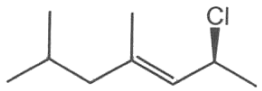
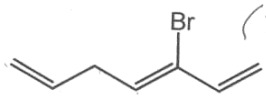
1. Name the following compounds. Don't forget about stereochemistry. (~~15~~ 10 points)

a. 

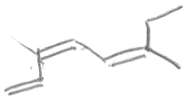
b. 

(Z)-3-bromohepta-1,3,6-triene

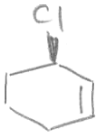
(2S,3E)-2-chloro-4,6-dimethylhept-3-ene

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

a. (3Z,5Z)-6-methyl-1,3,5-octatriene



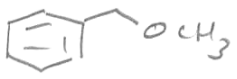
b. (*R*)-3-chlorocyclohexene



3. For each of the reactions shown below show the following: (36 points)

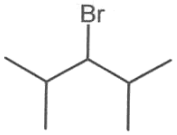
a. Draw the expected product(s)
b. Show stereochemistry where necessary.
c. Indicate whether the reaction proceeds by the S_N1 or S_N2 mechanism only
d. Indicate whether a carbocation rearrangement was involved in the formation of the product

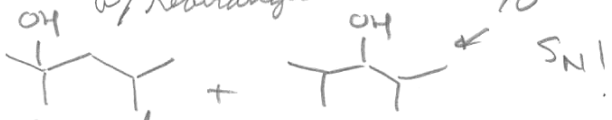
a. 



(+ HOTs)

S_N1 no rearrangement no stereochem

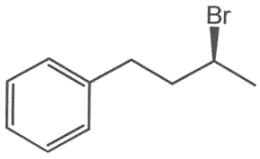
b. 

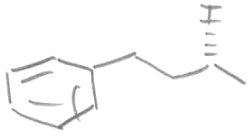


w/ rearrangement w/o S_N1

no stereoche

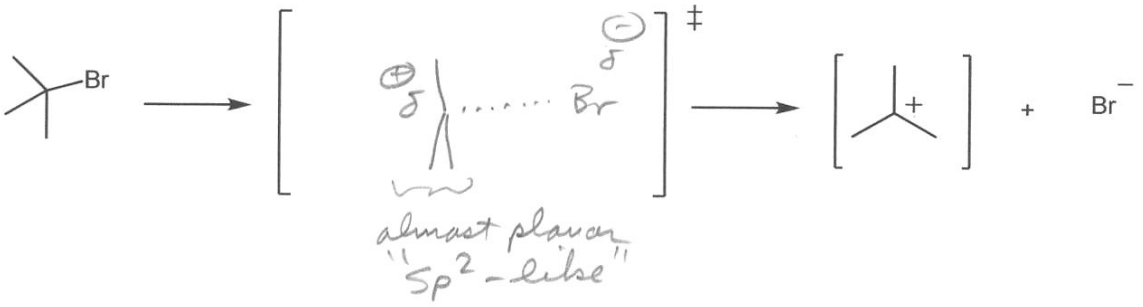
E1 not required

c. 

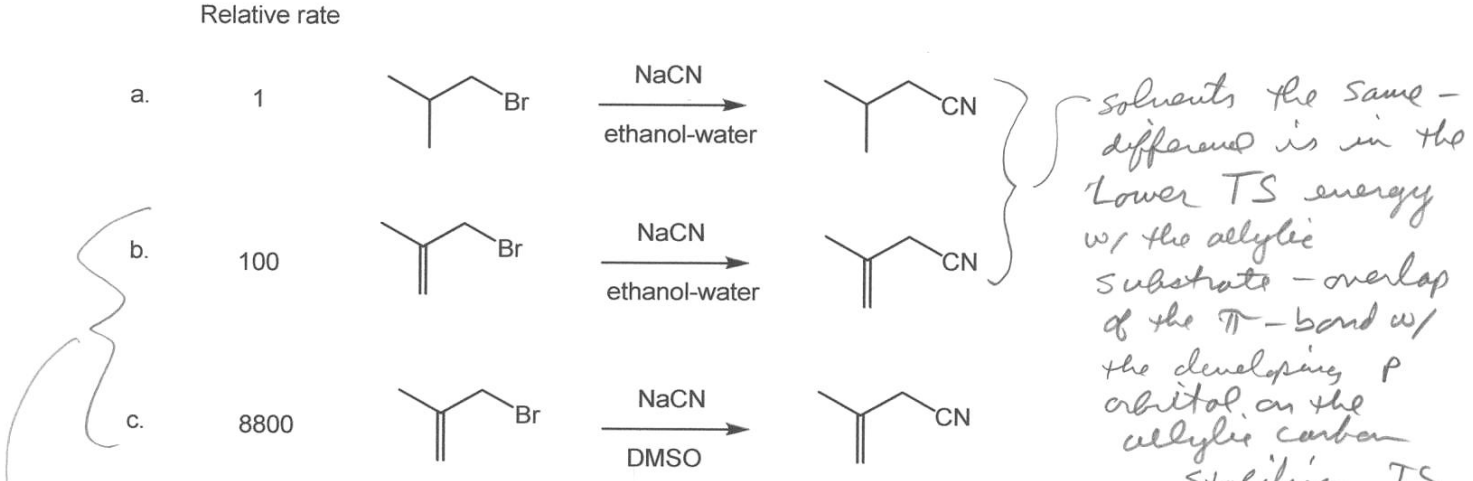


S_N2 no rearrange

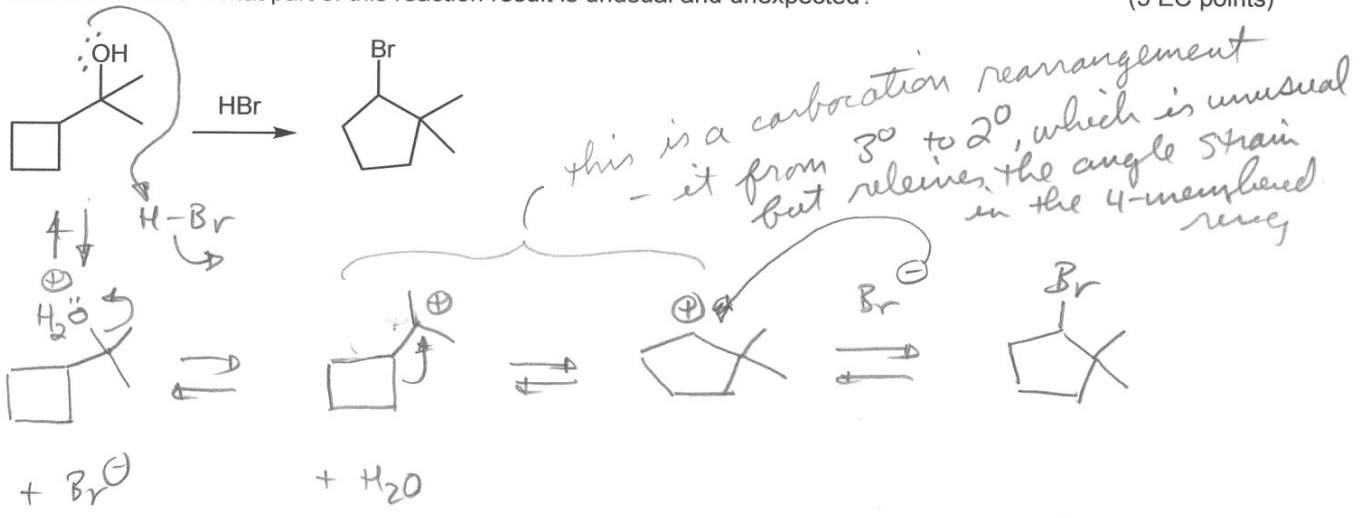
4. Suggest a structure for the transition state for the formation of the *t*-butyl carbocation. Be as clear and detailed about the geometry as possible. (Hint: use the Hammond postulate) (10 points)



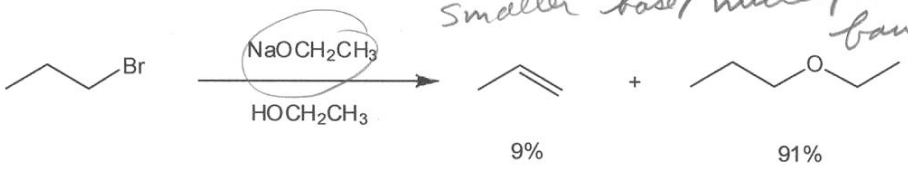
5. Explain the two trends in rates – a. compared to b. and then b. compared to c. (10 points)



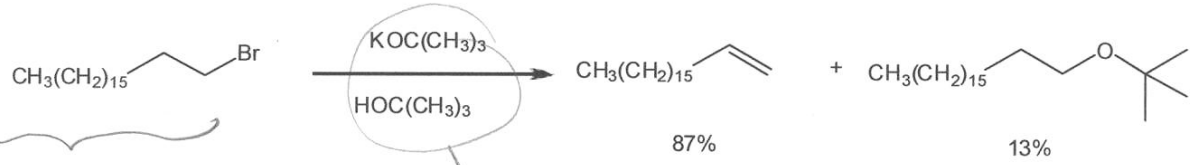
6. Suggest a mechanism for the following reaction. (10 points)
EXTRA CREDIT What part of this reaction result is unusual and unexpected? (5 EC points)



7. Explain the results shown below. (i.e., the change in the ratio of the products). (15 points)



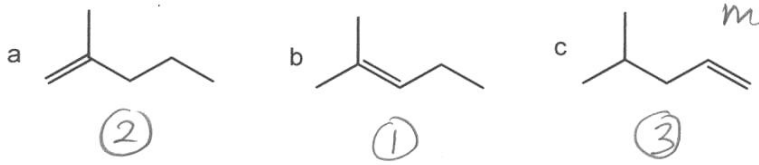
smaller base/nucleophile favors S_N2 over E2



both substrates are the same w/ regard to being 1° and steric hindrance

larger/bulkier base/nucleophile gives much less substitution than elimination due to steric hindrance of attack. E2 favored over S_N2

8. Assign the stability for the alkenes shown below - 1 for most stable, 3 for least stable. Which compound has the *largest* value for the enthalpy of combustion (ΔH_{comb}) – gives off the most heat when burned? Explain why. (Note that the heats of combustion for all three alkenes are negative) (15 points)



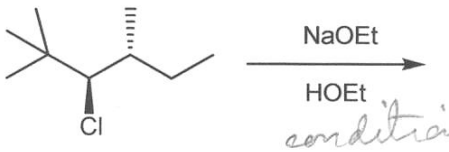
mono substituted

(2) (1) (3)

tri substituted

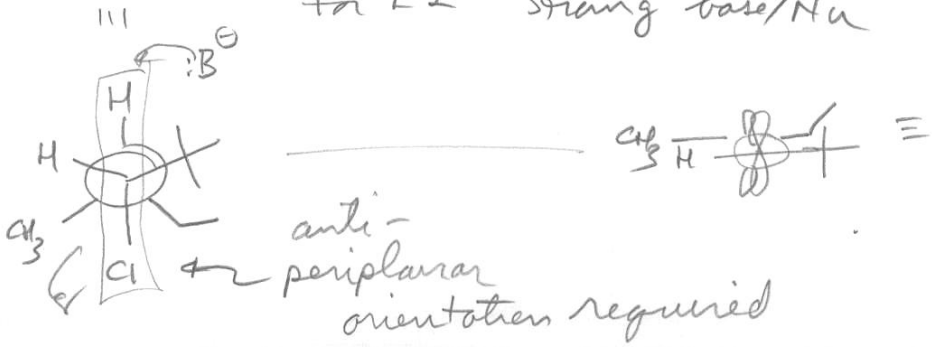
largest ΔH since it's the least stable

9. Show the product(s) from the following reaction. (5 points)



too hindered to do S_N2!

conditions for E2 — strong base/Nu



only alkene produced

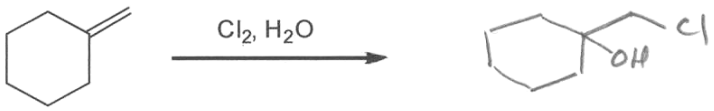
10. How does the rate of the S_N2 reaction depend on the nucleophile (Nu:) and on the leaving group (LG:)? (note the leaving group is not the same as the substrate, R-LG) (10 points)

Rate = $k[Nu][R\text{-}LG]$ – the strength of Nu directly affects the rate – stronger nucleophiles react faster

The better the L.G. – the most stable after the S_N2 reaction – the faster the S_N2

11. Consider the reaction of the alkene shown below.

a. Show *all* of the products formed in this reaction.
b. Indicate whether the addition proceeds with *anti* or *syn* addition.
c. Does the addition follow Markovnikov's rule? Explain (15 points)



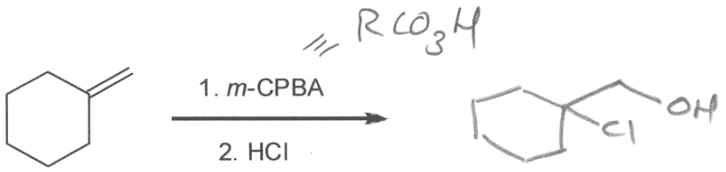
a.

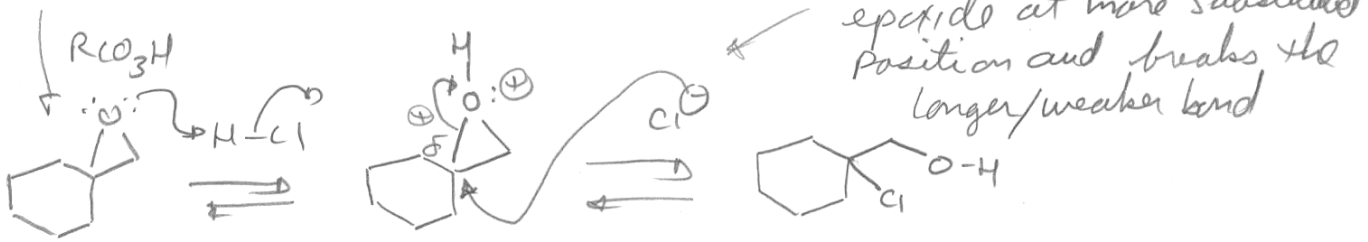
b. anti addition

but can't tell in the product shown

c. Yes, since the more electronegative group adds to more substituted carbon

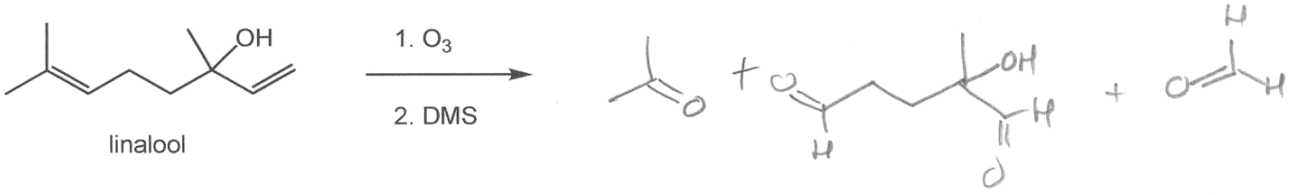
12. The following set of condition yields a similar, but different, product as in Question 1. Draw the product and show a mechanism for its formation. (10 points)



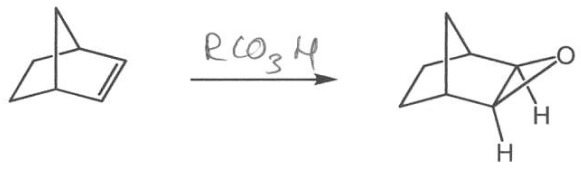


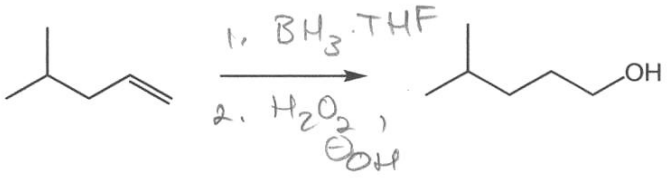
chloride attacks protonated epoxide at more substituted position and breaks the longer/weaker bond

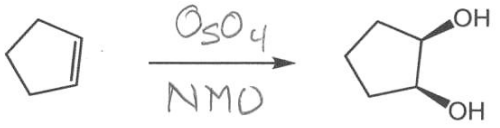
13. Show all of the products from the *ozonolysis* of linalool (found in coriander and lavender) (10 points)



14. Fill in the *reagents* required to accomplish the following reactions. (15 points)

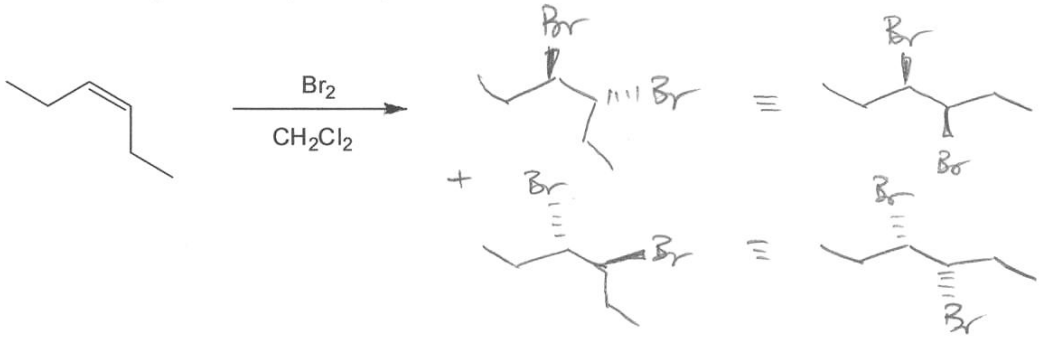
a 

b 

c 

15. Reaction of *cis*-3-hexene with bromine (Br_2) gives a dibromide.

a. Does the addition reaction occur *syn* or *anti*?
b. Show any and all products with the resulting stereochemistry and using the correct notation (line, dash and/or wedge)
c. How many isomers are produced? — 2 isomers
d. Are any *meso* compounds produced? (20 points)



neither of these are meso

16. EXTRA CREDIT suggest a likely transition state geometry for the following rearrangement. Be as detailed and descriptive with your drawing as you can. (10 EC points)

both are "sp^2-like" but not completely planar