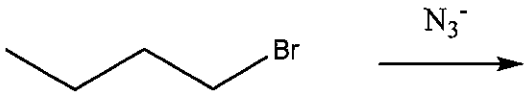
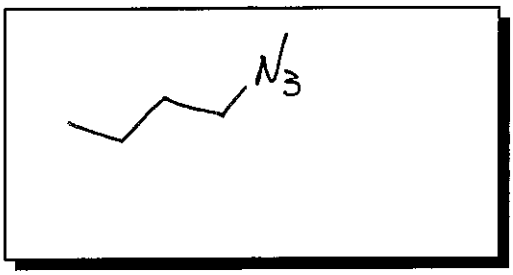
1. (12pts) For these reactions, predict whether the reaction will go through an S_N1 or S_N2 mechanism. Draw the structures of the major substitution product(s) in the box and list the product of the reaction as optically active or optically inactive.

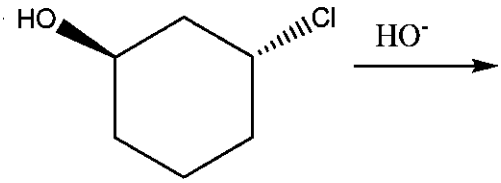
A. Type of mechanism: S_N2

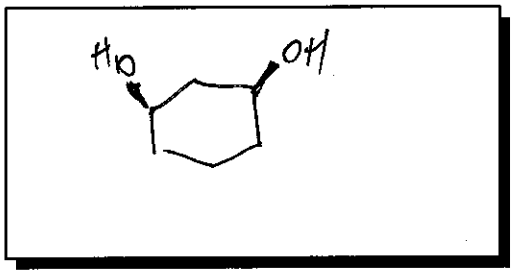




optically active or inactive: inactive

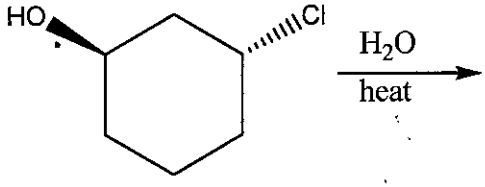
B. Type of mechanism: S_N2

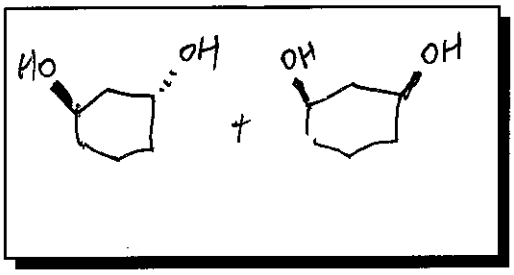




optically active or inactive: inactive

C. Type of mechanism:

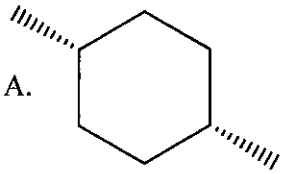




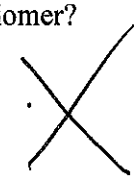
optically active or inactive: active

2. (12pts) Do the following compounds have enantiomers and/or diasteriomers? If so, draw an appropriate structure in the box. If not, put an "X" through the entire box.

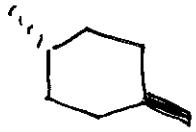
A.



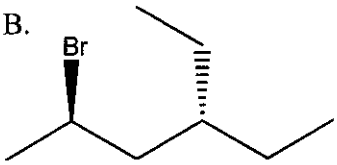
enantiomer?



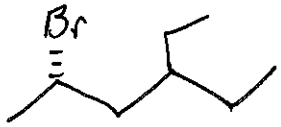
diastereomer?



B.

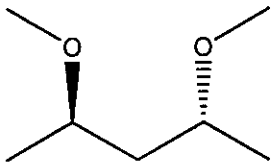


enantiomer?

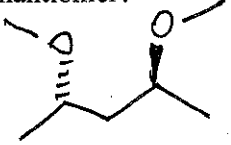


diastereomer?

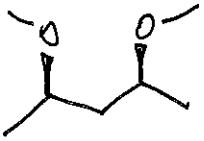
C.



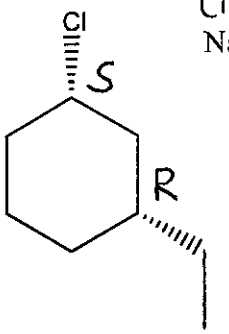
enantiomer?



diastereomer?



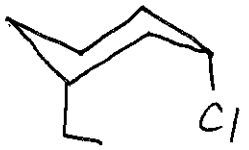
3. (15 pts) Give the name of this compound, including R/S designations. Draw both chair conformations of this structure. Indicate which one is more stable or if they are of equal stability.



Name: (1S,3R)-1-chloro-3-ethylcyclohexane

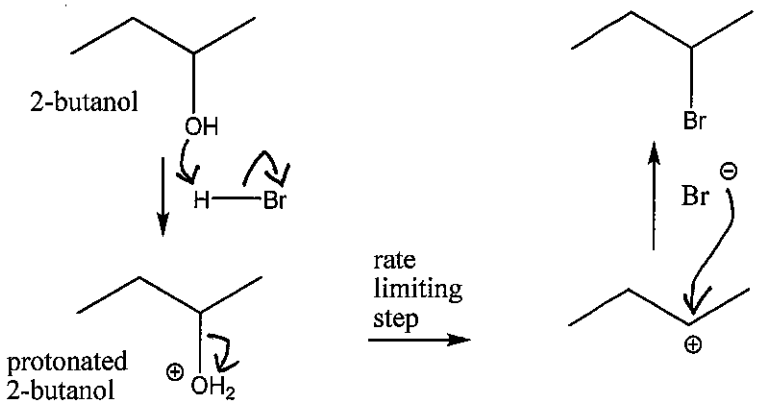
chair conformation #1

chair conformation #2



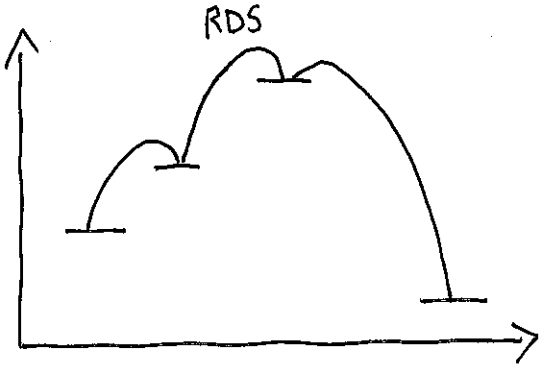
more stable

4. (16 pts) When 2-butanol is treated with HBr, 2-bromobutane is produced. The mechanism is shown below, and is an acid/base reaction followed by an S_N1 mechanism. Answer the questions below based on this mechanism.



A. Fill in the appropriate arrows in the scheme above.

B. Draw an energy diagram for this three-step mechanism with appropriate relative energies. (Assume the reaction is exothermic overall, the carbocation is the least stable intermediate, and the protonated alcohol is less stable than 2-butanol.



C. Based on the mechanism, would the rate go up, down, or remain the same if more Br^- were added to the reaction? Explain.

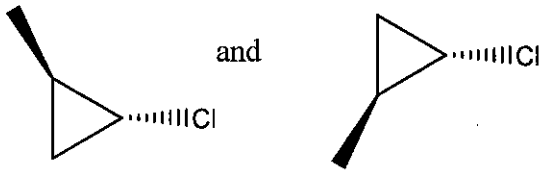
Remain the same. Br^- reacts after the rate determining step.

D. Based on the mechanism, if the reaction were to start with (S)-2-butanol, would the bromide product be (R), (S), or a racemic mixture? Explain.

Racemic mix. When the carbocation forms, it is planar and can be attacked from both sides by Br^-

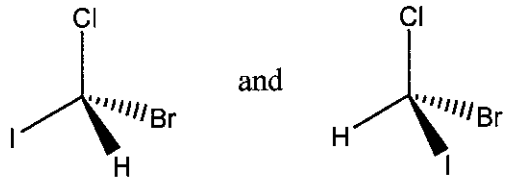
5. (16pts) Give the relationship of each pair of molecules as same, enantiomers, diasteremoers, constitutional isomers, or no relationship. Circle any meso compounds.

A.



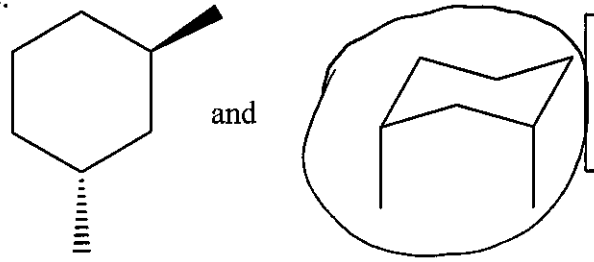
relationship: enantiomers

B.



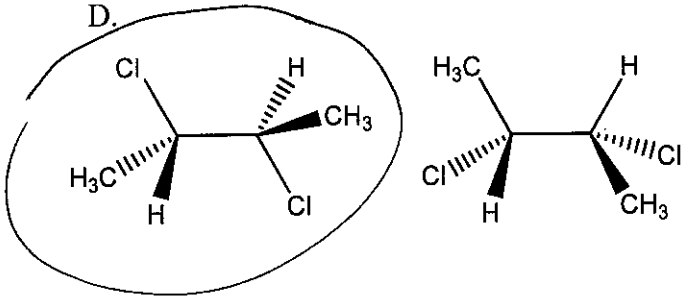
relationship: enantiomers

C.



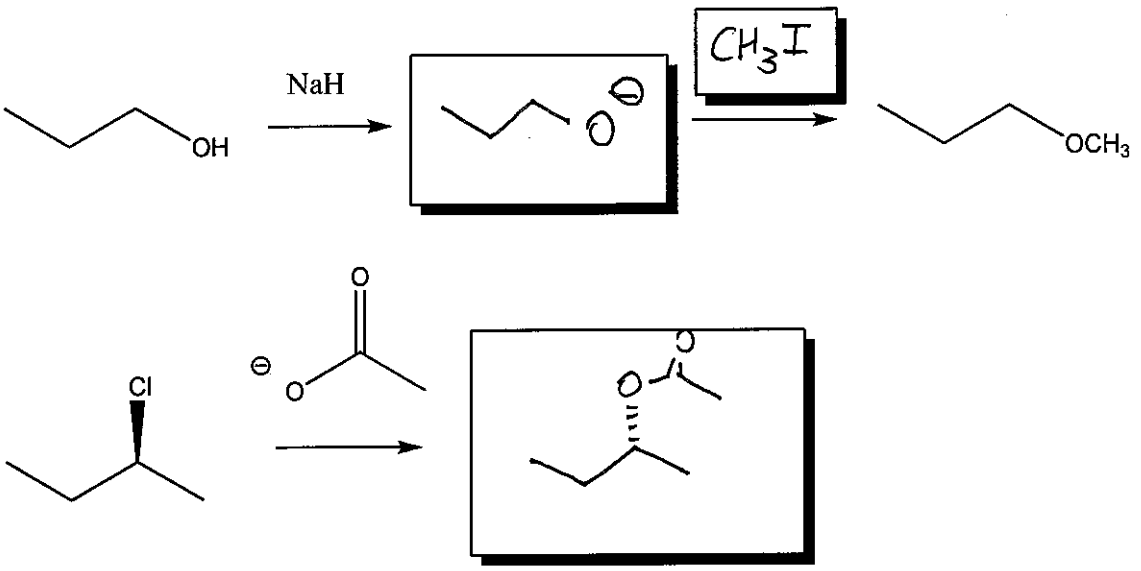
relationship: diastereomers

D.

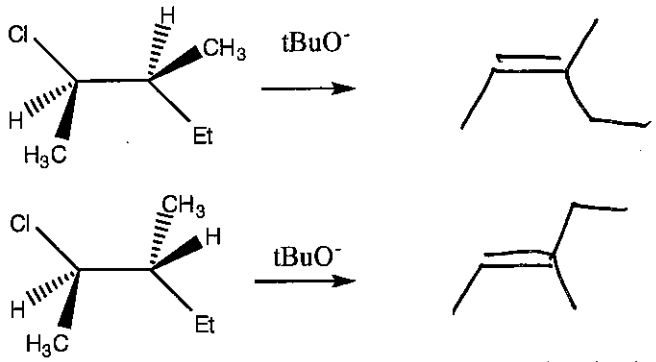


relationship: diastereomers

6. (9pts) Fill in the missing reactants, reagents, and products of these substitution reactions. (Assume an S_N2 mechanism.)

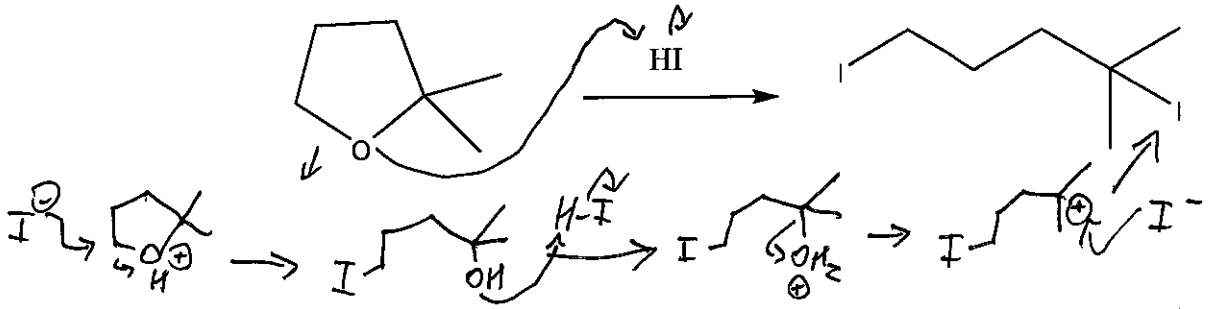


7. (6pts) Predict the products of the following E2 eliminations across the C2-C3 bond. What is the stereochemical relationship of the products?



diastereomers

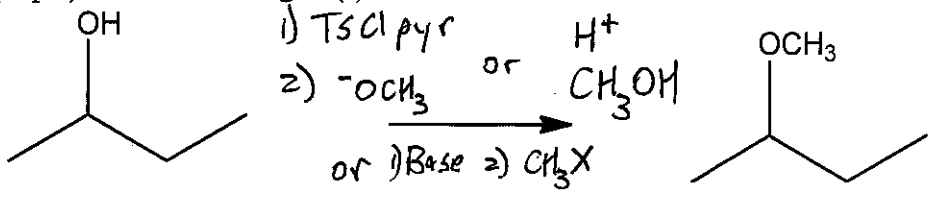
8.(10pts) Draw a mechanism for this reaction including all arrows and intermediates. It will involve two substitution reactions.

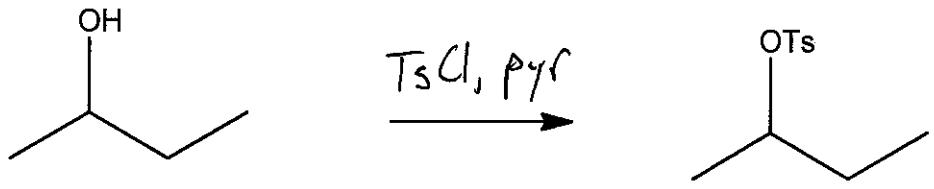


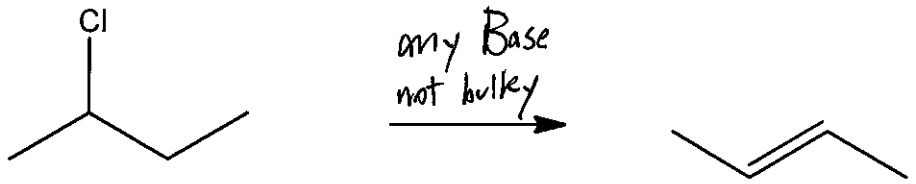
The two substitutions in the mechanism above are different from each other. Explain how they are different and why the two parts of the reaction have different mechanisms.

S_N1 vs S_N2 based on substrate. 1° center attacked by I^- directly, 3° forms carbocation.

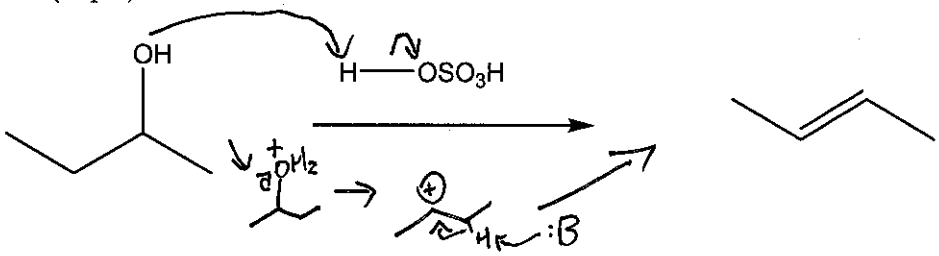
9. (12pts) Provide the reagent(s) needed to cause these transformations.







10. (12pts) Draw a mechanism with all arrows and intermediates for this E1 reaction:



Why is the more substituted (Zaitsev) product formed preferentially? ("The product is more stable" is not a complete answer.) Refer to Hammond and Stability of TS

This reaction is endothermic, but it can still be made to proceed to the right. Explain.

Le Chatlier's principle – removal of H_2O