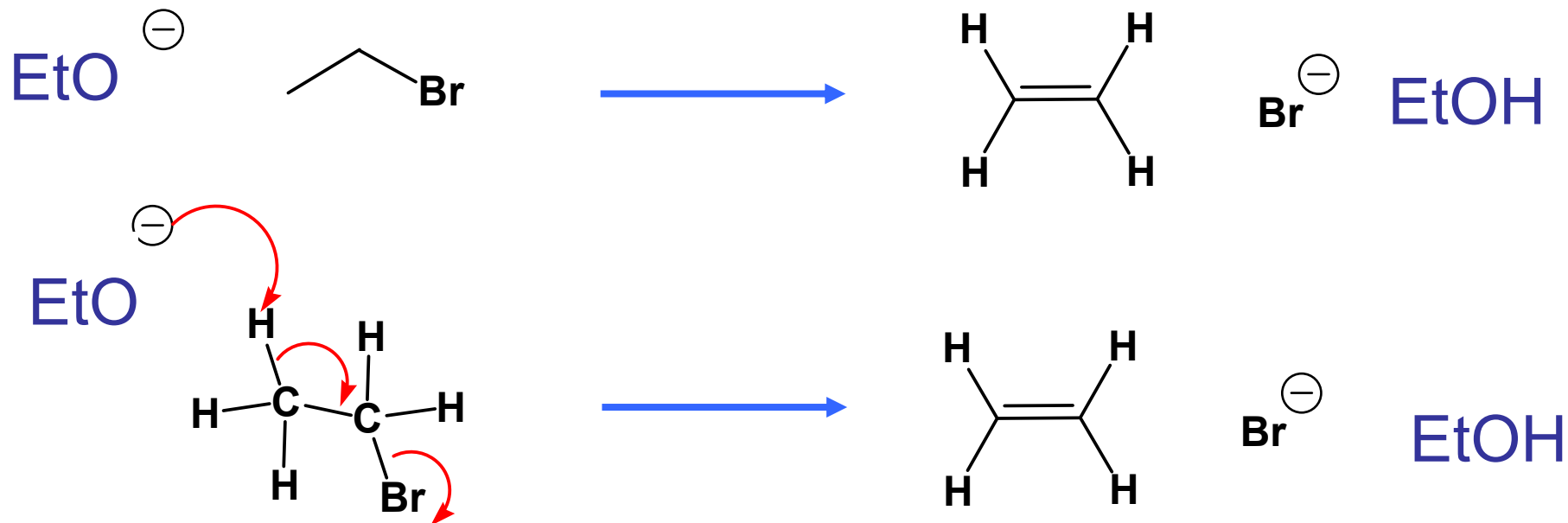


## Chapter 7:

### Part 4: E2 & E1 Reactions

1. Stereochemistry of the E2 Mechanism
2. The E1 Mechanism
3. The Stereochemistry of the E1 Mechanism
4. The E1cb Mechanism

# The E2 Reaction

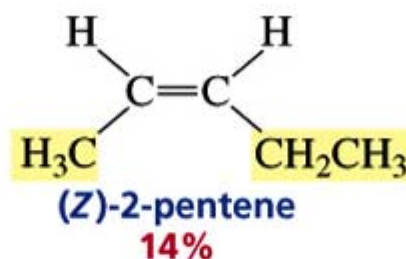
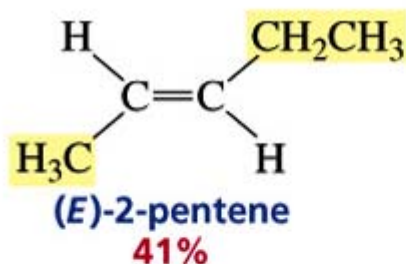
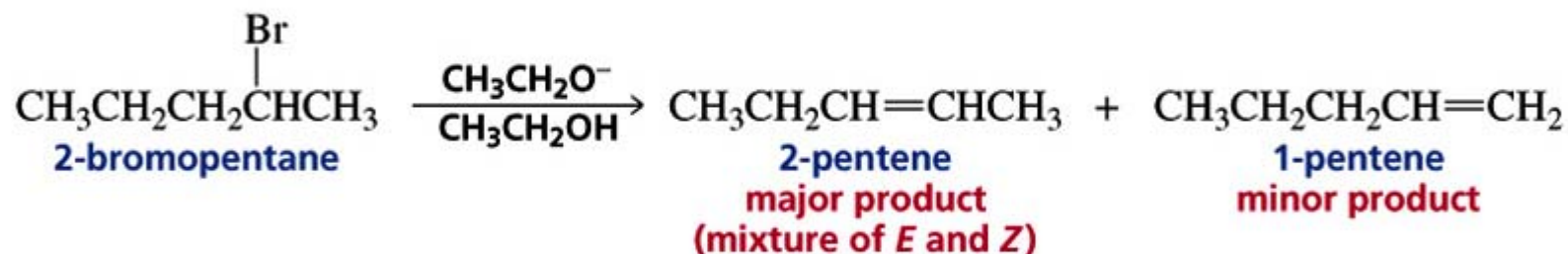


The presence of a leaving group creates a slight positive charge at the electrophilic carbon and at the protons on the  $\alpha$  carbon.

A basic reagent can thus attack this proton and cause elimination.

The driving force is the protonation of a stronger base and formation of a weaker one.

Consider the regioselectivity of the E2 reaction

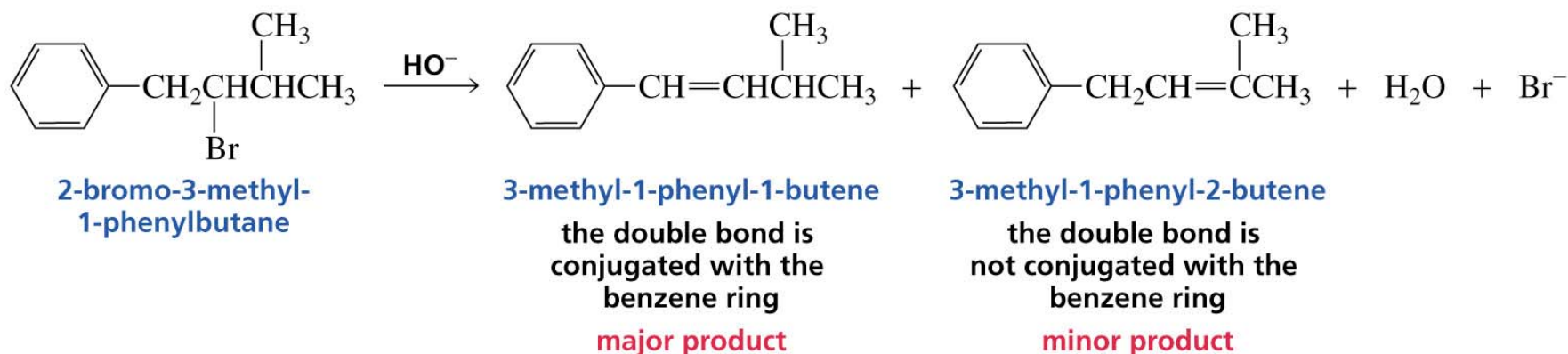
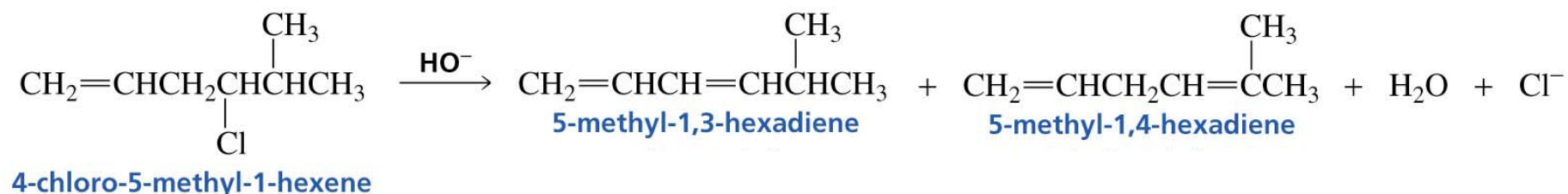


The major product of an E2 reaction is the most stable alkene

The greater the number of substituents, the more stable is the alkene

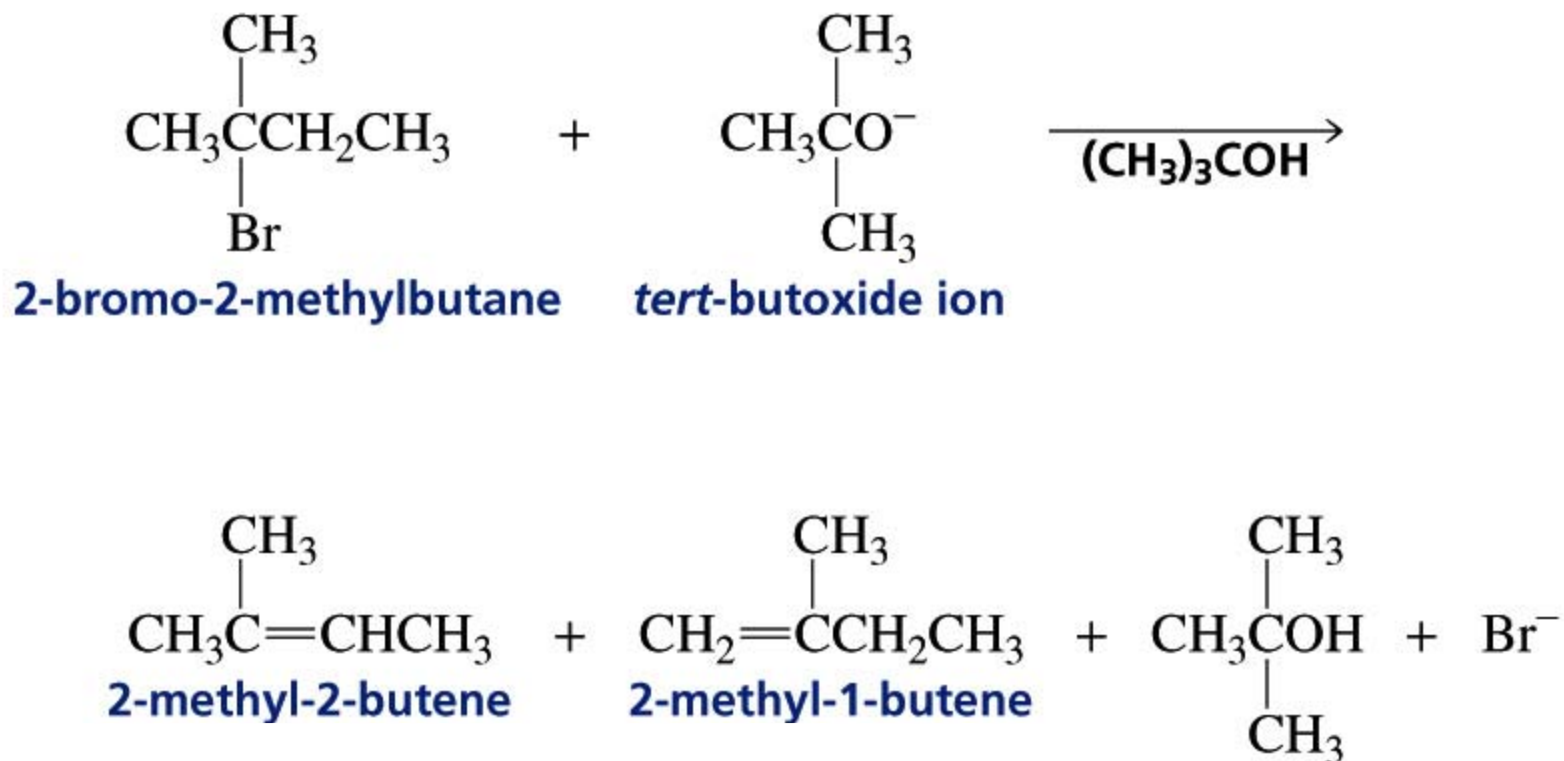
Zaitsev's Rule - The more substituted alkene product is obtained when a proton is removed from the  $\beta$ -carbon that is bonded to the fewest hydrogens -

Conjugated alkene products are preferred over the more substituted alkene product



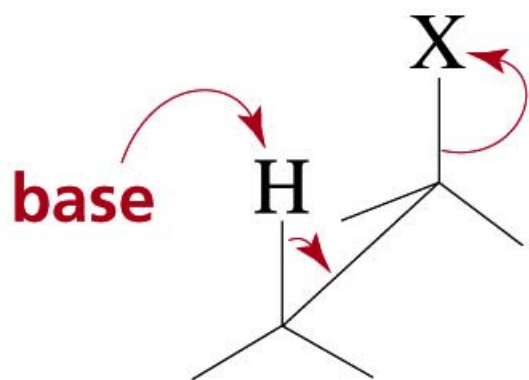
This is an Exception to Zaitsev's rule.

Steric hindrance also affects the product distribution  
YOUR BOOK CALLS THIS HOFFMAN's Rule.

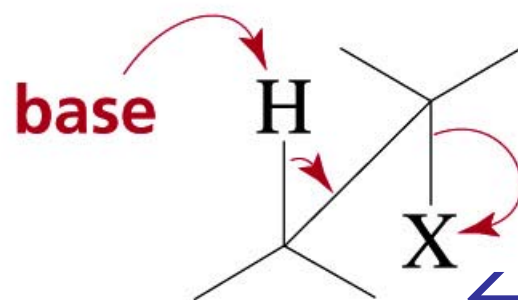


# Stereochemistry of the E2 Reaction

The bonds to the eliminated groups (H and X) must be in the same plane



**syn elimination**



**anti elimination**

← FAVORED!!

The best overlap of the interacting orbitals is achieved through back side attack

Anti elimination avoids repulsion of the electron-rich base

The anti elimination is favored over the syn elimination

*This is a PROBLEM in Reactions with cycloalkylhalides!*

## *Characteristics of the E2 mechanism*

- Second order kinetics:  $\text{rate} = k[\text{RX}][\text{B}]$ 
  - bimolecular rate-determining step
- Concerted Reaction
- Reaction is regiospecific
  - more substituted alkene is preferred product
- Reaction is stereospecific
  - trans is preferred

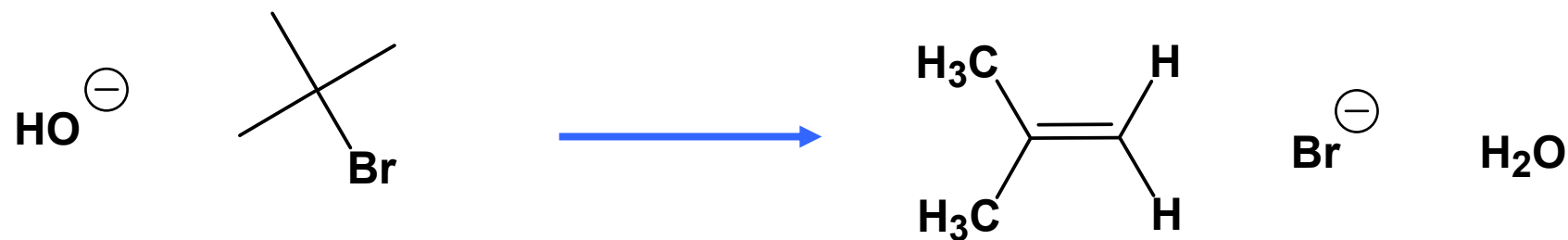
# The E1 Mechanism

- 1. We CAN have elimination in the absence of base.
- 2. Carbocation is intermediate
- 3. Rate-determining step is unimolecular

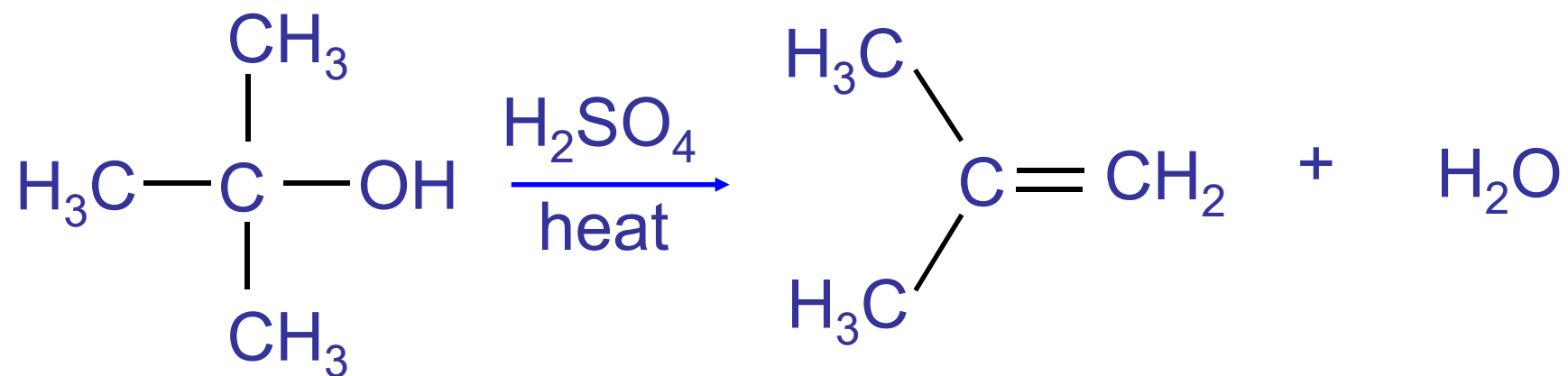
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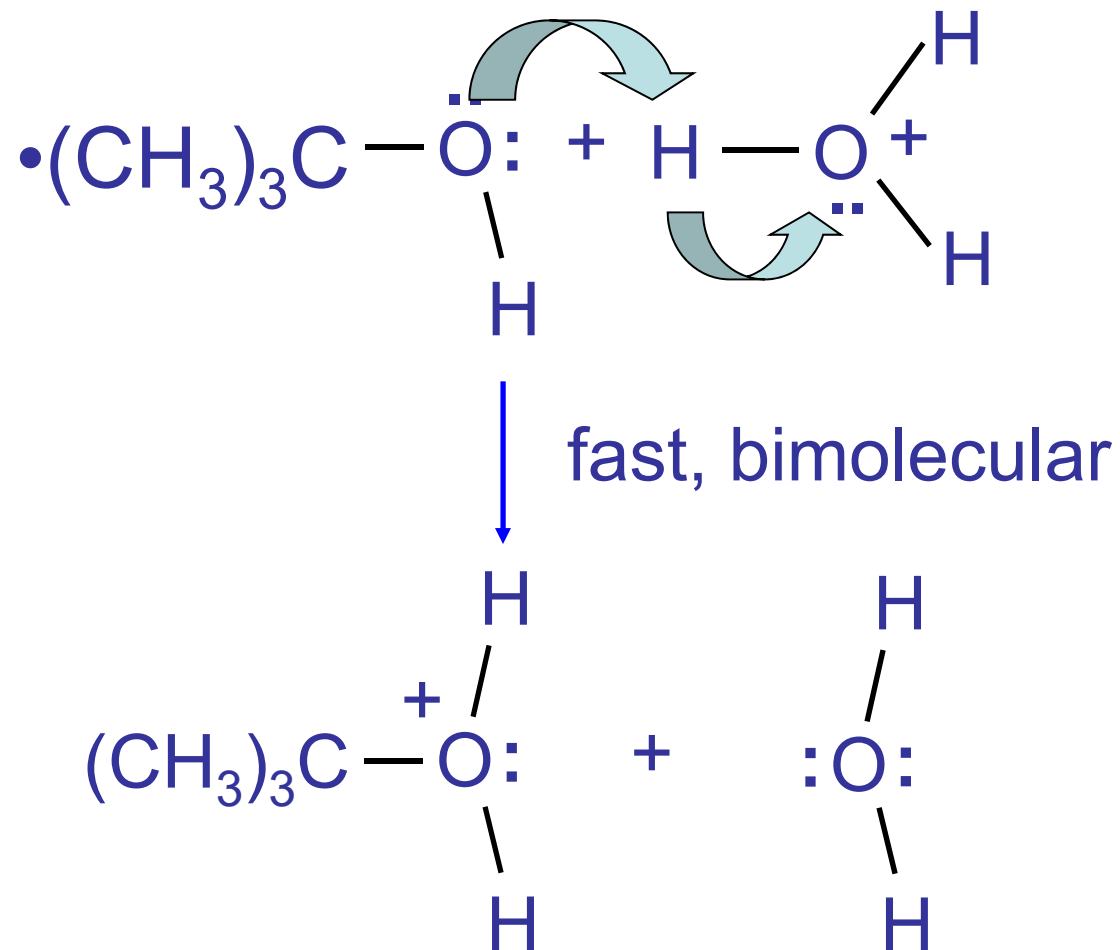
# The E1 Reaction



# Dehydration of tert-Butyl Alcohol

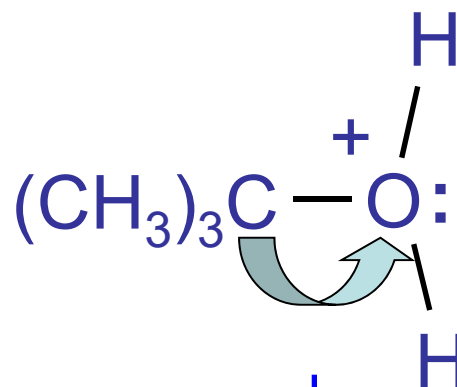


## Step 1: Proton transfer to *tert*-butyl alcohol



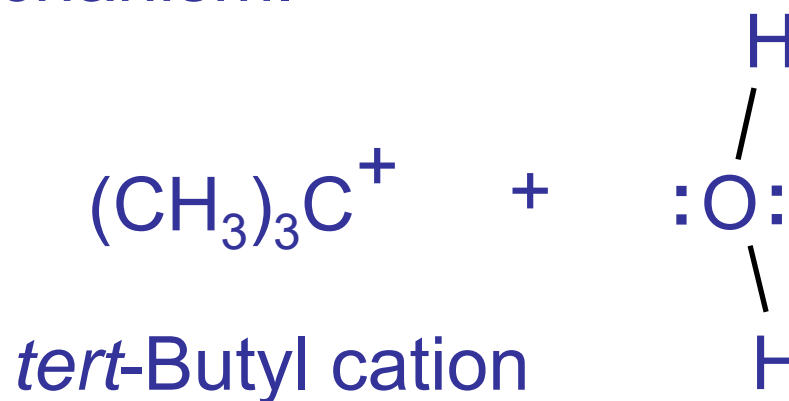
## *tert*-Butyloxonium ion

Step 2: Dissociation of *tert*-butyloxonium ion to carbocation

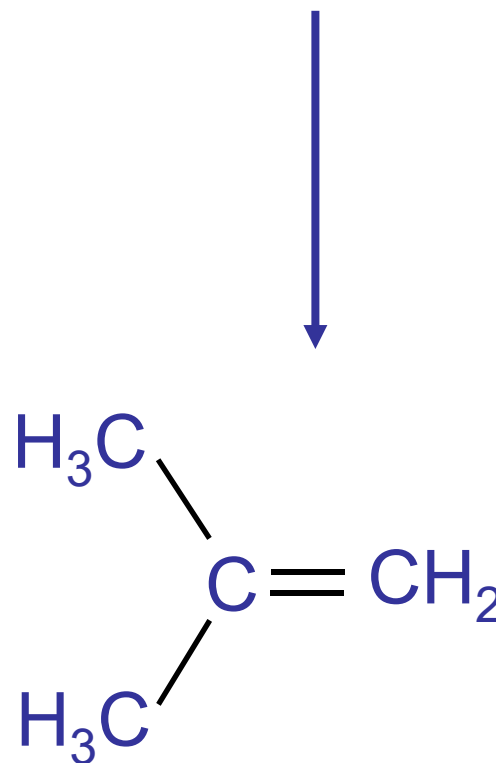
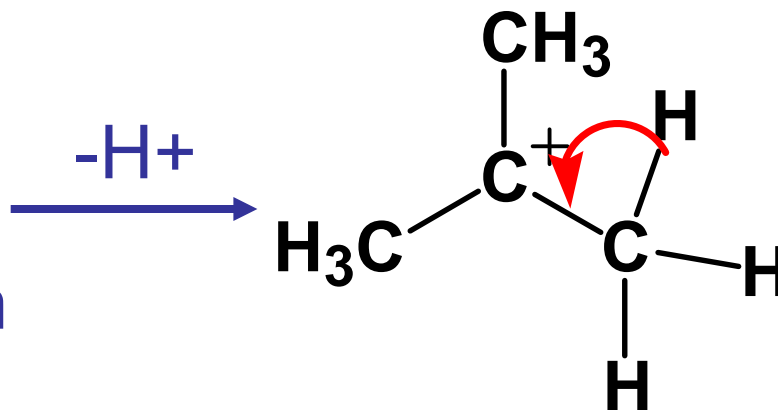


slow, unimolecular

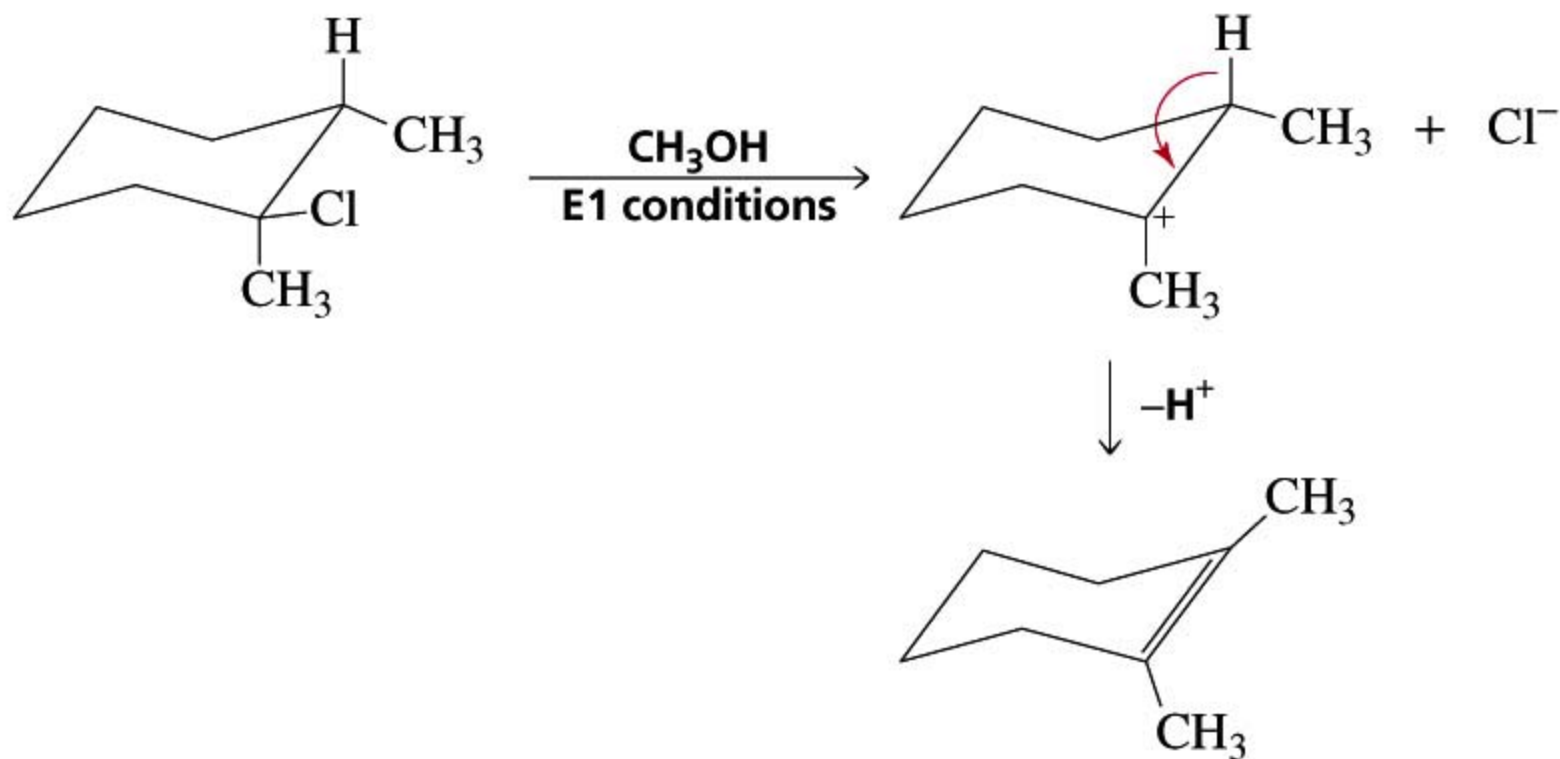
Because rate-determining step is unimolecular, this is called the E1 mechanism.



Step 3:  $(\text{CH}_3)_3\text{C}^+$   
*tert*-Butyl cation



# E1 Elimination from Cyclic Compounds



An E1 reaction involves both syn and anti elimination

## *Characteristics of the E1 mechanism*

- First order kinetics:  $\text{rate} = k[\text{RX}]$ 
  - unimolecular rate-determining step
- carbocation intermediate
  - rate follows carbocation stability
  - rearrangements sometimes observed
- Reaction is regiospecific
  - more substituted alkene is still preferred product
  - reaction is not stereospecific

# For Next Time....

Suggested Homework Problems Chapter 7

#1,14,21,26, 31, 36,38,41,44,50,52,53,59,64,65

Exam#2 → Wednesday OCTOBER 25th!