Chemistry 230–002 Third Examination
November 20, 2003

Name (please PRINT LEGIBLY) _____
(last) (first)

Student ID #_____

Problem	Score	
1. (a-f)	_____	/ 24
2. (a-b)	_____	/ 32
3. (a-b)	_____	/ 24
4. (a-c)	_____	/ 12
5. (a-b)		/ 8
Total	_____	/ 100

Please observe the following.

1) Write LARGE and LEGIBLY.

2) Read each question carefully before answering. Many points are never awarded on every exam because students do not read the instructions.

3) Explanations muct be clear, coherent, and unambiguous to receive credit.

4) For questions with multiple parts, be *consistent*. Your answer to a later part will be graded based on the earlier part being correct, whether or not it actually is. For example, suppose I asked the following questions:

(a) What is the hybridization of methane? (5 pts)
(b) What is the H–C–H bond angle? (5 pts)

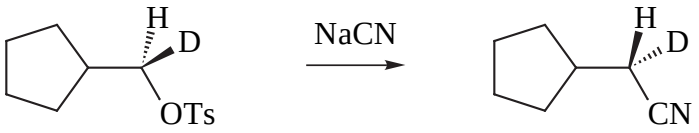
Three students gave the following answers:

	Student 1	Student 2	Student 3
(a)	sp^2	sp^2	sp^3
(b)	120°	109°	109°
Score:	0 pts + 5 pts	0 pts + 0 pts	5 pts + 5 pts

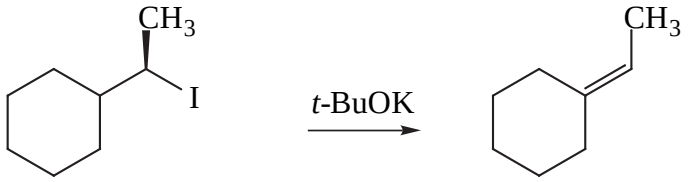
Student 1 *correctly* answered (b) *given her answer for (a).* Student 2 *incorrectly* answered (b) *given his answer for (a), even though (b) is formally correct.* Student 3 correctly answered both (a) and (b) and got full credit for the question.

1. (4 pts. each, 24 pts. total) Draw the *major* product of each of the following reactions. If no reaction is expected to occur, write "No reaction." Be sure to indicate the stereochemistry of the product, if appropriate. (A mixture of configurations should be indicated with a squiggly bond ∿∿∿ to one of the groups attached to the stereogenic C atom.)

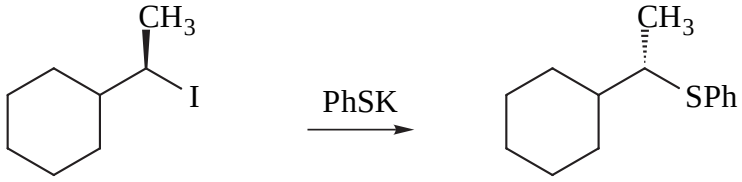
(a)



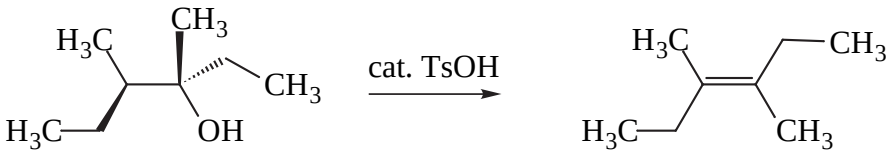
(b)



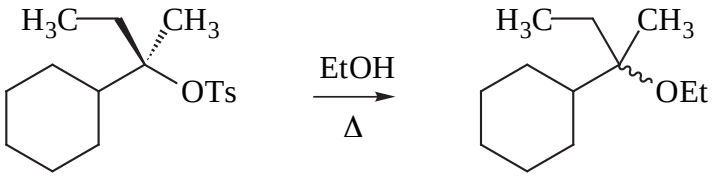
(c)



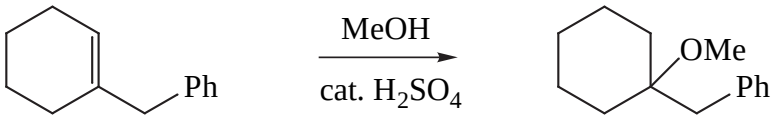
(d) (TsOH is a strong acid.)



(e)

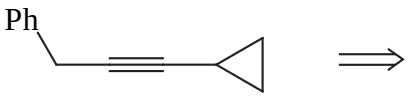


(f)

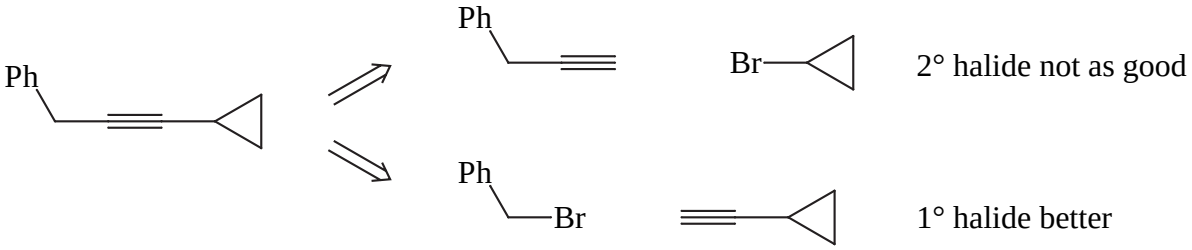


2. (16 pts. each, 32 pts. total) Design syntheses of each of the following compounds from the indicated starting materials. Show all reagents required for each transformation. You are advised to conduct a retrosynthetic analysis before working in the forward direction. ***Either synthesis may require more than one step.***

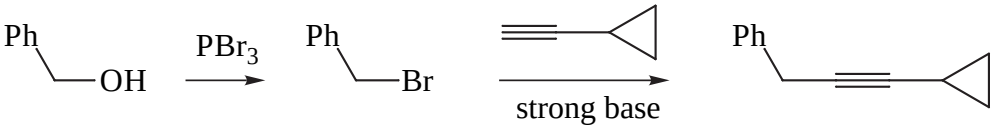
(a)



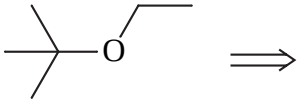
an alkyne and an alcohol



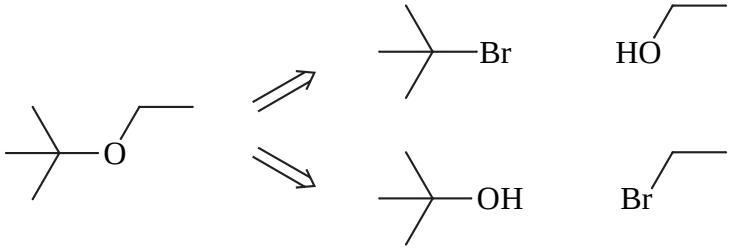
Answer:



(b)



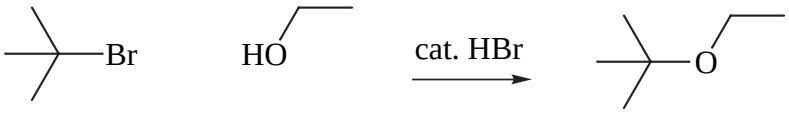
starting materials containing no more than 4 C atoms



basic: E2 not S_N2
acidic: S_N1

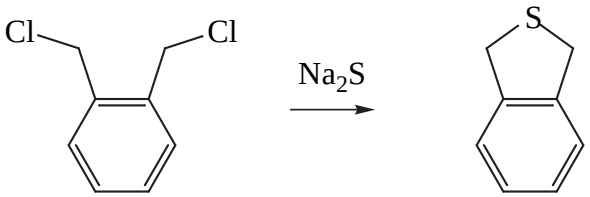
basic: E2 not S_N2
acidic: NR

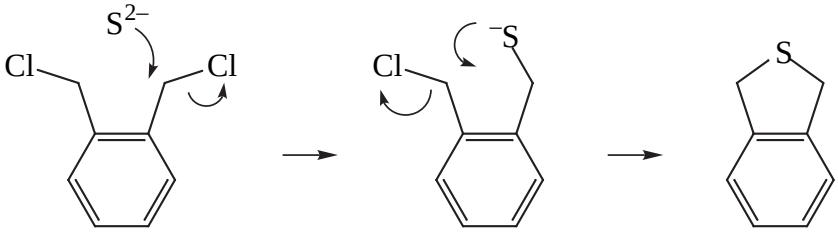
Answer:



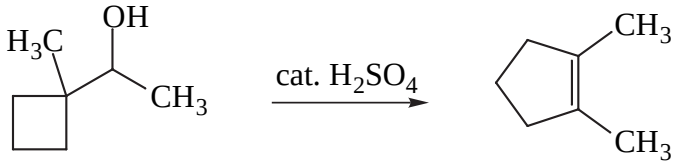
3. (24 pts. total) Draw reasonable mechanisms for each of the following reactions. Use the curved arrow convention to show the movement of electrons. *Remember to obey Grossman's Rule!*

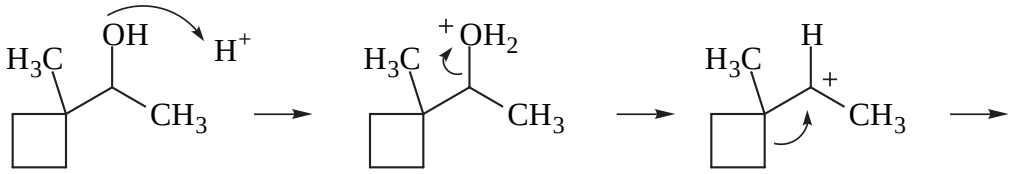
(a) (8 pts.)

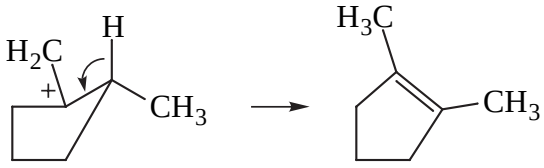




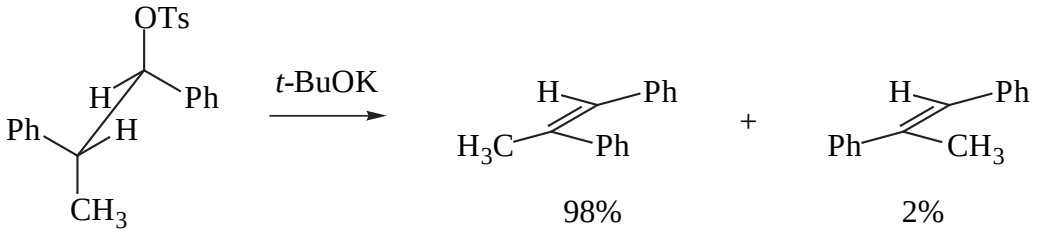
(b) (16 pts.)







4. (4 pts. each, 12 pts. total) When the alkyl tosylate shown below is treated with *t*-BuOK, the major elimination product is *not* the one that would be predicted by Zaitsev's rule.



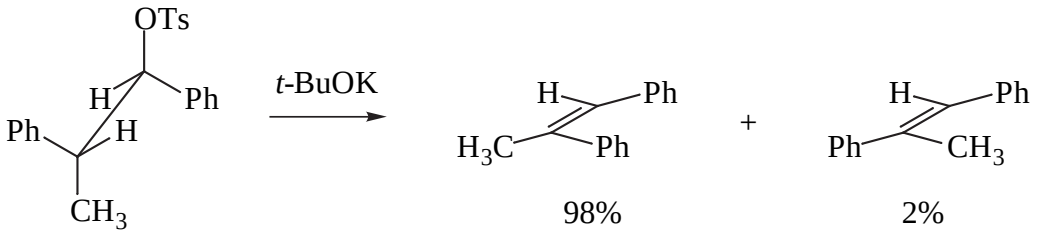
(a) Write an equation that would allow you to determine the difference in energy between the two alkene products. (Show the numbers that you would plug into the equation, but do not solve it.)

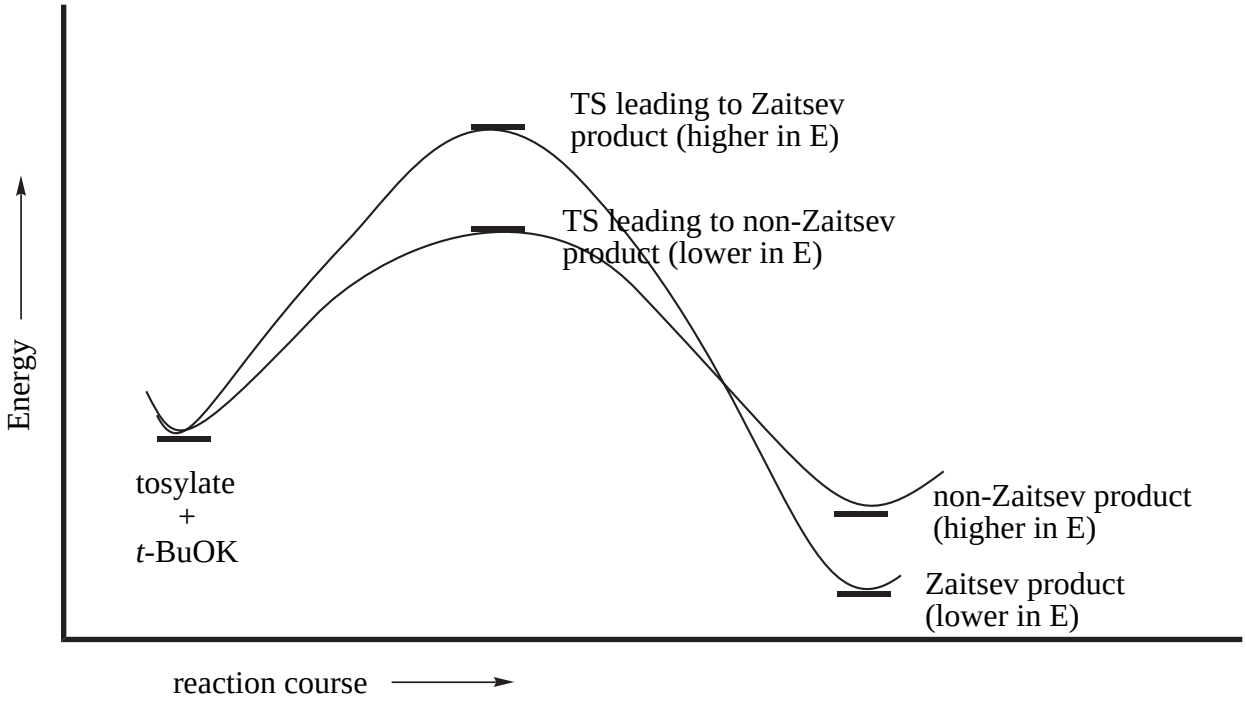
OOPS! I didn't give you enough information to solve this problem. If you wrote $\Delta G = \Delta H - T\Delta S$ or $\Delta G = -RT\ln K$, where T = 298 K and R is the gas constant, you got credit.

(b) Explain clearly and succinctly why Zaitsev's Rule is not followed in this reaction.

There is a requirement for antiperiplanar alignment of the H–C and C–LG bonds in E2 elimination reactions. In this compound, when such an alignment is made, the two Ph groups are gauche to one another, becoming cis in the product, the higher-energy arrangement.

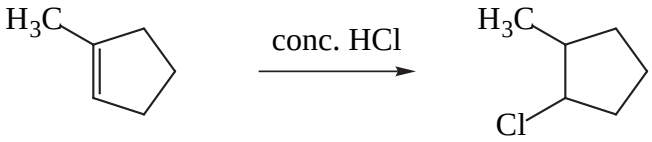
(c) Draw a reaction coordinate diagram (energy vs. reaction course) that illustrates the elimination reaction shown. (It's the same reaction as the one on the previous page.) Clearly label the starting materials, the Zaitsev product, the non-Zaitsev product, and the transition state(s) in your diagram. I've drawn part of the diagram to get you started.





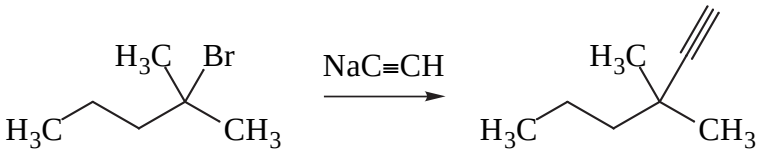
5. (4 pts. each, 8 pts. total) Undergraduate research assistant Sally Humdinger has tried to carry out each of the following reactions, but neither one has worked as written. Clearly and succinctly, explain to her why not.

(a)



This electrophilic addition reaction would proceed with Markovnikov regioselectivity, putting the Cl on the more substituted C of the alkene.

(b)



Under these basic conditions, the 3° alkyl halide would undergo elimination when treated with the good nucleophile / good base.