

Name Kay (print) Name \_\_\_\_\_ (sign)

Please show work for partial credit and full credit on the Long Answers and in some of the Short Answer Questions. Multiple choice questions have no partial credit. Please write anything you want graded legibly. If you run out of space, continue on the empty back pages but clearly label where the remaining answer can be found. (If I can't find your answer or cannot read it, I obviously cannot grade it). Return your entire exam including the periodic table. (Please count pages and make sure there are real pages + periodic table )

It is your responsibility to **return the entire exam package** (with periodic table assembly inside the rest of the exam) **directly into Dr. Hahn's hands**. If you do not and the exam disappears or sits around for days NOT in Dr. Hahn's possession, that exam will count as an UNEXCUSED missed exam.. NOTE: Even if you accidentally come up with the final correct answer, if your work leading to the final correct answer does not lead to your final correct answer, you may lose all credit on the question.

**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (2 pts each, 2<sup>1/2</sup> pts total)**

1) What is the IUPAC name of the following compound?

1) A



A) 3-Methyl-4-penten-1-ol

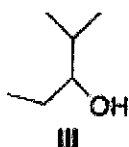
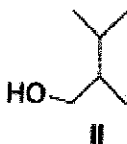
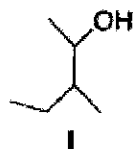
B) 3-Methyl-1-penten-5-ol

C) 5-Hydroxy-3-methyl-1-pentene

D) 3-Methyl-5-penten-1-ol

2) Which of the following compounds is (are) primary alcohols?

2) D



A) Only I and II

B) Only I

C) Only II and III

D) Only II

3) Which of the following explains why epoxides are much more reactive than ethers?

3) A

A) The C-O-C bond angle of an epoxide is 60°, making epoxides to have angle strain.

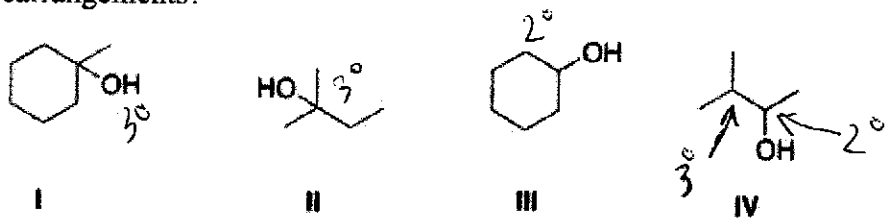
B) The C-O-C bond angle of an epoxide is 109°, making epoxides to have angle strain.

C) The C-O-C bond angle of an epoxide is 120°, making epoxides to have angle strain.

D) The oxygen atom of an epoxide is  $sp^2$  hybridized.

4) Which of the following alcohols is most likely to yield a carbocation that is susceptible to rearrangements?

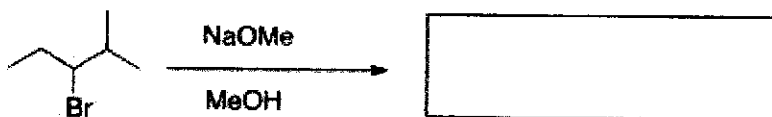
4) D



- A) I                      B) II                      C) III                      **D) IV**

5) What is the major elimination product obtained from the following reaction?

5) B



- A) I                      **B) II**                      C) III                      D) IV

6) Which of the following compounds are epoxides?

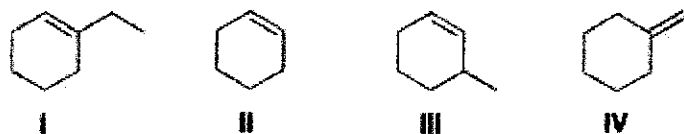
6) D



- A) I, II, III, and IV                      B) Only I, III, and IV  
C) Only I and III                      **D) Only III and IV**

7) Which of the following alkenes is the most stable?

7) A



- A) I**                      B) II                      C) III                      D) IV

most substituted

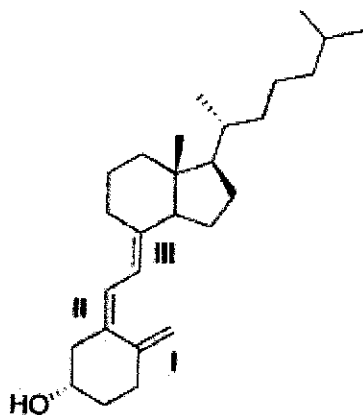
8) What are the major products obtained upon treatment of *tert*-butyl methyl ether with excess HI?

8) A

- A) *tert*-Butyl iodide and iodomethane**                      B) *tert*-Butyl alcohol and methanol  
C) *tert*-Butyl iodide and methanol                      D) *tert*-Butyl alcohol and iodomethane

9) Classify each alkene in vitamin D<sub>3</sub> labeled I, II, III by the number of carbon substituents bonded to the double bond.

9) A



- A) I = Disubstituted; II = trisubstituted; III = trisubstituted.  
 B) I = Disubstituted; II = trisubstituted; III = disubstituted.  
 C) I = Monosubstituted; II = disubstituted; III = trisubstituted.  
 D) I = Disubstituted; II = disubstituted; III = trisubstituted.

10) Which of the following statements about an E1 mechanism is *not* true? E1  
base not  
part of  
rate law

10) B

- A) The reaction is fastest with tertiary alkyl halides.  
 B) Stronger bases favor the E1 reaction.  
 C) The reaction follows first-order kinetics.  
 D) A better leaving group makes the reaction rate increase.

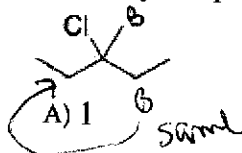
11) Which of the following statements about the mechanism of an E2 reaction is *not* true?

11) D

- A) A better leaving group should make a faster reaction.  
 B) It is fastest with tertiary halides.  
 C) All bonds are broken and formed in a single step.  
 D) It exhibits first-order kinetics.

12) How many unique  $\beta$  carbons are found in the alkyl halide below?

12) B



B) 2

C) 3

D) 4

13) Which of the following represents the rate law for an E2 reaction?

13) A

A) Rate =  $k[\text{alkyl halide}][\text{base}]$

B) Rate =  $k[\text{base}]^2$

C) Rate =  $k[\text{alkyl halide}]$

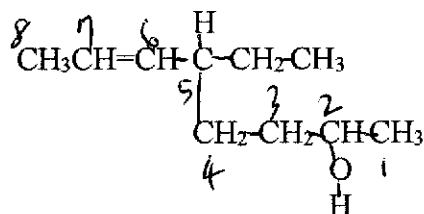
D) Rate =  $k[\text{alkyl halide}]^2$

**Part II: Short Answers (44 pts)** Show work on all questions for partial and full credit even on questions which do not specify.

A. Nomenclature: (8 pts total, 2 pts each)

1. Given the structural formula shown below, give the IUPAC name of the molecule.

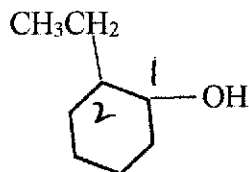
a. name 9-ethyloct-6-en-2-ol



oct ~~ane~~  
en-ol  
6 ↑  
2

9-ethyl

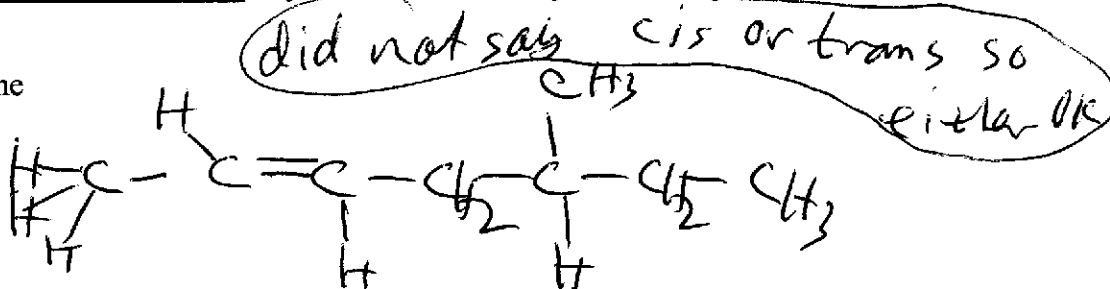
b. name 2-ethylcyclohexan-1-ol



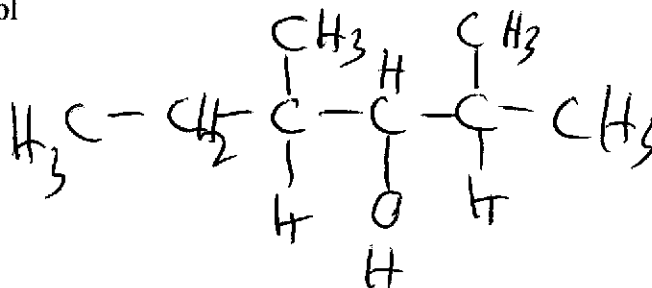
cyclohexan ~~ane~~ ol  
2-ethyl  
can leave out

2. Given the following IUPAC name, draw a structural formula of the molecule (skeletal formula acceptable, condensed structure, Lewis Dot structure acceptable, molecular formula not acceptable - **don't forget to show the hydrogens** in your formula unless you are using the skeletal structure.)

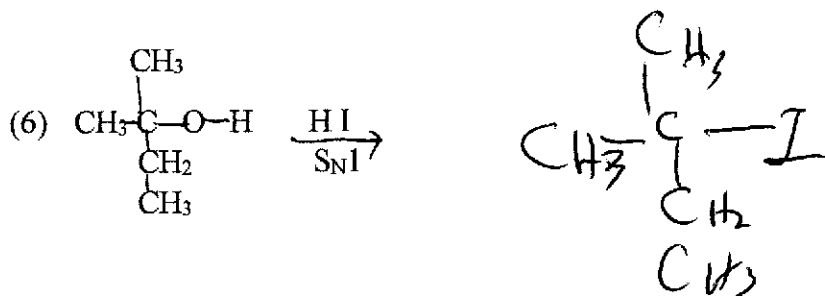
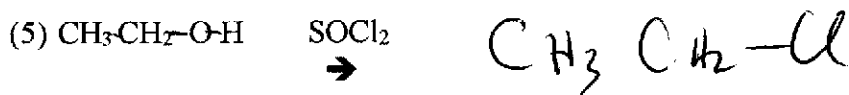
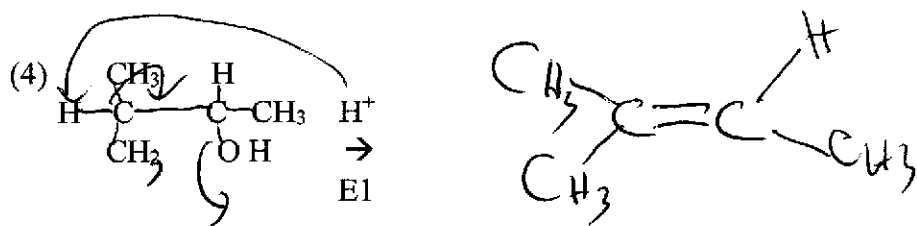
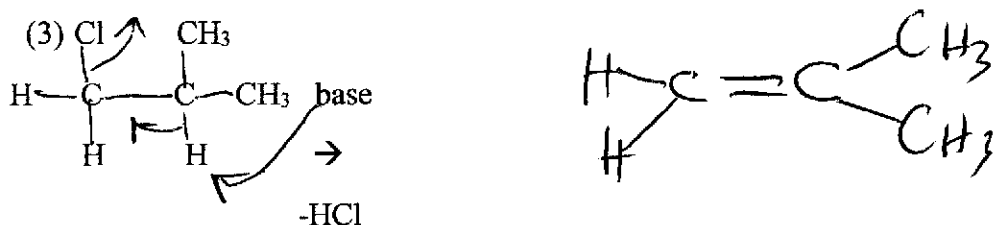
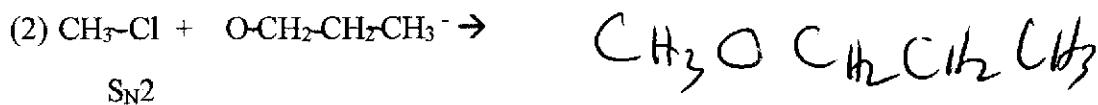
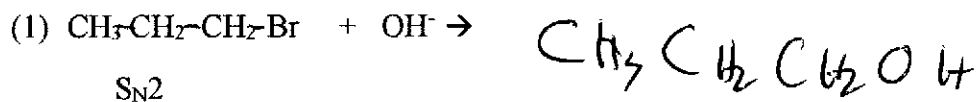
a. 5-methyl-2-heptene

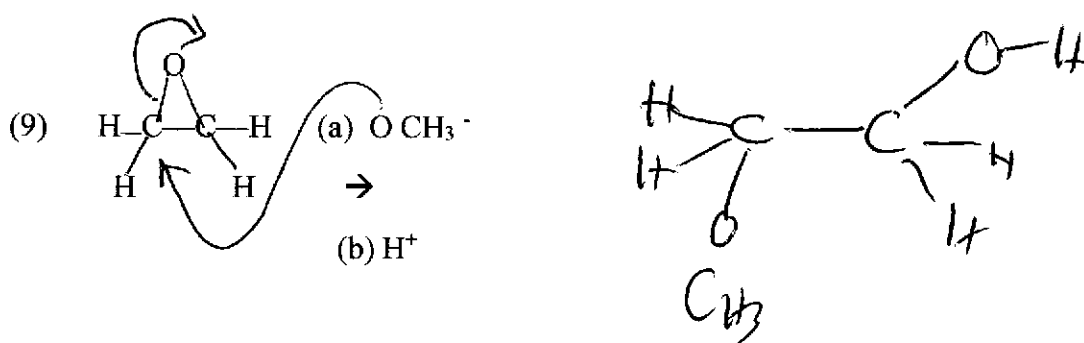
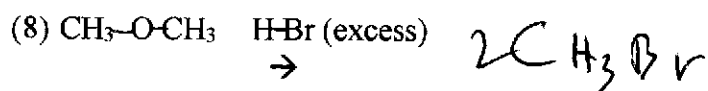
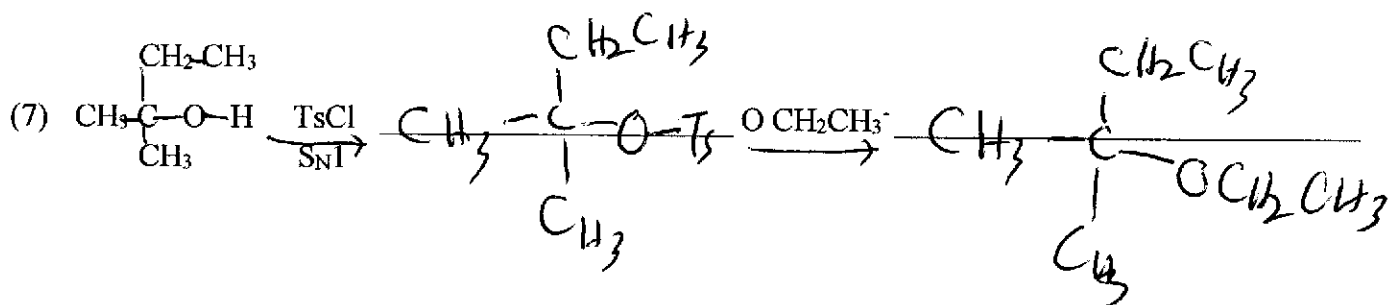


b. 2,4-dimethylhexan-3-ol



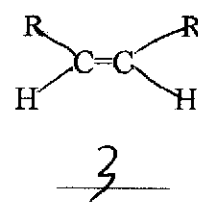
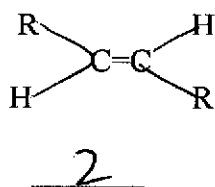
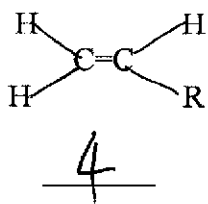
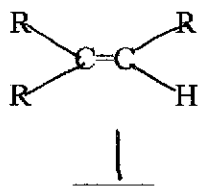
B. Reactions: Complete the following reaction by giving the organic product. Reaction does not need to be balanced. (18 pts total, 2 pts each)



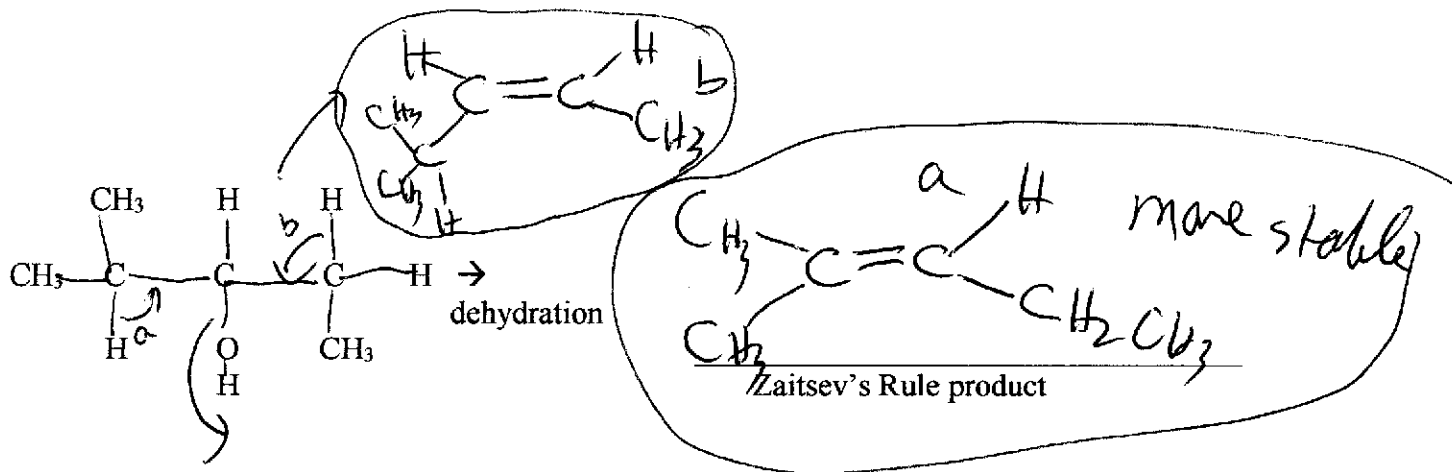


C. Short Answer: (18 pts)

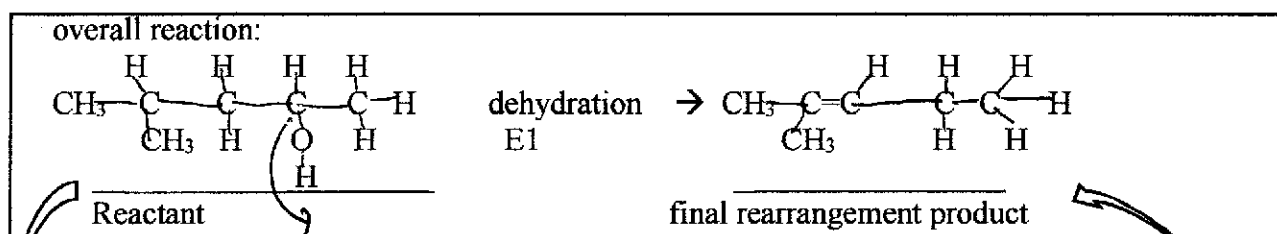
1 Order the following alkenes from the **most stable (1)** to **least stable (4)**. (Do not lose all points by reversing the meaning of the numbers.) (8 pts, 2 pts each) ( $R \neq H$ )



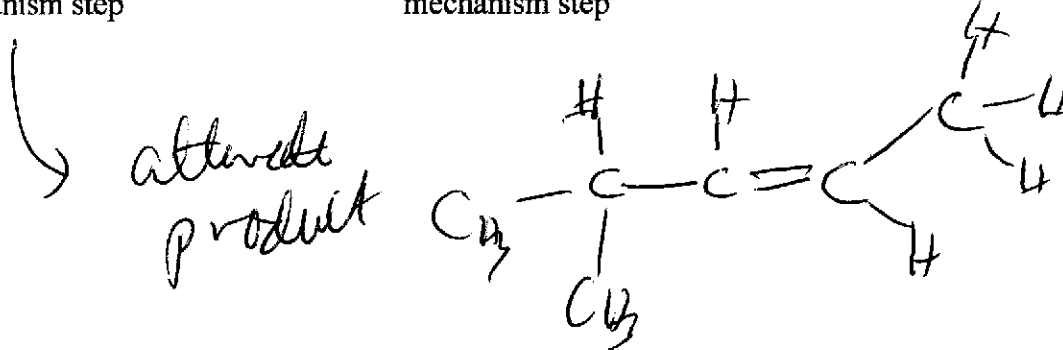
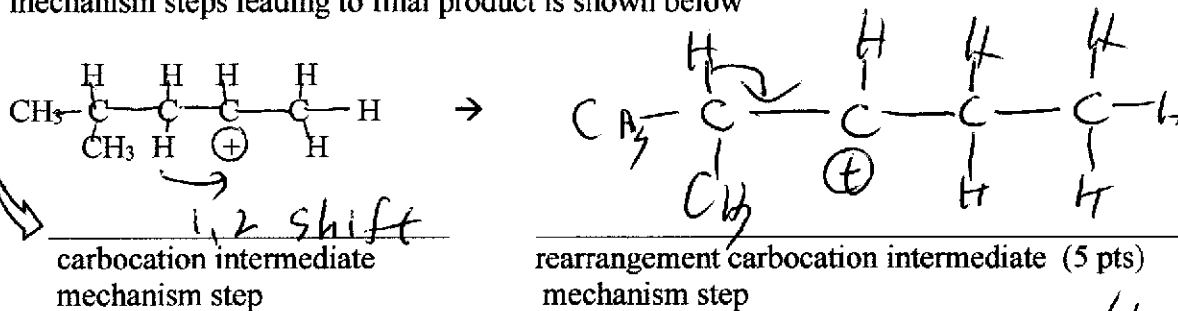
2 In the molecule shown below, show the Zaitsev's Rule elimination (E1 or E2) product. (5 pts)



3. The following shows a rearrangement reaction for a dehydration reaction. Show the rearranged carbocation which leads to the product. (5 pts)



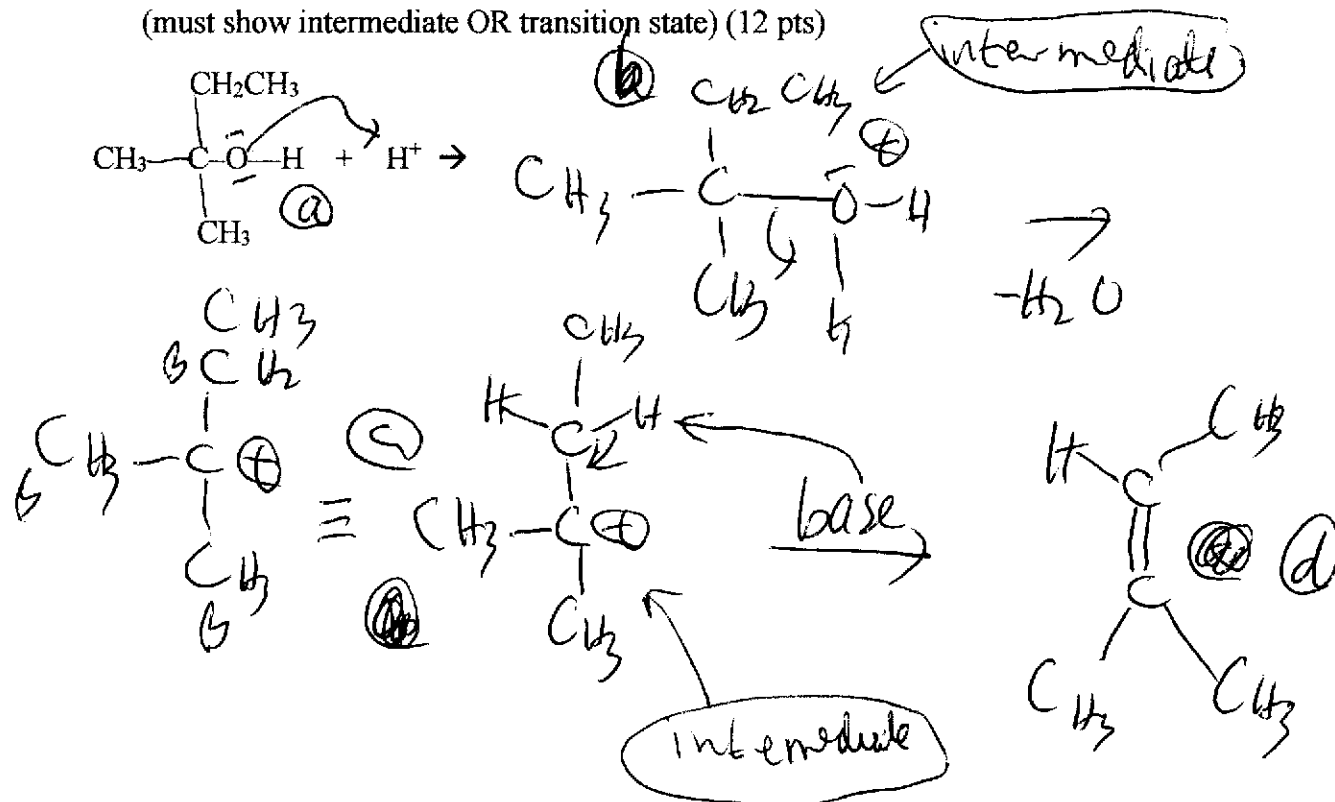
mechanism steps leading to final product is shown below



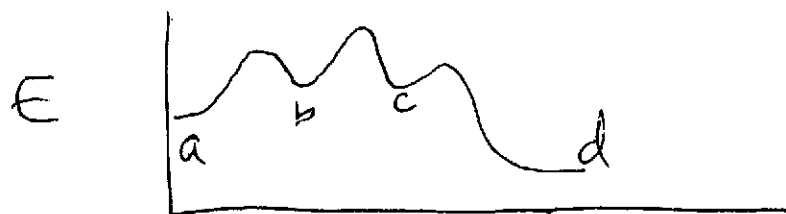
**Part III: Long Answers** (30 pts) Show work on all questions for partial and full credit even on questions which do not specify.

1. Complete an **E1** reaction mechanism for the reaction of the following. (20 pts)

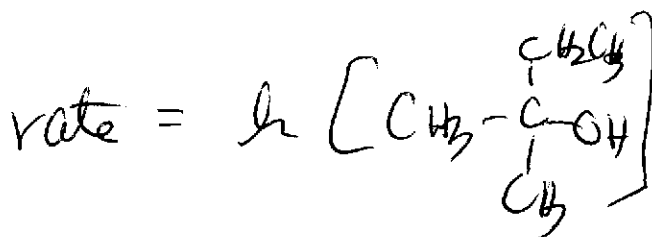
(a) Give the mechanism to the dehydration elimination product. Give the major product mechanism. (must show intermediate OR transition state) (12 pts)



(b) Give the energy diagram for the reaction mechanism shown above.

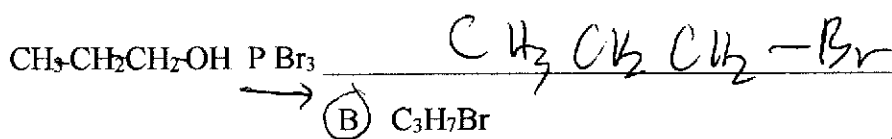
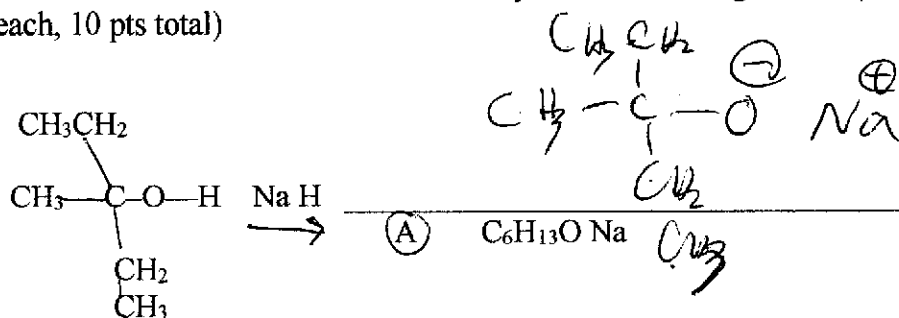


(c) Give the rate law for the reaction mechanism shown above





2 Complete the following synthesis by filling in the blank. I have provided some hints to help you come up with the answers. NOTE: The way I grade this is for you to fill in reasonable molecules based on the immediate prior molecule. i.e. If you fill in part A with the wrong molecule and then do the next reaction to molecule B correctly you will get half credit for answering B correctly. If you fill in B with what you would have gotten if you got A correctly but which cannot possibly be generated from your wrong A, you will lose all credit even if it matches what you should have gotten. (hint: Williamson Ether Synthesis) (2 pts each, 10 pts total)



A + B → C

