Exam 2 Spring 2014

Name Key Room _____

Student ID_____ Seat Number_____

Circle One **11:15 AM Class** **12:20 PM Class**

The exam consists of 10 questions on a total of 12 pages, including periodic table.

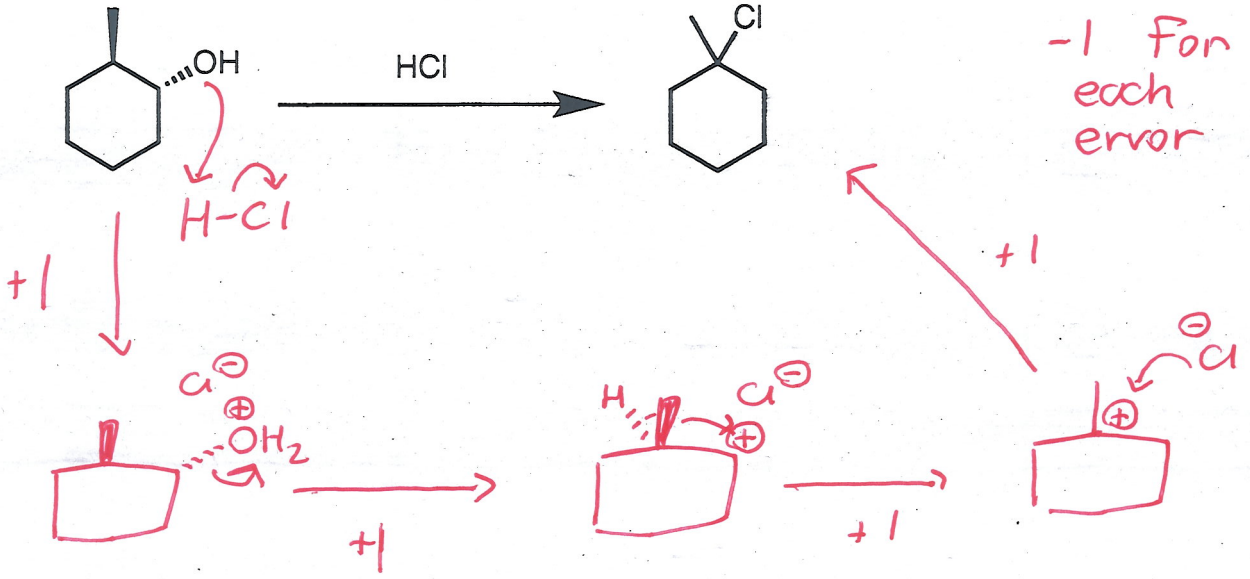
1. _____/10
2. _____/10
3. _____/10
4. _____/10
5. _____/10
6. _____/10
7. _____/10
8. _____/10
9. _____/8
10. _____/12

Regrading: All requests for regrades must be submitted in writing within 48 hours of the return of the exam. You must explicitly state what has been misgraded and why it is an error. The entire exam will be regraded, which could result in points being added or deducted overall.

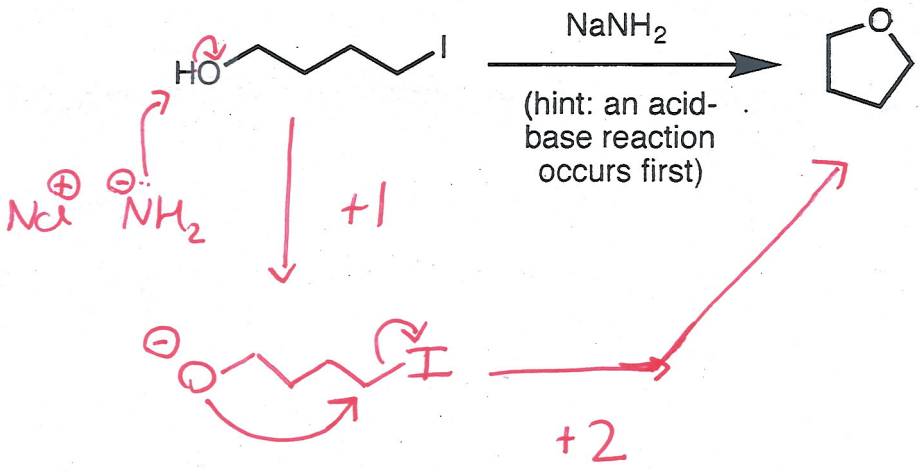
Key

1. (10 points) Draw a mechanism for each of the following reactions.

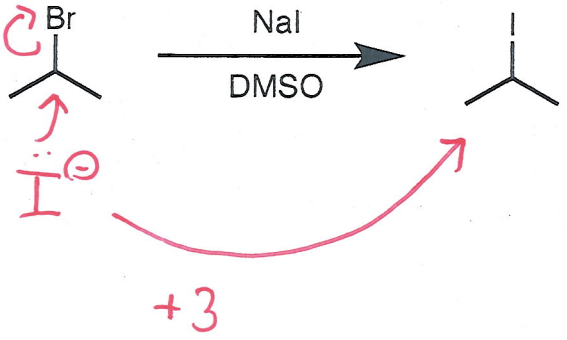
a) (4 points)



b) (3 points)



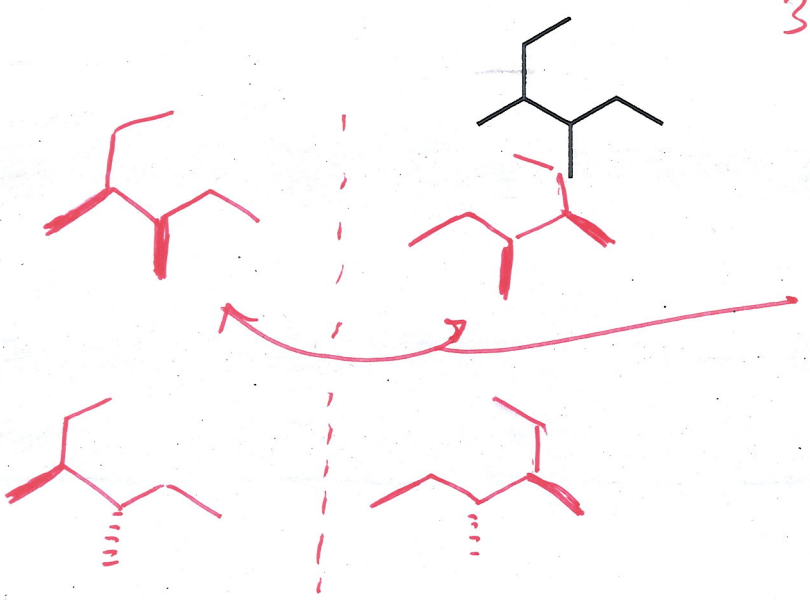
c) (3 points)



Key

2. (10 points)

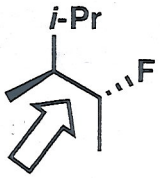
a) (6 points) Draw ***all*** of the stereoisomers of the following compound.



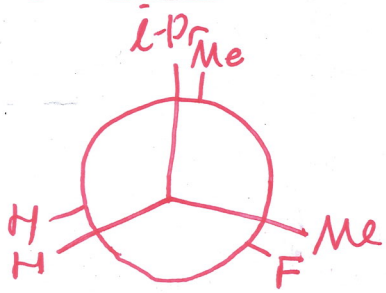
3 stereoisomers
+2 for each stereoisomers

same compound
-2 for not indicating

b) (4 points) Using Newman projections draw the ***highest energy conformation*** of the compound illustrated below. Only consider conformations that rotate the indicated bond.



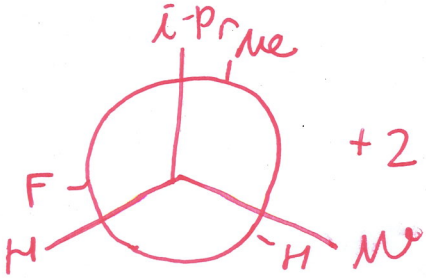
correct



+4

+3 for enantiomer

+1 for enantiomer not in correct conformation



+2

all other diastoemers +1

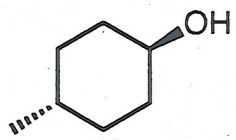
-1 for staggard

No credit for incorrect compound.

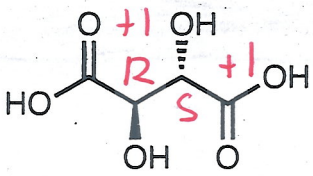
Key

3. (10 points)

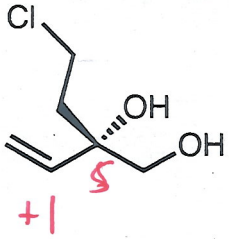
a) (6 poitns) Please identify if each of the following compounds are "chiral", "achiral" or "achiral and meso". ***If the compound contains chirality centers, please indicate R or S for each center.***



achiral +1

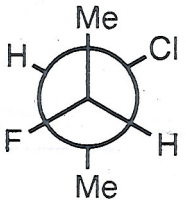


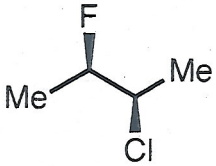
achiral and Meso +1



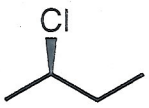
chiral +1

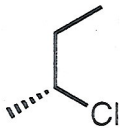
b) (4 points) Determine the relationship between the followings pairs of compounds. Write "same," "constitutional isomers," "enantiomers," or "diastereomers."





diastoomers +2



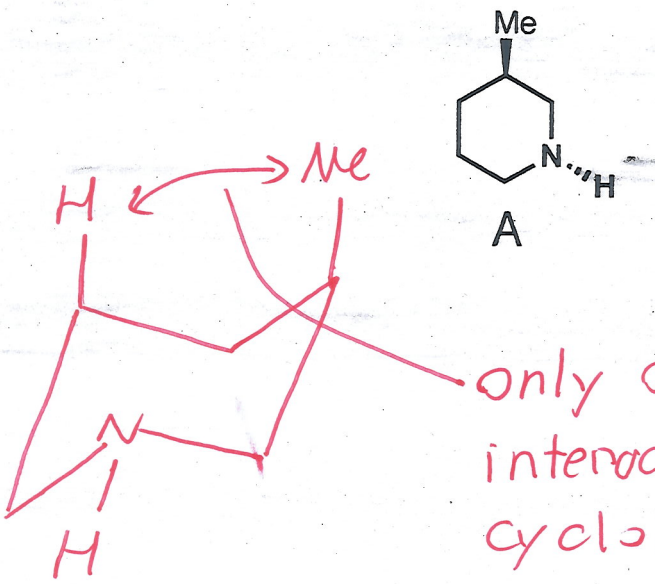


some compound +2

+0, 3, 6, 10 overall For quality of answer

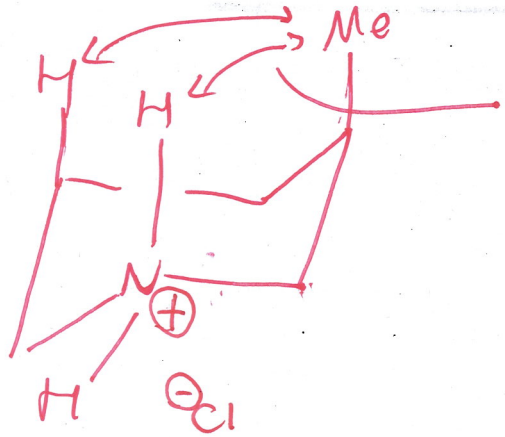
4. (10 points)

a) (5 points) The difference between the axial and equatorial conformations of compound **A** is -5.4 kJ/mol. Why is this different than the free energy difference between axial and equatorial conformations of methylcyclohexane, which is -7.6 kJ/mol? Please support your answer with figures and text.



only one 1,3 diaxial interaction. Methyl-cyclohexane has 2x 1,3 dioxial interactions

b) (5 points) When compound **A** is dissolved in aqueous HCl, the difference between the axial and equatorial conformations of compound **A** is now very similar to that of methylcyclohexane, why? Please support your answer with figures and text.

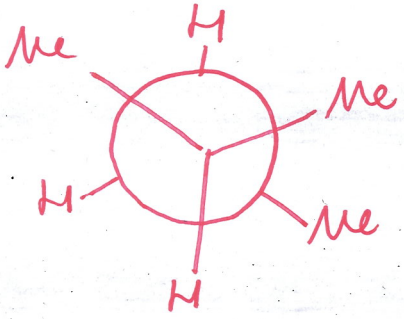


2 x 1,3 dioxial interactions, same as Methyl cyclohexane

Overall
- 1 for completely wrong structure but everything else right

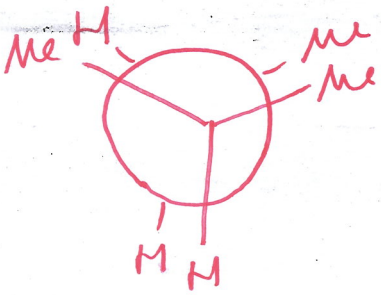
5. (10 points)

a) (3 points) Draw the ***lowest*** energy conformation of 2-methylbutane. Use a Newman projection to illustrate your answer.



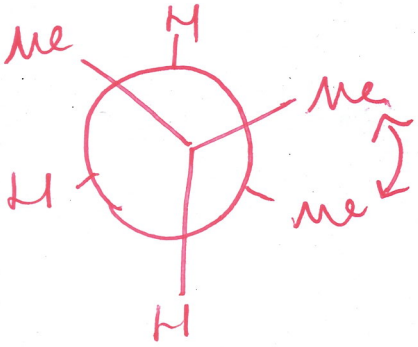
- 1 for each error (bad Newman projection, eclipsed not lowest)

b) (3 points) Draw the ***highest*** energy conformation of 2-methylbutane. Use a Newman projection to illustrate your answer.



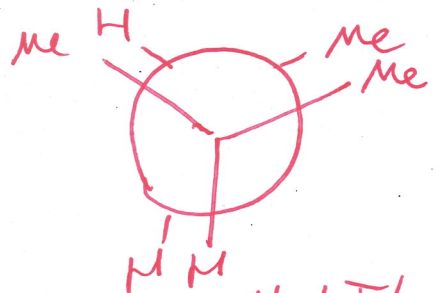
- 1 for each error (bad Newman prg. edipsed not lowest)

c) (4 points) Using the values provided at the end of the exam, what is the energy difference between these two conformations.



Gauche
3.8 kJ/m

6 kJ/mol



11 kJ/mol

4 kJ/mol

overall 21 kJ/mol

17.2 kJ/mol

-1 for no difference bt high/low # correct

-1 for using eclipsed values to get 13.8 kJ/mol

6. (10 points) Consider the following ***S_N1 reaction*** and answer the following questions.

a) (2 points) What is the rate equation of this reaction?

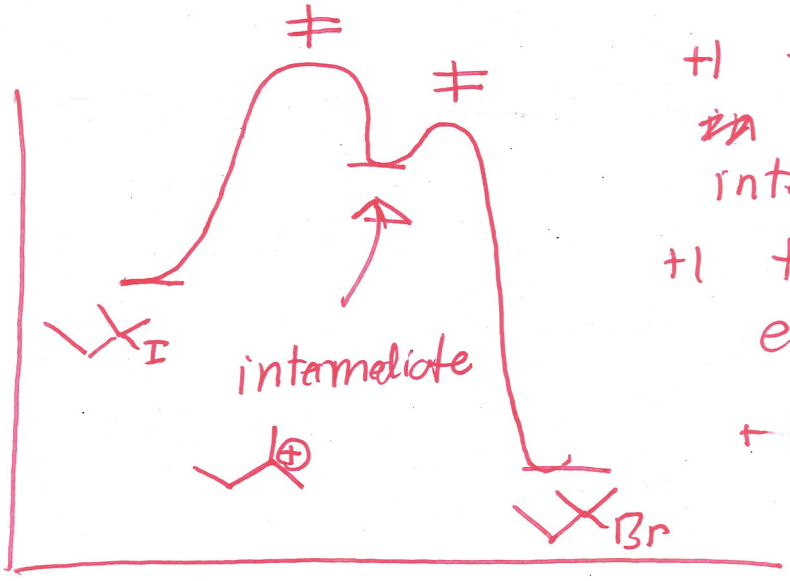
Rate = $k[\text{X}_\text{I}]$ +2 for correct

b) (2 points) Would the reaction occur at a faster rate if the concentration of NaBr was doubled? Provide a brief explanation.

+1 NO. NaBr is not part of the rate equation

+1

b) (6 points) Draw a reaction coordinate energy diagram for the above process. (You may assume the reaction is exergonic) ***Clearly identify all intermediates and transition states.***



+1 for each labeled T.S. and intermediate

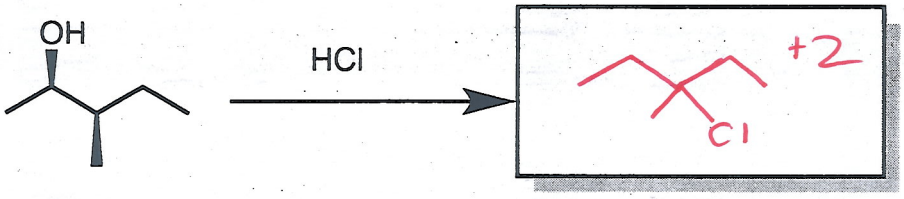
+1 for correct energy levels

+1 for exergonic

7. (10 points)

For the following ***substitution*** reactions, fill in the blank. (2 points each)

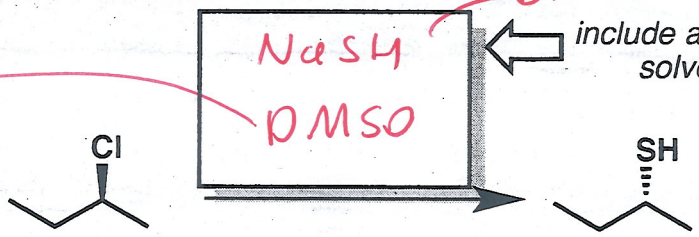
a)



ok

+1 for

b)

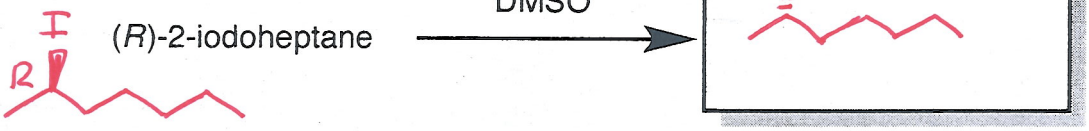


or $^{\ominus}SH$

DMF
MeCN
acetone
also acceptable

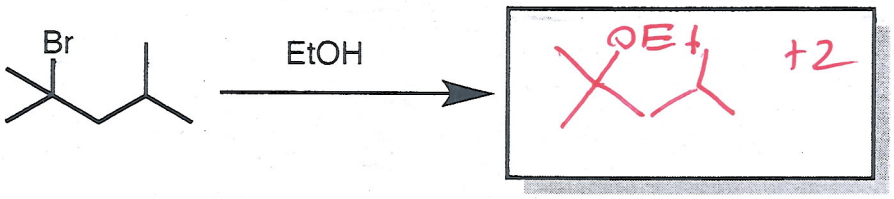
+1 for each

c)

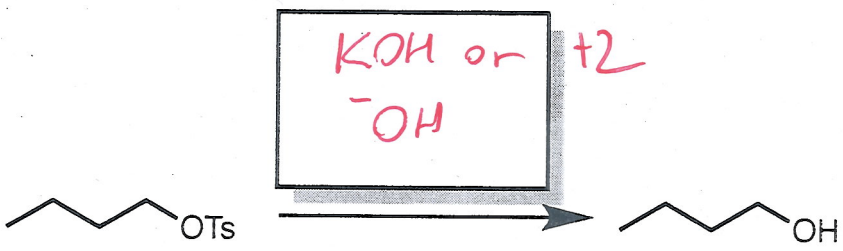


+1 for enantiomer

d)



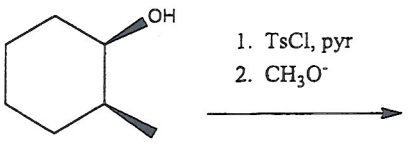
e)



Key

8. (10 points)

a) (6 points) Predict the major product(s) in each elimination reaction.

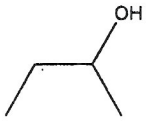


1. TsCl, pyr
2. CH_3O^-

+2

+1

+1

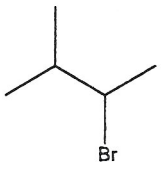


H_2SO_4

+2

+1

or

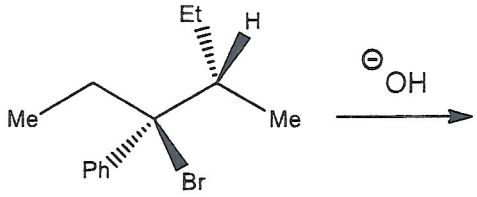


$tBuO^-K^+$

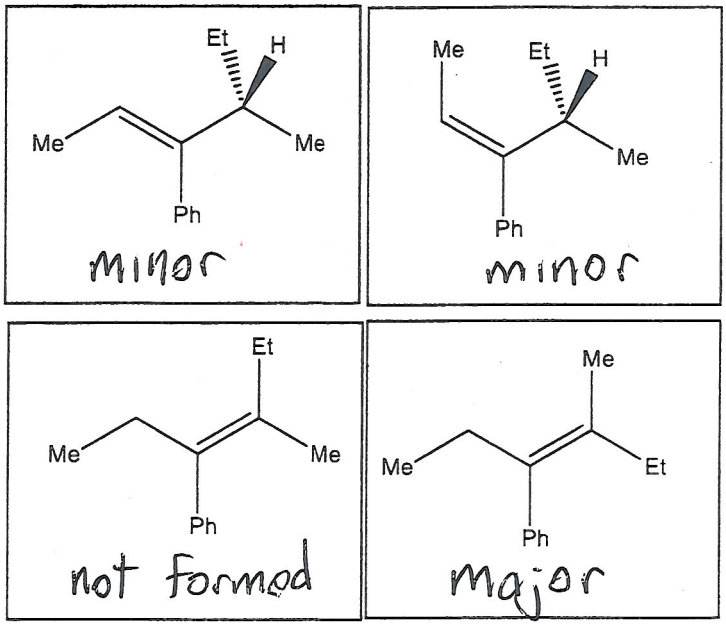
+2

+1

b) (4 points) Under each potential product of this E2 elimination, write "major product," "minor product," or "not formed."

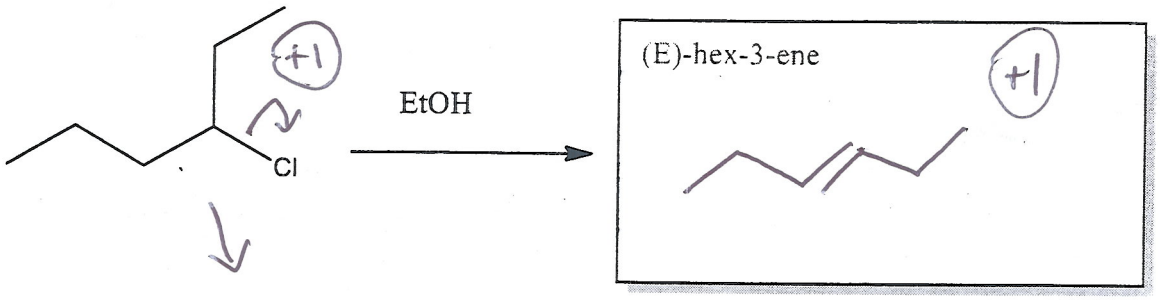


$\ominus$ OH

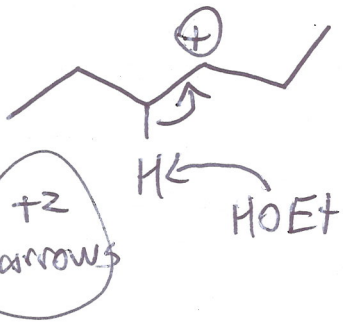


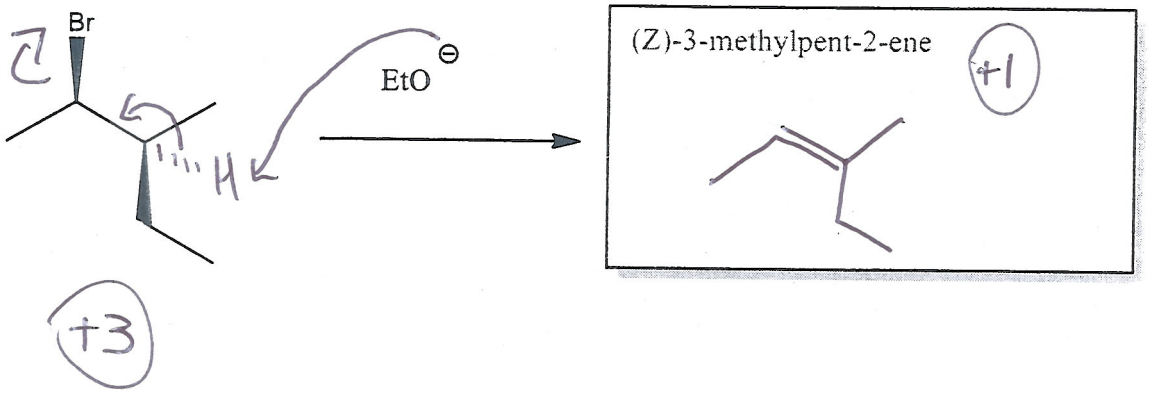
Key

9. (8 points) Draw the products and provide mechanisms for these reactions.



E1





E2

+3

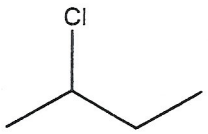
Key

10. (12 points) For each of the reactions below, indicate the major mechanism by which it proceeds as either E1, E2, S_N1, S_N2, or a mixture of these mechanisms. Then draw the major product of each reaction. (Partial credit will be given for a major product consistent with the mechanism selected, even if the selected mechanism is incorrect. If the major product given is inconsistent with the selected mechanism, then it is wrong.)

HO^-

mechanism(s): E2 (+2)

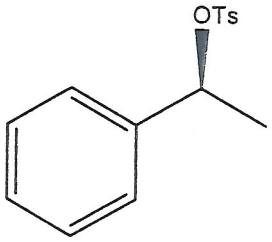
major product(s): (+2)



H_2O

mechanism(s): $S_N1/E1$ (+1) (+1)

major product(s): (+1) + OH (+1)



^-CN
DMF

mechanism(s): S_N2 (+2)

major product(s): CN (+2) (+1 other enantiomer)