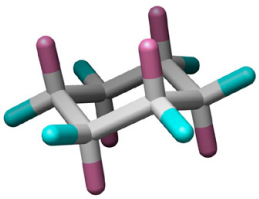


Chem 341 • Organic Chemistry I

Lecture Summary 14 • September 26, 2007

Chapter 6 - Alkenes: Structure and Reactivity

Alkenes

Alkenes are a compounds that contain double bonds. The general formula for an alkene with one double bond is: C_nH_{2n} because you would have to lose two H's from an alkane to form the pi-bond. This is the same general formula as found in cycloalkanes.

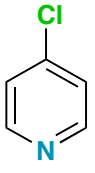
Small alkenes are industrially important. Ethene and Propene are multibillion dollar industries - mostly for the polymer/plastics industry. These small alkenes are produced by high temperature cracking of petroleum-derived alkanes.

Unsaturation

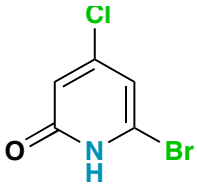
We use the term saturated to refer to an organic molecule that has all single bonds and as many H's as can be attached. Thus, if there are less H's, such as with pi-bonds or cyclic structures, we call these unsaturated molecules. It is useful to see how much unsaturation there is in a molecule - especially if you are trying to figure out the structure of an unknown compound. Simply stated, the Degrees of Unsaturation is the number of pi-bonds or rings present in a molecule. You can figure out the number of unsaturations there are by examining the number of H's you would expect if the molecule were completely saturated and comparing that with the number of H's that actually exist in your molecule. The formula is shown below. Note that we need to add to the number that actually exists for every halogen in the molecule because these monovalent atoms will replace an H in the molecular formula. Nitrogens, being trivalent, will add an additional H to the formula, so we need to subtract one for every N. Oxygens do not affect the number of H's in a formula, so they do not need to be considered at all.

$$DU = \frac{\left(\text{Number of H's if saturated}\right) - \left(\text{Number of H's that are present}\right)}{2}$$

$$DU = \frac{\left(2n+2\right) - \#H - \#X + \#N}{2}$$



$$DU = \frac{12 - (4 - 1 + 1)}{2} = 4$$



$$DU = \frac{12 - (3 - 2 + 1)}{2} = 4$$

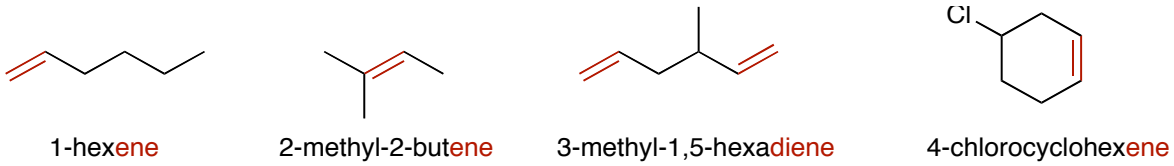
Nomenclature

Alkene naming adds a few twists to what we already know of the IUPAC systematic naming.

1) Find the longest chain containing the double bonds (or multiple double bonds). Alkenes get priority over other substituents

2) Number the chain from the end nearest the double bond. Double bonds, again, get priority. Only after that do you consider other substituents and give them the lowest number possible.

3) Name the molecule using -ene as the suffix to replace the -ane. If necessary, number the double bond with the carbon it starts with (lowest number end). If there are more than one double bonds in a molecule, number each one and add -diene, -triene, etc. to the suffix. Cyclic alkenes are similar starting with number 1 being one end of a double bond. Number the ring toward the closest substituent.



1-hexene | 2-methyl-2-butene | 3-methyl-1,5-hexadiene | 4-chlorocyclohexene

There are some common names associated with substituents containing a double bond. A vinyl group is a two carbon alkene attached to a larger molecule. Note that any H's attached to an alkene are referred to as vinylic hydrogens. An allyl group has an extra CH_2 in between the double bond and it's attachment. Allylic hydrogens are on an sp^3 carbon adjacent to a double bond.

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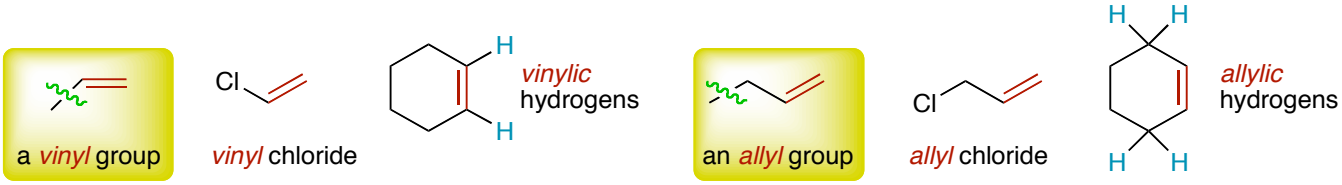
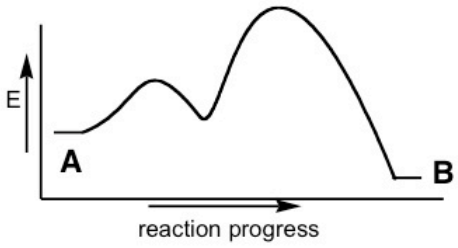


Quiz of the day

Q:	Which of the statements is true for the reaction characterized by the following reaction energy diagram?  	☐ 1:	This is a single step reaction.
		☐ 2:	ΔG° is positive.
		☐ 3:	The first step is rate determining.
		☑ 4:	There is one intermediate.