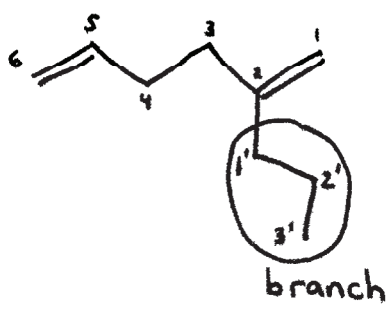
ex:  → **1,3-cyclopentadiene**

③ Branched Alkenes.

→ 1st priority: principal (main) chain is the one with the most d.b.'s. It's not simply the longest chain!

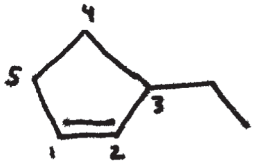
→ Tiebreaker: if 2 or more chains have the same # of d.b.'s, choose the longest chain.

ex:



→ 2-propyl-1,5-hexadiene

ex:



→ 3-ethylcyclopentene

↳ no need to specify "1" for the alkene location. It's implied.

④ Alkenal Substituents (Branches).

→ "alkenes as branches"

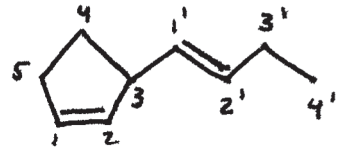
→ change "-ene" ending to "-enyl" ending

a) number the branch from its point of attachment to the main chain.

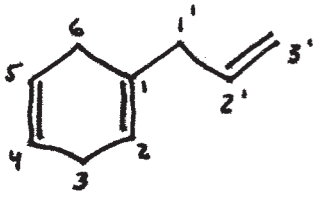
b) specify branch #'s with a locator #.

* examples on the next page...

	IUPAC	COMMON NAME
$-CH=CH_2$	- ethenyl	- vinyl
$-CH_2-CH=CH_2$	- 2-propenyl	- allyl
$-CH=CH-CH_3$	- 1-propenyl	(none)

ex: 

→ **3-(1-butenyl)cyclopentene**

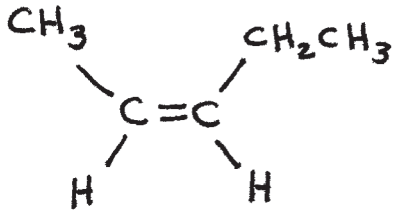
ex: 

→ **1-(2-propenyl)-1,4-cyclohexadiene**

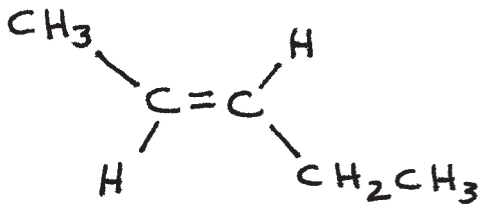
or

1-allyl-1,4-cyclohexadiene

⑤ Stereoisomerism = possible if and only if each of the d.b. C's has [2] different things attached.



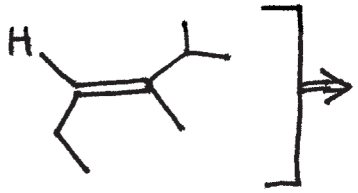
cis-2-pentene



trans-2-pentene

cis = "similar groups" on the same side.

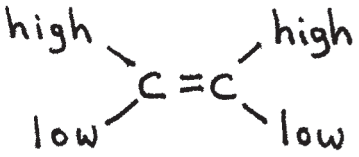
trans = "similar groups" on the opposite side.

* note: 

cis/trans unclear here, so see rule ⑥ on the next page...

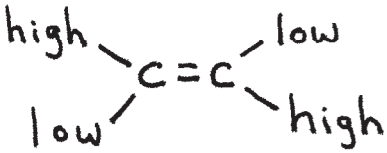
⑥ Priority System within Nomenclature.

↳ assign high and low priorities to groups or atoms attached to each double-bond (d.b.).



↝ **Z-configuration** (together)

↳ "ze zame zide"!



↝ **E-configuration** (opposite)

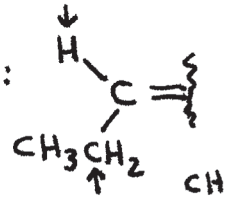
* unimportant, but: Z = zusammen, E = entgegen → German words

- highest priority substituents ⇒ atom with the highest atomic #

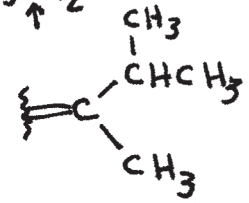
↳ (1) compare the atoms directly attached to the d.b. carbons.

1st tiebreaker ↝ (2) list atoms attached to the atoms in (1) above in order of decreasing atomic #, and compare until first point of difference

2nd tiebreaker ↝ (3) move to first atom of the list and repeat.

ex: 

↝ C higher priority than H

ex: 

↝ ① C ② (C,C,H) ⇒ this branch has highest priority

↝ C (H,H,H)

↳ zipped together on the next page...

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