Chapter 5: Structure and Preparation of Alkenes: Elimination Reactions

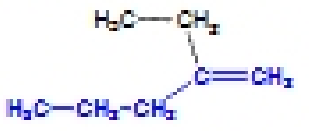
Alkenes (olefins) are hydrocarbons that contain a carbon-carbon double bond and are said to be "unsaturated."
molecular formula C_nH_{2n}

5.1: Alkene Nomenclature (please read and understand)

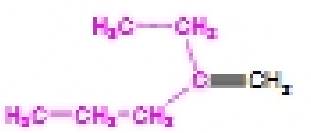
Prefix-Parent-Suffix

Suffix for alkenes: -ene
Many of the same rules for alkanes apply to alkenes

1. Name the parent hydrocarbon by locating the longest carbon chain that contains the double bond and name it according to the number of carbons with the suffix -ene.

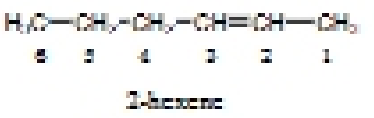


Parent = pentene



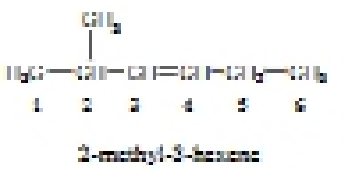
not hexene
(does not contain double bond)

2a. Number the carbons of the parent chain so the double bond carbons have the lowest possible numbers. Indicate the double bond by the number of the first alkene carbon.



2-hexene

b. If the double bond is equidistant from each end, number so the first substituent has the lowest number.



3-methyl-3-hexene

3. Write out the full name, numbering the substituents according to their position in the chain and list them in alphabetical order.

4. If more than one double bond is present, indicate their position by using the number of the first carbon of each double bond and use the suffix -diene (for 2 double bonds), -triene (for 3 double bonds), -tetraene (for 4 double bonds), etc.

1,4-pentadiene

1,3-pentadiene

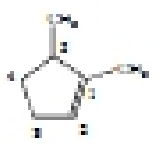
5a. Cycloalkenes are named in a similar way. Number the cycloalkene so the double bond carbons get numbers 1 and 2, and the first substituent is the lowest possible number.

3-methylcyclohexene

NOT

6-methylcyclohexene

b. If there is a substituent on one of the double bond carbons, it gets number 1.

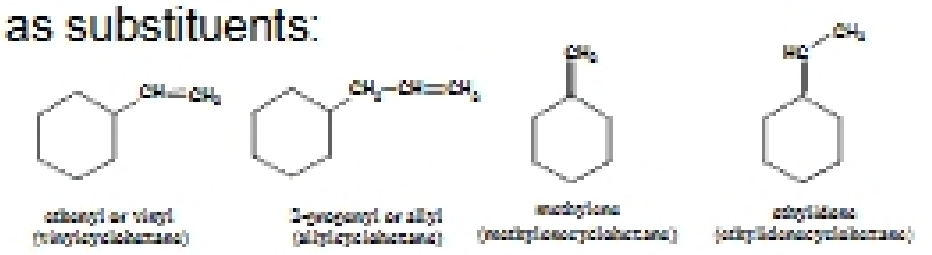


1,3-dimethylcyclopentene

NOT

2,3-dimethylcyclopentene

Alkenes as substituents:



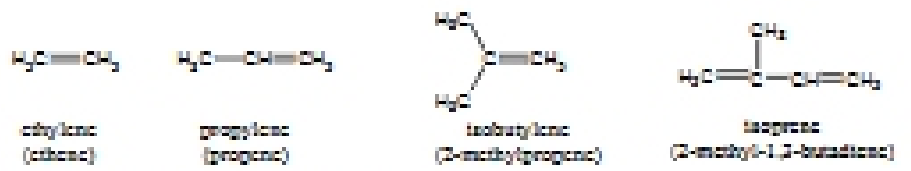
ethenyl or vinyl
(vinylcyclohexane)

2-propenyl or allyl
(allylcyclohexane)

methylene
(methylenecyclohexane)

ethylidene
(ethylidenecyclohexane)

Non-IUPAC Alkenes



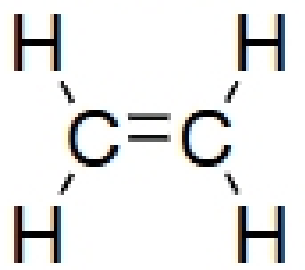
ethylene
(ethene)

propylene
(propene)

isobutylene
(2-methylpropene)

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

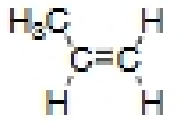
5.2: Structure and Bonding in Alkenes



bond angles:
- H-C-H = 117°
- H-C-C = 121°

bond distances:
- C-H = 110 pm
- C=C= 134 pm

Each carbon is sp^2 hybridized – trigonal planar geometry
C=C bond consists of one σ–bond (sp^2 hybridized orbitals)
and one π–bond (unhybridized p-orbitals) (see ch. 2 notes)



propene

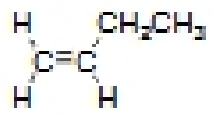
5.3: Isomerism in Alkenes

Isomers are different compounds that have the same molecular formula.

Constitutional (structural) : different connectivity

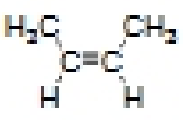
Stereoisomers: same connectivity, but different spatial arrangement of atoms or groups.

C_4H_8: four isomeric butenes

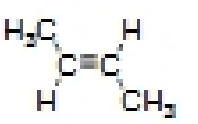


1-butene

2-methylpropene



cis-2-butene



trans-2-butene

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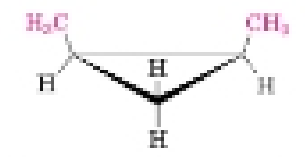
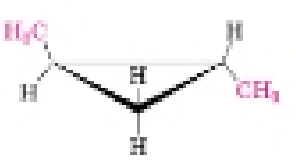
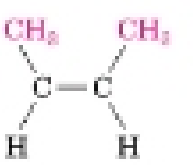
Alkenes Stereoisomers - recall cycloalkane stereoisomers: substituents are either on the same side of the ring (cis) or on opposite sides (trans).



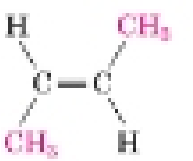
cis-1,2-Dimethylcyclopropane



trans-1,2-Dimethylcyclopropane



cis-2-Butene



trans-2-Butene

Substituents on an alkene can also be either cis (on the same side of the double bond) or trans (on opposite sides of the double bond. Cis/trans isomers of alkenes are stereoisomers- they have the same connectivity but different three-dimensional arrangements of groups

Interconversion of alkene stereoisomers does not normally occur - requires breaking the π-bond.

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