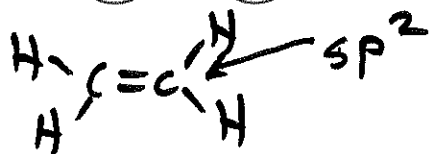
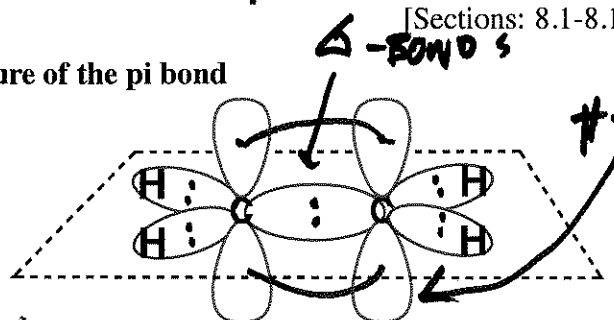


Chapter 8: Alkene Structure and Preparation via Elimination Reactions

[Sections: 8.1-8.13]

Nature of the pi bond



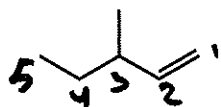
| | bond length | bond strength |
|----------------------------------|-------------|-------------------------------------|
| $\text{H}_3\text{C}-\text{CH}_3$ | 1.54 Å | 368 KJ/mol |
| $\text{H}_2\text{C}=\text{CH}_2$ | 1.34 Å | 632 KJ/mol |
| ΔH_{TT} | | 632 σ + π - 368 σ |
| | | 264 KJ/mol |

Handwritten note: Å = 10⁻¹⁰ m

- a C=C double bond is stronger than a C-C single bond
- the pi bond component, however, is generally weaker than the sigma bond component.

Nomenclature of Alkenes

- the longest continuous carbon chain containing both carbons of the C=C bond is the parent chain
- assign the C=C bond the lowest locant value
- in cyclic molecules the C=C bond is always given the 1,2-designation



3-METHYL-1-PENTENE

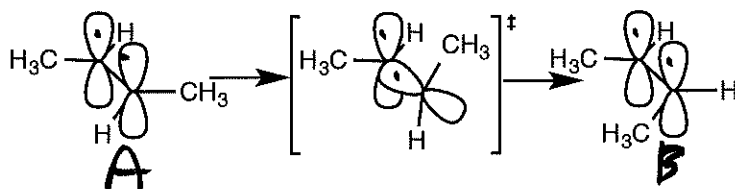
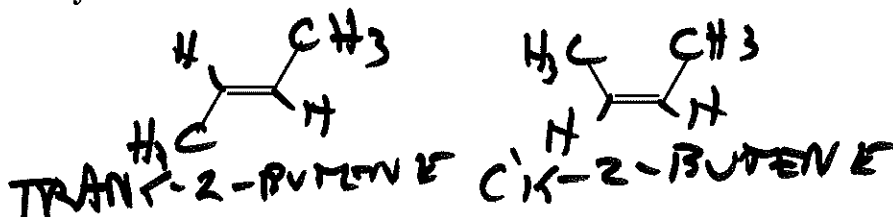


2-ETHYL-3-METHYL-1-HEXENE

3-METHYLPENT-1-ENE

1-ETHYL-5-METHYLCYCLOPENTENE

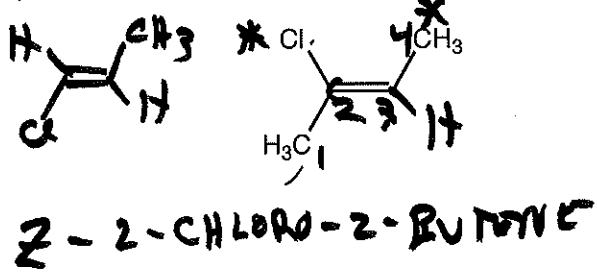
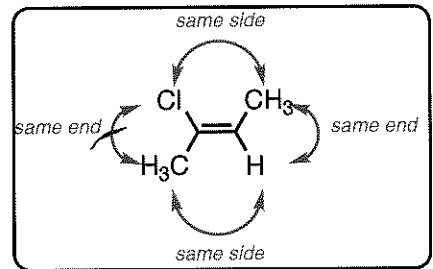
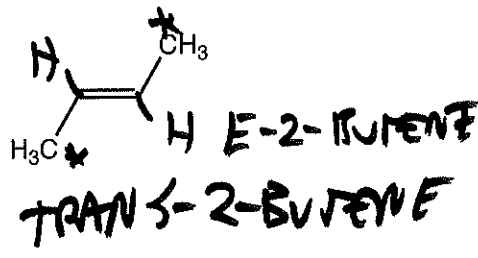
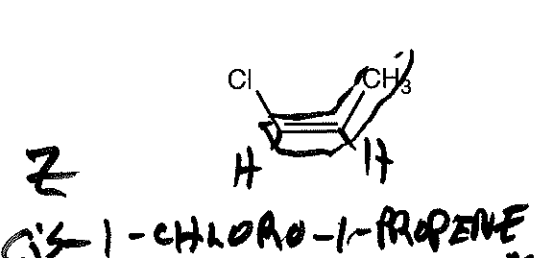
Stereochemistry of Alkenes



- unlike sigma bonds where rotation takes place readily, rotation about a pi bond would require breaking the pi bond (loss of overlap of the P-orbitals) and therefore does not take place under normal condition
- this gives rise to two different stereoisomers. Relationship?

STEREISOMERS
DIASTEREOMERS

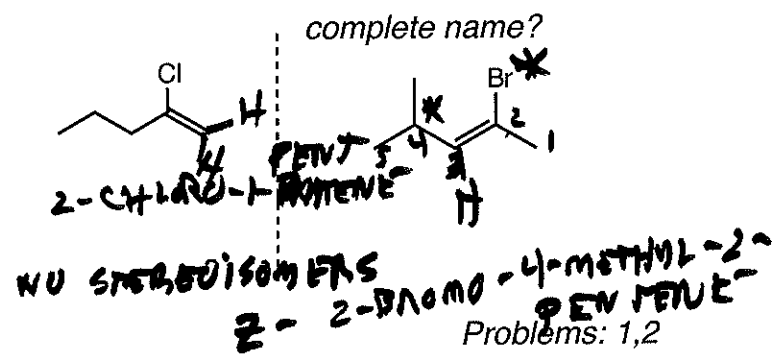
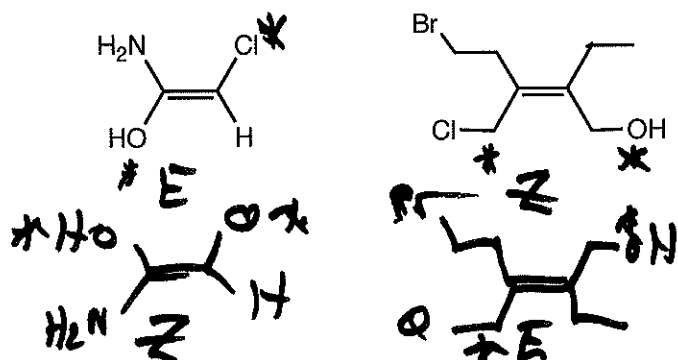
Alkene Nomenclature With More Than Two Substituents on the Double Bond



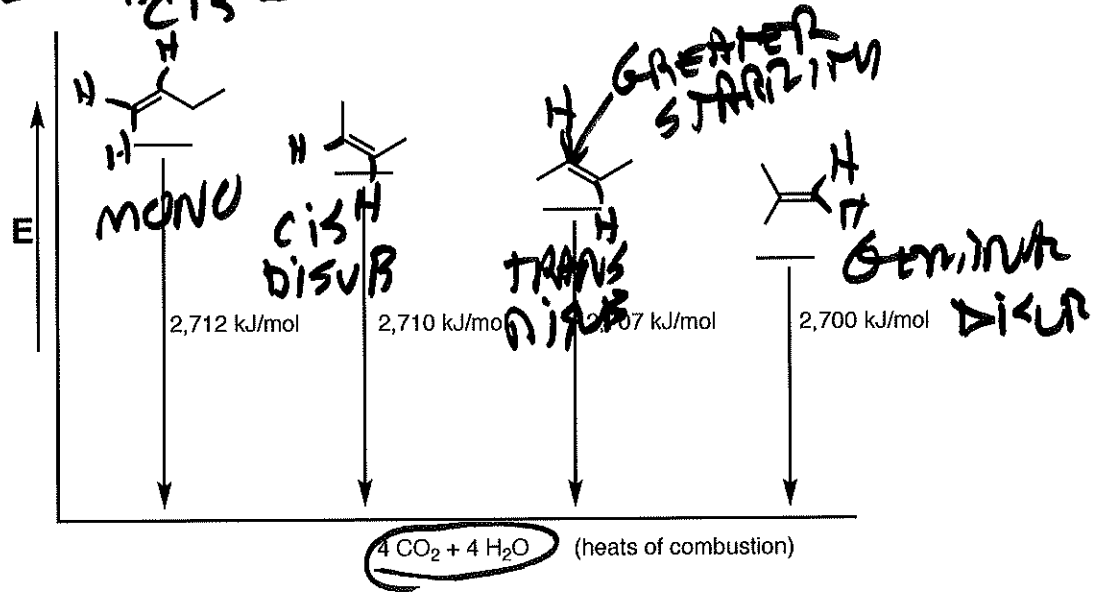
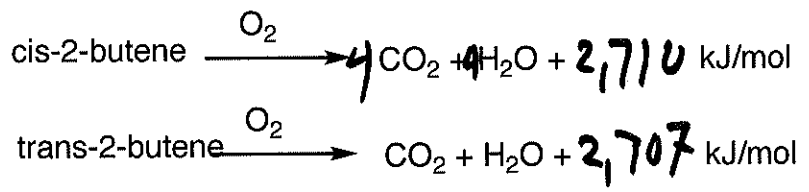
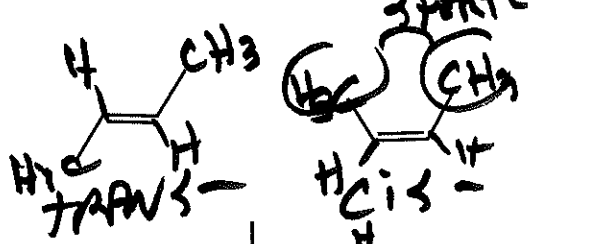
Plan of Attack for naming alkenes

- assign priority for the two substituents on one "end" of the double bond
- repeat the process for the other end of the double bond
- if the two high-priority groups are on:
 - the same side of the double bond = Z isomer
 - the opposite sides of the double bond = E isomer
- cis isomers can also be called Z isomers, trans = E

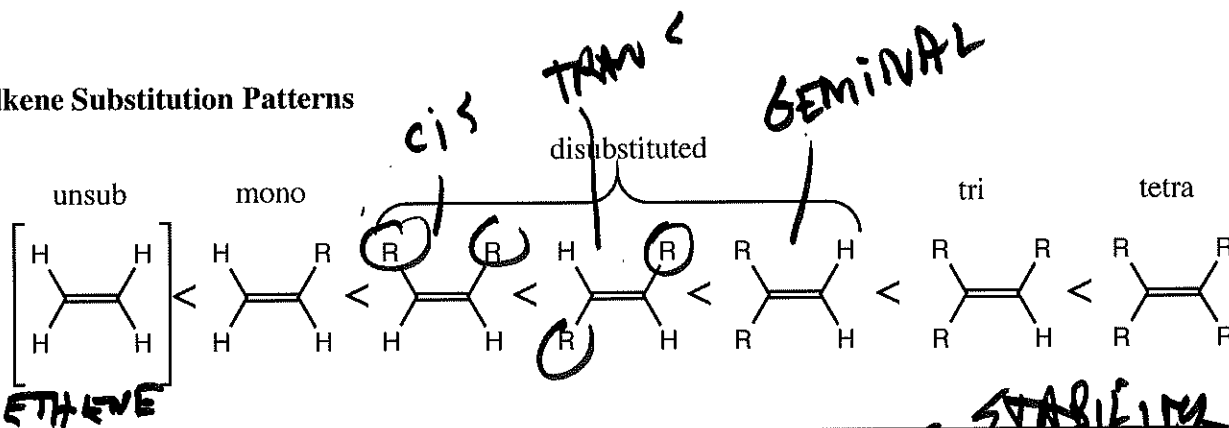
Z or E? Draw the other isomer



Relative Stability of Alkene Isomers



Alkene Substitution Patterns

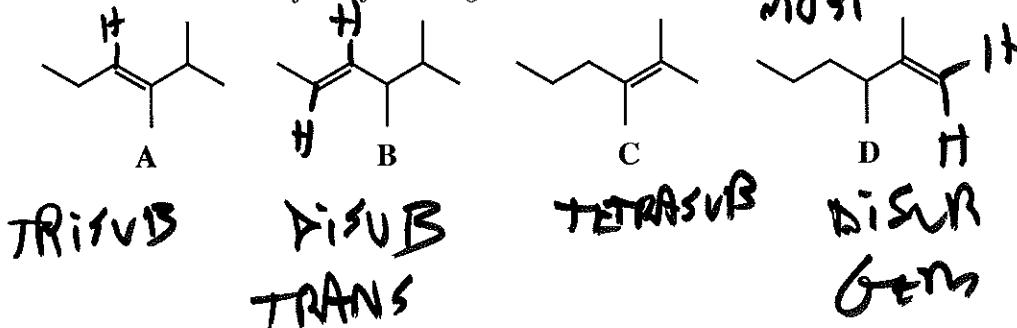


ETHYLENE

stability

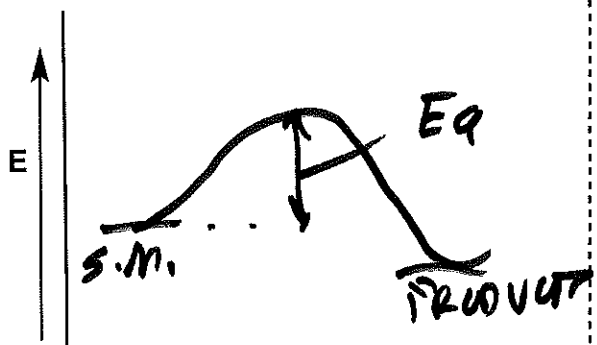
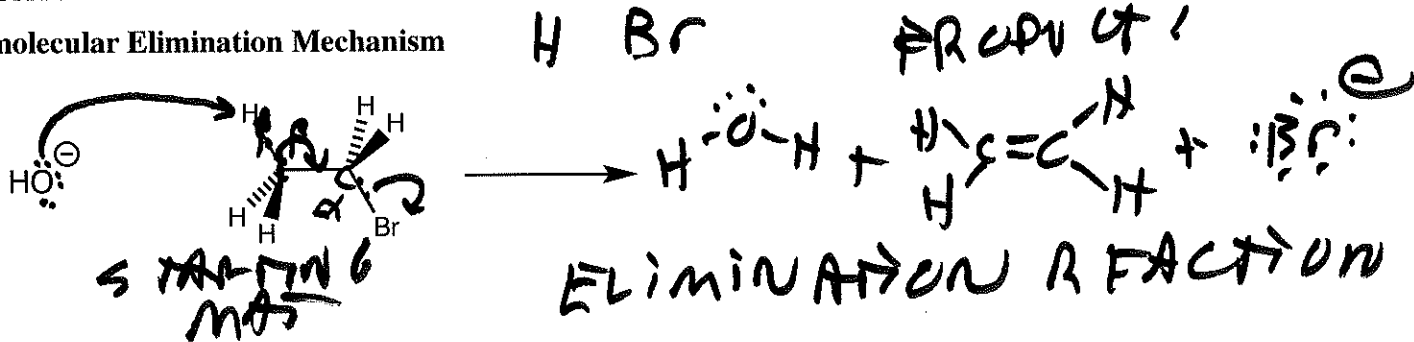
STABILITY
C > A > D > B
LEAST

Predict the relative stabilities of the following isomeric alkenes



Problems: 3, 4

Bimolecular Elimination Mechanism



- identify starting materials and products
- exothermic or endothermic?
- multistep or concerted?
- RDS = unimolecular or bimolecular?

rate law:

• dependent upon concentrations of compounds during (and prior to) the RDS

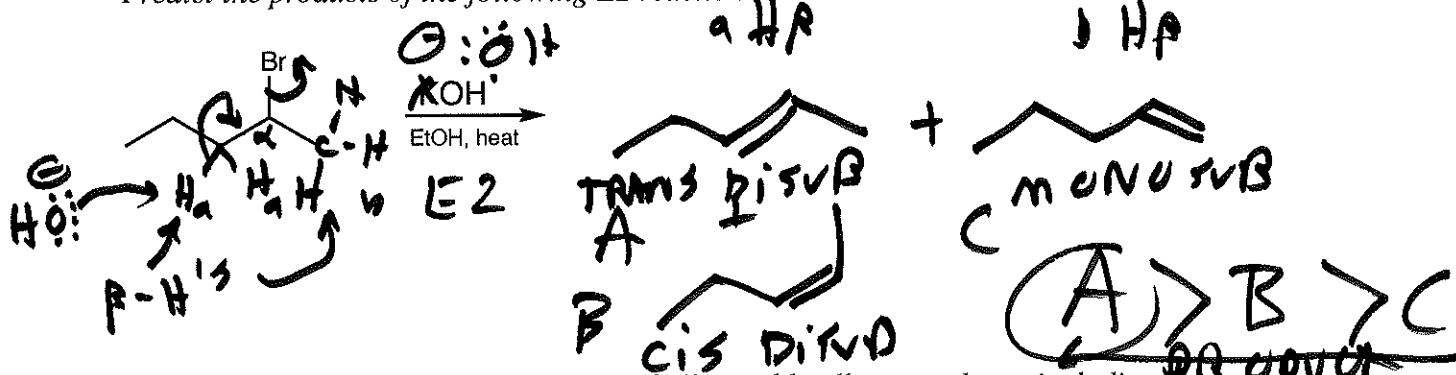
$$\text{rate} = k [\text{OH}^-] [\text{R-X}] = k [\text{BASE}] [\text{R-LG}]$$

reaction name:

E2

- STRONG BASE
- POLAR PROTIC SOLVENT
- HEAT Δ

Predict the products of the following E2 reactions:



- E2 elimination results in the formation of all possible alkene products, including stereoisomers
- E2 elimination using strong, small bases (such as HO^-) results in formation of the most stable alkene product (Zaitsev's rule)
- the most stable alkene is the most substituted

Predict all of the products of the following E2 reactions. Circle the major product:

Plan of Attack for E2 reactions

- identify the base
- identify the leaving group
- locate all β -hydrogens
- draw products from removal of a β -hydrogen and the leaving group
- draw stereoisomers where relevant
- check to make sure no products are duplicated!

