Easily Legible Printed Name:_____

CHEM 3371 (100), Spring 2017
Professor Walba
First Hour Exam
February 14, 2017

scores:

1) 20

2) 20

3) 20

4) 20

5) 20

_____
100

CU Honor Code Pledge: On my honor, as a University of Colorado at Boulder Student, I have neither given nor received unauthorized assistance.

Signature: Key

Recitation TA Name: _____
Ed Guzman

Recitation day and time: _____

This is a closed-book exam. The use of notes, calculators, scratch paper, or cell phones will not be allowed during the exam. You may use models brought in a clear Ziploc bag. Please put all your answers on the test in the appropriate place. Use the backs of the pages for scratch (there are two additional blank scratch sheets after the last page of the exam). DO NOT PUT ANSWERS ON THE SCRATCH SHEETS.

PLEASE read the questions very carefully!

Partial Periodic Table

1A							8A
1 H	2A	3A	4A	5A	6A	7A	2 He
3 Li	4 Be	5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
						35 Br	
						53 I	

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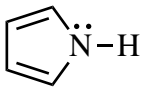
1 (20 pts) a) For each of the following heterocyclic molecules, indicate whether the molecule is aromatic or not aromatic by circling your answer, give the hybridization of the heteroatom in the box, and give a **brief** explanation of your answer in the open space to the right of the structure.

1) 

(aromatic) / not aromatic

sp^2

six π electrons including the lone pair, which is in a p orbital

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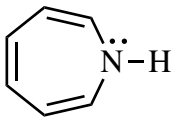
2) 

aromatic / (not aromatic)

sp^3

If the nitrogen is sp^3 hybridized, there is NOT an unbroken ring of p orbitals. If the nitrogen is sp^2 hybridized, then there are 8 π electrons - making the system antiaromatic (which is not aromatic)

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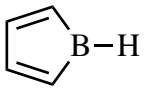
3) 

aromatic / (not aromatic)

sp^2

There are four π electrons - this molecule would be antiaromatic. (this is not part of the official answer, but FYI this molecule has actually nevery been synthesized)

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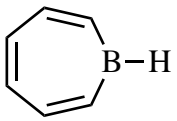
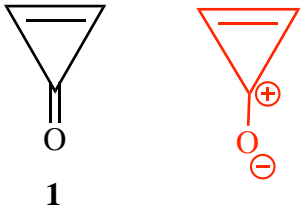
4) 

(aromatic) / not aromatic

sp^2

six π electrons in an unbroken ring of p orbitals

b) Cyclopropenone (compound **1** below) looks extremely strained, but it's actually surprisingly stable (has a surprisingly low heat of formation). Also, the measured dipole moment is larger than one would expect for a ketone. Give a brief explanation of your hypothesis for why this is the case.



1

This fairly amazing molecule is aromatic with 2 π electrons and three p orbitals.

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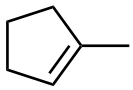
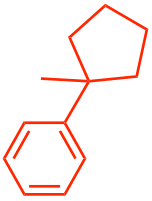
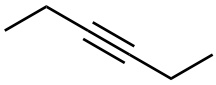
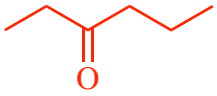
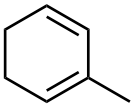
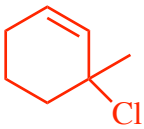
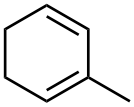
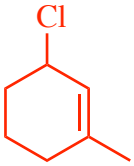
2) (20 pts) Give the **single major product** for each of the following reactions, carefully showing stereochemistry using wedges and dashes if appropriate. If a racemate is formed, show only one enantiomer and label it "rac." Assume chiral starting materials are single pure enantiomers unless they are labeled "rac."

a)  H_2SO_4 (large excess) 

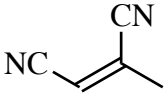
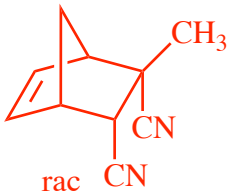
b)  cat $Hg(OAc)_2$, H_2O; H^+ 

c)  HCl (cold); (irreversible conditions) 

rac

d)  HCl, cat $FeCl_3$ 

rac

e)  +  mild heating; (irreversible conditions) 

rac

Total points for this page: 20

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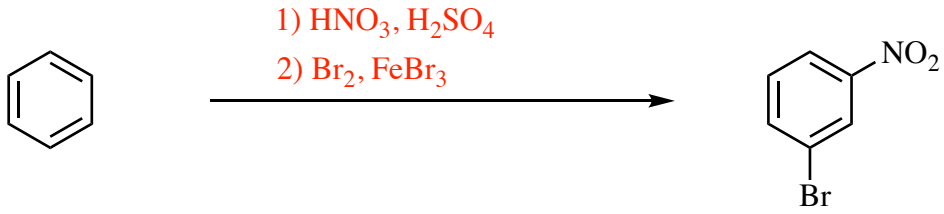
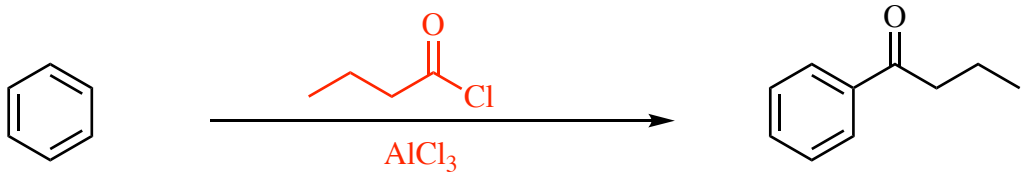
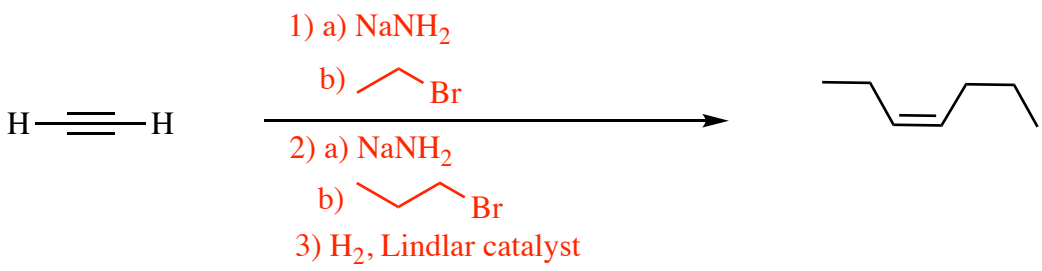
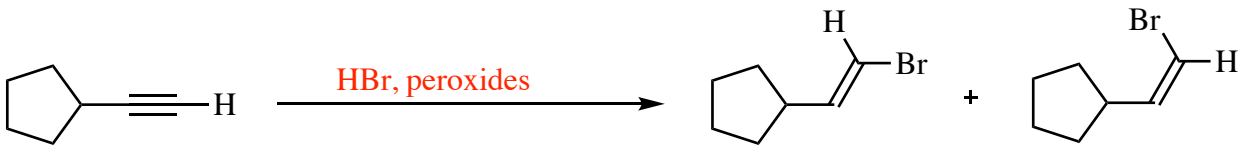
3) (20 pts) Propose reagents for accomplishing each of the following transformations. For reactions involving sequential addition of reagents, label the two parts of the reaction using letters. Your synthesis may require multiple reactions, with isolation of intermediate products, to make the target. Use numbers to indicate individual steps in a multi-step synthesis. Make your synthesis efficient (i.e. the target product should be the major product). Assume chiral starting materials and products are single pure enantiomers unless they are labeled "rac."

a) 

b) 

c) 

d) 

e) 

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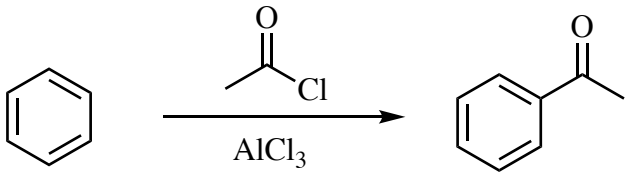
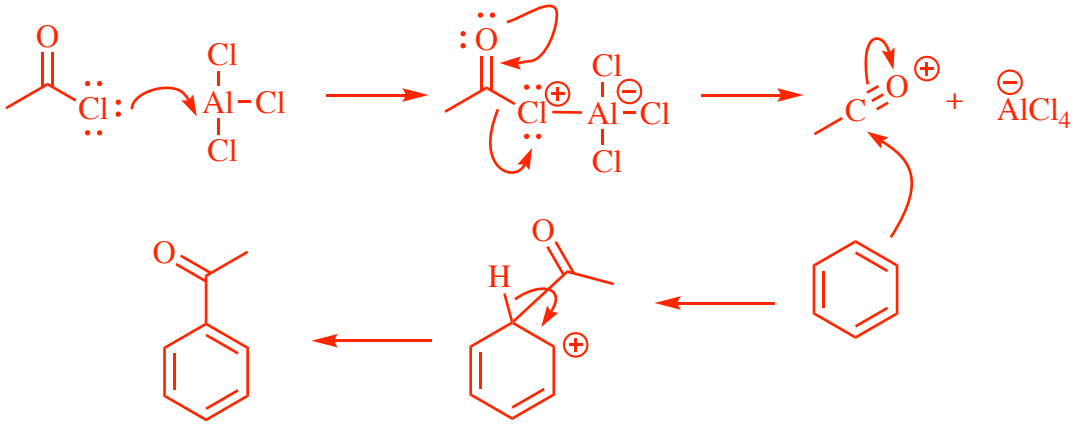
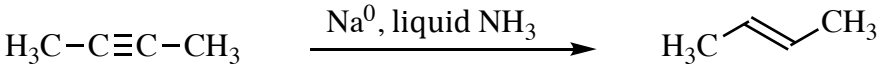
4) (20 pts) Propose an arrow-pushing mechanism for each of the following reactions.

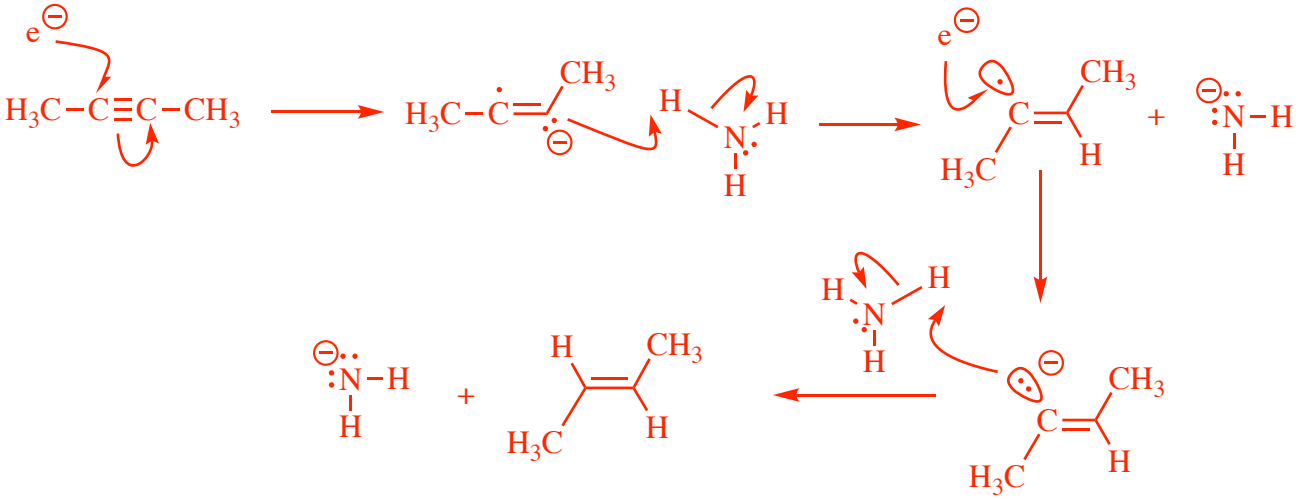
a)





b)





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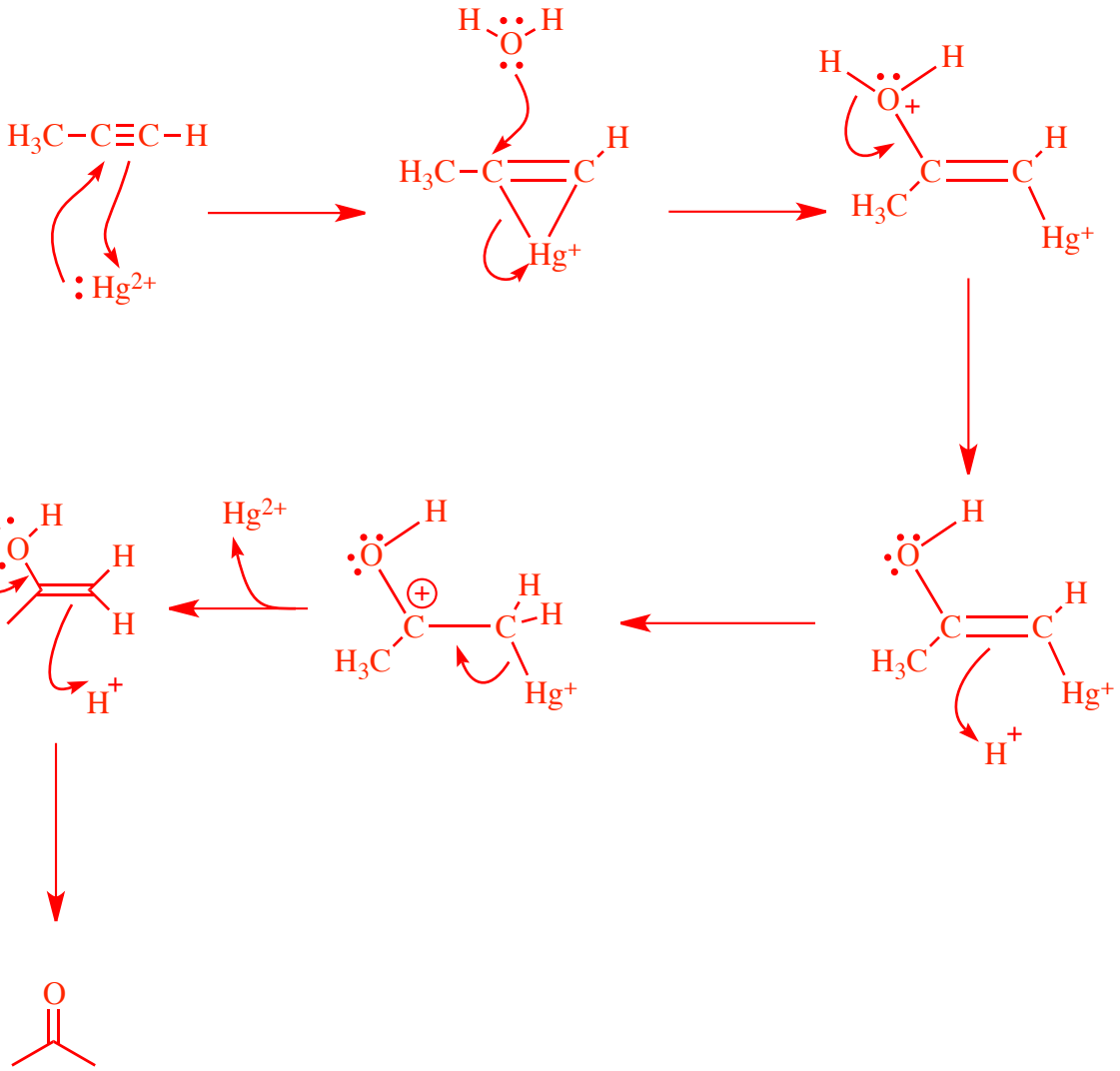
Q4 – continued

c) $H_3C-C\equiv C-H$ $\xrightarrow[H_2SO_4,\ H_2O]{\text{cat } Hg(OAc)_2}$ 



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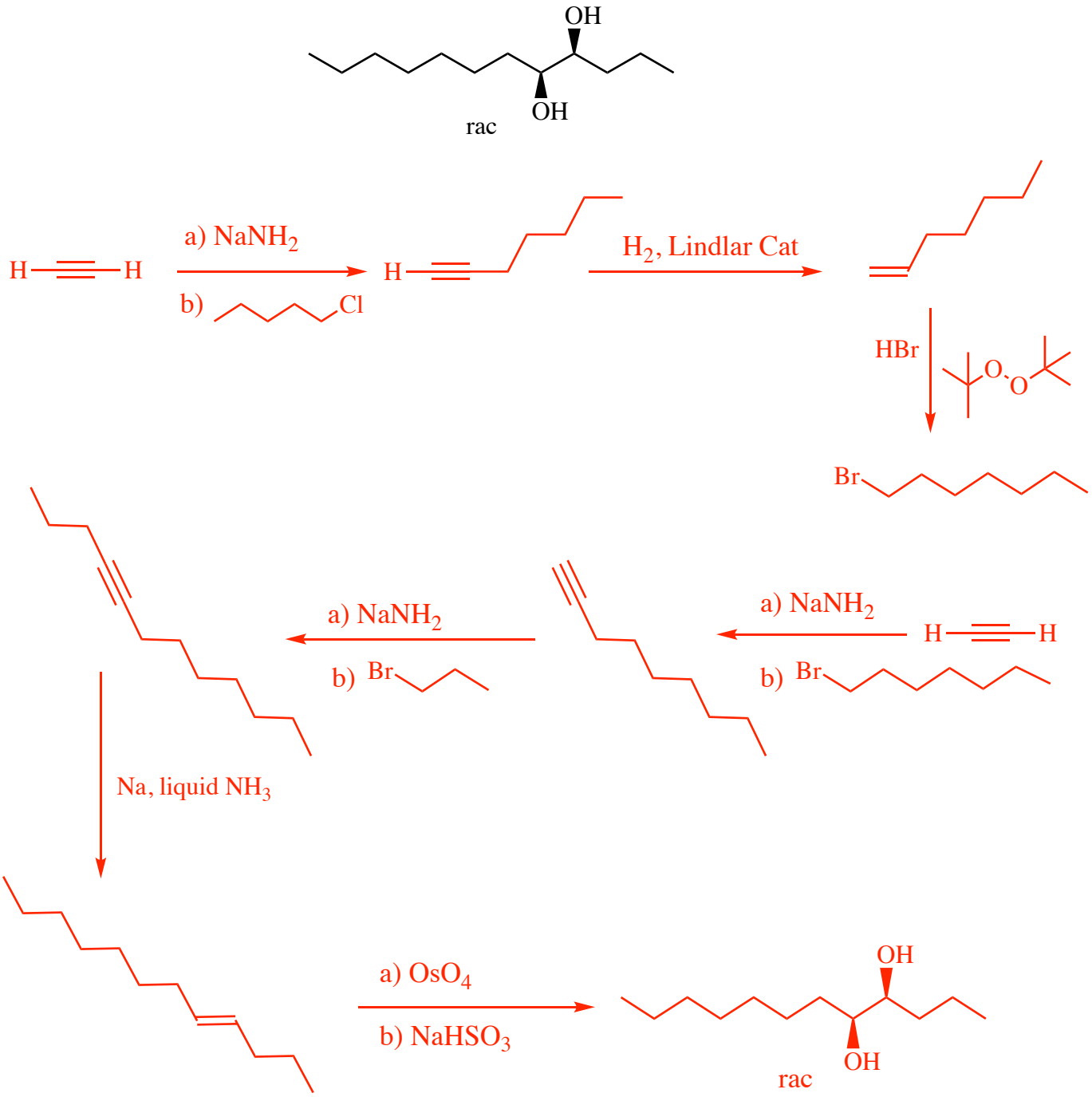
5) (20 pts) Propose a synthesis of the following diol target using any organic starting materials with **five carbons or less**. You may use any necessary inorganic reagents. Try to make your synthesis efficient (i.e. the target should be produced in high yield). More than one step will be required. Each reaction in the sequence leading to an isolated and purified product should be shown. Please use letters to indicate sequential addition of reagents in a single reaction. **Do not put multiple reactions over/under one arrow**



Total points for this page: 20