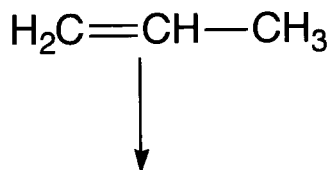
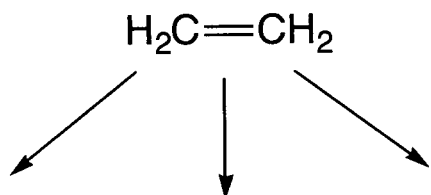


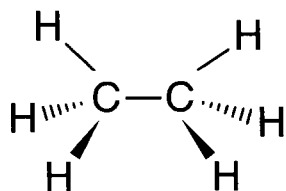
## Chapter 7: Structure and Synthesis of Alkenes (omit 7-11)

F104

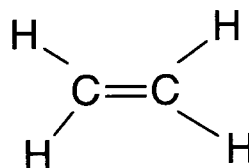
Important functional group/Important industrial compounds



Structure: compare to alkane



BDE of CC bond =  
free rotation



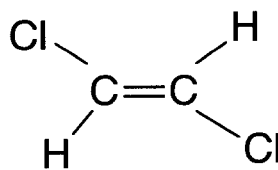
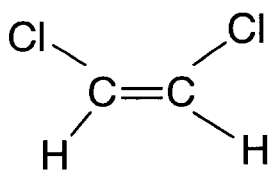
BDE of CC double bond =  
restricted rotation

BDE of  $\pi$  bond:

Physical Properties:

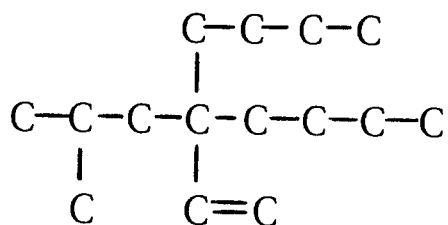
Since relatively nonpolar compounds - similar to the alkanes of corresponding molecular mass

Cis isomers generally more polar than trans isomers:

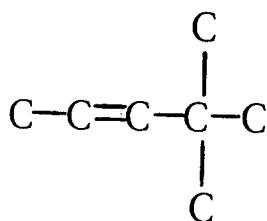


## ALKENE NOMENCLATURE

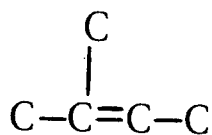
1. Parent name is longest chain that contains the double bond.  
Change "ane" to "ene".



2. Begin numbering at end nearer the double bond. (Double bond gets lowest possible number in absence of other functional groups.)

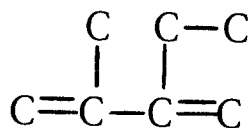


3. If double bond has same number from either end, number to give substituents lowest possible numbers. (first point of difference)

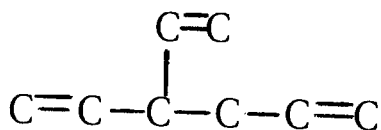


4. Write name according to previous rules. (numbers, commas, dashes, alphabetical order, etc.)

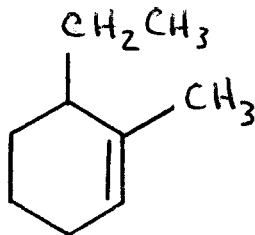
5. If more than one double bond, use prefixes di, tri, tetra, etc. : diene = 2 double bonds, triene = 3 double bonds, etc. Choose as parent name the chain that contains the most double bonds possible.



6. If it is not possible to include all double bonds in parent chain, use alkenyl name for side chain containing the double bond. Name as complex side chain as for alkanes or may use common alkenyl names on page 306 of Wade.

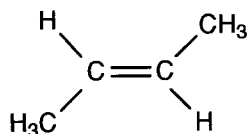
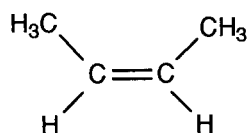


7. In cycloalkenes, the double bond is always between C1 and C2. Give substituents the lowest numbers possible. ( first point of difference - Be sure to include the double bond number in the set.) If only one double bond in ring, not necessary to include the number 1 for the double bond's location in the name.

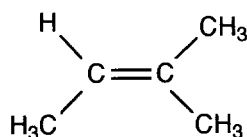
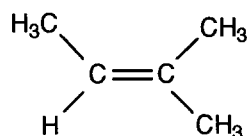


## Geometric Isomerism

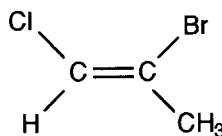
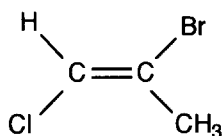
The  $\pi$  bond restricts free rotation which leads to the possibility of geometric isomers. Each isomer must have a unique name.



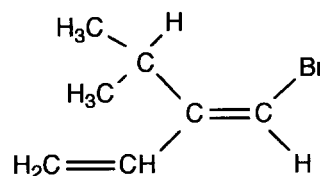
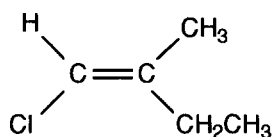
Are these geometric isomers?



### Naming tri and tetra-substituted alkenes:



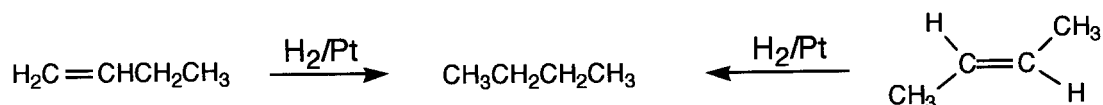
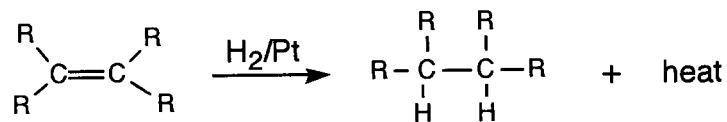
1. Assign priority to each group attached to each carbon atom of the double bond according to the Cahn-Ingold-Prelog system learned in chapter 5. (Higher atomic # gets higher priority, lower atomic # gets lower priority.)
2. Look at the positions of the two higher priority groups on each carbon atom of the double bond. If both are on the same side of the double bond, assign **Z** stereochemistry. If the groups are on opposite sides of the double bond, assign **E** stereochemistry.
3. **Remember:** if identical atoms are bonded to the carbon atoms of double bond, examine the next sets of atoms. Assign priority at the first point of difference.
4. **Remember:** groups containing double or triple bonds are assigned priority as if the groups around the bond were doubled or tripled.



## Alkene Stability

Determination of order observed in Ch. 6 (more substituted = more stable):

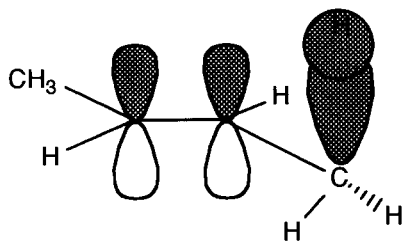
Heats of Hydrogenation - energy released in the following reaction:



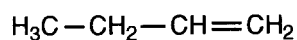
\* alkene that evolves the most heat

Explanation of order: (complex!)

1. hyperconjugation - increases the electron density of the pi bond which strengthens the bond  
- more alkyl groups = greater the hyperconjugation



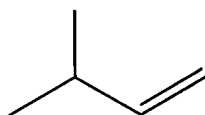
2. bond strength - greater the s character of the hybrid - stronger the bonds formed



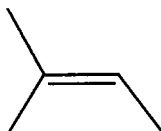
VS



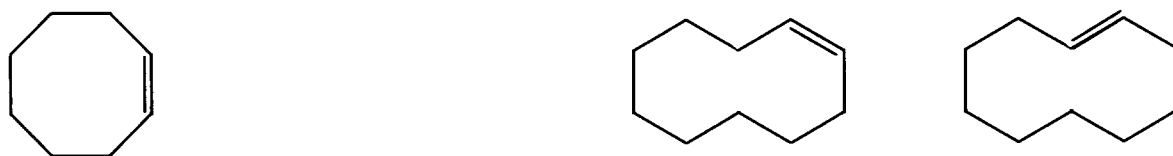
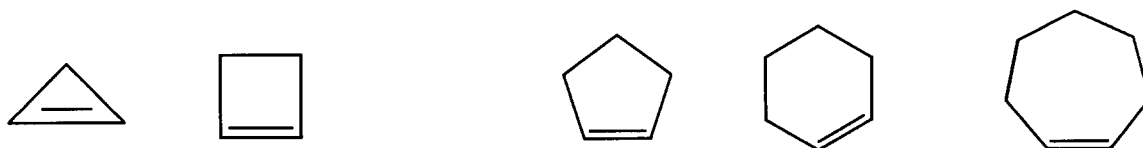
3. steric factors - more stable when alkyl groups are separated as much as possible



VS



## Cycloalkene stability

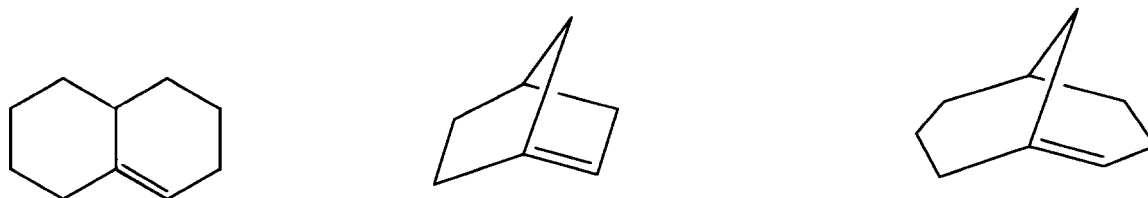


**bicyclic compound:** a compound that contains two rings

**bridged bicyclic** - each bridge must contain at least one carbon atom

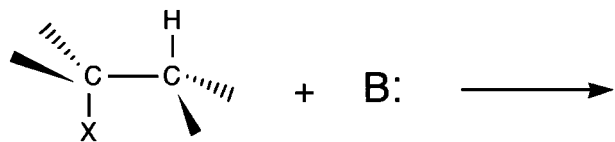


**Bredt's Rule:** A bridged bicyclic compound cannot have a double bond at a bridgehead position unless one of the rings contains at least eight carbon atoms.



## Alkene Synthesis:

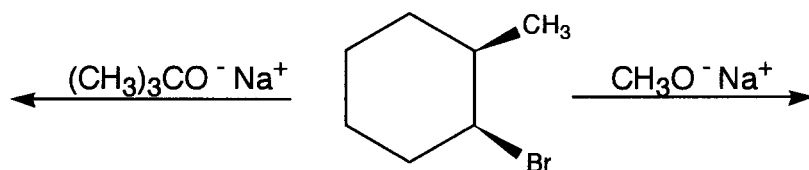
### A. Dehydrohalogenation of Alkyl Halides by E2 (Review - Ch. 6)



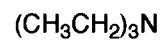
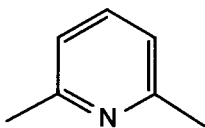
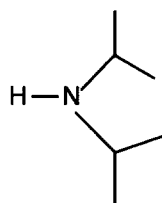
Remember:

- strong base required
- anticoplanar arrangement of X and H (trans, diaxial if cyclic)
- size of base determines the orientation of the double bond

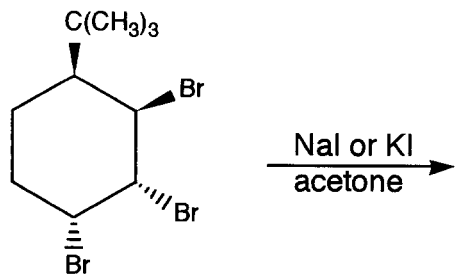
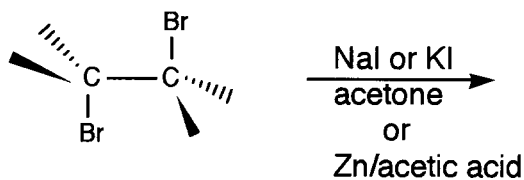
Example:



Bulky bases increase E2:



### B. Debromination of vicinal dibromides:







**Important Tips for Proposing Mechanisms:** (see pp. 303-306 for others)

1. Examine the starting materials and try to identify potential nucleophiles (electron rich) and electrophiles (electron poor).

2. Draw curved arrows to represent electron flow from nucleophile to electrophile.

3. Show one step at a time, unless certain that steps occur simultaneously such as in  $S_N2$  and E2.

4. If reaction conditions involve strong acids/strong electrophiles, avoid forming strong bases/strong nucleophiles.

NO:

OK:

5. If reaction conditions involve strong bases/strong nucleophiles, avoid forming strong acids/strong electrophiles.

NO:

OK:

6. If reaction conditions involve initiators such as peroxides or light, try a radical process.

Example:

