

## First 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 \_\_\_\_\_

Recitation TA's Name: \_\_\_\_\_ [Amy, Kate or Katie]

Recitation Day and Time: \_\_\_\_\_

Points:

Page #	Max. Points	Your Score
2	10	
3	10	
4	18	
5	12	
6	12	
7	24	
8	10	
9	4	
		_____ 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!

Question # 1

10 pts total

Circle the correct answer (2 pts each):

- a)  $\text{NaIO}_4$  is a cheap, non-toxic, method for dihydroxylation of alkenes. TRUE  FALSE
- b) Cuprates are useful for alkylation reactions because they are less basic than Grignard reagents.  TRUE FALSE
- c) LAH is a useful reagent for the reduction of esters to aldehydes. TRUE  FALSE
- d) Reduction can involve the addition of O to a molecule. TRUE  FALSE
- e) The carbon atom of a carbonyl group is electrophilic.  TRUE FALSE
- f) A carbene has a carbon with 4 valence electrons plus an empty p orbital TRUE  FALSE
- g) Oxidation can involve the removal of H from an organic compound.  TRUE FALSE
- h)  $\text{NABH}_4$  is a useful reagent for the reduction of carboxylic acids to aldehydes. TRUE  FALSE
- i) Simple carbene ( $:\text{CH}_2$ ) can not be prepared from  $\text{CH}_3\text{Br}$  and  $t\text{-BuOK}$ .  TRUE FALSE
- j) A reaction that produces diastereoisomers will always produce them in equal amounts. TRUE  FALSE

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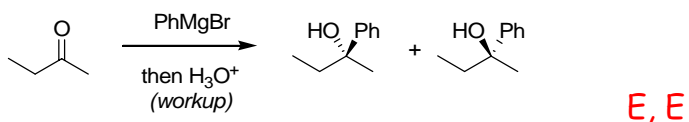
**Question # 2****10 pts total**

For each of the reactions below

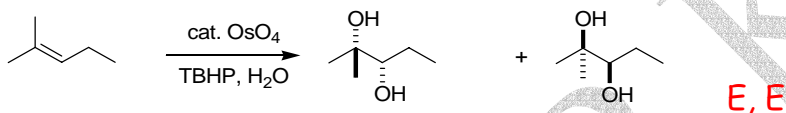
(i) indicate what the relationship between the products is (enantiomers; diastereoisomers; or same compound)

*and* (ii) indicate whether you would expect the products to be formed in equal (E) or non-equal amounts (NE). If you think the question of the ratio of products is not relevant to a particular example write NA.

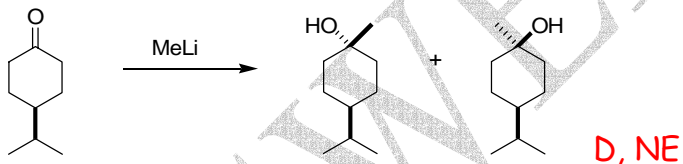
a)



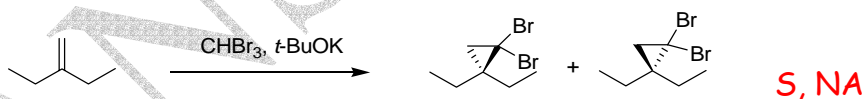
b)



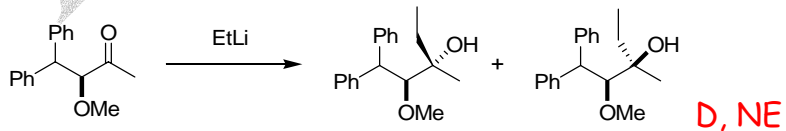
c)



d)



e)

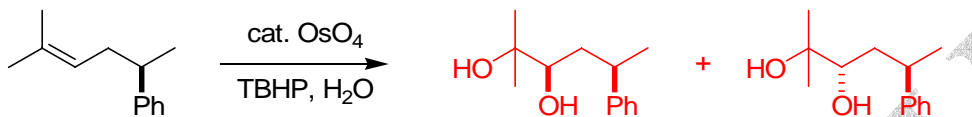


Question # 3

30 pts total

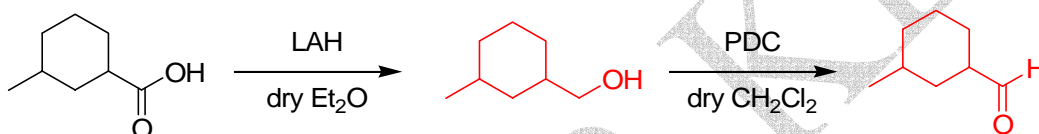
Draw the product of the following reactions. Remember that aqueous workup is performed at the end of reactions. If a reaction generates enantiomers draw both enantiomers. In cases where diastereoisomers are formed draw both diastereoisomers.

a)



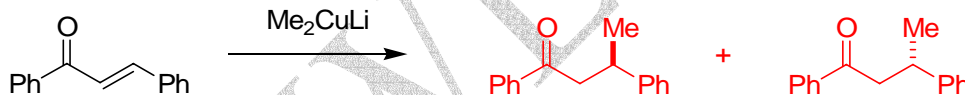
4 pt

b)



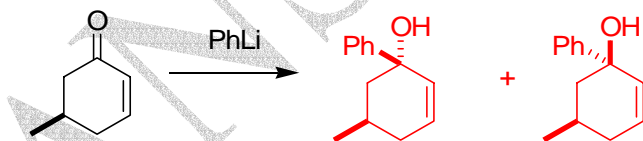
4 pt

c)



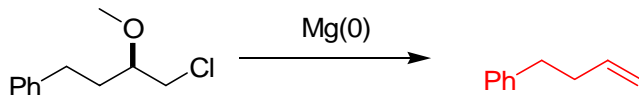
4 pt

d)



4pt

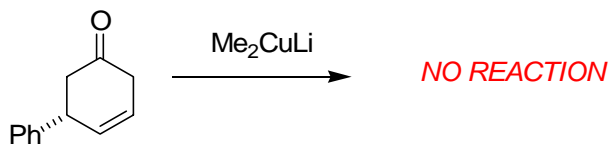
e)



2pt

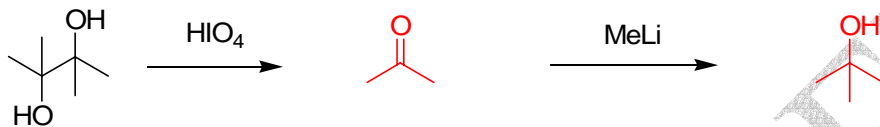
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f)



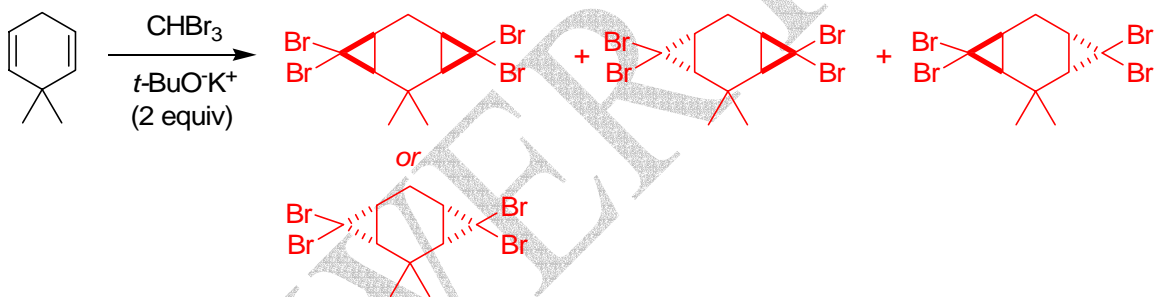
2pt

g)



4pt

h)



6pt

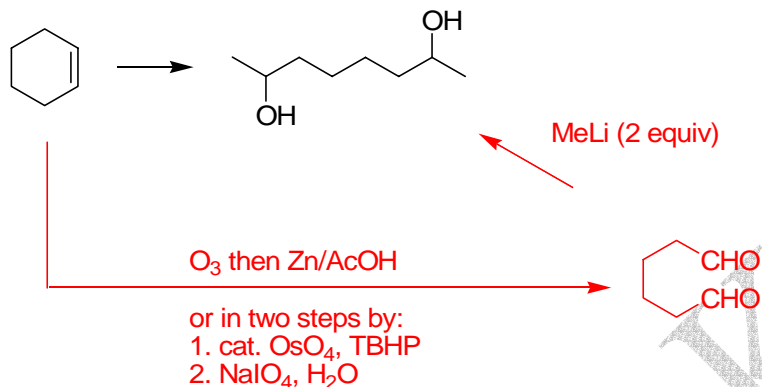
Question # 4

36 pts total

How would you synthesize the following molecules from the shown starting materials using organic reagents containing less than 7 carbons, and any inorganic reagents you choose. *Please pay attention to stereochemistry where it is shown!* For partial credit show retrosynthesis and/or the products of each step if your synthesis requires more than one step.

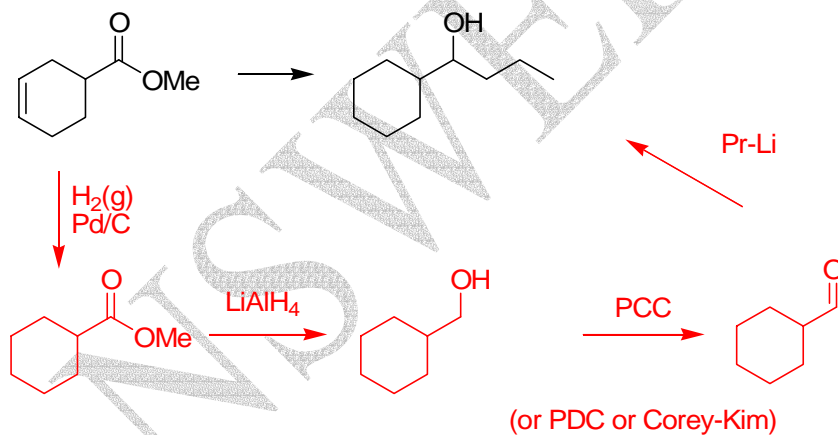
a)

4 pt

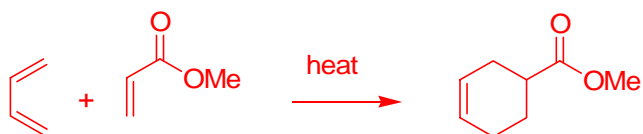


b)

8 pt



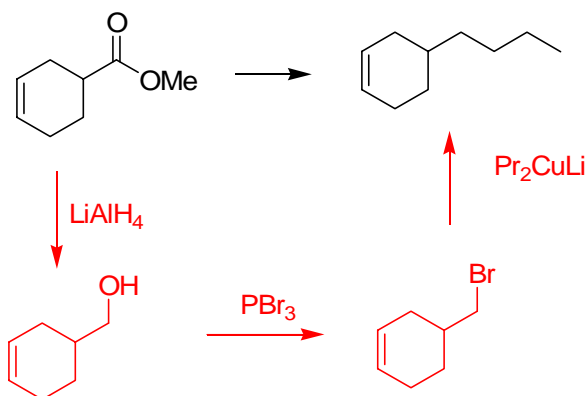
BONUS (2pts for correct answer. No partial credit and you can't score >100% on the exam): How would you synthesize the starting material from two organic compounds of 4 carbons?



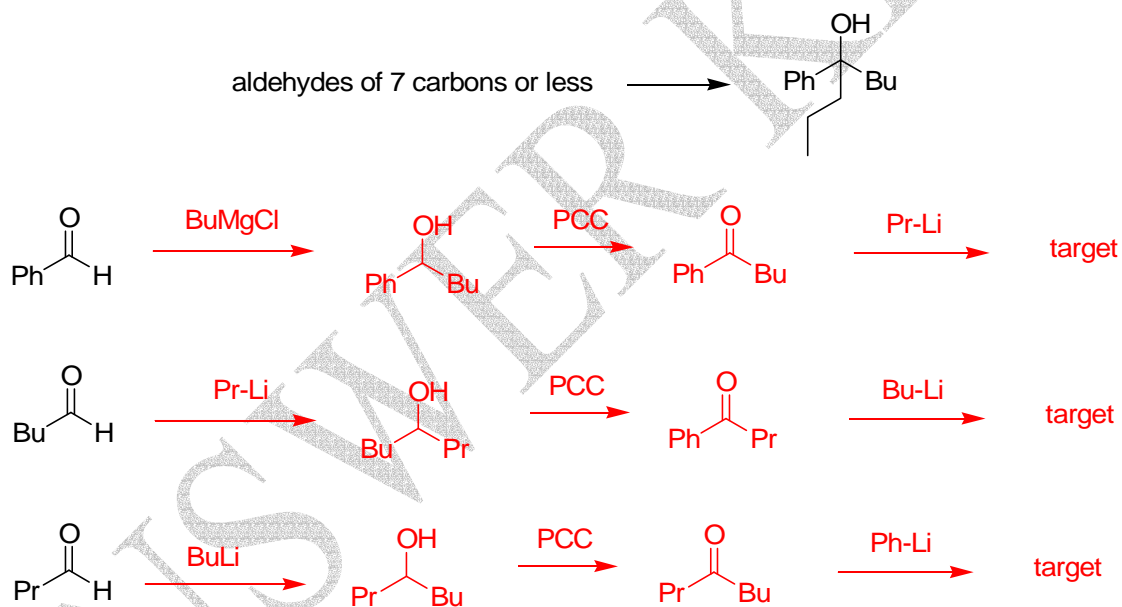
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c)

6 pt



d) For this question provide **3 different syntheses** [i.e. you must start from a different compound!] starting with aldehydes of 7 carbons or less: 18 pt



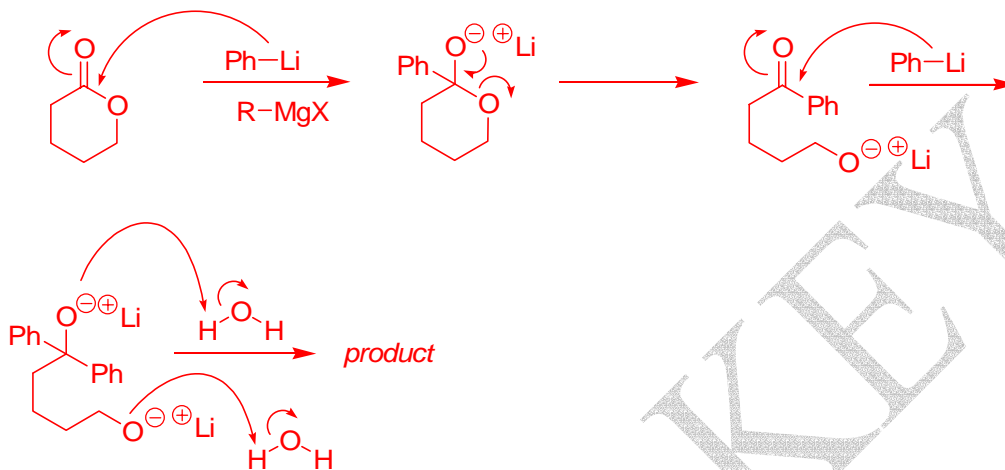
*several other permutations are also possible*

**Question # 6****14 pts total**

Write mechanisms for the following two reactions. *Be sure to show all the intermediates and all the arrows required for each step [including aqueous workup if it is required].*

a)

10pt

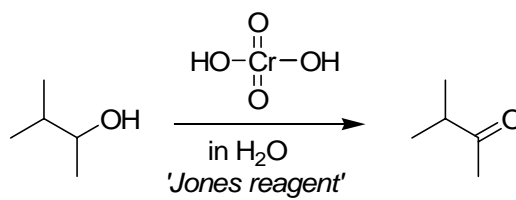


ANSWER KEY

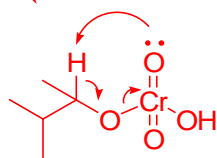


b)

4pt



*chromate ester formation*



ANSWER KEY