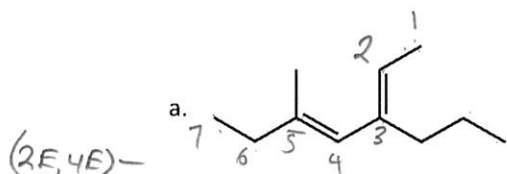


1. Name the following compounds. Don't forget to assign any stereochemistry using the correct notation. (15 points)

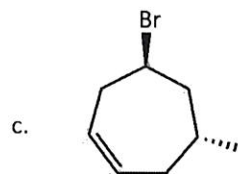


(2E, 4E)-

5-methyl-3-propylhepta-2,4-diene



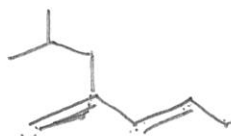
bicyclo[2.2.1]hept-2-ene



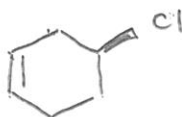
(4S, 6R)-4-bromo-6-methylcycloheptene

2. Draw the structure of the following compounds. (10 points)

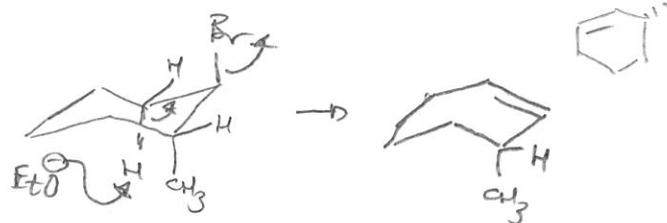
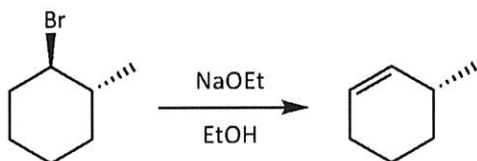
- a. (3E)-2-(2-methylpropyl)penta-1,3-diene



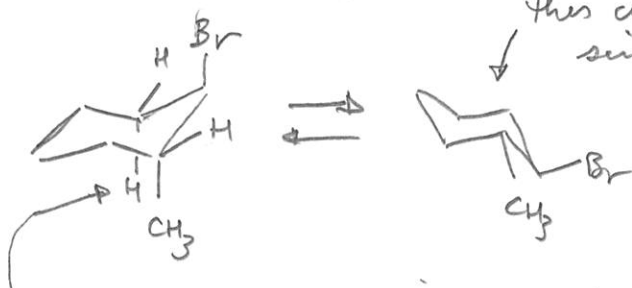
- b. (S)-4-chlorocyclohexene



3. Explain why the alkyl bromide shown below undergoes E2 reaction and only results in the Hofmann product shown below (none of the Zaitsev product is formed). (10 points)



view the chairs!



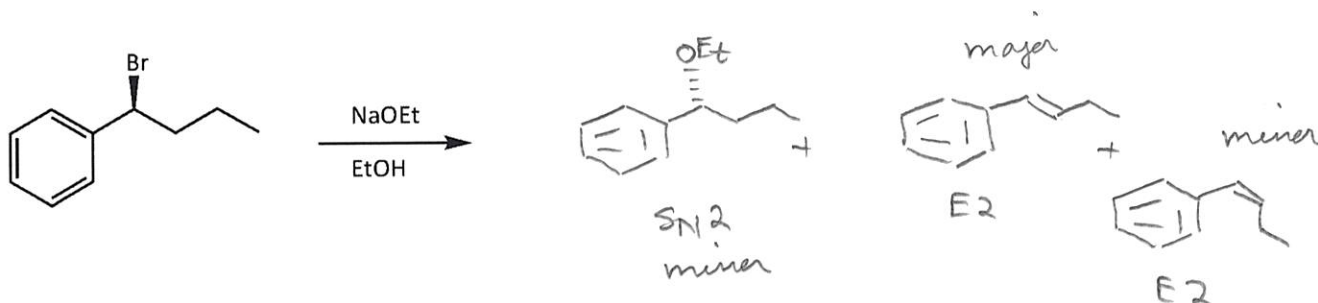
this chair cannot undergo elimination since the bromine is equatorial

this is the only available  $\beta$ -hydrogen that can undergo elimination

4. The following reaction gives a mixture of substitution and elimination products. (20 points)

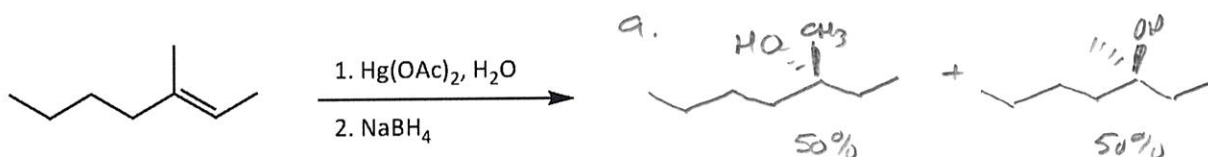
Answer the following:

- Show all of the possible products from this reaction. (10)
- Indicate whether the products are formed from  $S_N1$ ,  $S_N2$ , E1, or E2 mechanisms. (5)
- Indicate the major and minor product(s). (5)



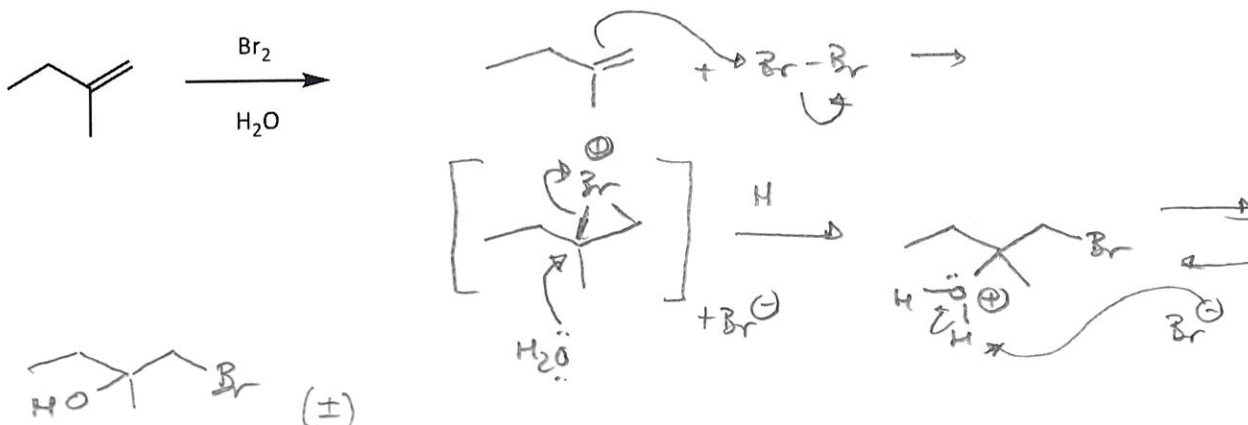
5. Consider the reaction of the alkene shown below. (20 points)

- Show *all* of the products formed in this reaction. (10)
- Does the addition follow Markovnikov's rule? Explain (10)



b. Yes, the addition follows Mark. rule - the H-OH adds where the more electronegative element adds to more sub. carbon

6. Show the product (or products) from the following reaction and show a reasonable and complete mechanism for the overall reaction. (Hint: the product is called a bromohydrin) (15 points)



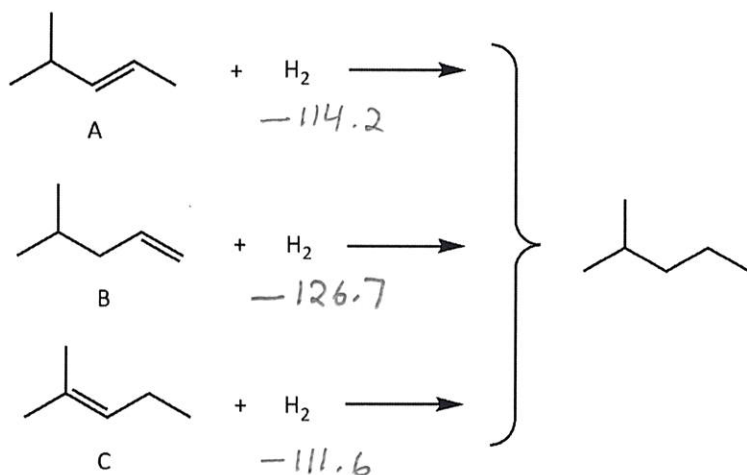
7. Does the reaction in Question 6 (above) obey Markovnikov's rule? Explain. (5 points)

8. Consider the series of isomeric alkenes shown below. (20 points)

a. Arrange the alkenes in order from most stable to least stable (use the letters A, B, and C and the > and < symbols. (5)



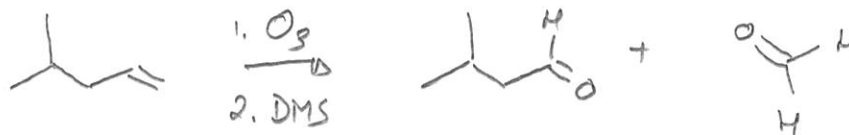
b. The heats of hydrogenation ( $\Delta H_{\text{hydrog.}}$ ) are -111.6, -114.2, and -126.7 kJ/mol, *irrespectively*. Assign these to the corresponding alkene. (15)



9. Which alkene in the above set (Question 8) would have the largest value for the *heat of combustion* ( $\Delta H_{\text{comb.}}$ )? Explain. (10 points)

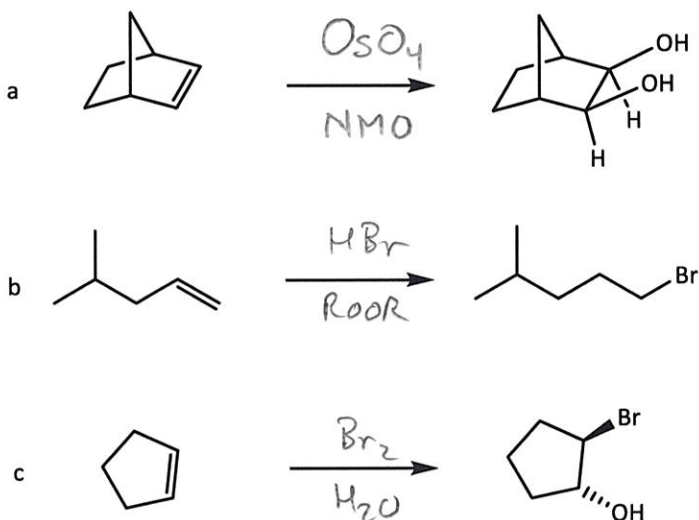
alkene B would have largest  $\Delta H_{\text{comb.}}$  it is the least substituted, so it is the least stable. This is consistent w/ the  $\Delta H_{\text{hydrog.}}$  data, as well

10. Show the product (or products) from the ozonolysis (1.  $\text{O}_3$ , 2. DMS) of compound B in Question 8. (5 points)



11. Fill in the *reagents* required to accomplish the following reactions.

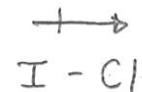
(15 points)



12. Styrene undergoes addition of I-Cl (iodine monochloride) to give one of the products shown below (but not both). Note that this reaction is similar to the addition of Cl<sub>2</sub>. (Hint: electronegativity) (20 points)

a. Which product is formed, A or B? (5)

B

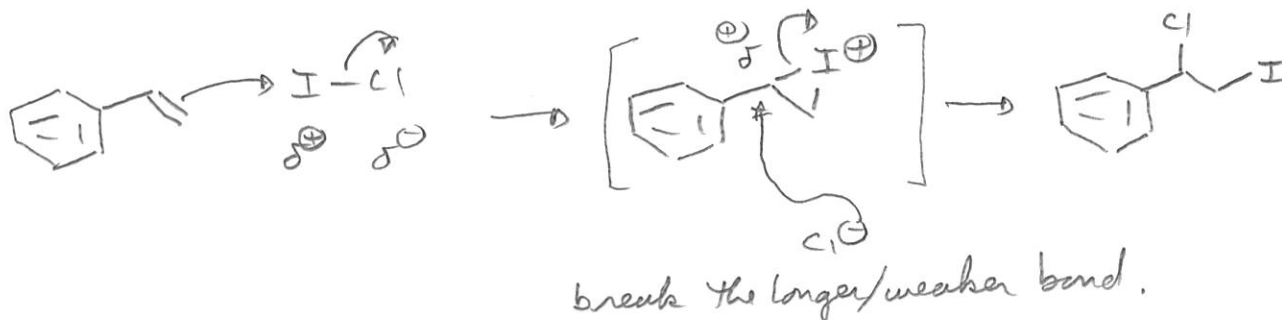
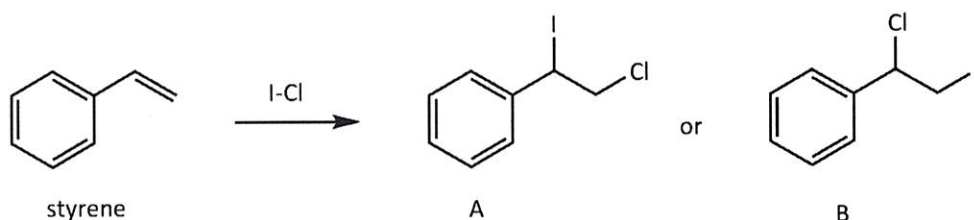


b. Provide a reasonable explanation for your choice in a. (10)

*In the first step, the alkene attacks the iodine end of the molecule,*

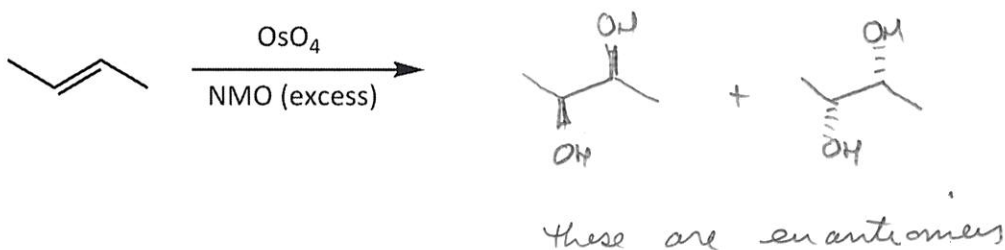
c. Does the formation of this product follow Markovnikov's rule? Explain. (10)

*then chloride attacks the more substituted carbon*



13. Consider the reaction of the alkene shown below. (25 points)

- a. Is the addition *syn* or *anti*? (5) *syn*
- b. Show all of the products formed and the resulting stereochemistry of the product(s) using the correct line (—), dash (-----), and wedge (▬) notation. (10)
- c. Indicate whether *enantiomers* are produced or whether the product is a *meso* compound. Explain your answer. (10)



14. How many *degrees of unsaturation* (total number of rings and/or double bonds) are in a molecule with molecular formula  $\text{C}_8\text{H}_{12}$ ? Suggest a *reasonable* structure for a molecule that has only one double bond, but has this formula. (Note that there are *many* possibilities) (10 points)

EXTRA CREDIT Provide an IUPAC name for the compound (the more complicated the structure the more EC points you get) (10 EC points)

$\text{C}_8\text{H}_{12}$  compare to  $\text{C}_8\text{H}_{18}$  has 3° of unsaturation



15. EXTRA CREDIT Challenge Problem. Show a complete mechanism for the following reaction. (10 EC points)

