

Second 2-Hour Exam

By printing your name below, you pledge that

"On my honor, as a University of Colorado at Boulder student,
I have neither given nor received unauthorized assistance on this work."

Name Answer Key

Recitation TA's Name: _____ [Matt, Greg, Carley, Jacquie or Kate]

Recitation Day and Time: _____

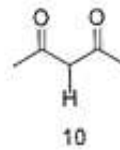
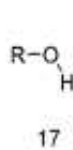
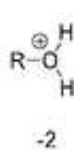
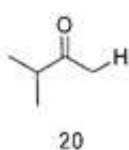
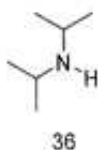
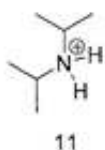
Points:

Page #	Max. Points	Your Score
2	22	
3	10	
4	22	
5	6	
6	22	
7	18	
		_____ TOTAL (out of 100)

General Instructions:

- This is a closed book exam! No notes and no molecular models may be used
- You have 2 hours to complete the exam
- Write your name on the top of each page
- Use the back of pages for scratch paper
- Don't cheat!

Some potentially useful pKa values:

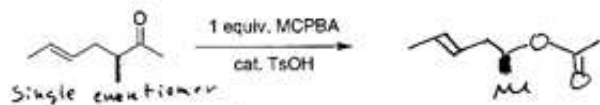


Question # 1

22 pts total

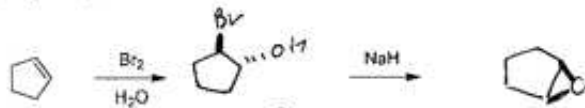
For each of the reactions below provide the products or missing intermediates. Draw all possible stereoisomers for reactions that provide stereoisomers.

a)



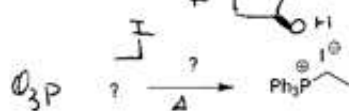
2 pt

b)



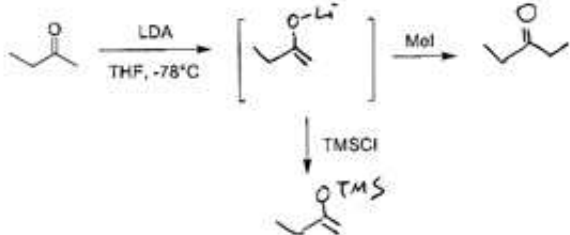
4 pt

c)



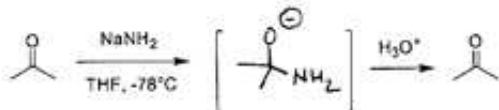
2 pt

d)



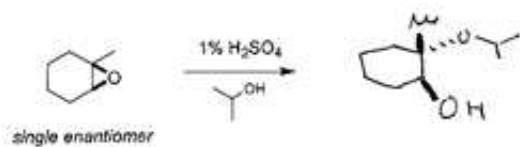
6 pt

e)



2 pt

f)



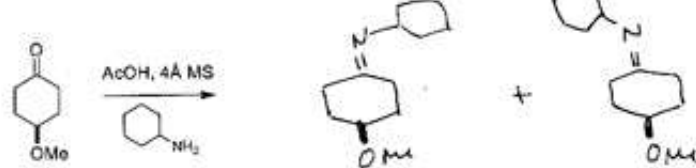
2 pt

d)



2 pt

e)



2 pt

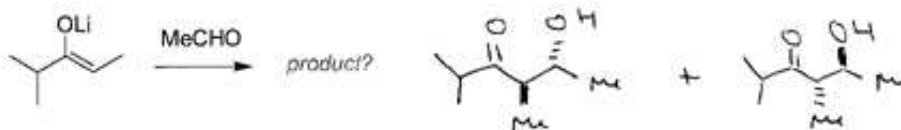
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Question # 2

10 pts total

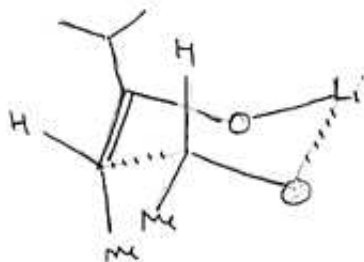
Draw the major product of the following reaction [pay attention to stereochemistry!] and draw the appropriate transition state structures based on the Zimmerman-Traxler models to explain the observed stereochemistry.

a)

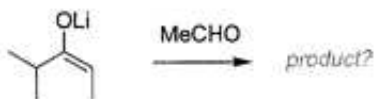


draw Zimmerman-Traxler structure to explain stereochemistry in product:

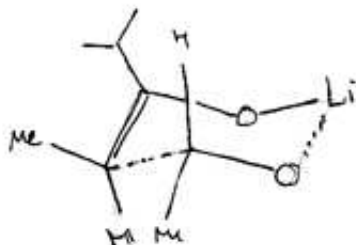
5 pt



b)



draw Zimmerman-Traxler structure to explain stereochemistry in product:

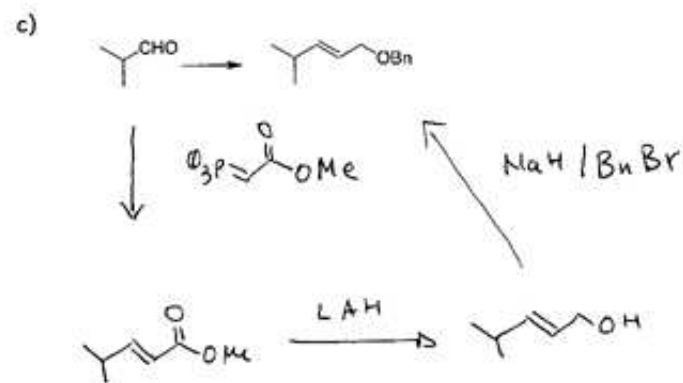
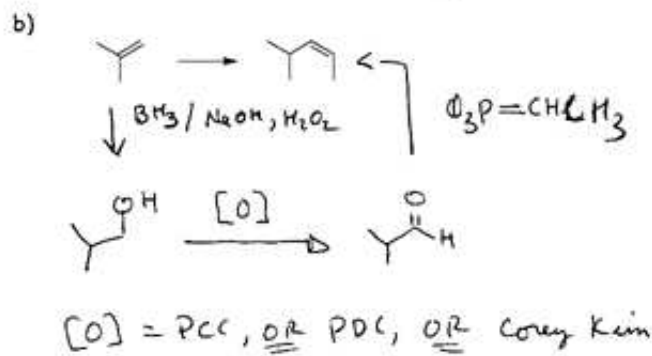
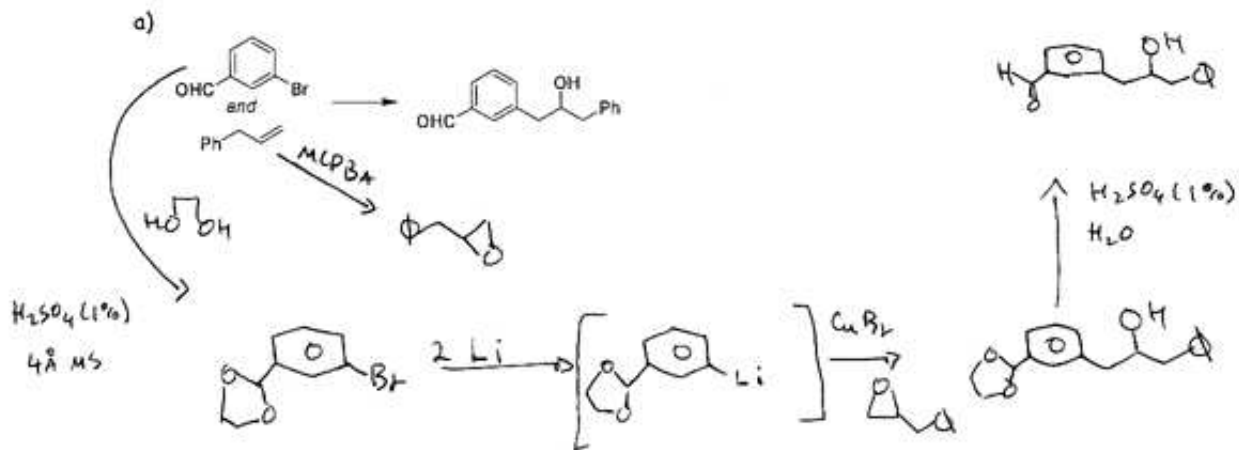


5 pt

Question # 3

22 pts total

How would you synthesize the following molecules from the starting materials shown and any other reagents you choose? Be sure to show the products of each step if your synthesis requires more than one step.

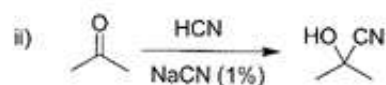


Question # 4

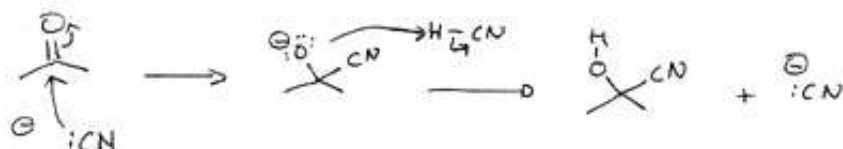
28 pts total

1) Consider the following two data points:

(6 pts)



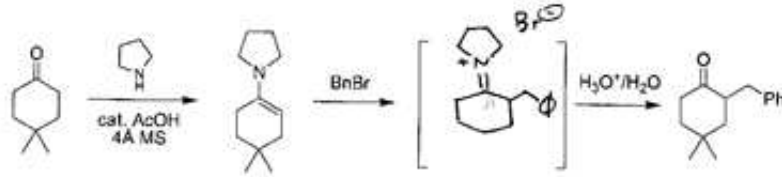
- a. Write a mechanism for the second reaction. Be sure to show all the intermediates and all the arrows required for each step [including aqueous workup if it is required].



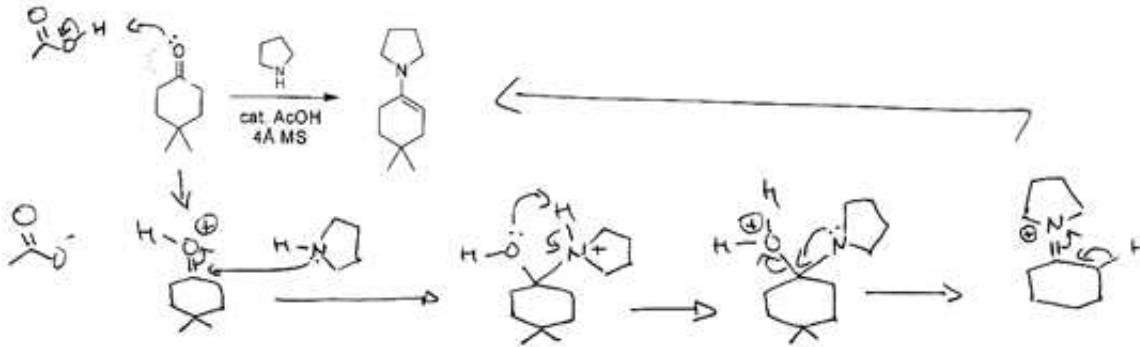
- b. Explain in one sentence why reaction (i) fails and reaction (ii) works. Hint: pK_a of HCN is 10.

HCN is not acidic enough to protonate the ketone, and by itself is not nucleophilic since there is very little free CN^- around. The addition of 1% CN^- provides enough CN^- to act as a nucleophilic catalyst and attack the carbonyl in the first step of the catalytic cycle.

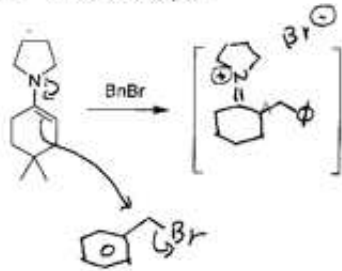
2) Fill in the missing intermediate structure for the sequence shown below and then write complete and detailed mechanisms for all steps of this sequence as shown below. (22 pts)



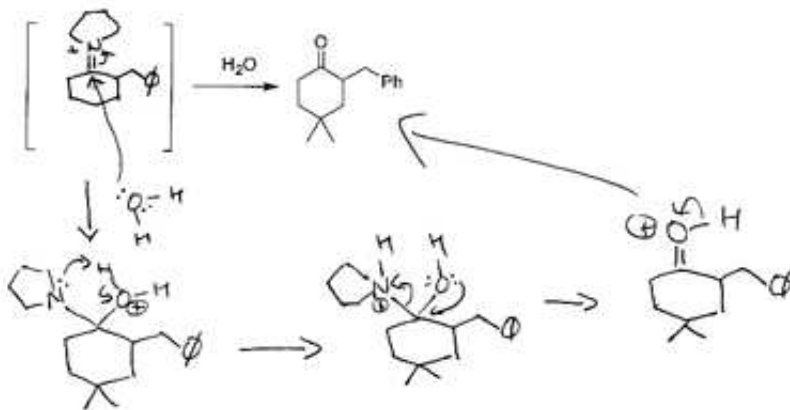
• Mechanism for:



• Mechanism for:



• Mechanism for:

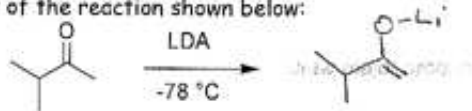


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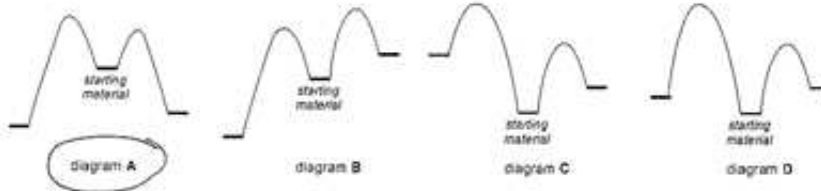
Question # 5

18 pts total

a) Draw the major product of the reaction shown below:

i) Is this reaction under kinetic or thermodynamic control?ii) Provide K_{eq} for this reaction: $K_{eq} = 10^{16}$

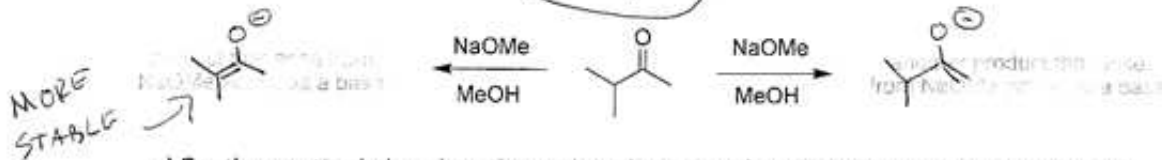
iii) Circle the reaction coordinate vs energy diagram shown below that best represents this reaction?



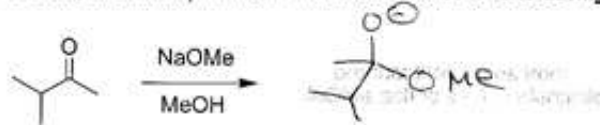
b) i) For the reaction below, draw the products that arise from NaOMe acting as a base

ii) Provide K_{eq} for this reaction: $K_{eq} = 10^{-3}$

iii) Indicate which of the products you have drawn is the more stable

iv) Is this reaction under kinetic or thermodynamic control?

v) For the reaction below, draw the product that arises from NaOMe acting as a nucleophile



c) For the reaction below, draw the most stable product that arise from NaOMe acting as a base.

There are two other important resonance structure contributors to this molecule, one of which is less important than the others. Draw them below and indicate which is the least important.

