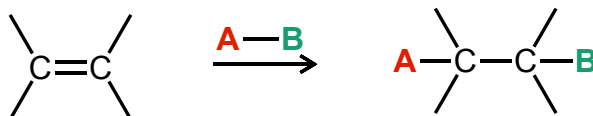


## Addition to Alkenes ( $\pi$ bonds)

Addition reactions add more groups **across the C=C bond** of an alkene substrate.

This overview first highlights the terminology used to describe common addition reactions as well as the key intermediates (or transition states) that lead to the products of addition reactions.

### Generic Addition Reaction:



#### Bonds Broken

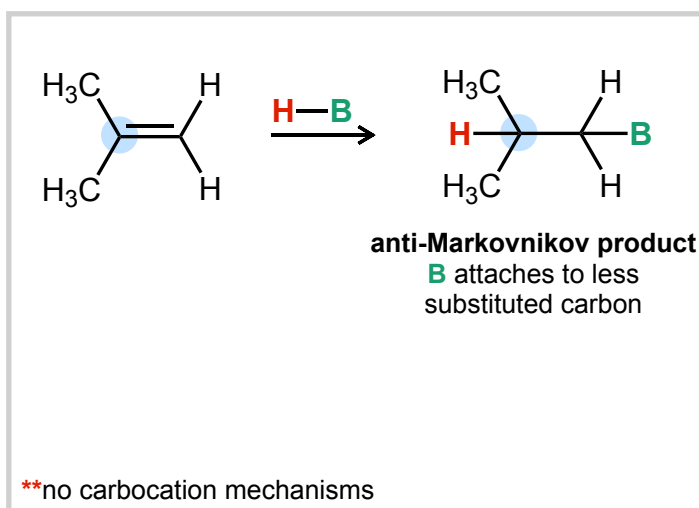
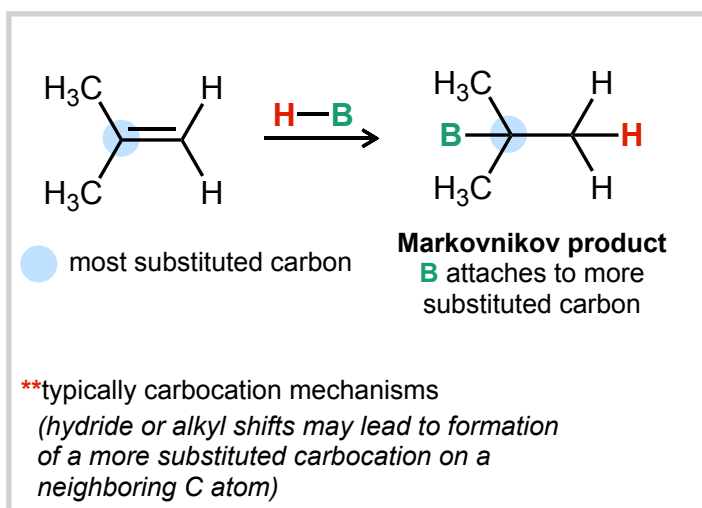
C=C  $\pi$ -bond  
A-B  $\sigma$ -bond

#### Bonds Formed

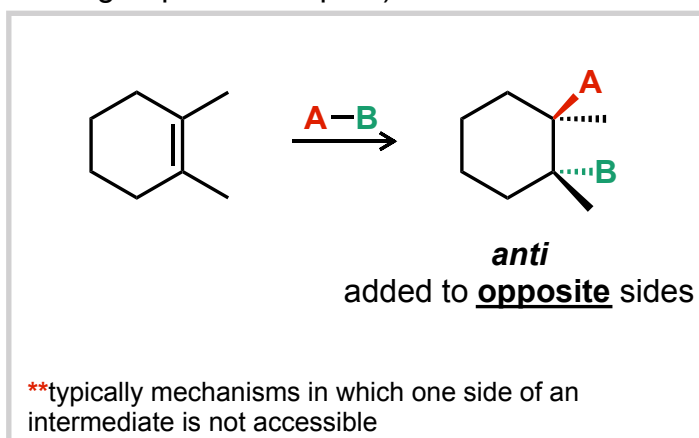
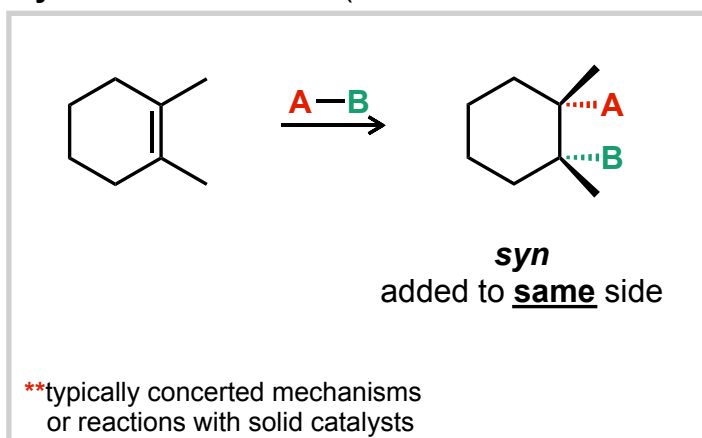
C-A  $\sigma$ -bond  
C-B  $\sigma$ -bond

### Common Terminology:

**Markovnikov vs. anti-Markovnikov addition** (describes which carbon that atom "B" ends up on)



**Syn- vs. anti-addition** (describes which "side" or "face" groups ended up on)

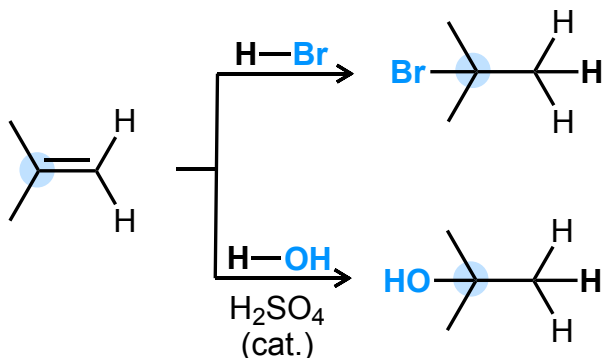


## Key Intermediates or Transition States

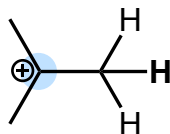
Certain reaction conditions are responsible for mechanisms that lead to specific regio- or stereoisomers. The **key intermediates** or transition states of **common addition reactions** are shown below. Notice the similarities in selectivity for the reactions in each quadrant.

### Markovnikov regioselectivity

product is the result of **carbocation** forming at the **more substituted carbon**

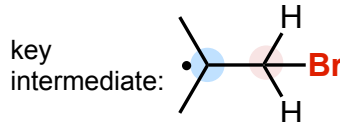
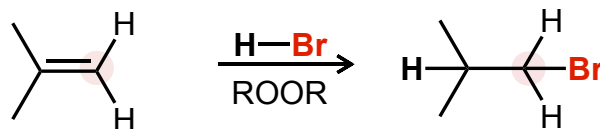


key intermediate for both reactions above:

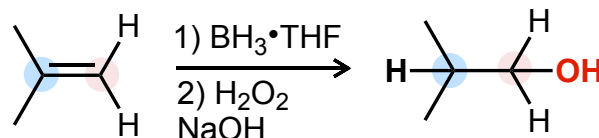


### Anti-Markovnikov regioselectivity

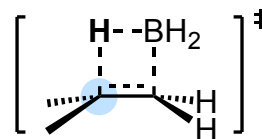
nucleophile attaches to **less substituted carbon**



product is the result of radical forming at the more substituted carbon (and **Br to less**)

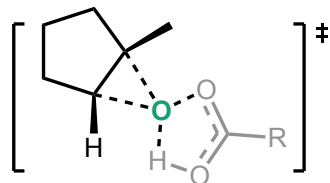
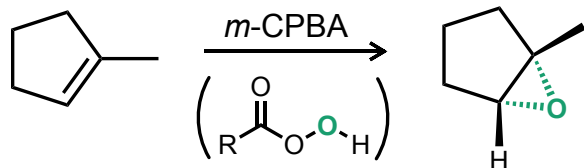
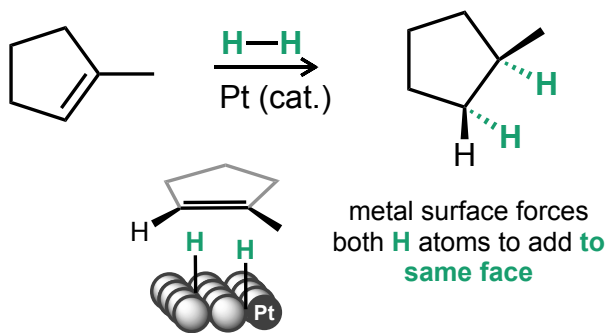


key transition state:



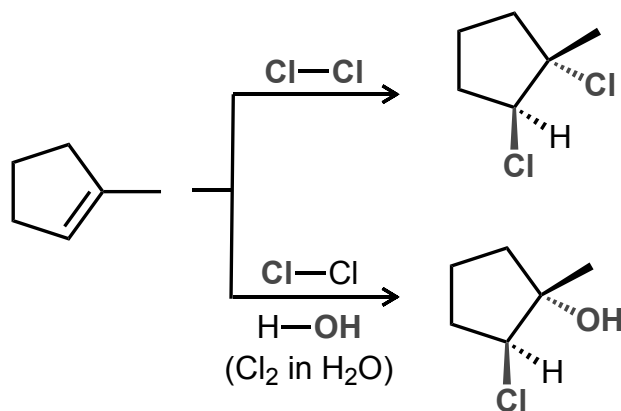
product is the result of larger **B atom** bonding to **less** substituted carbon

### Syn addition



single **O** atom can only add to **same face**

### Anti addition



key intermediate for both reactions above:

