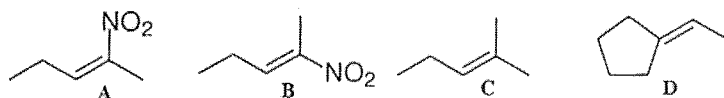


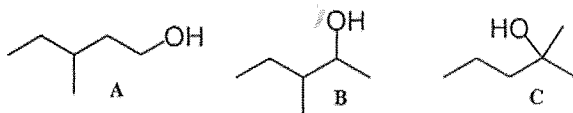
1. How many elements of unsaturation are in the formula  $C_6H_9NO_2$ ? (3 points)

- a. 0    b. 1    c. 2    **d. 3**    e. 4    f. 5    g. 6

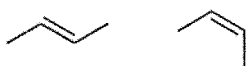
2. For the three structures shown, which of the statements is true? (3 points)



- a. A, C, and D are Z; B is E  
 b. A and B are the only Z compounds  
**c. A is the only Z compound; B is the only E compound**  
 d. B, C, and D are Z; A is E  
 e. B is the only Z compound; A is the only E compound
3. Rank the reactivity of the following toward  $H_2SO_4/H^+$  catalyzed dehydration. (3 points)
- a. A is fastest; C is slowest  
 b. B is fastest; C is slowest  
 c. A is fastest; B is slowest  
 d. C is fastest; B is slowest  
 e. B is fastest; A is slowest  
**f. C is fastest; A is slowest**

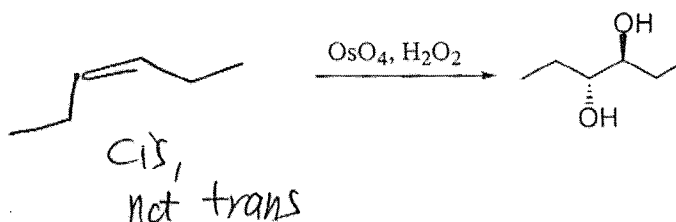


4. Which of the following reactants would give exactly the same products from both (E)- and (Z)-2-butene? (3 points)

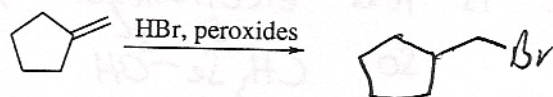
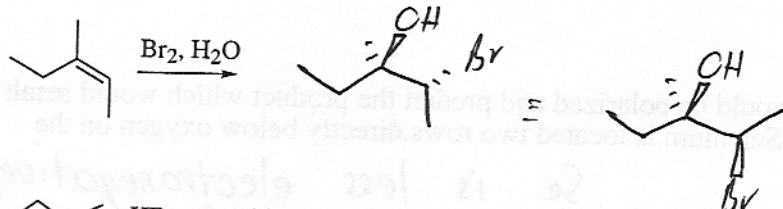
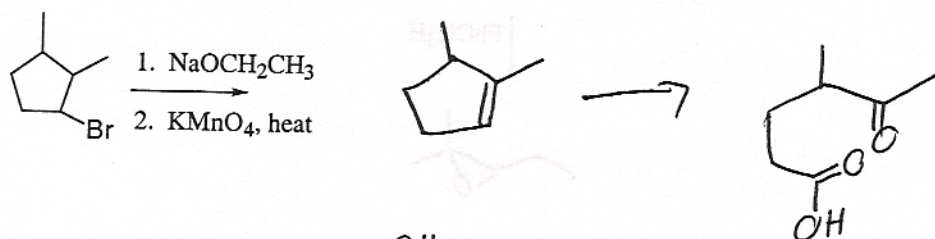
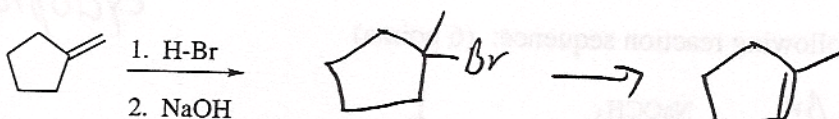
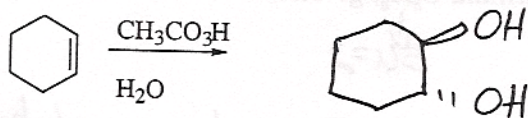
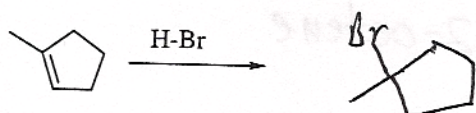
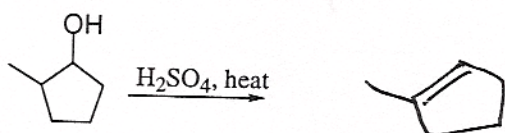
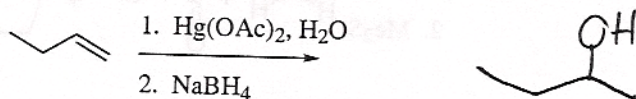


- a.  $Br_2$   
 b.  $PhCO_3H$   
**c. 1)  $BH_3$ -THF 2)  $NaOH, H_2O_2$**   
 d.  $OsO_4, H_2O_2$   
 e.  $D_2, Pt$

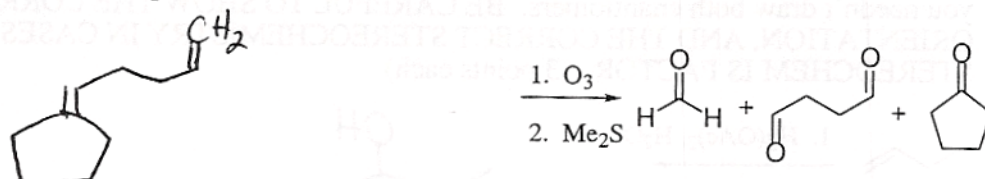
5. Draw the alkene that gives the product shown, and specify its stereochemistry. (2 points)



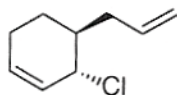
6. Draw the **major** product for each of the following reactions or reaction sequences. You needn't bother to show side products or minor products. For chiral molecules that are racemic, you needn't draw both enantiomers. BE CAREFUL TO SHOW THE CORRECT ORIENTATION, AND THE CORRECT STEREOCHEMISTRY IN CASES WHERE STEREOCHEMISTRY IS A FACTOR. (3 points each)



7. A single unknown reacts with  $O_3/Me_2S$  to give the following three products. What is the structure for the unknown? (3 points)

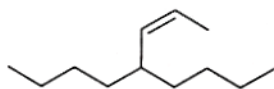


8. Provide the name or structure for the following. (3 points each)



trans-4-allyl-3-chlorocyclohexene

(racemic, don't do R/S stuff)



cis-4-butyl-2-octene  
or Z-

9. Provide a possible structure for a compound with formula  $C_5H_8$ , given that it reacts with excess  $H_2/Pt$  to give  $C_5H_{10}$ . (3 points)

must have alkene, ring

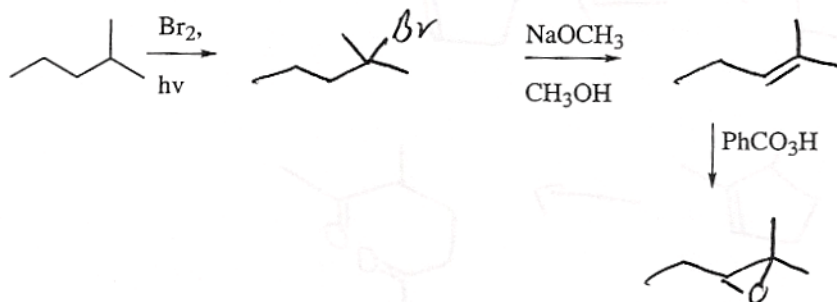
↓  
1 alkene

↓  
EU=2

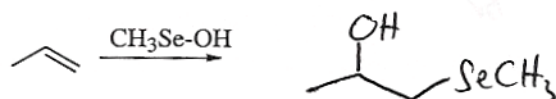


or any 5-carbon cyclobutenes, cyclopropenes

10. Fill in the blanks for the following reaction sequence: (6 points)



11. Consider how the Se-O bond would be polarized and predict the product which would result when  $CH_3SeOH$  adds to propene: (Selenium is located two rows directly below oxygen on the periodic table). (3 points)

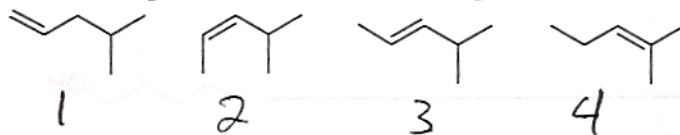


Se is less electronegative,  
so  $CH_3\overset{\delta+}{Se}-\overset{\delta-}{OH}$

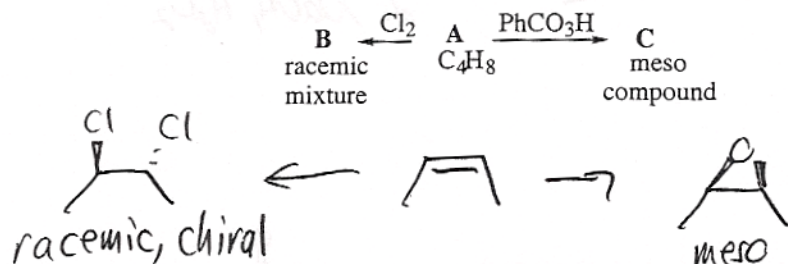
Markovnikov:  $\delta+$  outside adds  
 $\delta-$  inside

12. When the following isomeric alkenes are fully burned, rank the amount of heat produced in the combustions, from most heat produced (1) to least heat produced (4). (3 points)

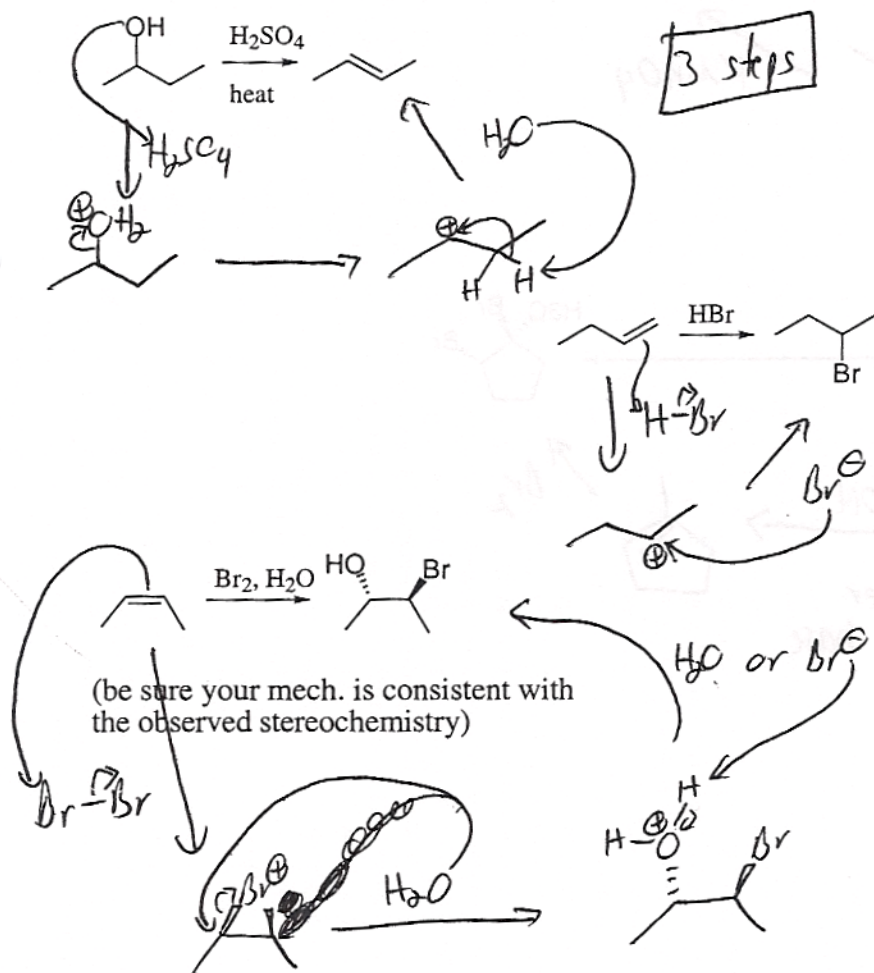
opposite  
to stability



13. Provide structures for starting material **A** and reactions products **B** and **C**, given the formula of starting material **A** and the stereochemical status of products **B** and **C**. (5 points)



14. Draw mechanisms for the following reactions, using formal arrow-pushing. Each intermediate along the mechanism pathway must be shown. (6 points, 3 points, 6 points)





15. Provide reagents for the following transformations. (5 points each)

