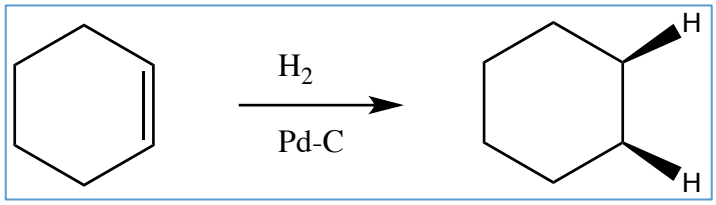
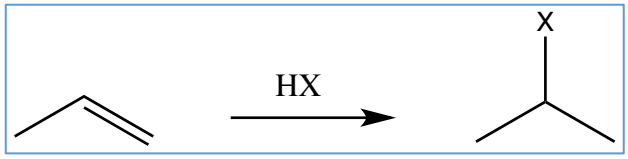
Alkenes: Summary of All Alkene Reactions (With Example/Important Notes)

1.) Catalytic Hydrogenation



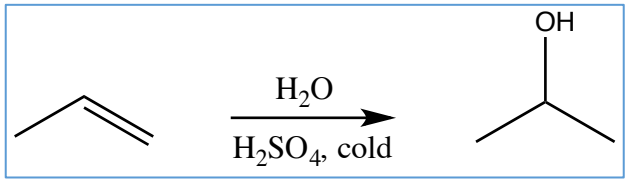
- **Syn** Addition (added to same side)
- Can occur with D_2 or T_2 (deuterium or tritium, isotopes of hydrogen)

2.) Markovnikov Addition of a Binary Acid (HCl, HBr, HI, or generally HX)



- When protonating the pi bond, form the **most** stable carbocation
- Rearrangements occur (carbocation formed in mechanism)

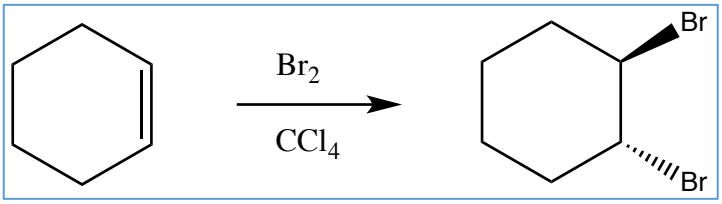
3.) Markovnikov Addition of Water



- When protonating the pi bond, form the **most** stable carbocation
- Rearrangements occur (carbocation formed in mechanism)

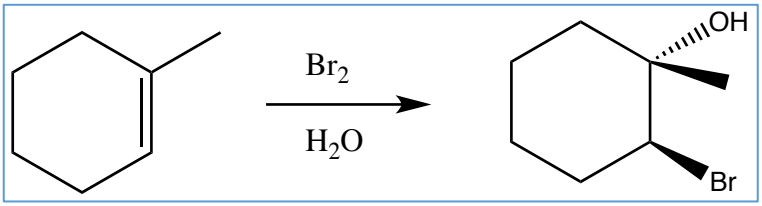
4.) Addition of Dihalide/Additional Nucleophile

4.1) Addition of Strictly a Dihalide



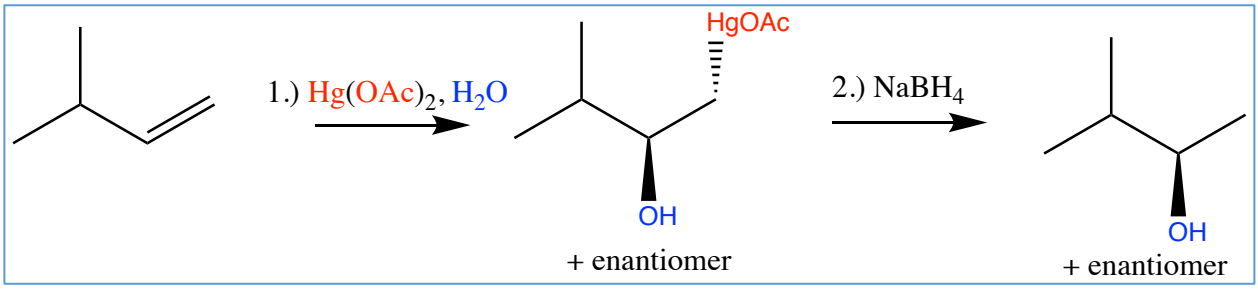
- Forms a **Vicinal** Dihalide (vicinal = 2 things attached to adjacent carbons)
- **Anti** Addition (2 new things attached are on **opposite** sides)
- Cyclic Bromonium Ion Formed: As a result, perform backside attack just like you would on an epoxide in an **acidic** environment

4.2) Addition of Dihalide and Another Nucleophile



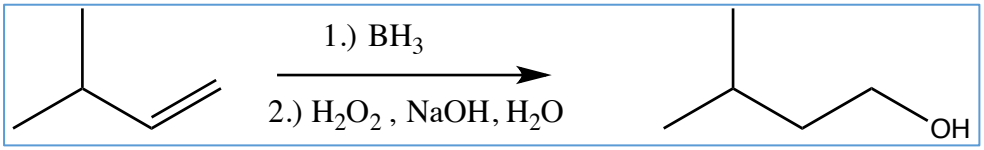
- Through the mechanism we discussed, the bromine adds **FIRST**, then water (or whatever other nucleophile you have) attacks. And remember, it attacks in the same manner you would attack an epoxide in an **acidic** environment.

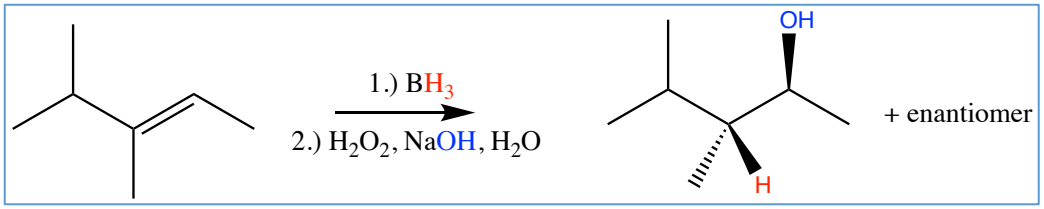
5.) Oxymercuration – Demercuration



- **NO** carbocation rearrangements. This is a straight up Markovnikov Addition.
- If asked for the alcohol-mercury product: This is an **Anti** Addition (similar mechanism to an epoxide in acidic environment).
    - Refer back to oxymercuration video for refresher if needed.

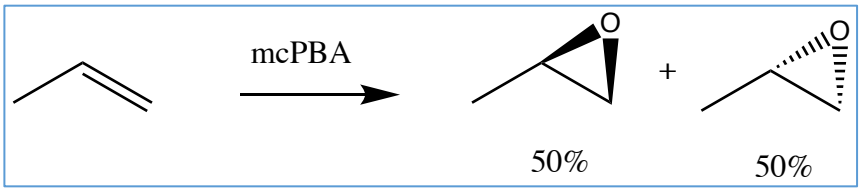
6.) Hydroboration – Oxidation (2 example shown)





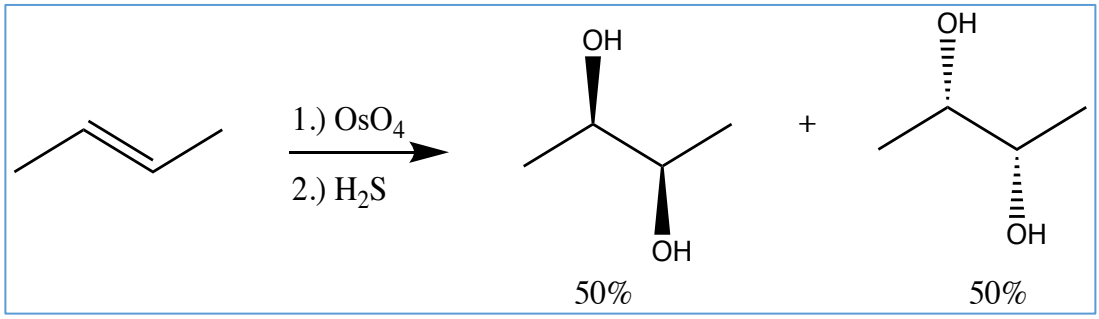
- No rearrangements whatsoever. This is an Anti-Markovnikov Addition of water
  - Remember: Anti here just means opposite of the Markovnikov product
- IF stereochemistry matters, this reaction is a **Syn** Addition
  - Watch out for tricks such as: BD_3 instead of BH_3 and $NaOCH_3$ instead of NaOH

7.) Epoxide Formation



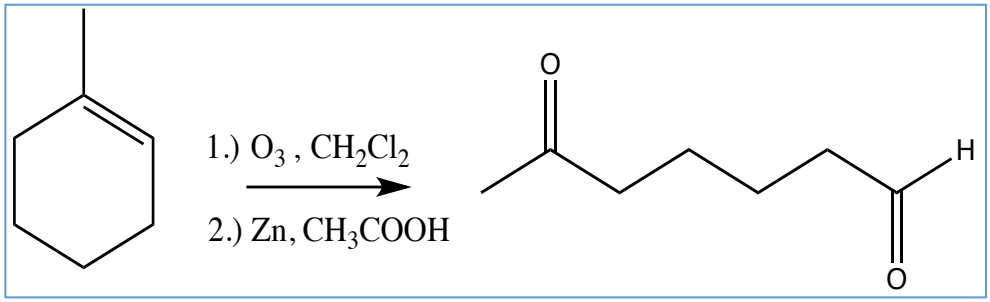
- Memorize this reagent. It yields racemic mixture (50% of both enantiomers)

8.) Dihydroxy Addition with Osmium Tetroxide



- **Syn** Addition (added to the same side)
- **Vicinal** diol (two alcohols, on carbons next door to each other)

9.) Ozonolysis



- Cleave the double bond(s) present in the molecule given: Form ketones and aldehydes where appropriate on the carbon atoms that **were** a part of the double bond

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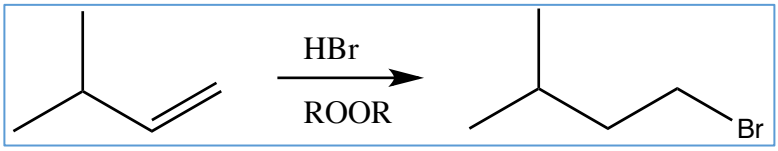
10.) Anti-Markovnikov Addition of HBr



- Definitely know this mechanism well (it's drawn out on the next page)
- Anti-Addition aka the opposite Markovnikov product
- THIS ONLY WORKS WITH HBr—NO EXCEPTIONS
- This is a chain reaction, meaning that when you draw the mechanism, it is important to include the formation of the bromine radical in the last step, because by nature of doing the reaction, it produces the very thing that will keep it going.

Mechanism on next page

Anti-Markovnikov Addition of HBr: Mechanism (of the reaction above)