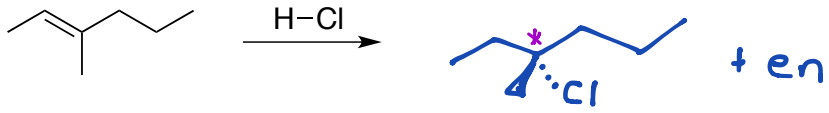
Answer Key

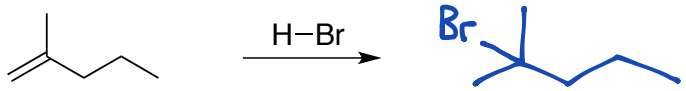
Chemistry 233

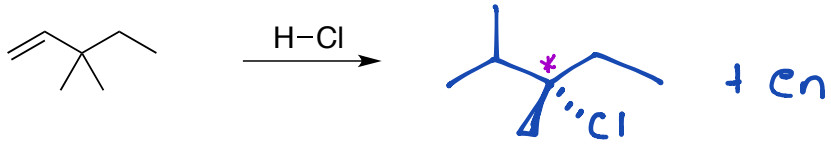
Chapter 8 Problem Set

Addition of HX To Alkenes

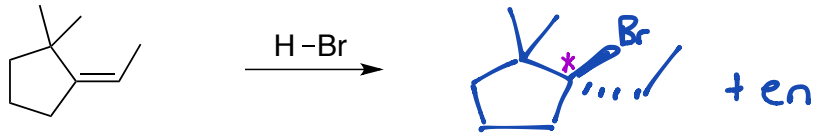
1. Predict the products for each of the following reactions. If the reaction generates a new chiral center, take that into consideration. When enantiomers are formed, you only need to draw one enantiomer. When diastereomers are formed, draw all products.

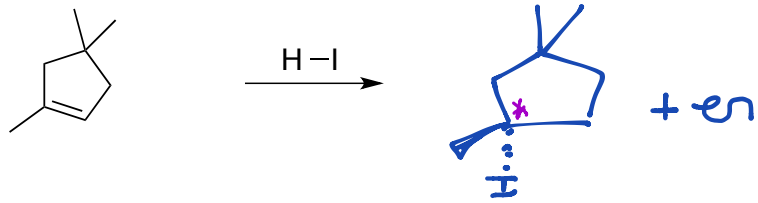
a. 

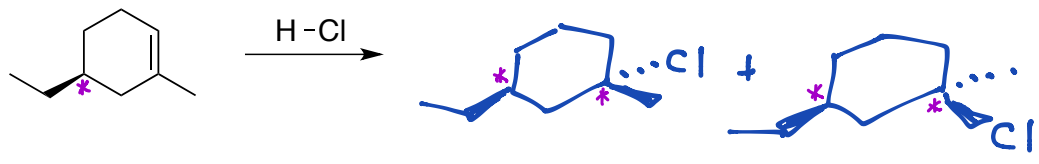
b. 

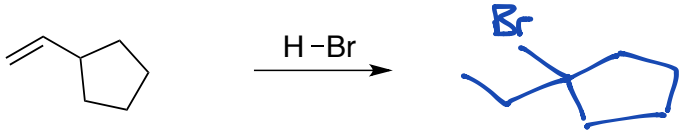
c. 

Carbocation rearrangement takes place

d. 

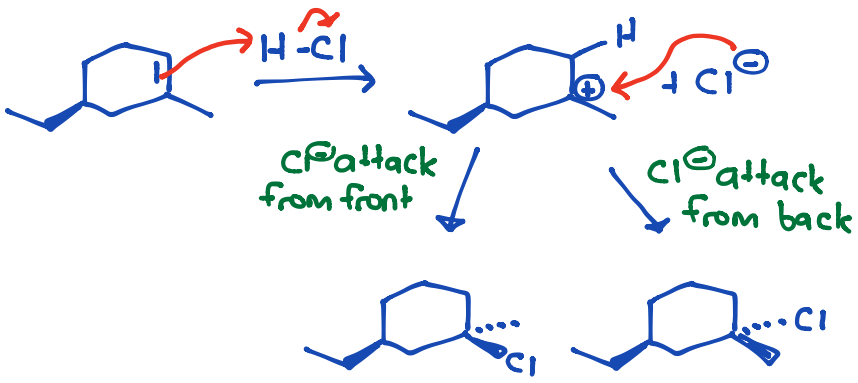
e. 

f. 

h. 

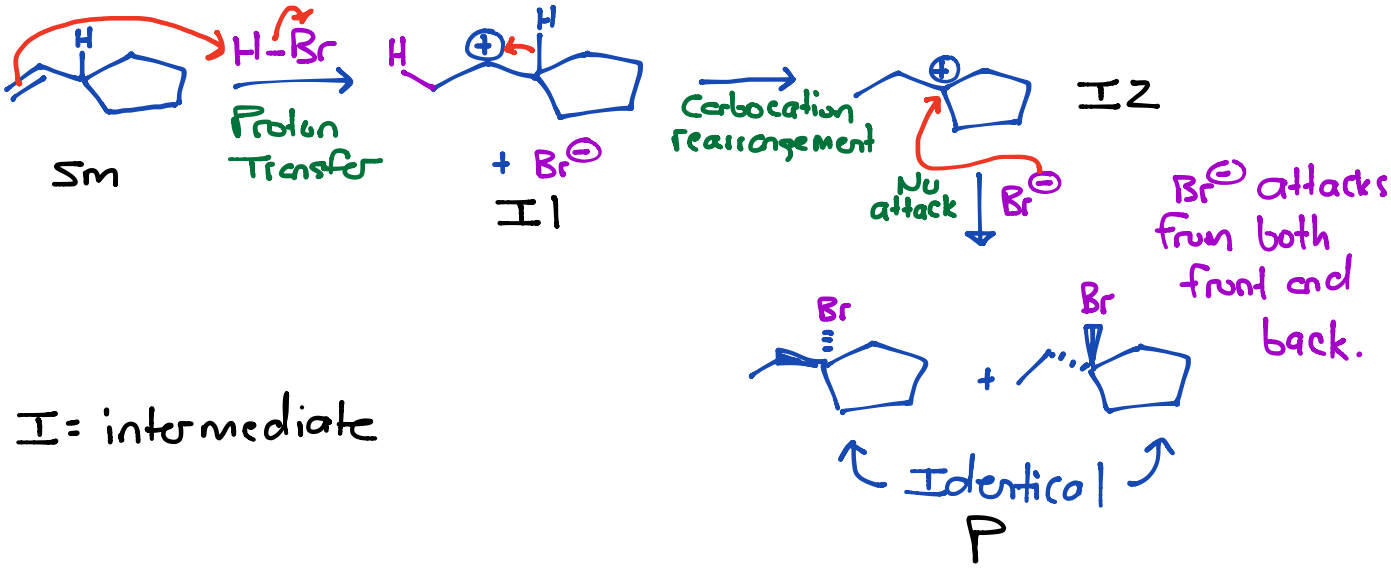
en = enantiomer

2. Show the full arrow pushing mechanism for the reaction in **part f** (above).



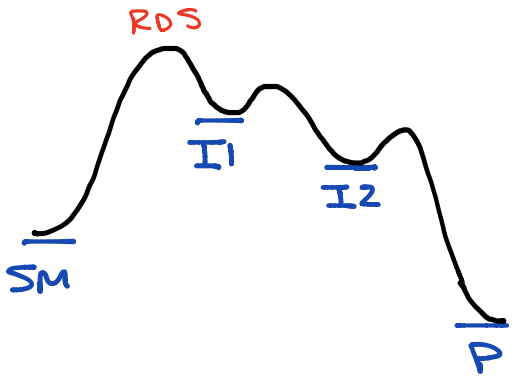
Remember the carbocation is sp^2 (trigonal planer) therefore the $Cl^{\ominus}$ has can add from either side to give the sp^3 (tetrahedral) product

3. Show the full arrow pushing mechanism for the reaction in **part h** (above).



I = intermediate

4. Draw a simple energy diagram for the reaction in **part h**. Label your starting material, product, and each intermediate. Note: The first step is the rate determining step.



Key features:

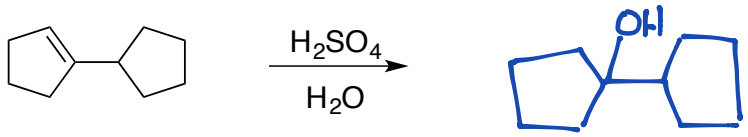
$E_P < E_{SM}$

$E_{I1} + E_{I2} > E_{SM} + E_P$

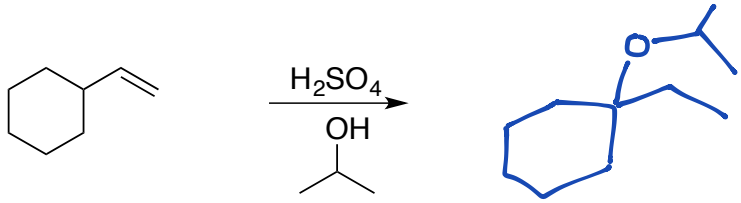
$E_{I1} > E_{I2}$
(2° cc) (3° cc)

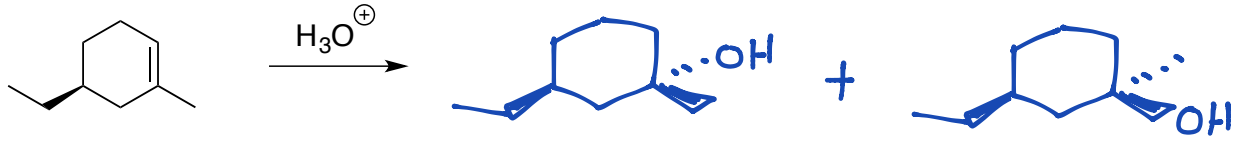
Addition of H^+ and H_2O or HOR to Alkenes

5. Predict the products for each of the following reactions. If the reaction generates a new chiral center, take that into consideration. When enantiomers are formed, you only need to draw one enantiomer. When diastereomers are formed, draw all products.

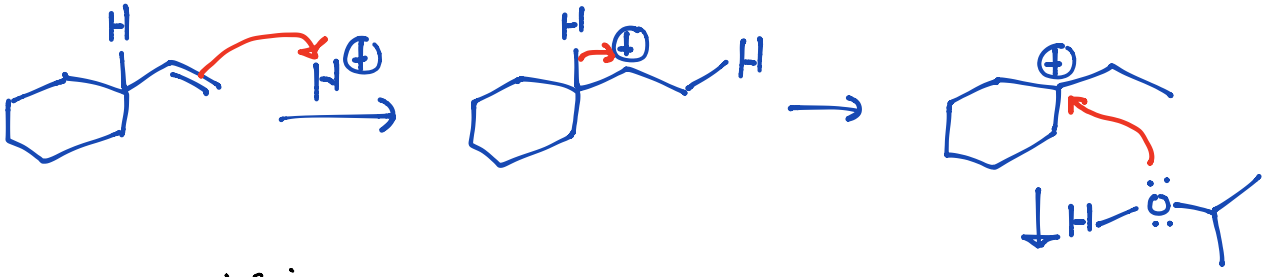
a. 

b. 

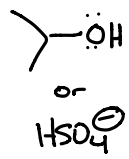
c. 

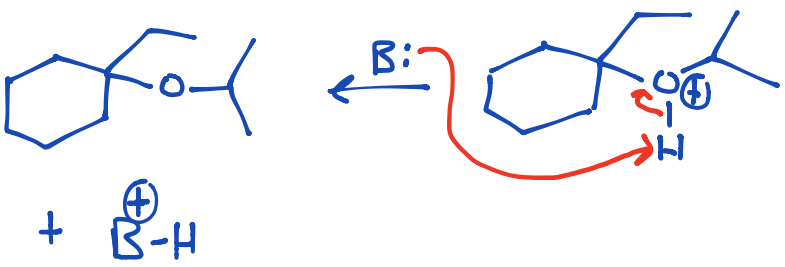
d. 

6. Show the full arrow pushing mechanism for the reaction in **part c** (above).



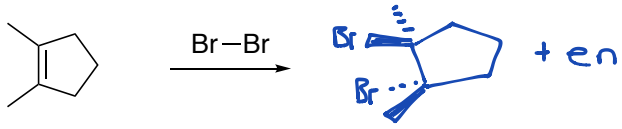
B: can be any species in the soln with a lone pair.

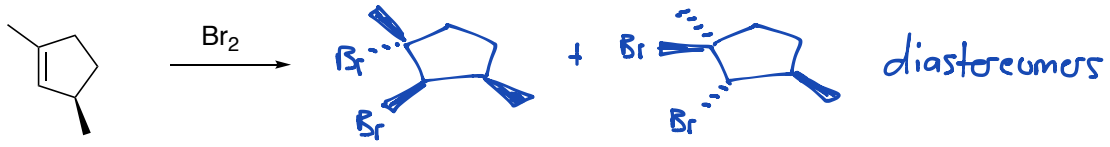
For example: 

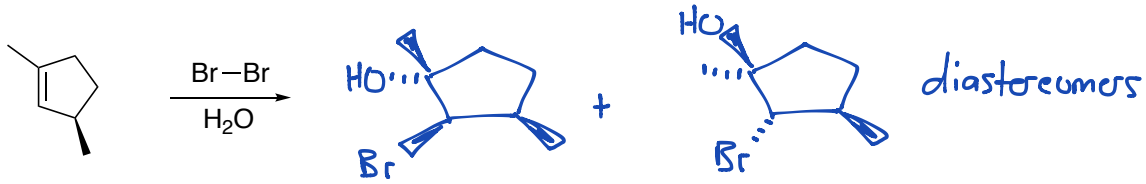


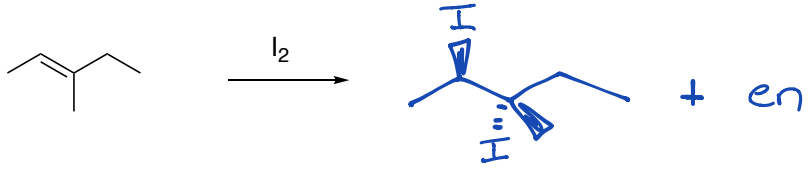
Halogenation of Alkenes and Halohydrin Formation

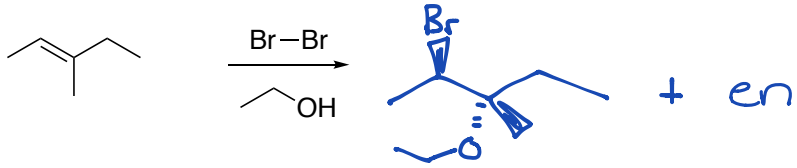
7. Predict the major products for each of the following reactions. Be sure to indicate stereochemistry where appropriate.

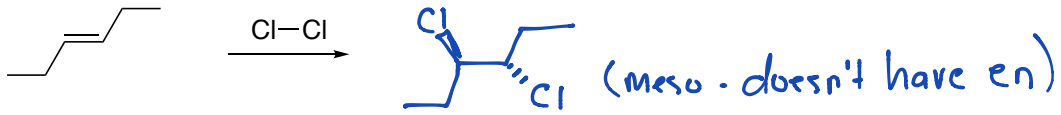
a. 

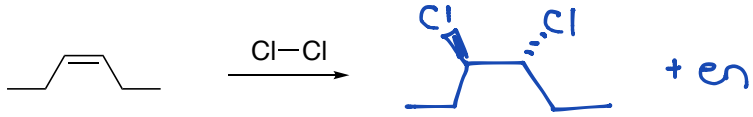
b. 

c. 

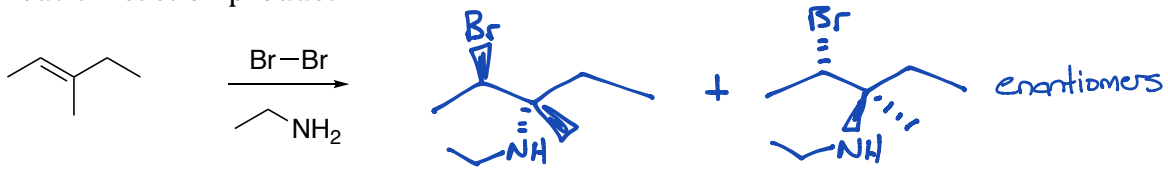
d. 

e. 

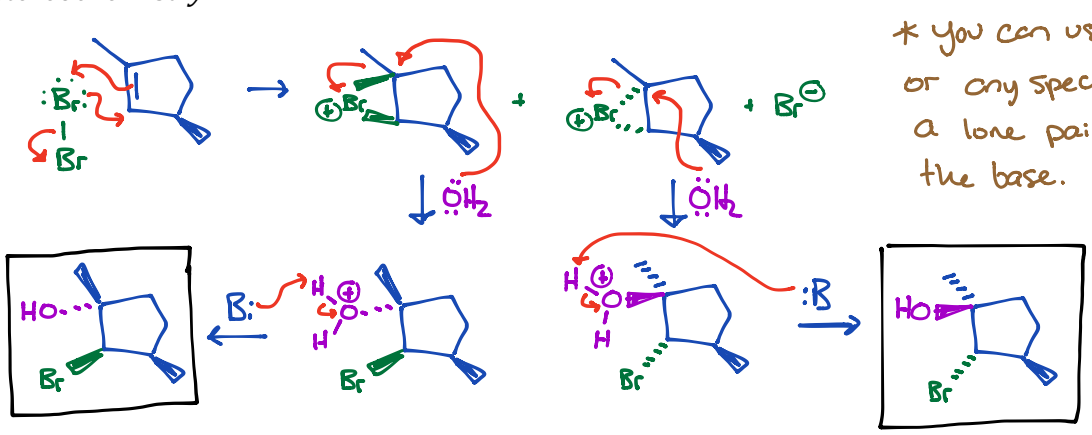
f. 

g. 

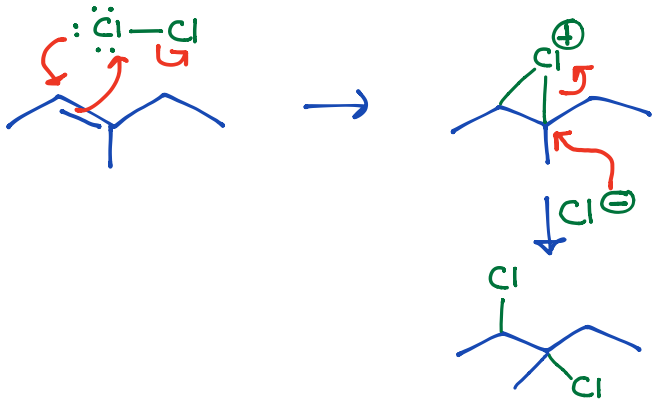
8. Predict the product for the following reaction. While it may appear different, it is mechanistically identical to 7e. The nitrogen has a lone pair (like the oxygen) which adds to the boromonium ion as a nucleophile. A proton is then lost from the nitrogen to give the neutral reaction product.



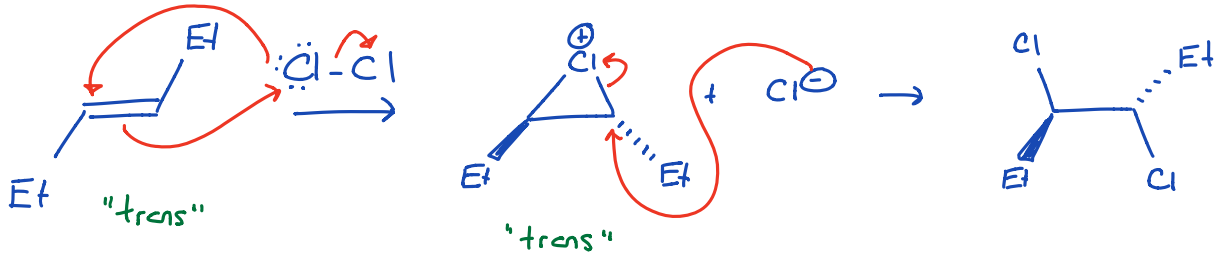
9. Show the full arrow pushing mechanism for the reaction in question **7c**. *Include stereochemistry.*



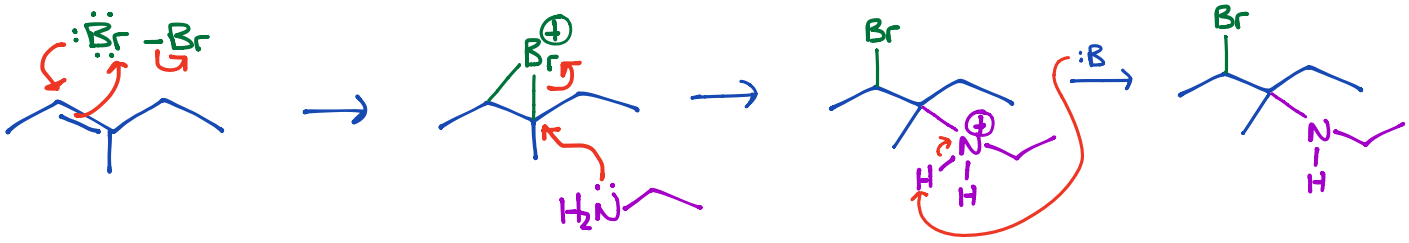
10. Show the full arrow pushing mechanism for the reaction question **7d**.



11. Show the full arrow pushing mechanism for the reaction question **7f**.

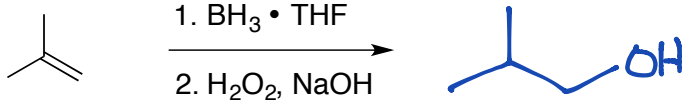


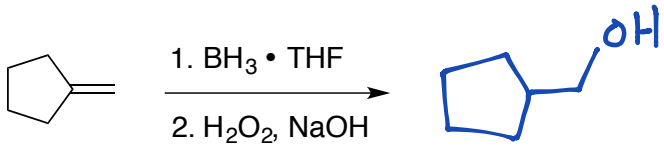
12. Show the full arrow pushing mechanism for the reaction question **8**.

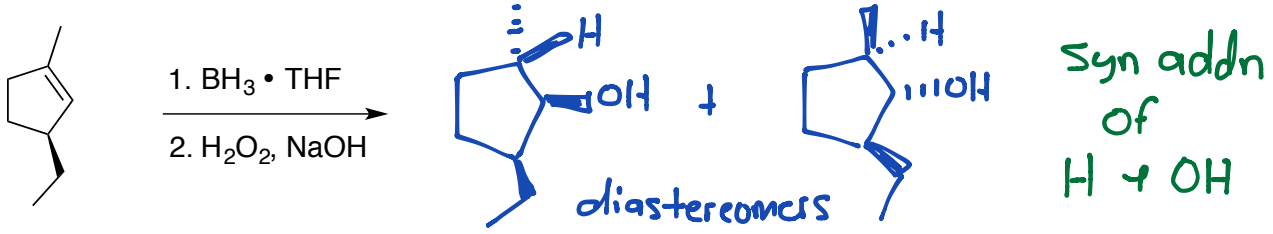


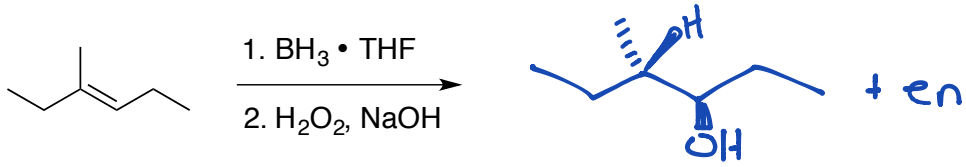
Hydroboration/Oxidation

11. Predict the major product for each of the hydroboration-oxidation reactions shown below.

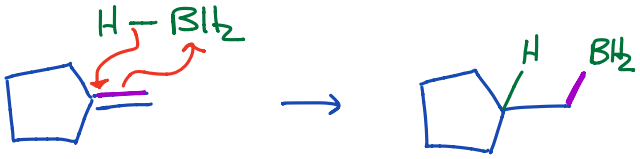
a. 

b. 

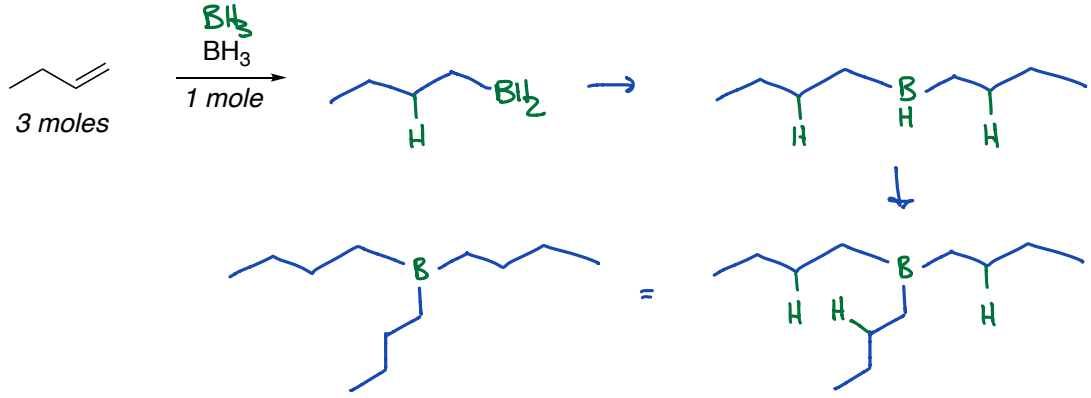
c. 

d. 

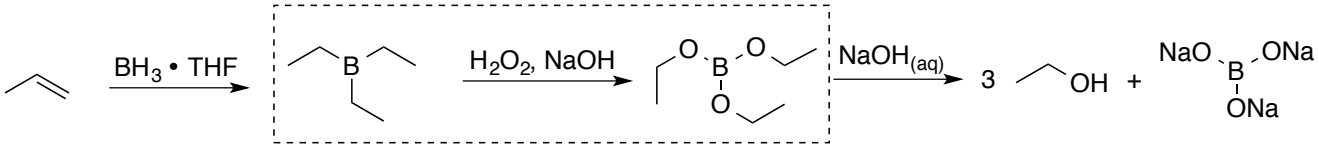
12. Show the arrow pushing mechanism for the addition of borane to the alkene in **11b**.

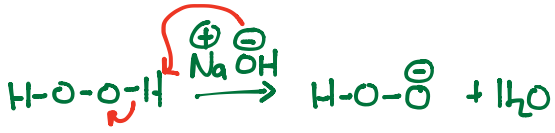


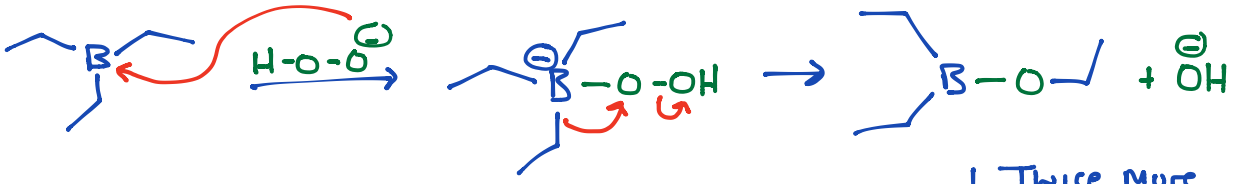
13. One mole of BH_3 can actually react with 3 moles of alkene. Show this product for the reaction below.



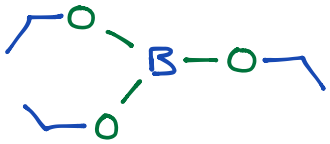
14. Show the full arrow pushing mechanism for the oxidation step shown in the box below.
You do not have to know this mechanism step for the exam but give it a shot.





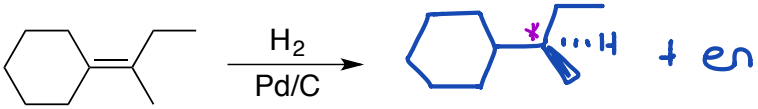


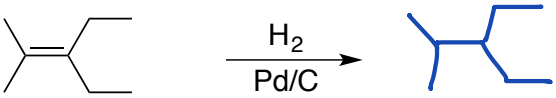
Twice more with H-O-O⊖

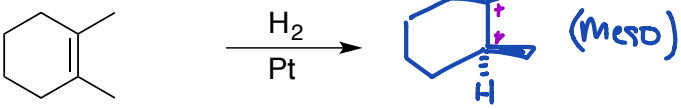


Alkene Hydrogenation

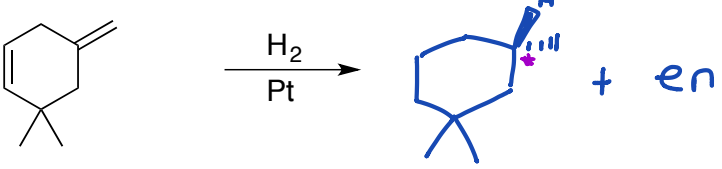
14. Predict the major product(s) for each of the following reactions. Show stereochemistry where appropriate. When enantiomers are formed, you only need to draw one enantiomer. When diastereomers are formed, draw all products.

a. 

b. 

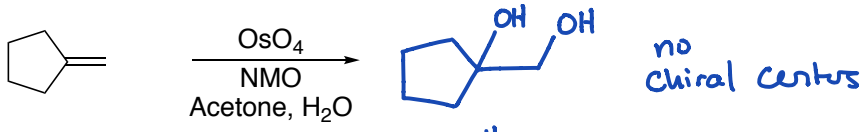
c. 

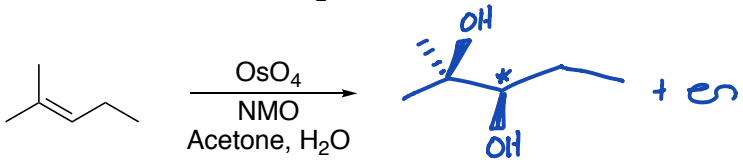
d. 

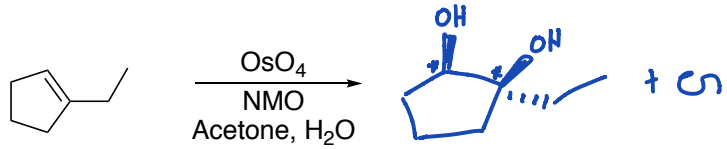
e. 

Dihydroxylation

15. Predict the major product(s) for each of the following reactions.

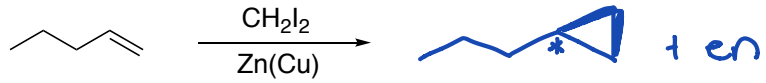
a. 

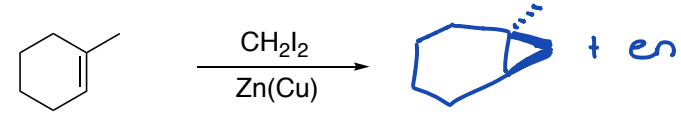
b. 

c. 

Cyclopropanation

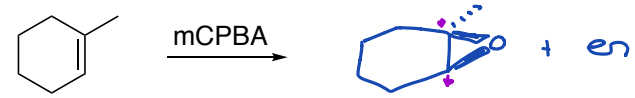
16. Predict the major product(s) for each of the following reactions.

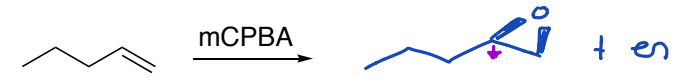
a. 

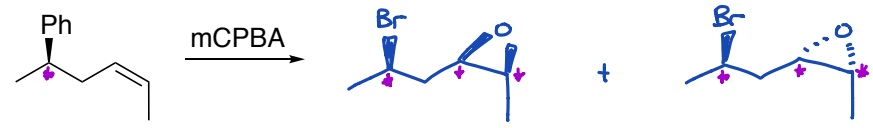
b. 

Epoxidation of Alkenes

17. Predict the major product(s) for each of the following reactions.

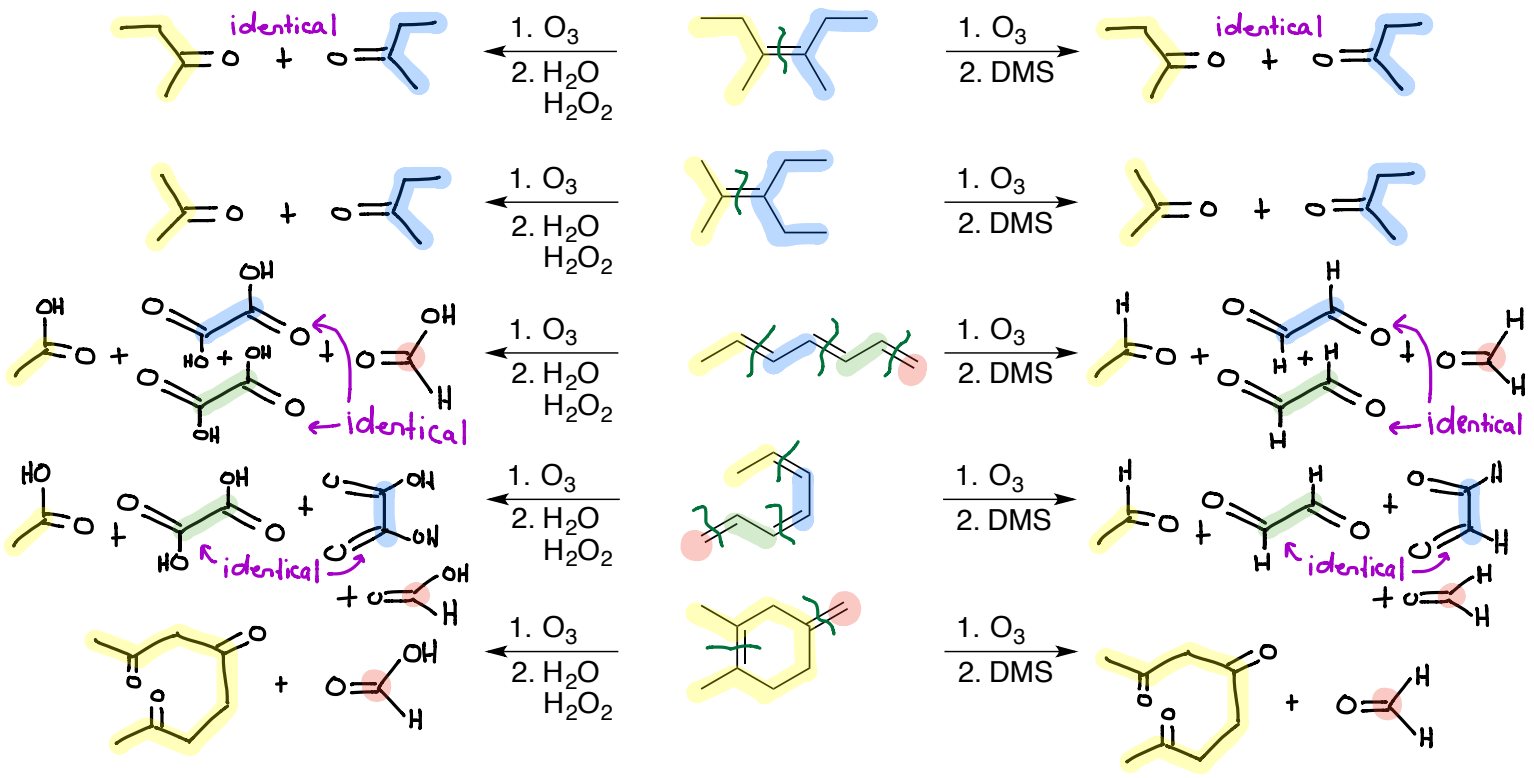
a. 

b. 

c. 

Ozonolysis of Alkenes

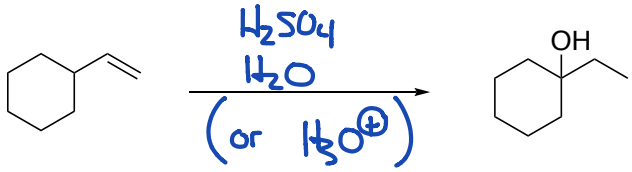
18. Predict the major products for each of the ozonolysis reactions shown below.



Synthesis Involving Reactions of Alkenes

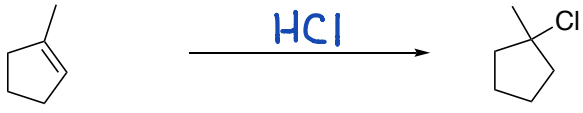
19. Identify the reagent(s) that you would need to accomplish the following transformations.

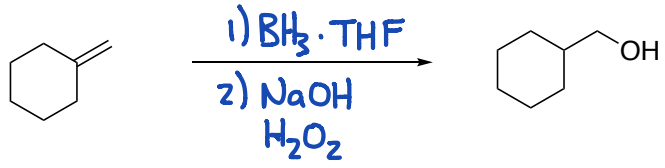
a.

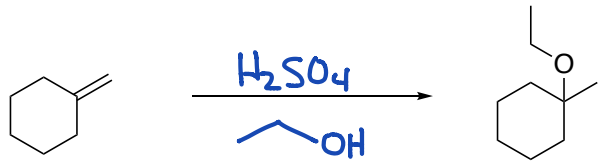


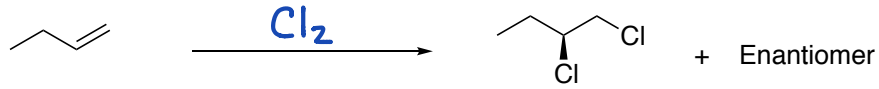
b.

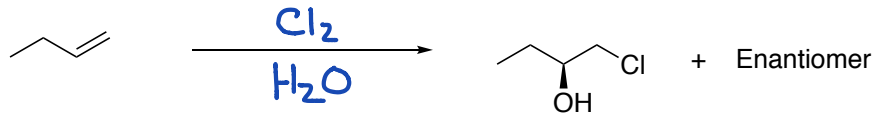
c.



d. 

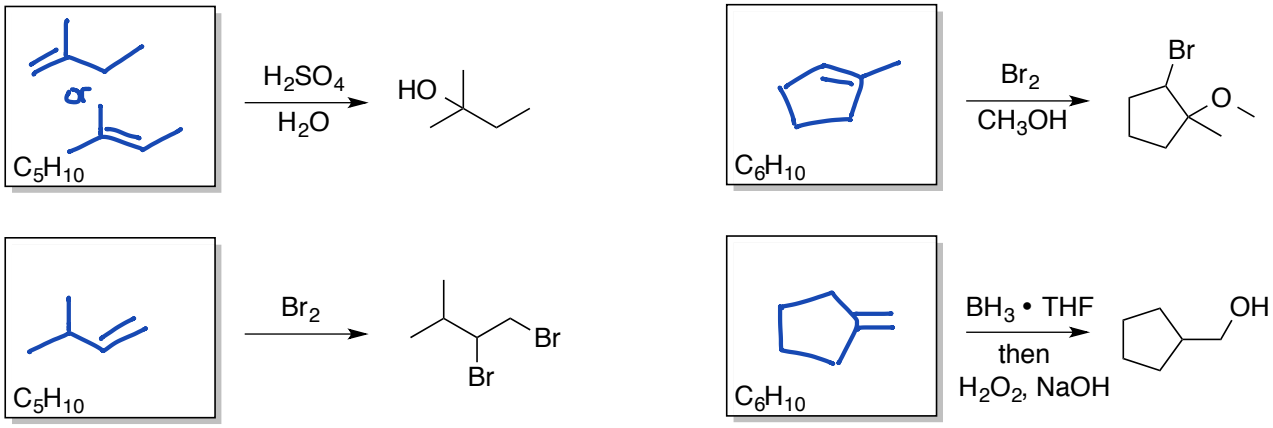
e. 

f. 

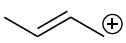
g. 

Additional Problems

20. Draw the structure of the alkene that was used in each of the following reactions. The molecular formula of the starting material is provided.



21. The carbocation below appears to be a primary carbocation yet it is even more stable than a tertiary carbocation. Explain.



Regular 1° ⊕ is not resonance stabilized

This is a 1° allylic cation and it is resonance stabilized.