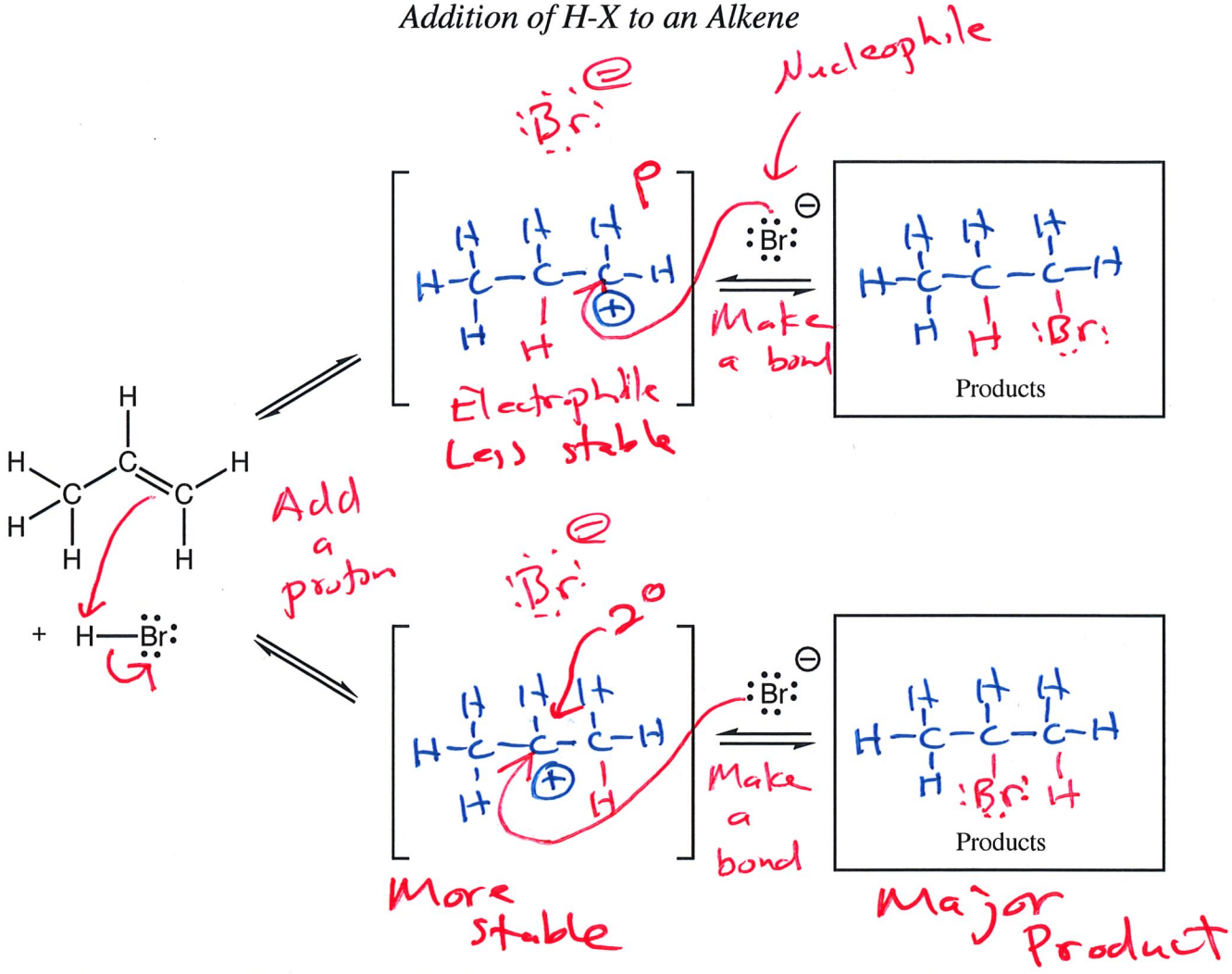
Addition of H-X to an Alkene



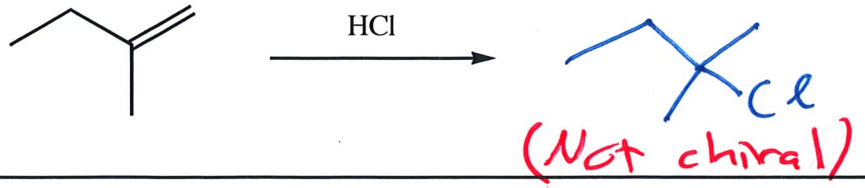
Summary: Alkenes react with H-X (X = Cl, Br, I) through addition a proton, creating a carbocation that reacts with $X^{\ominus}$ to make a bond

which const. isomer?

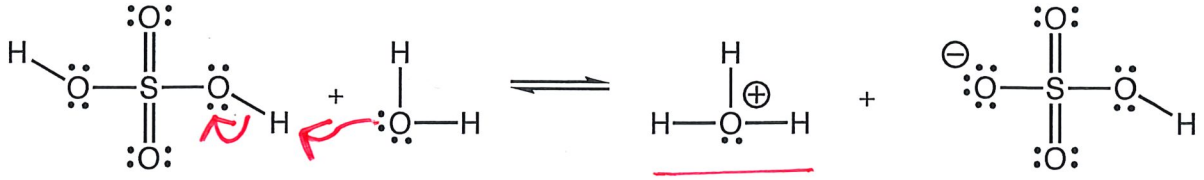
Regiochemistry: Markovnikov's Rule

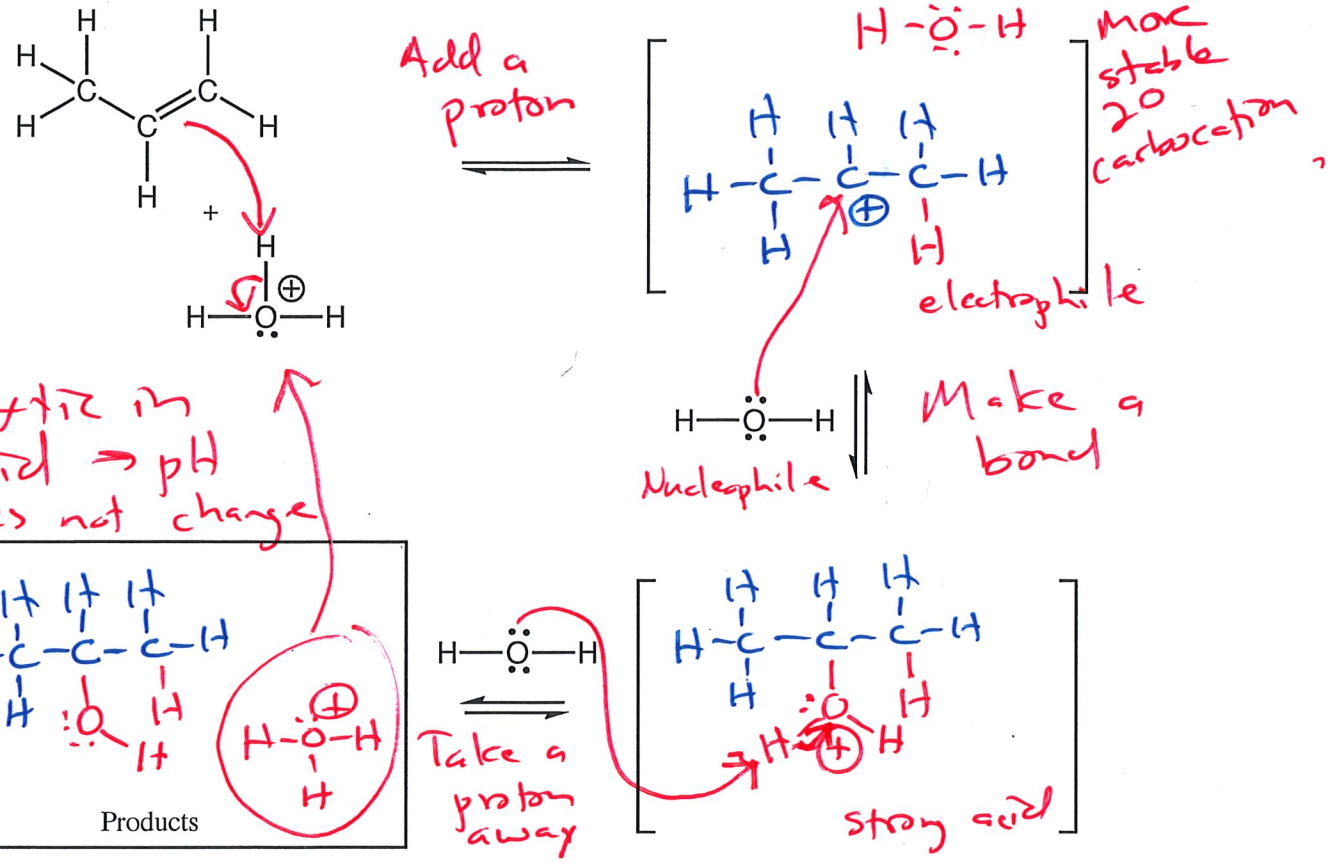
Stereochemistry: Mixed → both anti and syn

Example:



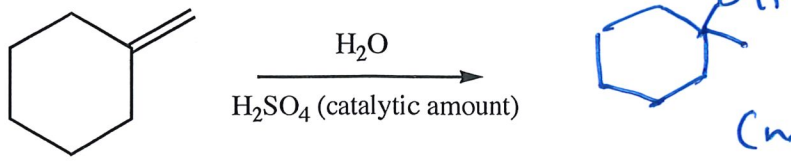
Acid-catalyzed Hydration of an Alkene





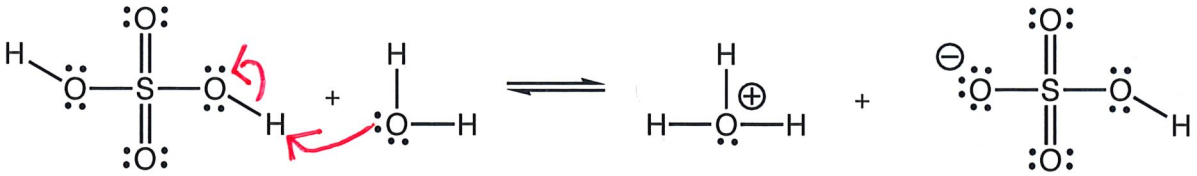
Summary:	Add proton to give carbocation, make a bond with water, take a proton away to give alcohol
Regiochemistry:	Markovnikov
Stereochemistry:	Mixed ⇒ anti and syn

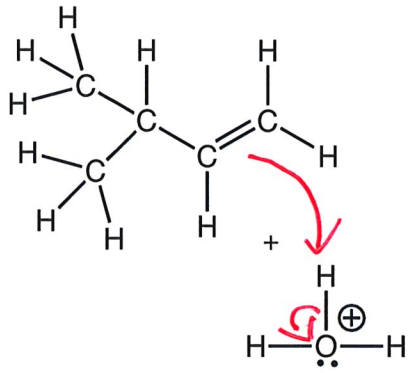
Example:



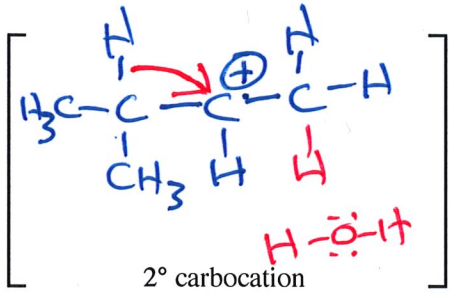
(not chiral)

Cation Rearrangement



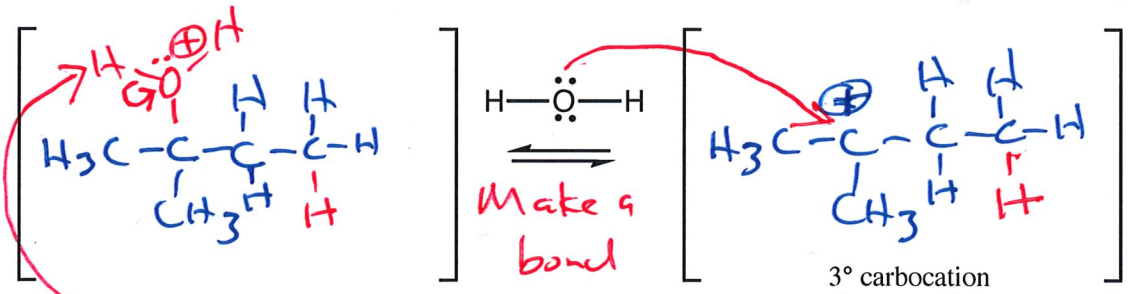


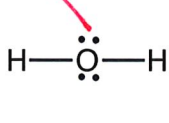
Add a proton



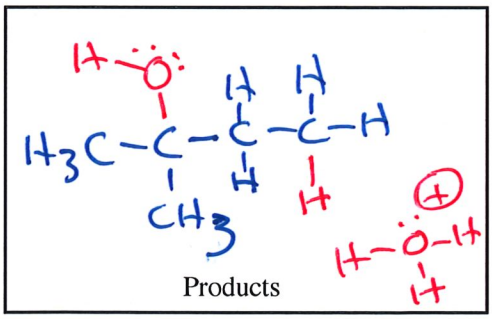
Rearrangement

1,2 hydride shift





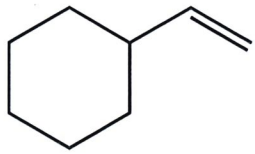
Take a proton away



Rearranged

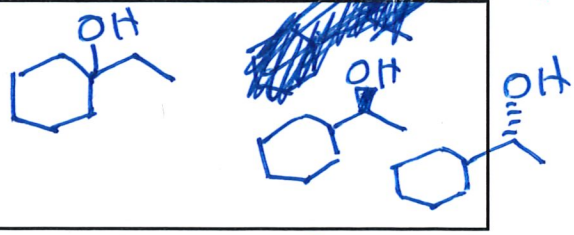
Not rearranged

Example:



H_2O

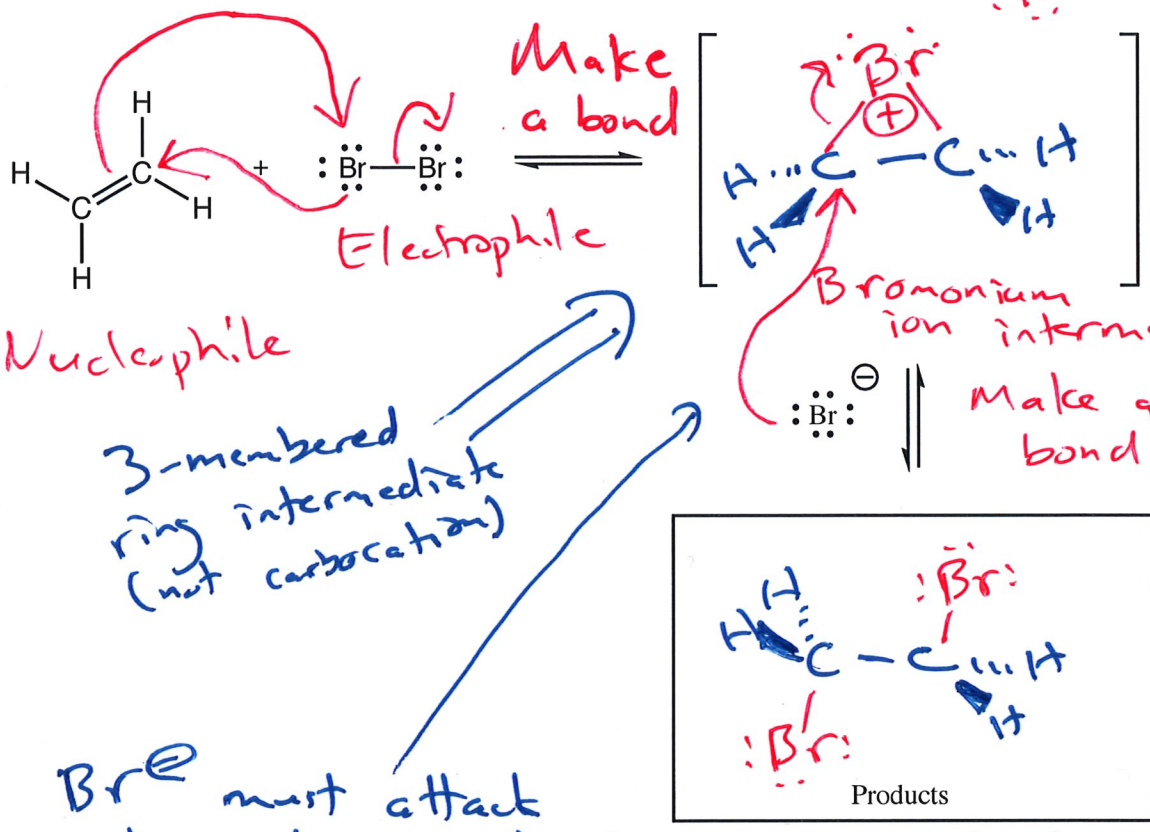
H_2SO_4 (catalytic amount)



Racemic

Alkene add X_2 in solvent → no water

Alkene Halogenation



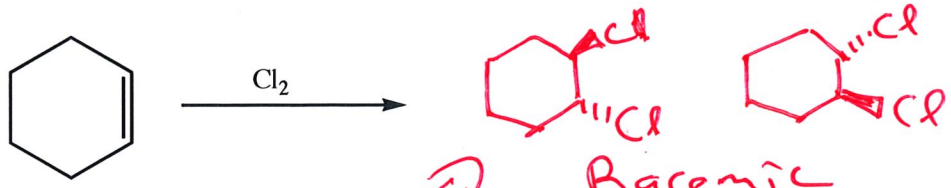
$Br^{\ominus}$ must attack from the side opposite the Br atom of 3-membered ring ⇒ (called "anti" addition geometry)

Summary: Alkenes add X_2 to give a halonium ion (3-membered ring) that is attacked from the side opposite the X atom to make a bond

Regiochemistry: N/A

Stereochemistry: anti

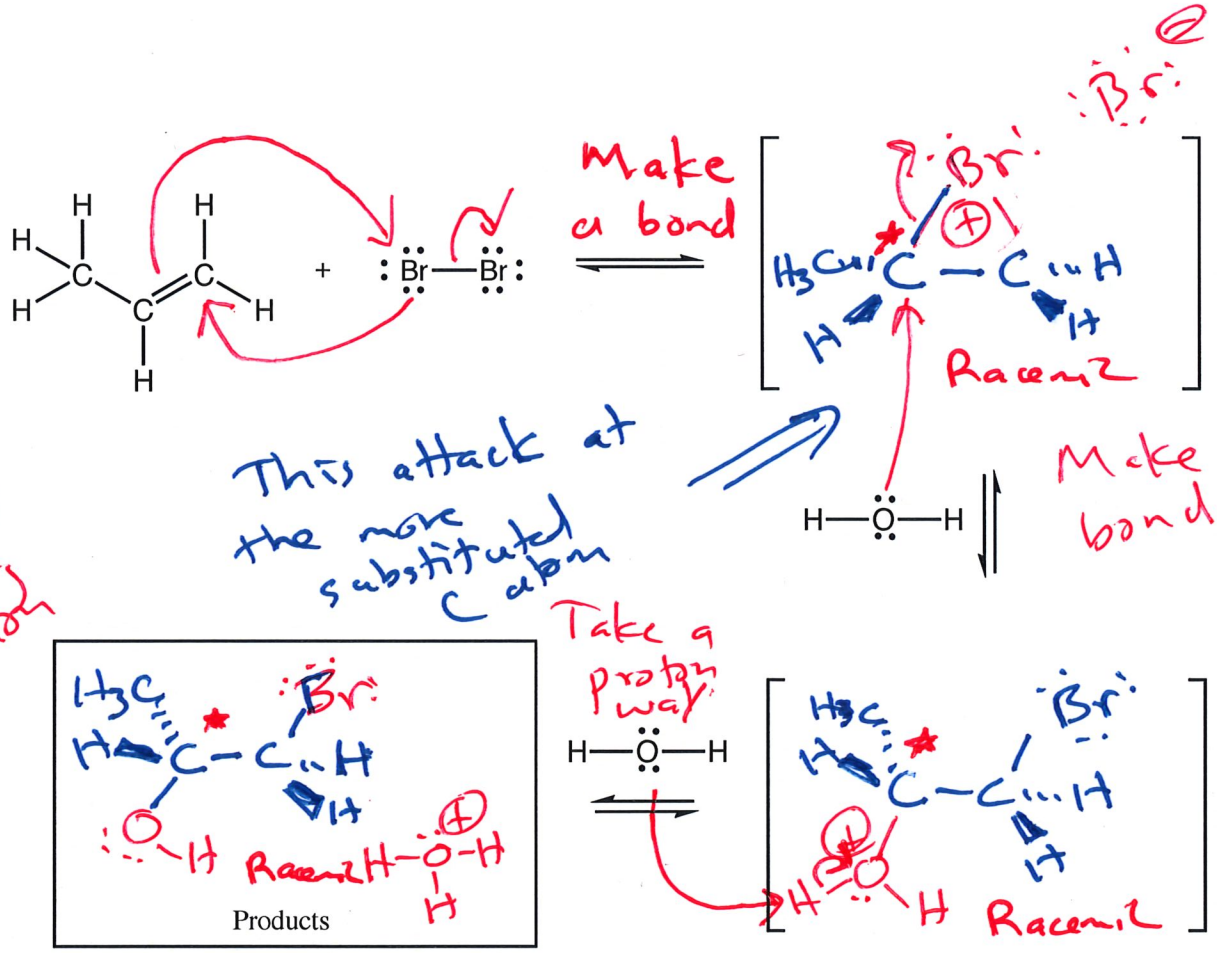
Example:



anti addition means trans products only ⇒ No cis!!

Add an alkene to a solution of water the add the X_2

Alkene Hydrohalogenation

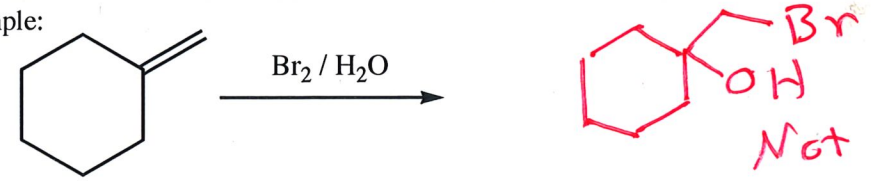


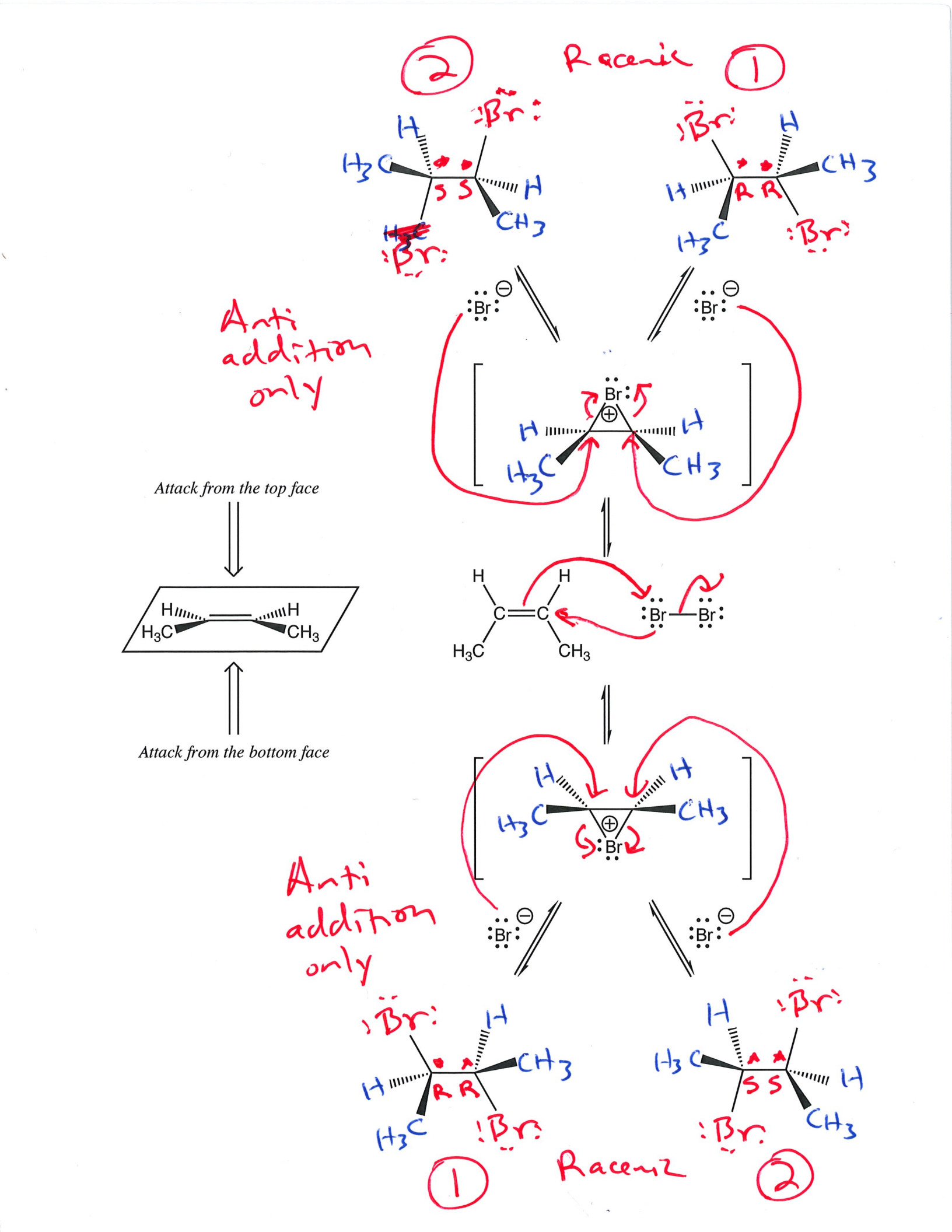
Summary: In H_2O, alkenes react with X_2 to give halonium ion intermediate that adds H_2O at more substituted carbon, take a proton away to give halohydrin

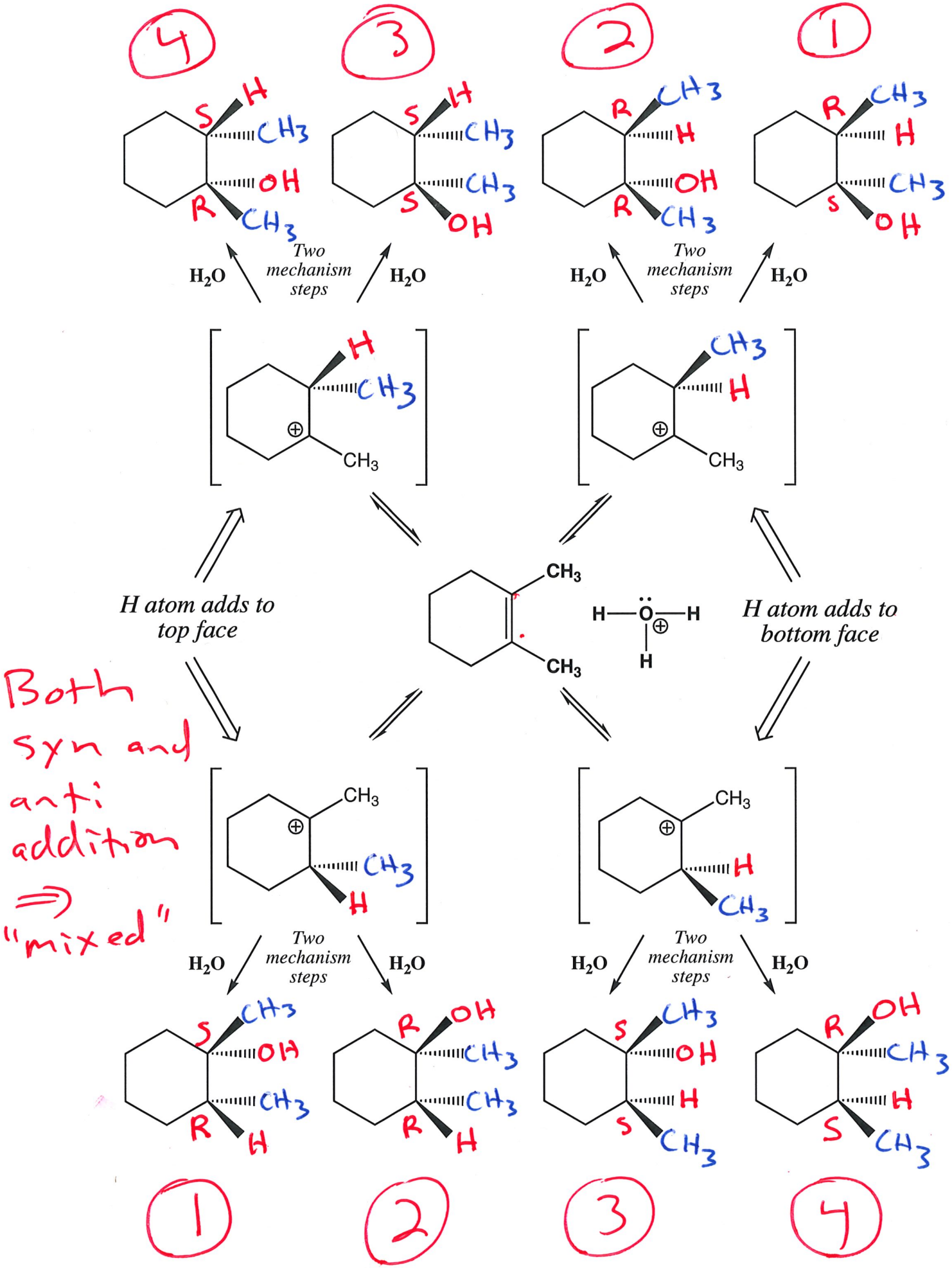
Regiochemistry: Markovnikov Rule

Stereochemistry: anti

Example:



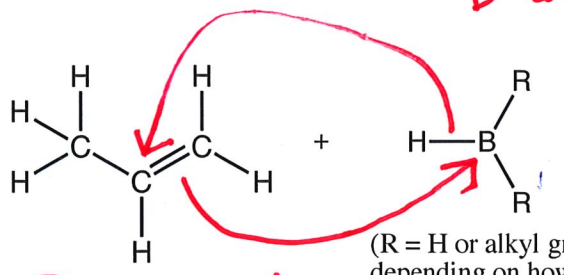

2
Racemic
1
Anti addition only
Attack from the top face
Attack from the bottom face
Anti addition only
1
Racemic
2


4
3
2
1
H2O
Two mechanism steps
H2O
H2O
Two mechanism steps
H2O
H atom adds to top face
H atom adds to bottom face
Both syn and anti addition ⇒ "mixed"
H2O
Two mechanism steps
H2O
H2O
Two mechanism steps
H2O
1
2
3
4

Hydroboration-Oxidation

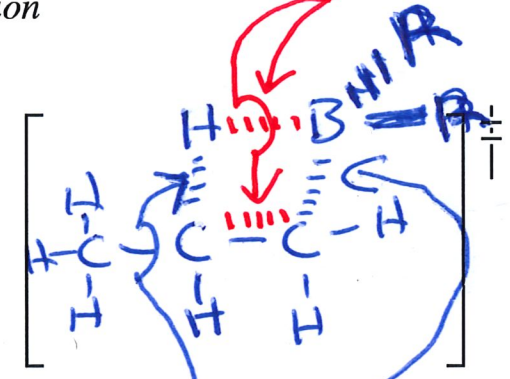
Nucleophile

Electrophile B atom



(R = H or alkyl group depending on how far reaction has progressed)

Bonds being broken

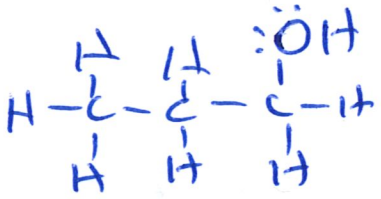


transition state

Bonds that are forming

The B and H atoms add to the same face of the alkene

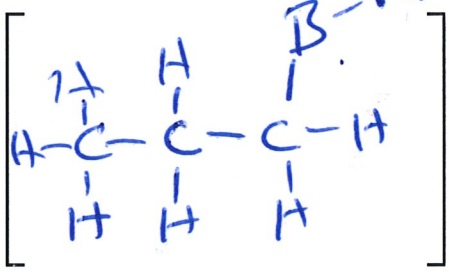
Syn addition



Products

2. H_2O_2 / $HO^{\ominus}$

(Chemist opens flask and adds new reagent)



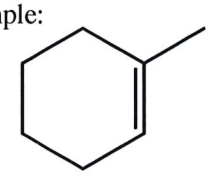
H ends up on more substituted C atom to minimize steric strain in transition state above

Summary: The pi bond of the alkene attacks the B atom while the H-of BH_3 attaches to the more substituted C of the alkene.

Regiochemistry: Non-Markovnikov

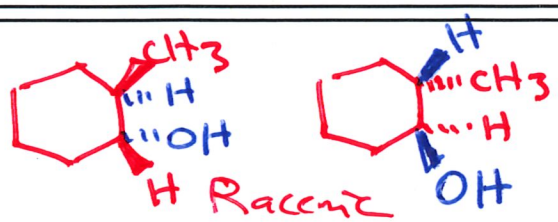
Stereochemistry: Syn

Example:



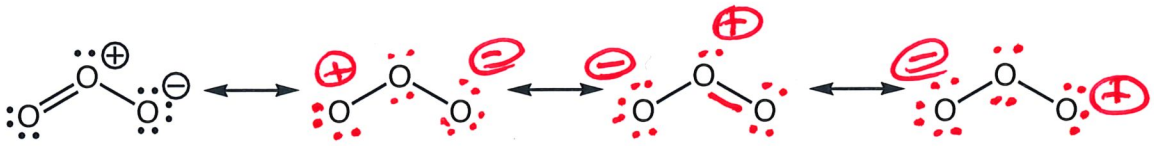
1. BH_3

2. H_2O_2 / $HO^{\ominus}$

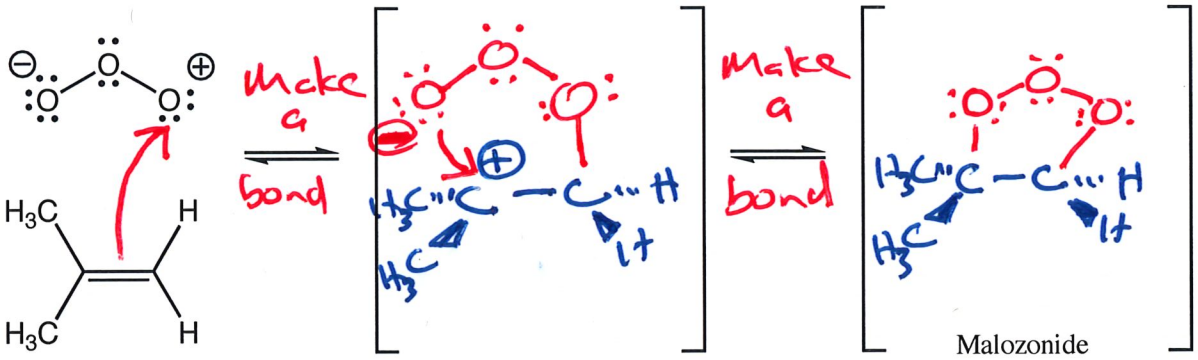


H Racemic

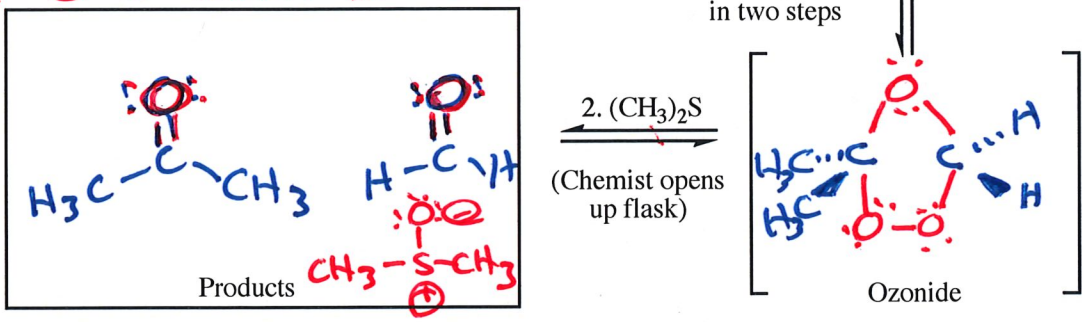
Ozonolysis Partial Mechanism



Ozone contributing structures



Replaced C=C with 2 C=O

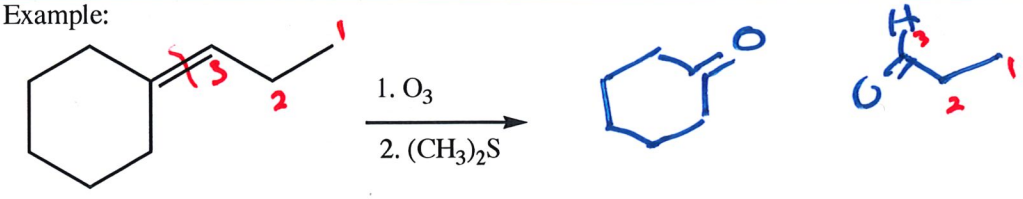


Summary: Reaction of an alkene with O_3 creates an ozonide that decomposes with $(CH_3)_2S$ to give aldehydes and ketones

Regiochemistry: N/A

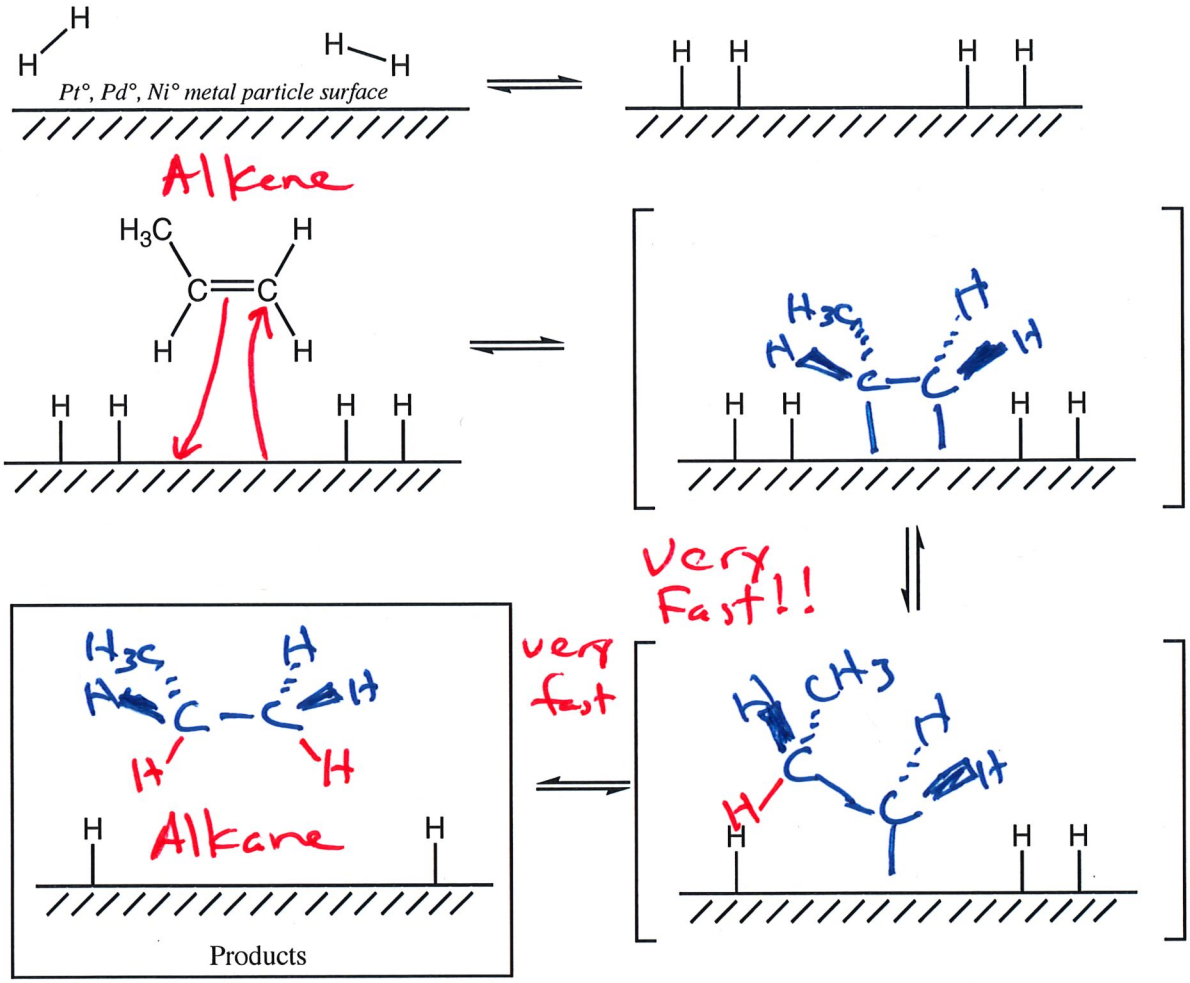
Stereochemistry: N/A

Example:



Converts alkenes to alkanes

Hydrogenation: H_2 with Pt°, Pd°, Ni°



Summary: H_2 adsorbs onto the metal surface → alkene adsorbs onto the metal surface → H atoms transfer to both C atoms on same face

Regiochemistry: N/A

Stereochemistry: Syn addition

Example: