CHEMISTRY 12A FALL 2019

Answer Key

EXAM 2

OCTOBER 29, 2019

NAME- WRITE BIG _____

STUDENT ID: _____

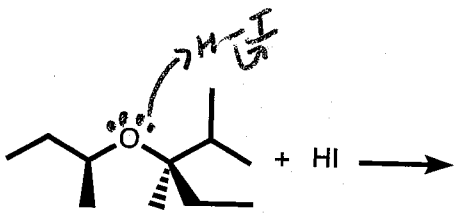
SECTION AND/OR GSI IF YOU ARE IN THE LABORATORY COURSE: _____

- **You will have 75 minutes in which to work.**
- **BE NEAT! Non-legible structure drawings will not be graded.**
- **Only answers in the answer boxes will be graded – you can write in other places, but we only grade the answers in the boxes.**
- **All pages of the exam must be turned in.**
- **No calculators**
- **No stencils**
- **Molecular models may be used**

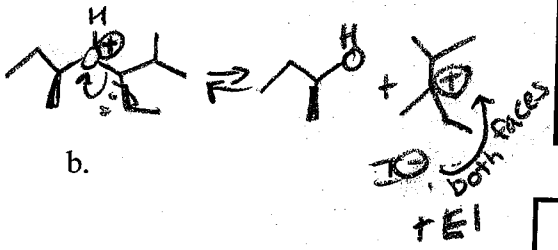
Problem	Points (Maximum)
1	22
2	18
3	24
4	14
5	28
6	14
Total	*120*

1. (22 points) For each reaction draw the major organic products, **including all stereoisomers**. Write NR if you think there will be no reaction. For part 1d, you will fill in the reagent.

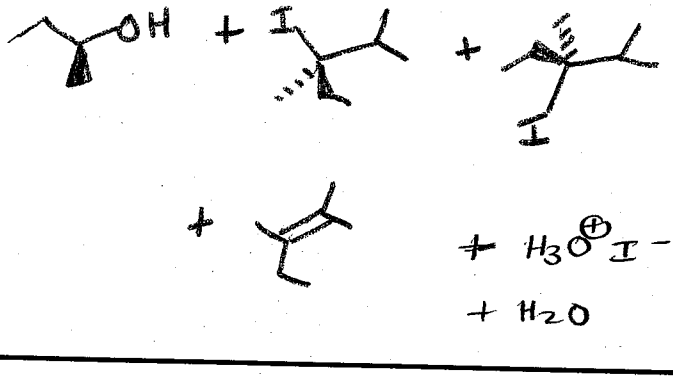
a.



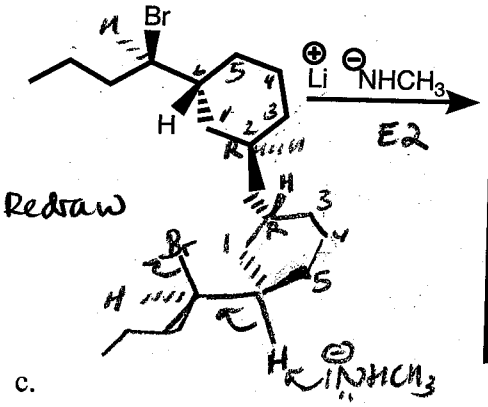
Show product of reaction with one HI



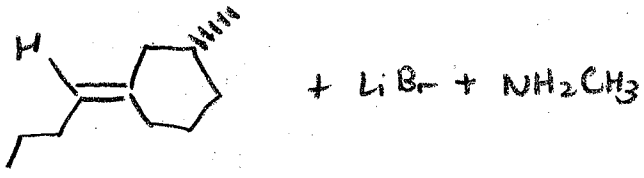
SN1/E1



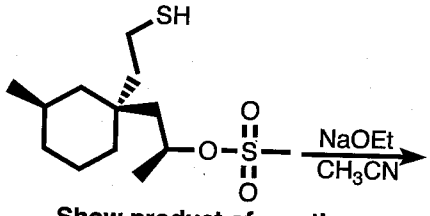
b.



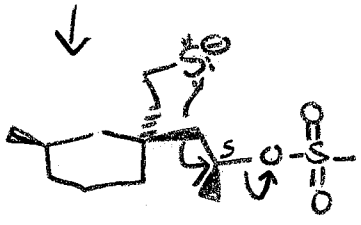
E2



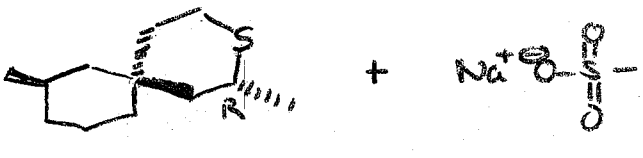
c.



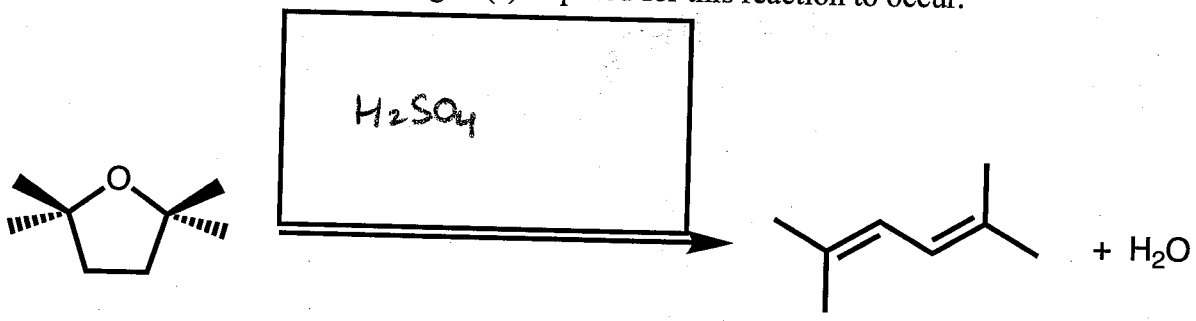
Show product of reaction with one NaOEt



SN2

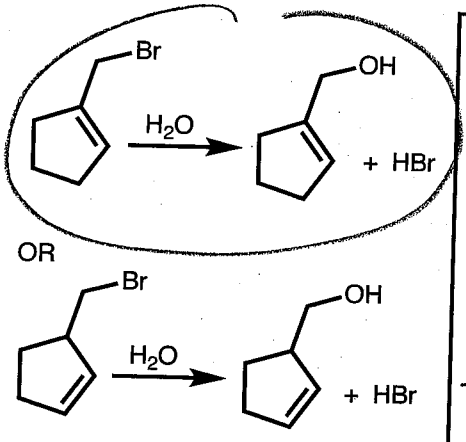


d. For this reaction, fill in the reagent(s) required for this reaction to occur.

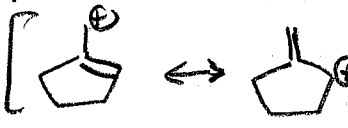


2. (18 points) **Circle** the reaction in the following pairs of reactions that you would expect to go faster. It is possible that both reactions have the same rate. It is possible that one of the reactions shown in each pair does not occur at a measurable rate. You may disregard any other products besides the ones pictured that may form under the reaction conditions. Give explanations in the boxes provided.

a.



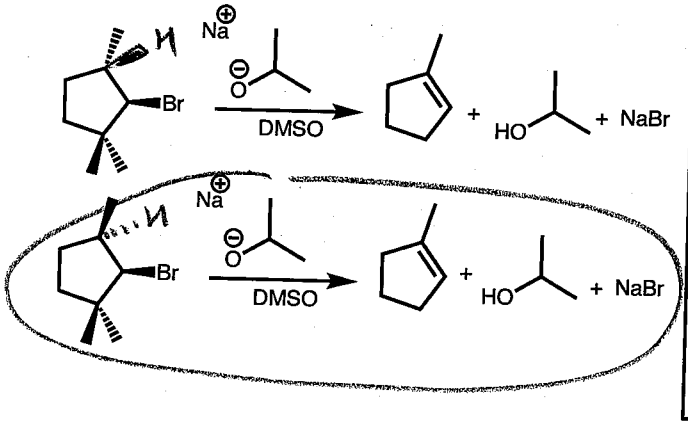
Type of Reaction: SN1
Explanation for your choice of faster reaction:
SN1 because polar protic solvent. H_2O weak Nu/Base. Br good L.G. In the 1st rxn carbocation is stabilized by resonance



Transition state resembles carbocation & is also stabilized by resonance

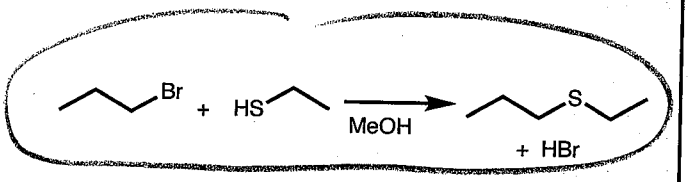
The second reaction forms a 1° carbocation w/ no resonance stabilization. This rxn will be very slow.

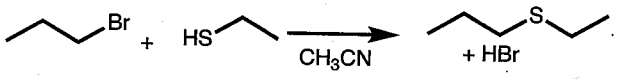
b.



Type of Reaction: E2
Explanation for your choice of faster reaction:
E2: 2° carbon; strong base, good L.G. Requires H & L.G. to be anti
2nd rxn is faster because the H & Br can be anti to each other because they are trans
the 1st rxn: H & Br are cis & these cannot be anti to each other

c.

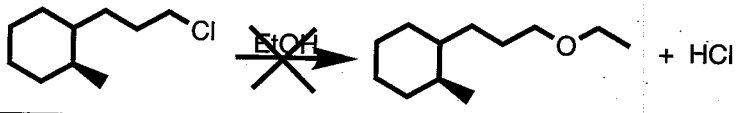


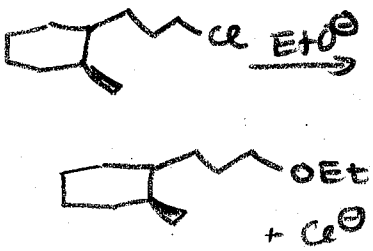


Type of Reaction: SN2
Explanation for your choice of faster reaction:
Unhindered 1° carbon; good L.G. RSH is good Nu, weak base. SN2 is faster in polar protic solvent because nucleophile is neutral & T.S. is more charged than Nu. Therefore T.S. is more solvated & stabilized by polar protic solvent than are starting materials & rxn is faster

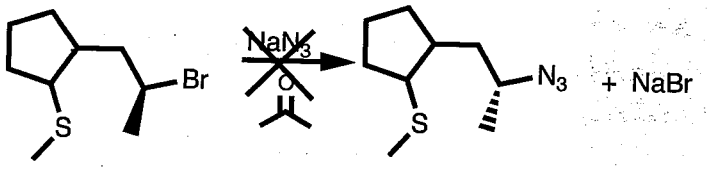
3. (24 points) The following reactions would not occur as written. i. What product or products would actually be made? ii. Why was the desired product not formed? iii. How could you change either the substrate **OR** reaction conditions to give the desired product?

a.

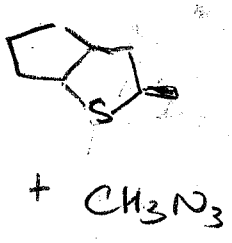
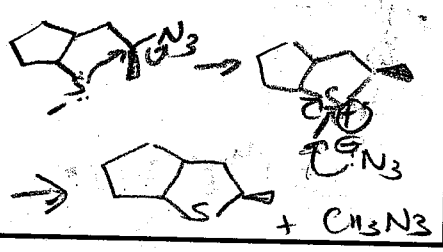
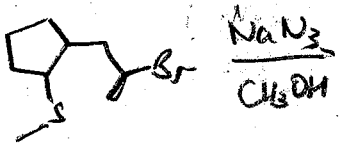


What product is actually made? (Draw structure or NR for no reaction)	Why was desired product not formed? (Explain in 1 sentence and include drawings of any relevant structures)	How could substrate OR reaction be changed to give desired product? Draw your revised reaction.
NR	SN1 doesn't occur at 1° carbon & EtOH is not strong Nu.	Use $EtO^{\ominus}$ as nu. 

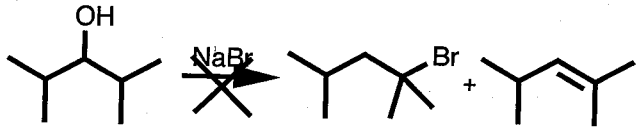
b.

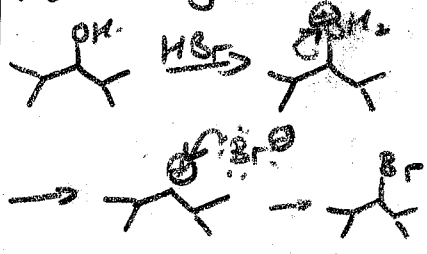


Multiple answers were accepted for this problem.

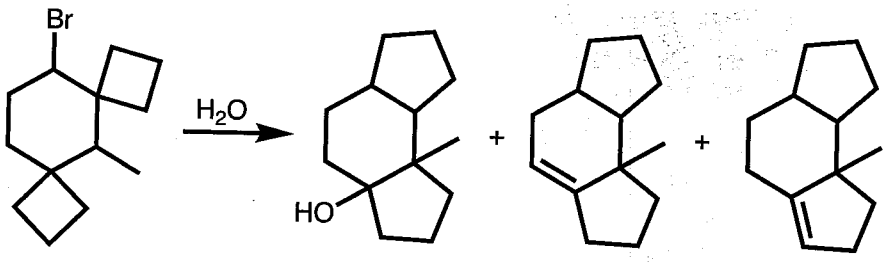
What product is actually made? (Draw structure or NR for no reaction)	Why was desired product not formed? (Explain in 1 sentence and include drawings of any relevant structures)	How could substrate OR reaction be changed to give desired product? Draw your revised reaction.
 + CH_3N_3	Neighboring group effect leads to 2 S_N2s 	S_N1 conditions are best, but will get multiple products 

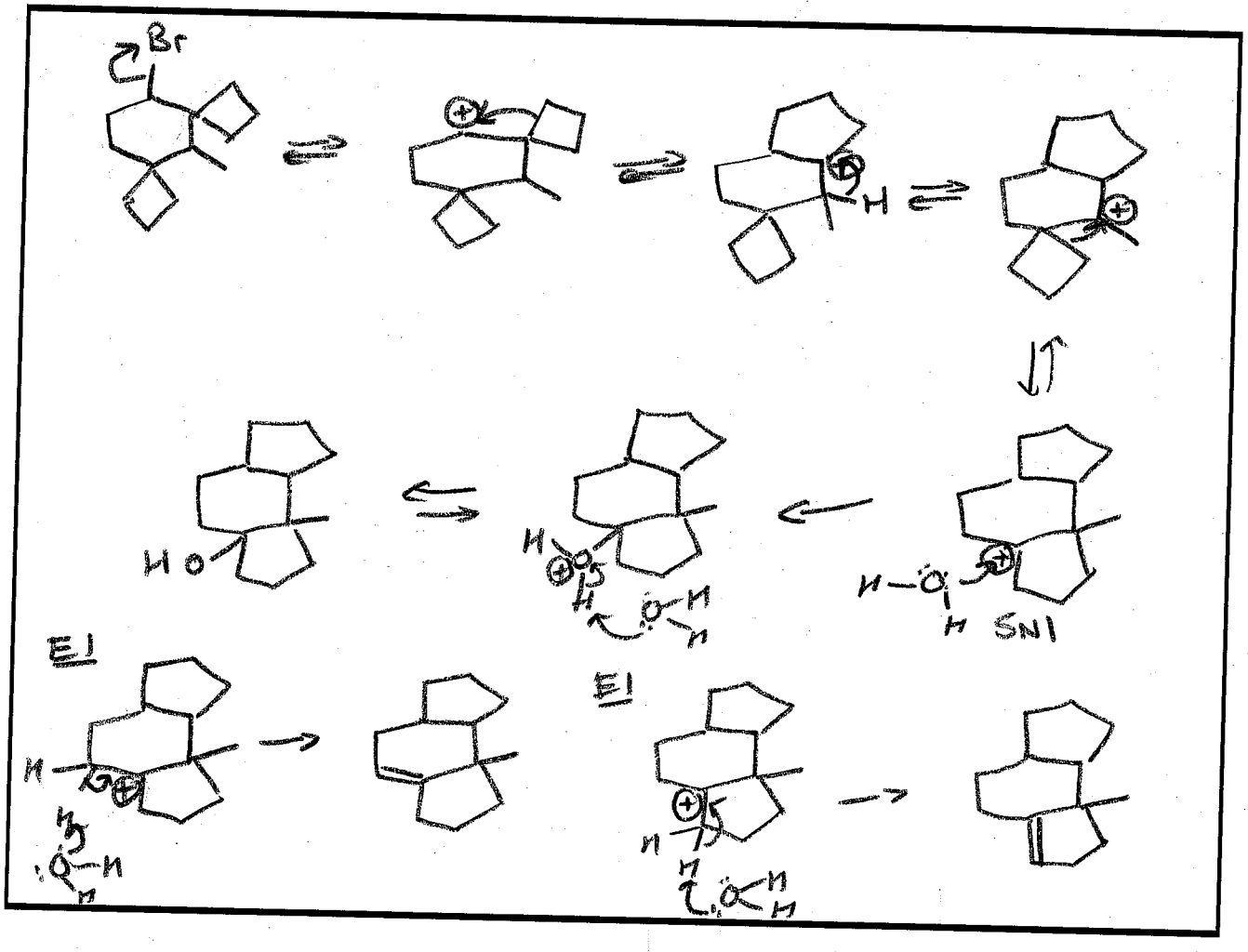
c.



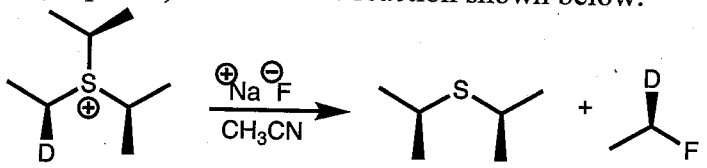
What product is actually made? (Draw structure or NR for no reaction)	Why was desired product not formed? (Explain in 1 sentence and include drawings of any relevant structures)	How could substrate OR reaction be changed to give desired product? Draw your revised reaction.
NR.	There is no L.G.	Use H-Br to make ROH into good L.G. 

4. (14 points) Draw the mechanism of the following reaction using arrows to indicate the flow of electrons.

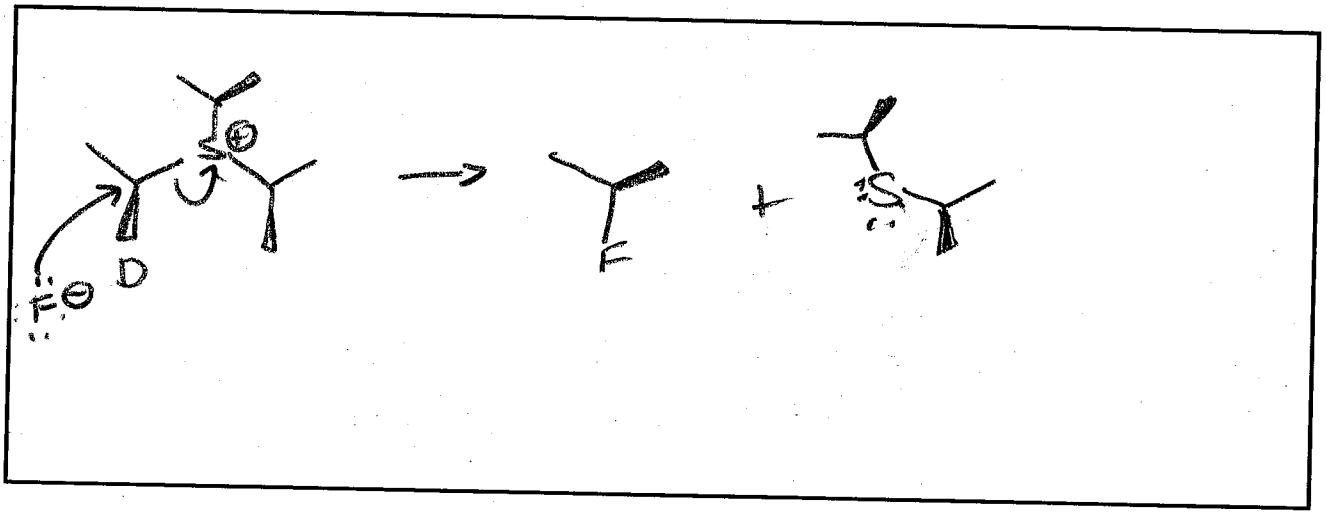




5. (28 points) Consider the reaction shown below:

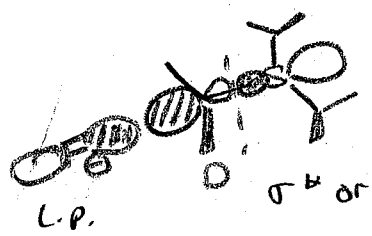


a. Draw the mechanism of the reaction using arrows to show the flow of electrons. Remember that D stands for deuterium, which is nearly identical to H in size and reactivity.

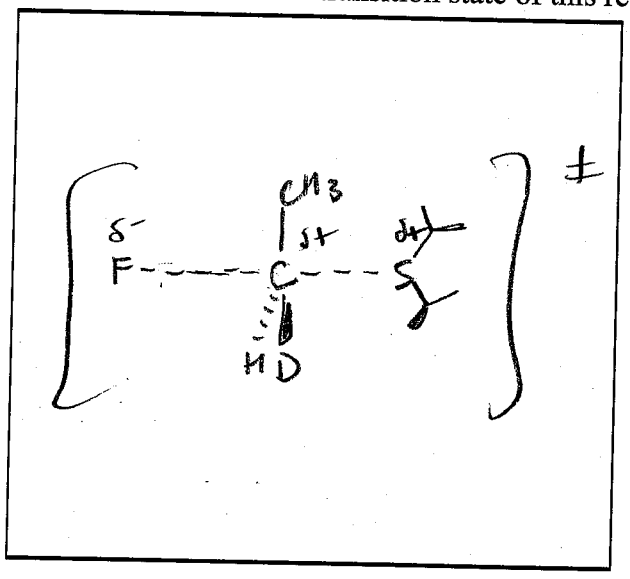


b. Explain why this reaction is stereospecific. Include drawings of the orbitals involved in the reaction as part of your explanation. Sketch and label all relevant orbitals on a line drawing of the reactants.

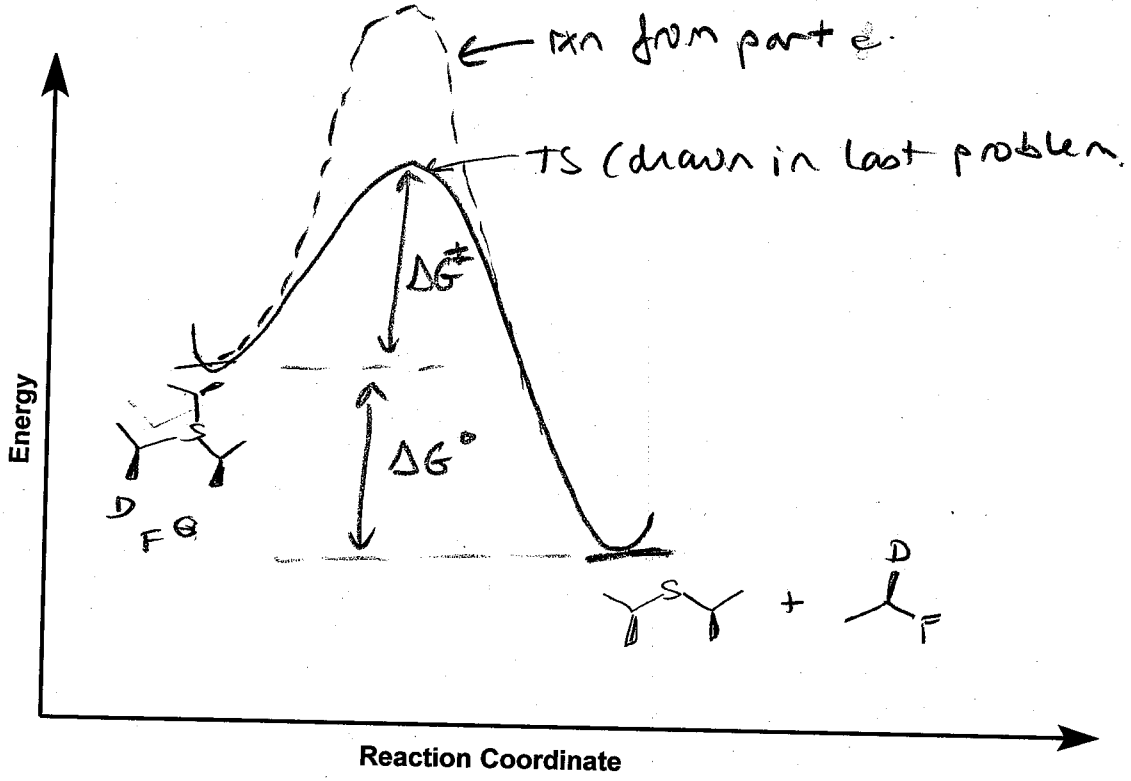
The rxn proceeds by the interaction of the lone pair of $F^{\ominus}$ with the σ^* orbital (LUMO) of the C-S bond. The interaction occurs at the back of the C-S bond because this is where the σ^* orbital is largest & this is the least sterically hindered position.



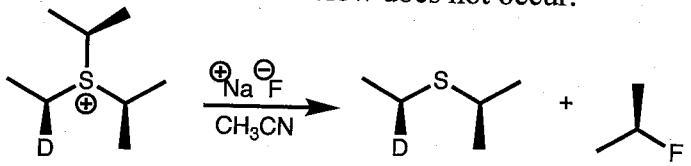
c. Draw a sketch of the transition state of this reaction.



d. Draw a reaction coordinate energy diagram for this reaction. Draw structures of the starting materials and products on your diagram. Label $\Delta G^{\ddagger}$, and $\Delta G°$, and the transition state.



e. The reaction shown below does not occur.

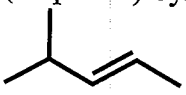


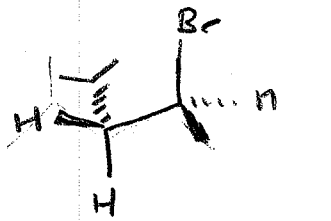
Explain why these products are not observed.

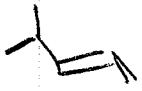
The 2° carbon is more sterically hindered & therefore, this rxn is slower

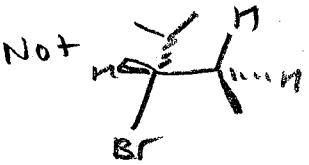
f. Modify your reaction coordinate diagram in part d of this problem to include the formation of the products shown in part e. You can assume the products of the reaction shown in part e are equal in stability to the products shown in part a of this problem.

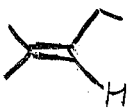
6. (14 points) Synthesize the molecules below from the indicated starting materials.

a.  from an alkyl halide and any other reagents

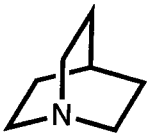




Not 

because this would also yield 

b.



from an alkyl trihalide and any other reagents