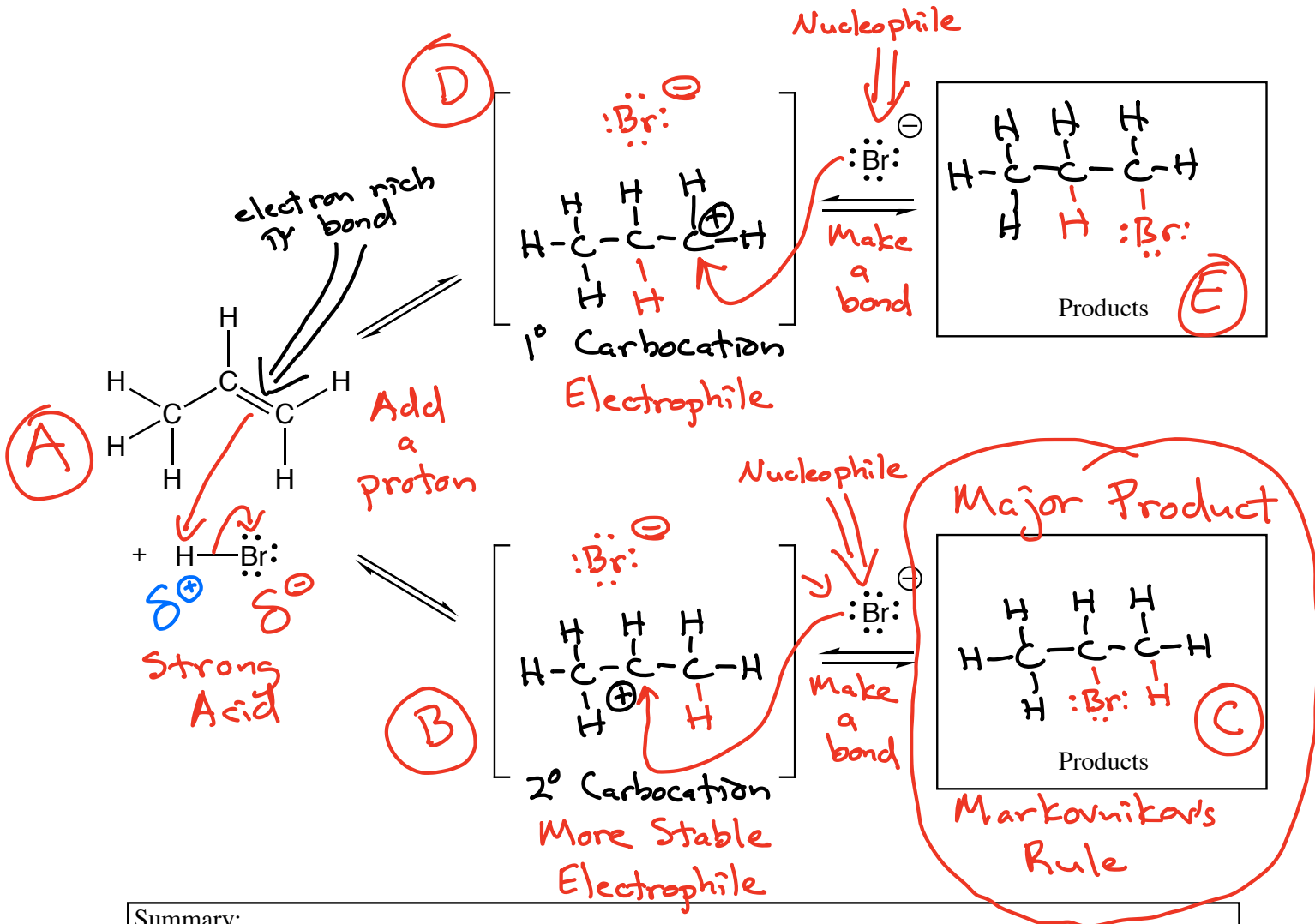


Addition of H-X to an Alkene

X = Cl, Br, I
but not F



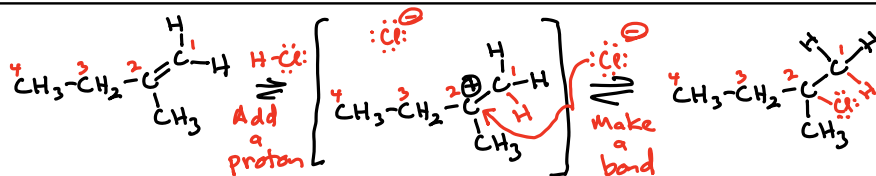
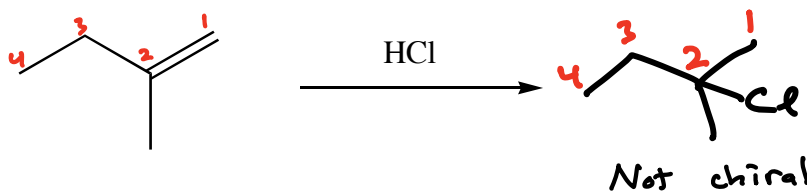
Summary:

The alkene pi bond reacts with H-X to add a proton to create a carbocation intermediate that makes a bond with X⁻ to give the product

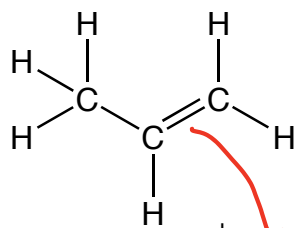
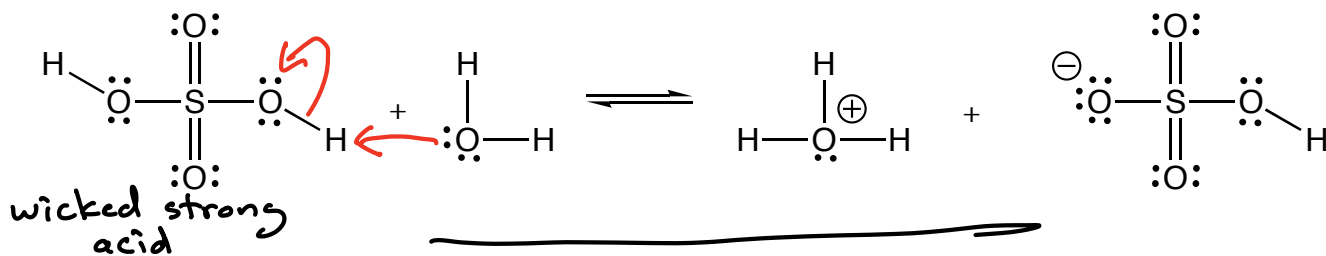
Regiochemistry: **Markovnikov's Rule**

Stereochemistry: **Mixed (time capsule) → Racemic Product**

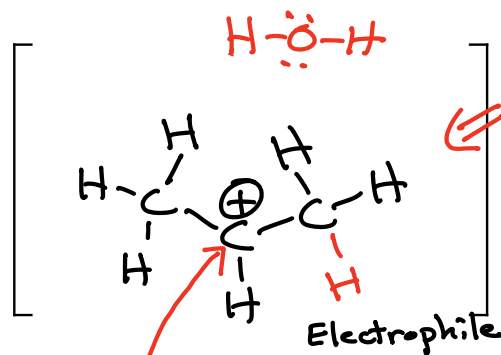
Example:



Acid-catalyzed Hydration of an Alkene

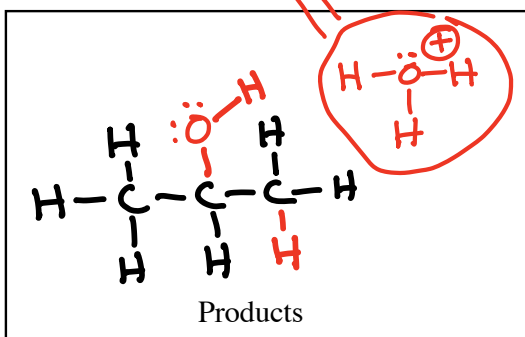
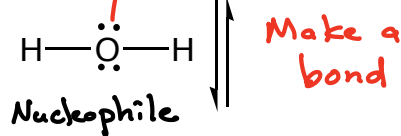


Add a proton

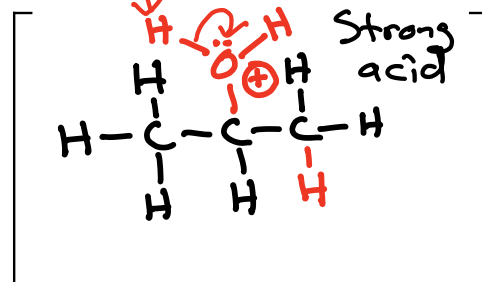


Catalytic in Acid!
 ⇒ The $[\text{H}_3\text{O}^{\oplus}]$ does not change during the reaction

strong acid



Take a proton away

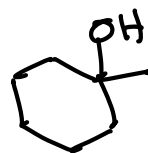
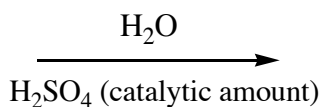
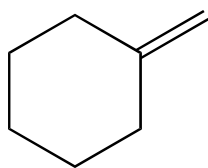


Summary: Proton adds to make a carbocation intermediate, water attacks to make a new bond, take a proton away to make the product alcohol. Catalytic in $\text{H}_3\text{O}^{\oplus}$

Regiochemistry: **Markovnikov's Rule**

Stereochemistry: **Mixed (time capsule)**

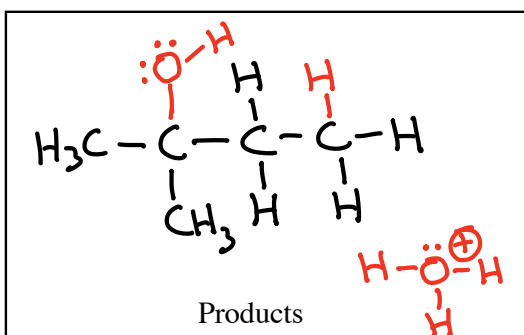
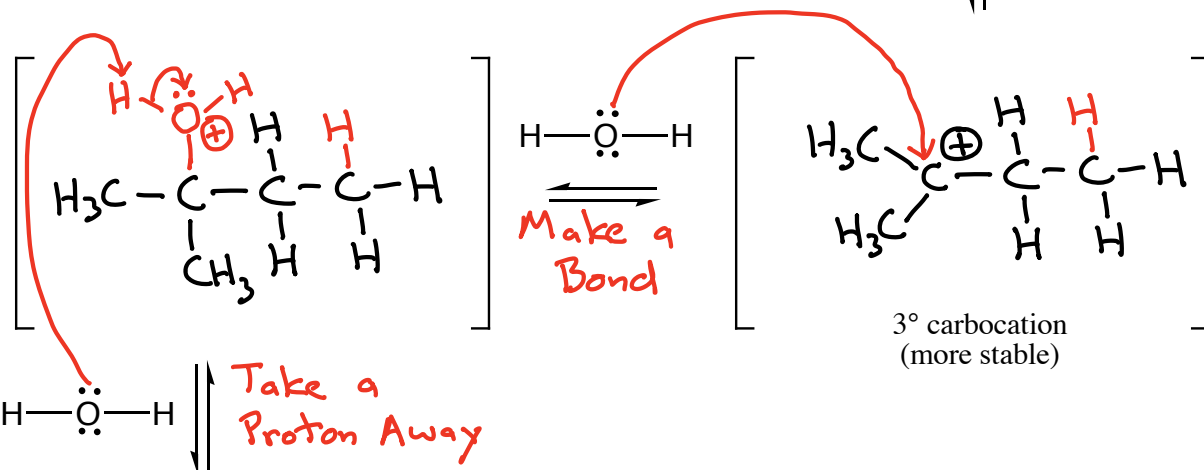
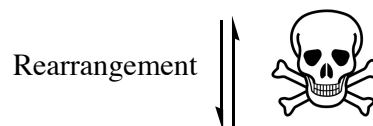
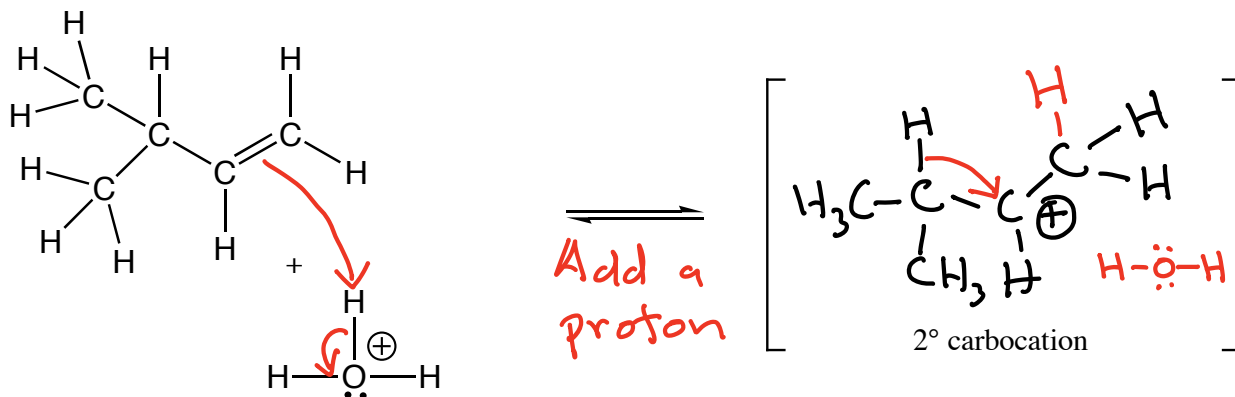
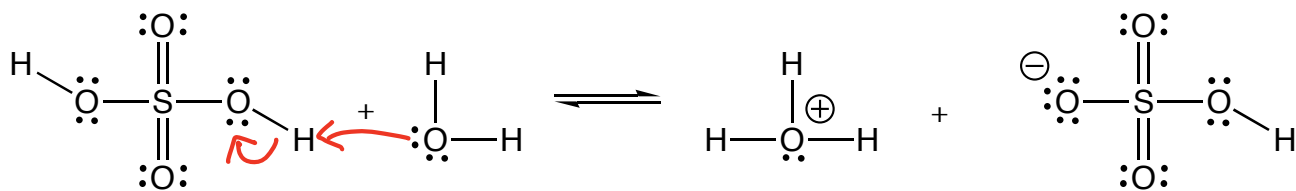
Example:



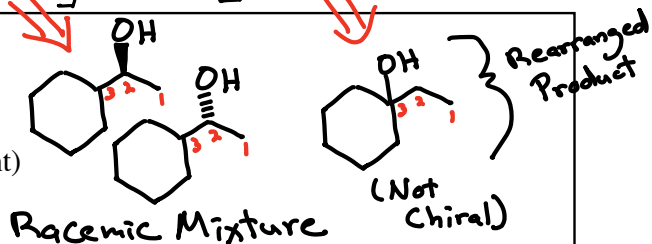
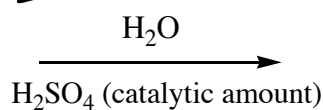
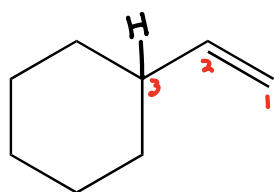
(Not chiral)

-OH on more substituted C atom ⇒ Markovnikov's Rule

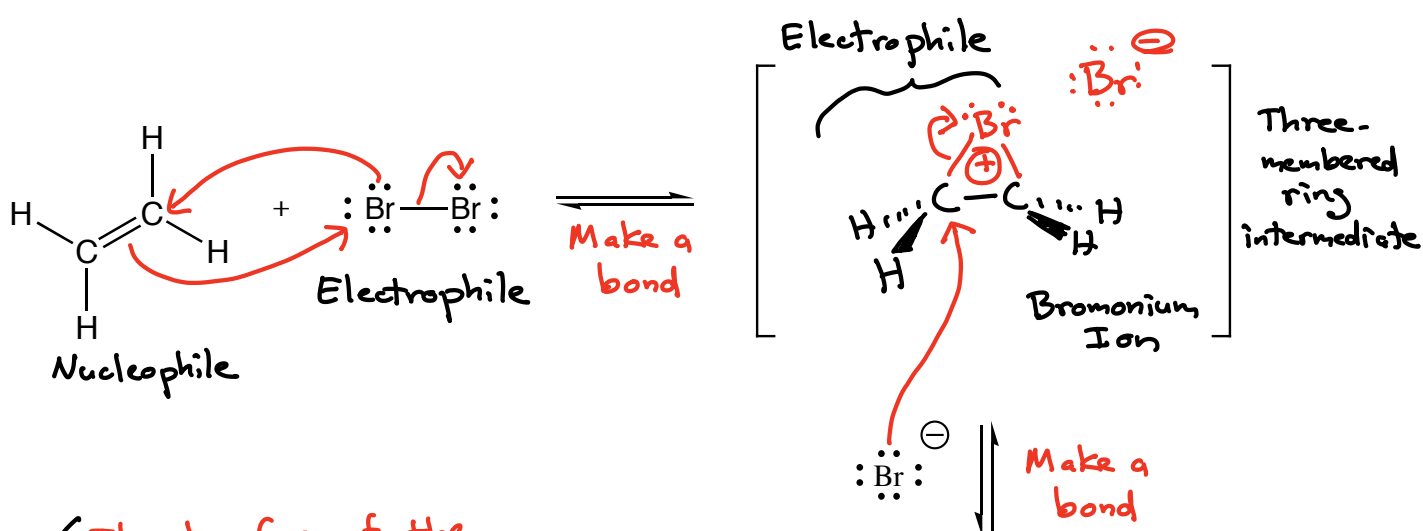
Cation Rearrangement



Example:



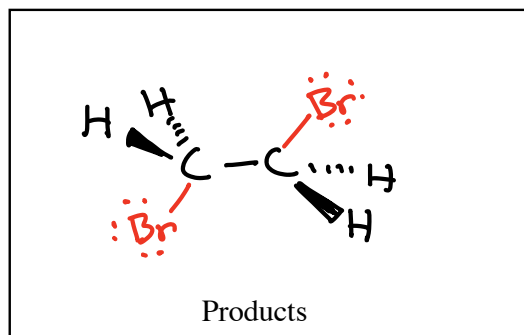
Alkene Halogenation



Called "anti" addition stereochemistry

The top face of the intermediate is "blocked" by the Br atom, so the $:\text{Br}^-$ nucleophile must react from the opposite face

⇓
Gives only a "trans" product - never "cis"

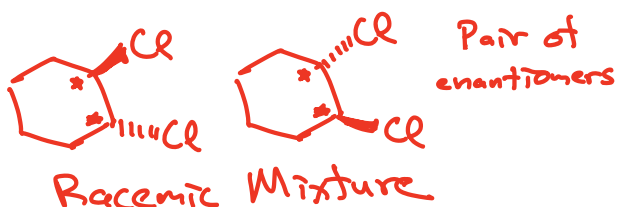
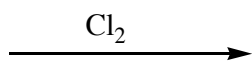
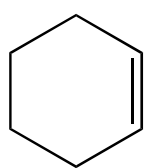


Summary: Alkenes react with X_2 to give a three-membered ring intermediate, then a new bond is made by X^- reacting from behind the C-X bond of the intermediate.

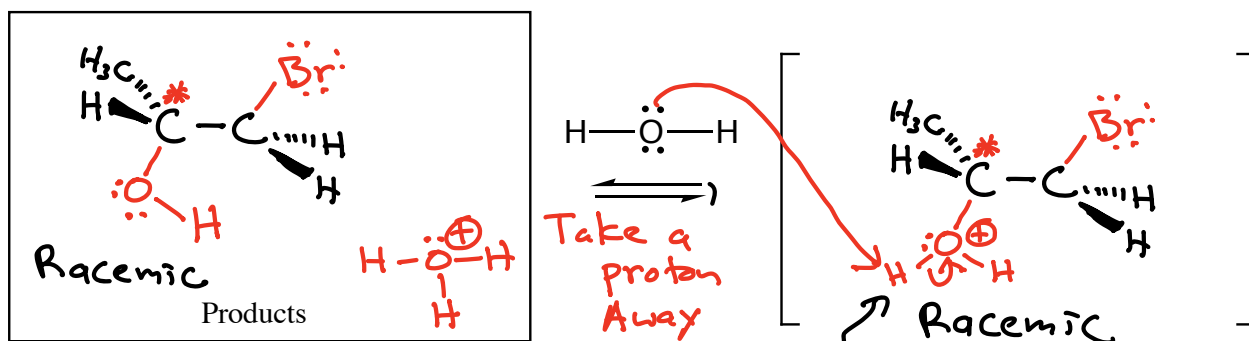
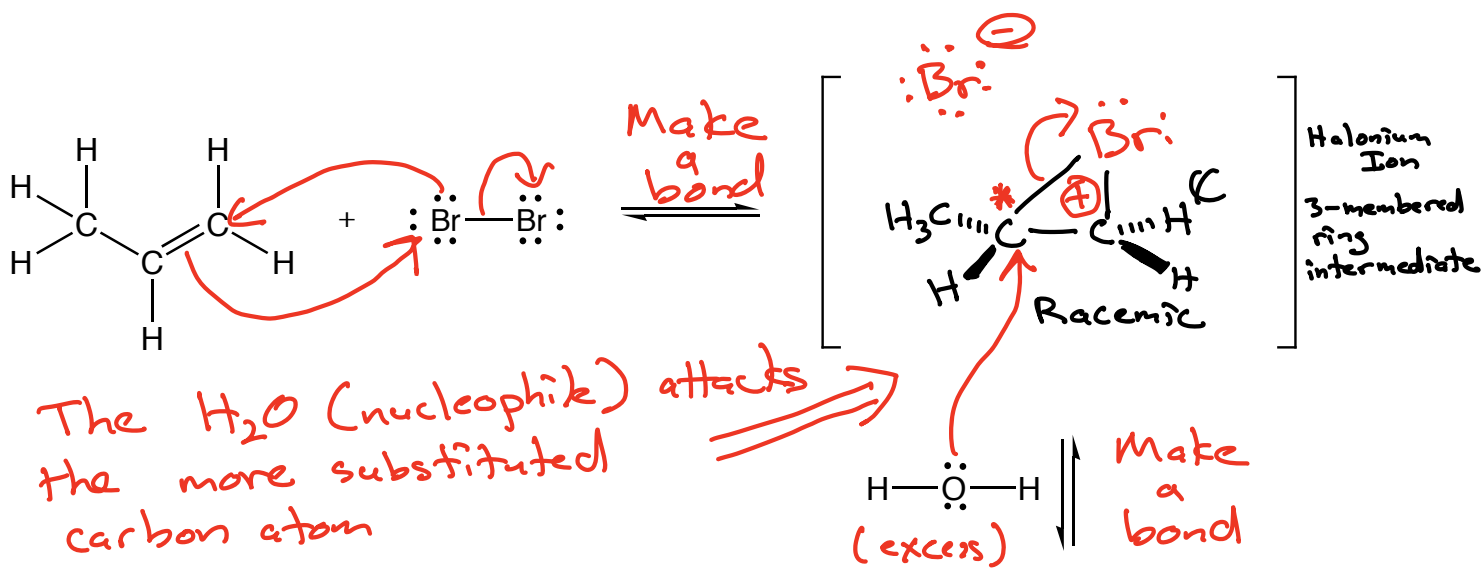
Regiochemistry: Not applicable \rightarrow Br is on both atoms

Stereochemistry: **Anti addition geometry** \rightarrow trans products

Example:



Alkene Hydrohalogenation



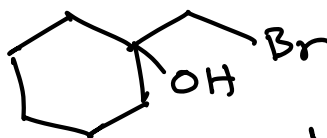
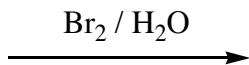
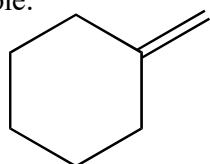
pH drops during the reaction!

Summary: Alkene reacts with X_2 to give a 3-membered ring intermediate (halonium ion) \rightarrow H_2O attacks the more substituted C atom and we take a proton away to give the halohydrin product.

Regiochemistry: Markovnikov (OH on more substituted C atom)

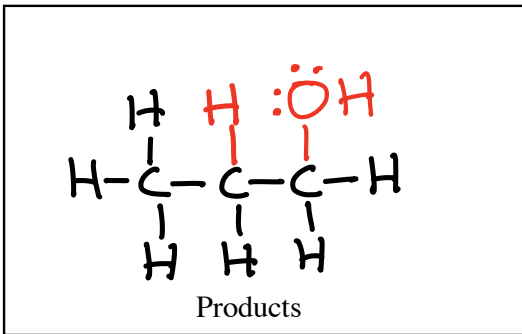
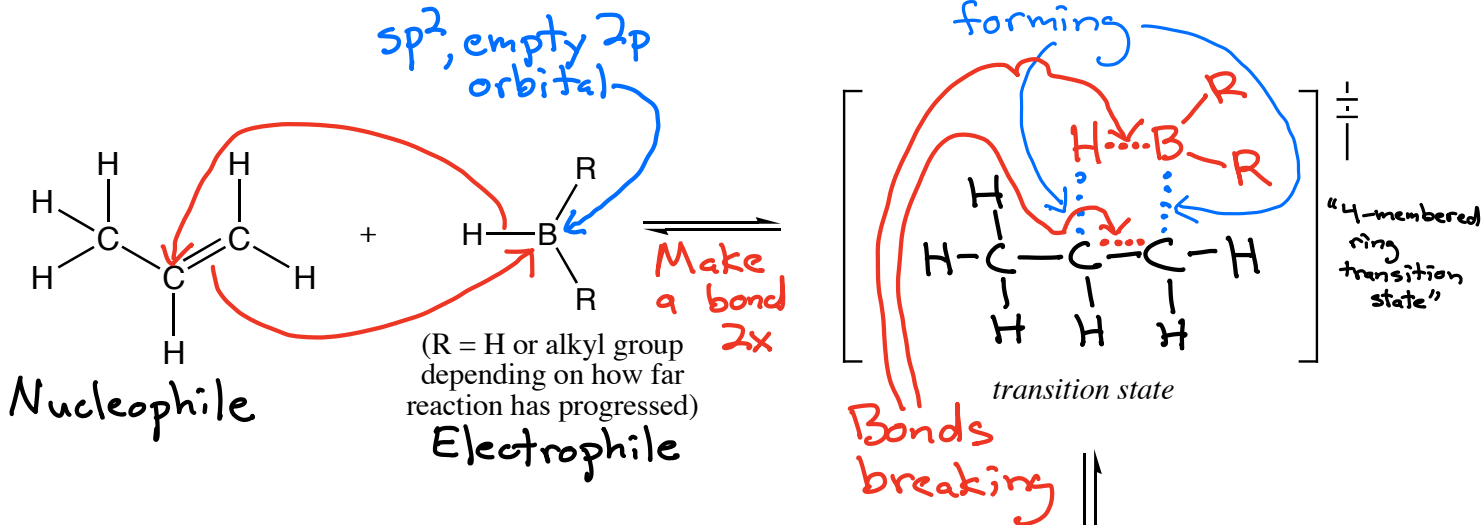
Stereochemistry: Anti

Example:

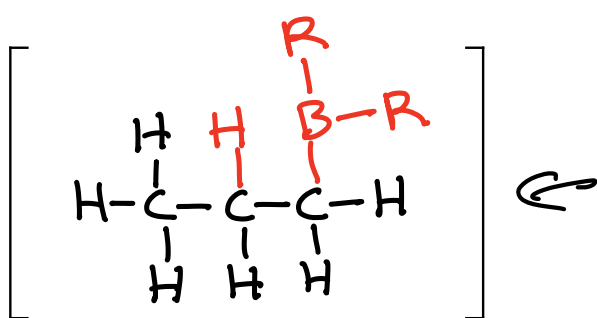


Not Chiral

Hydroboration-Oxidation



Not responsible for this mechanism
 2. $\text{H}_2\text{O}_2 / \text{HO}^-$
 (Chemist opens flask and adds new reagent)



H → More substituted C atom
OH → Less substituted C atom

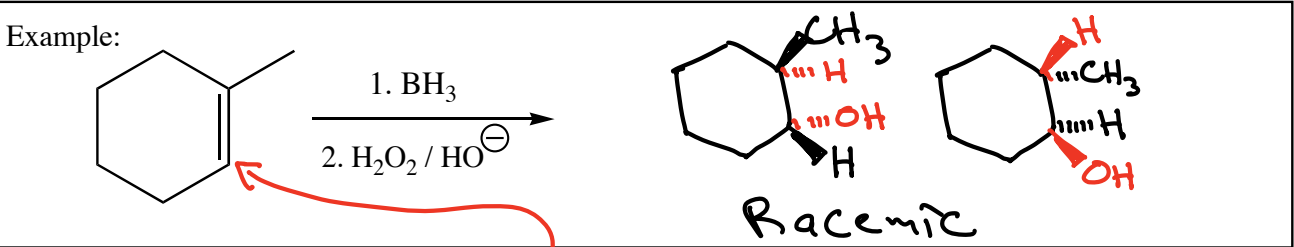
Steric strain in the first transition state

H and OH are syn

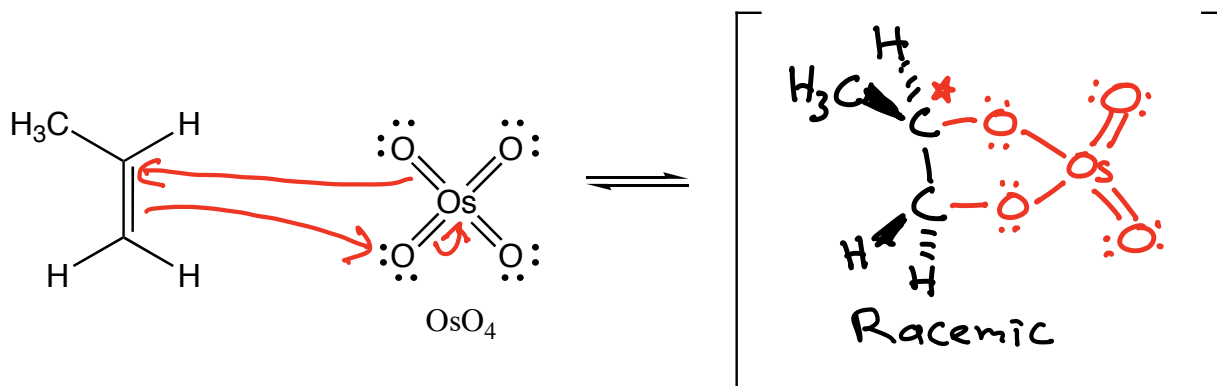
Summary: The pi bond of the alkene attacks the Lewis acid (electrophile) B atom at the same time a new bond forms between C and H. In 2nd step OH replaces B(R)₂. "4-membered ring transition state"

Regiochemistry: *Non-Markovnikov*

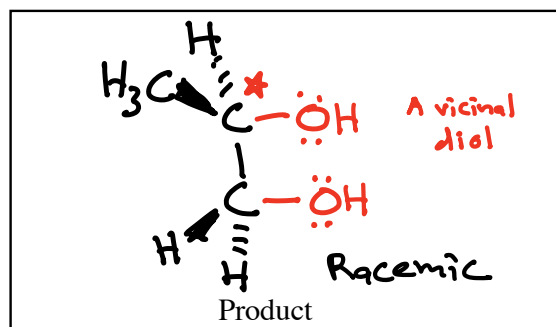
Stereochemistry: *Syn*



OsO_4 Partial Mechanism



2. $NaHSO_3 / H_2O$
(Chemist opens up flask) \Downarrow Not responsible for mechanism

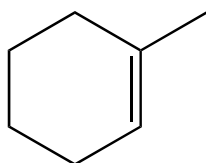


Summary: The mechanism involves a cyclic osmate ester, explaining the syn stereochemistry of addition.

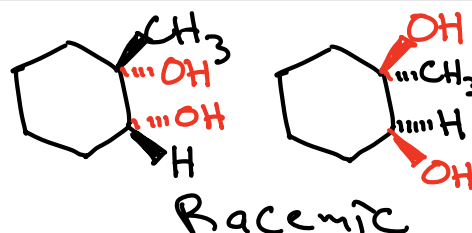
Regiochemistry: N/A

Stereochemistry: Syn

Example:

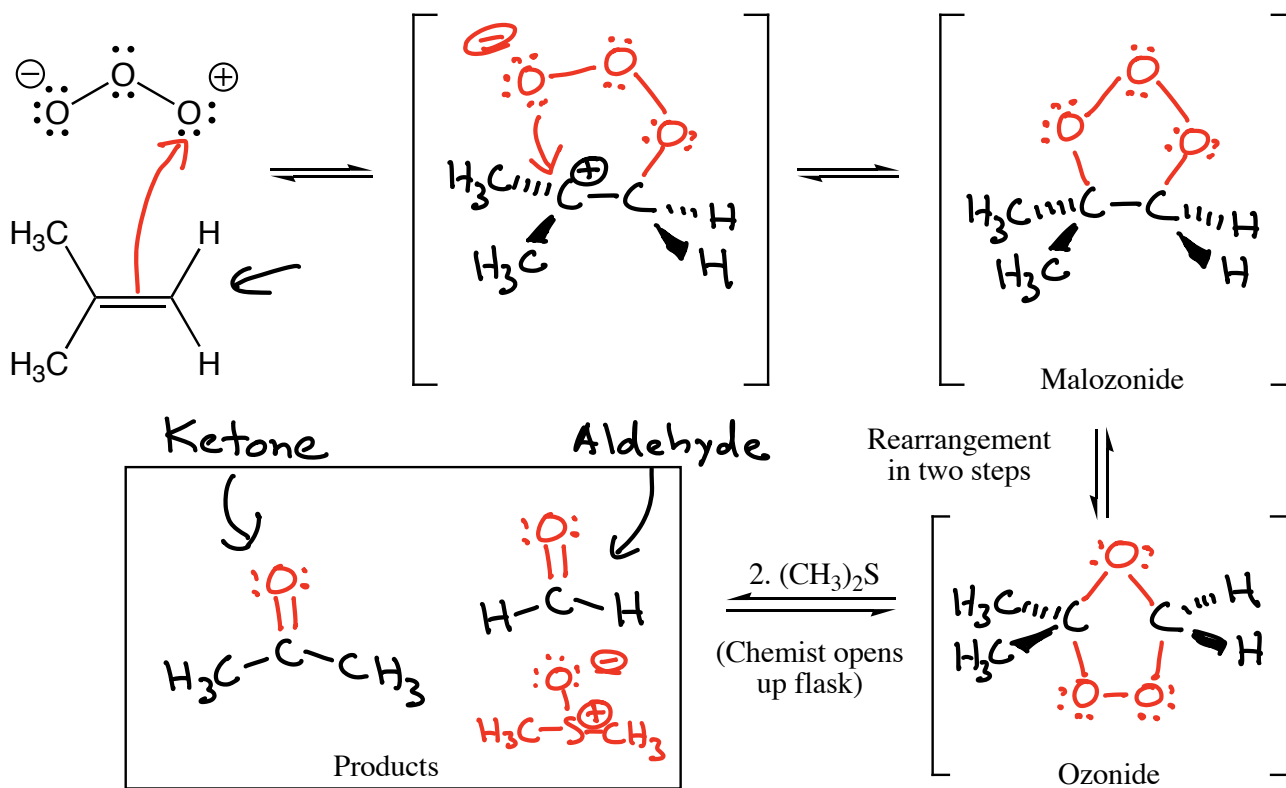
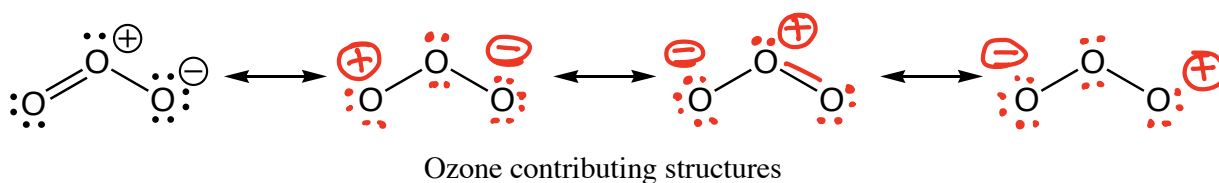


1. OsO_4
2. $NaHSO_3 / H_2O$



This breaks C=C bonds !!!

Ozonolysis Partial Mechanism

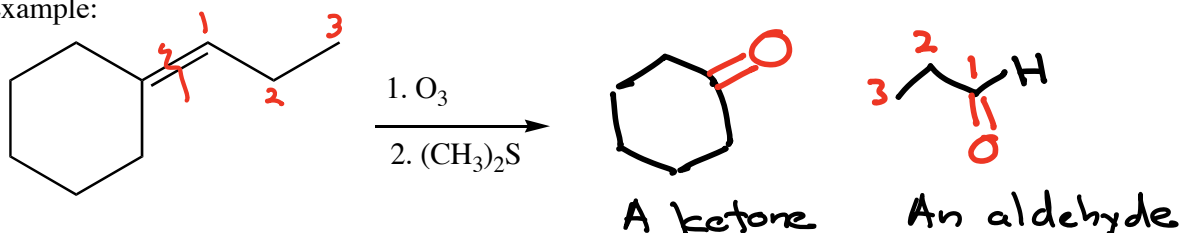


Summary: Reaction of an alkene with O_3 gives a malozonide than an ozonide intermediate (the C=C pi bond then C-C sigma bond is broken). Adding $(\text{CH}_3)_2\text{S}$ decomposes the ozonide into ketone and aldehyde products **Breaks C=C bond!**

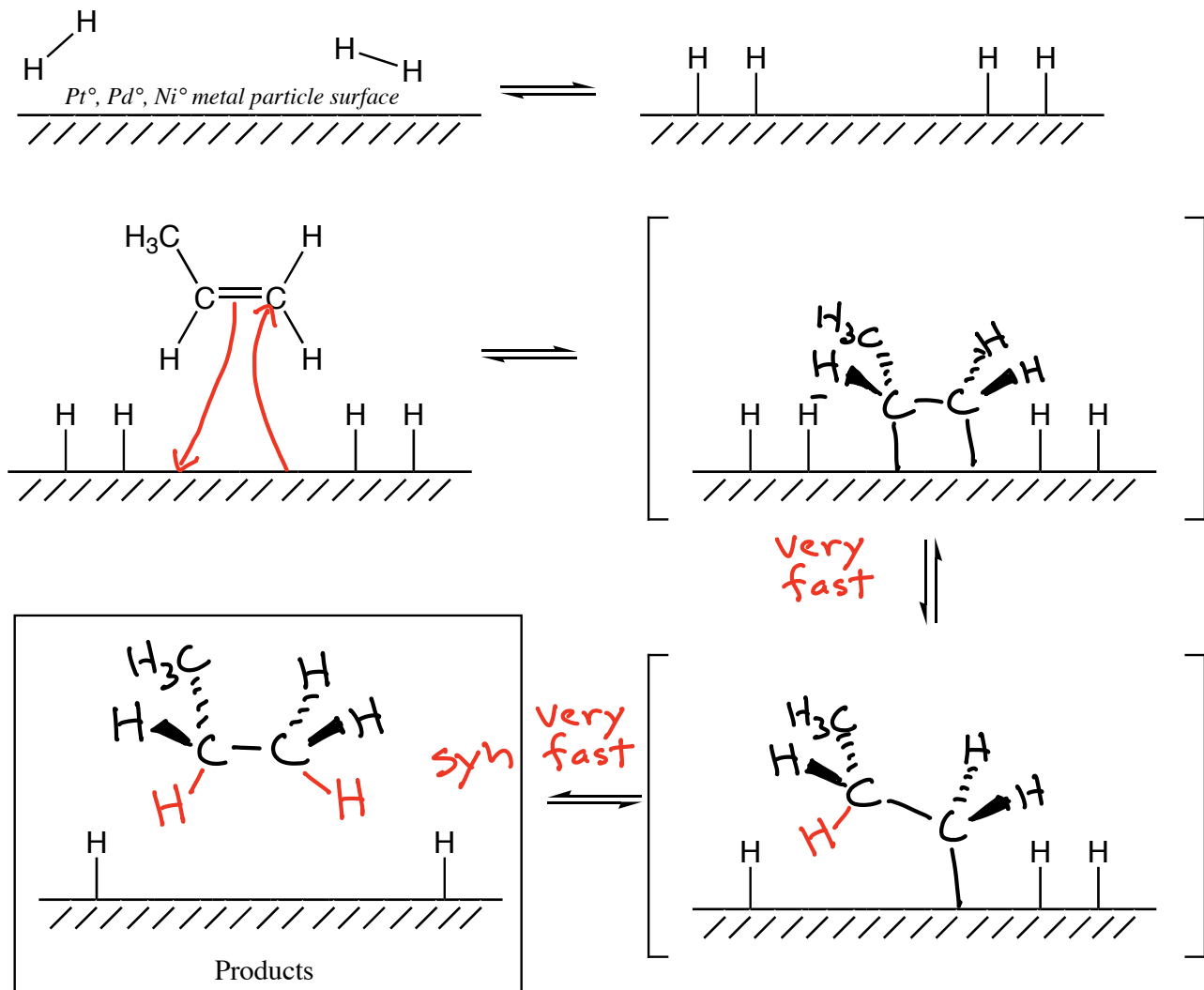
Regiochemistry: N/A

Stereochemistry: N/A

Example:



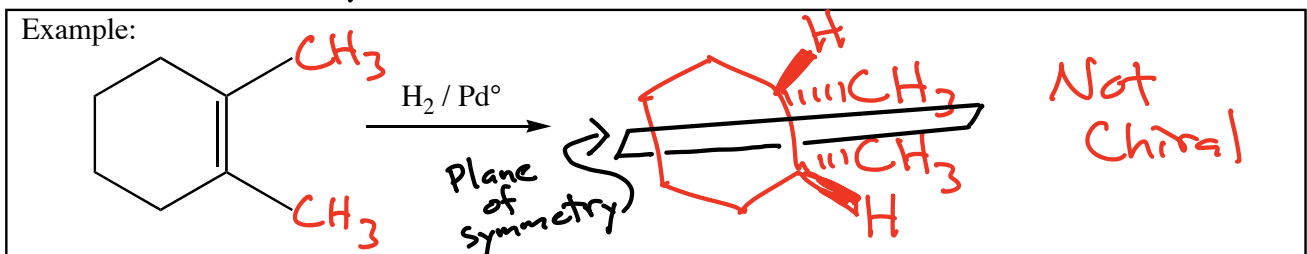
Hydrogenation: H_2 with Pt^0 , Pd^0 , Ni^0



Summary: H_2 adsorbs onto the metal surface. The alkene adsorbs onto the metal surface. H atoms transfer to both C atoms \rightarrow on the same face \rightarrow before the C-C bond rotates

Regiochemistry: N/A

Stereochemistry: Syn



Alkene

Alkane

