Printed Name:_____

CHEM 3371, Spring 2015
Professor Walba
First Hour Exam
February 10, 2015

scores:

1) 20

2) 20

3) 20

4) 24

5) 16

_____

100

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

Name (printed): Key

Signature: _____

Recitation TA: Patrick Chaffey or Carley Little
(circle your TAs name)

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 ziplock bag. Please put all you 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.

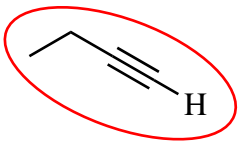
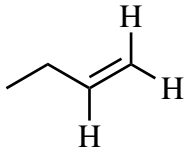
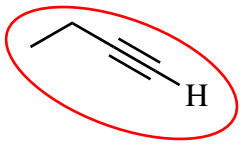
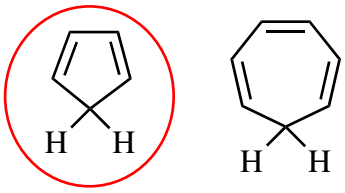
PLEASE read the questions very carefully!

Partial Periodic Table

1A	2A	3A	4A	5A	6A	7A	8A
1 H							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	

Printed Name:_____

1 (20 pts) a) For each of the following pairs of structures, circle the stronger Brønsted acid.

 	CH_4 NH_3	H_2O NH_3
NH_3 		left blank intentionally

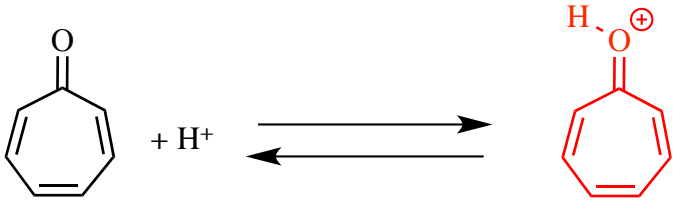
2 pts each

Total points for this page: 10

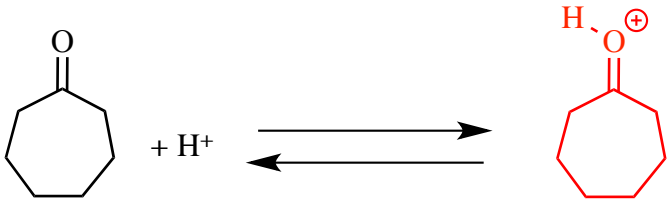
Printed Name:_____

1 – Continued

b) Tropone (**1**) is a much stronger base than cycloheptanone (**2**), and tropone also has a much larger dipole moment than cycloheptanone. Complete the equations below by drawing the structure of the protonated ketones.



1



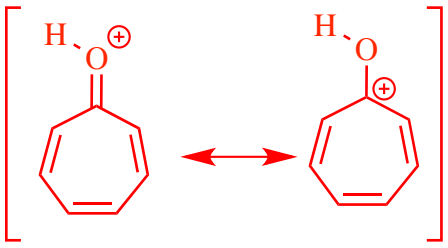
2

2 pts each

c) Which compound (**1** or **2**) has the higher K_{eq} for the equations above? Compound **1** 3 pt

d) Give a **brief** explanation for why tropone is a stronger base than cycloheptanone (your answer should fit in in the space below). You should have a molecular structure or two as part of your answer.

The conjugate acid of compound **1** is aromatic, so the equilibrium constant for protonation of compound **1** is much larger than that for protonation of compound **2**.



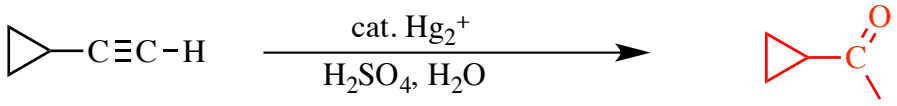
3 pts

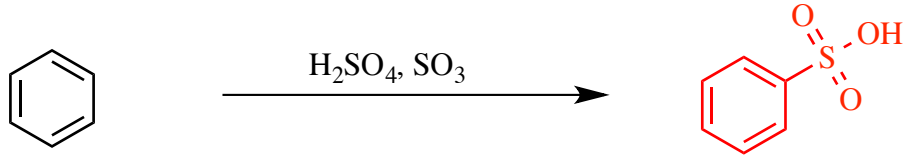
The following is not required for a full credit answer, but one of the key organic fundamentals is that "the relative acidity of two second-row acids is dominated by the relative stability of the ions." This is true when both acid-base equations have the ions on the same side of the equation (either "starting materials" or "products"). The ions can be the acids or the bases. In this case, the acids are the ions, and the aromatic ion is much more stable than the simple protonated ketone, so the aromatic ion is the weaker acid (more stable is weaker), and tropone is the stronger base.

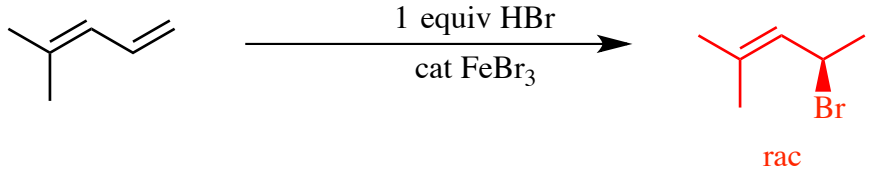
Total points for this page: 10

Printed Name:_____

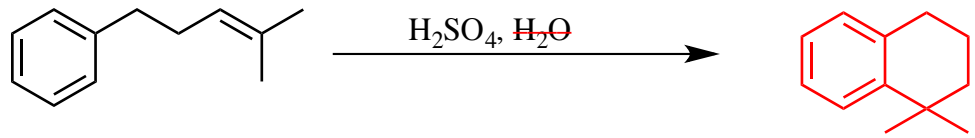
2) (20 pts) Give the single major product for each of the following reactions, carefully showing stereochemistry using wedges and dashes where appropriate. If a racemate is formed, show only one enantiomer and label it "rac."

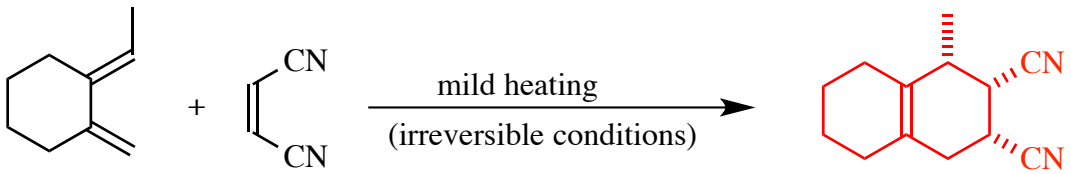
a) 

b) 

c) 

rac

d) 

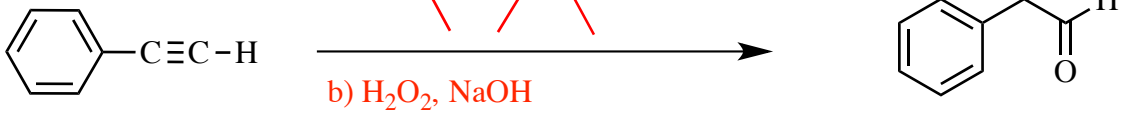
e) 

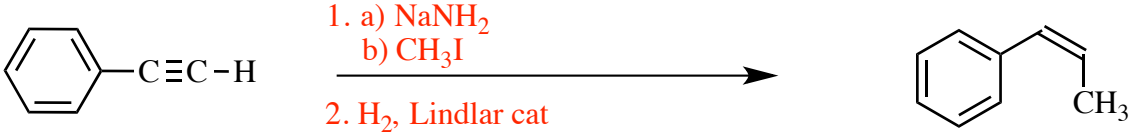
rac

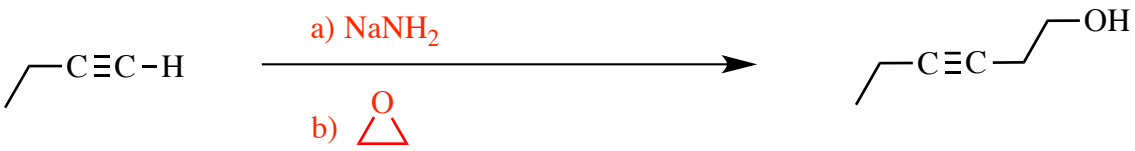
Total points for this page: 20

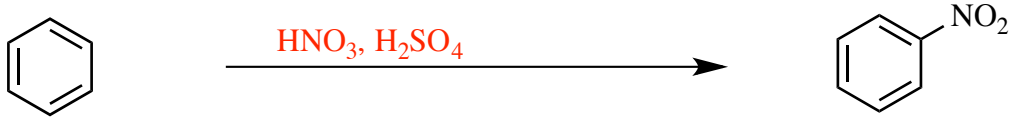
Printed Name:_____

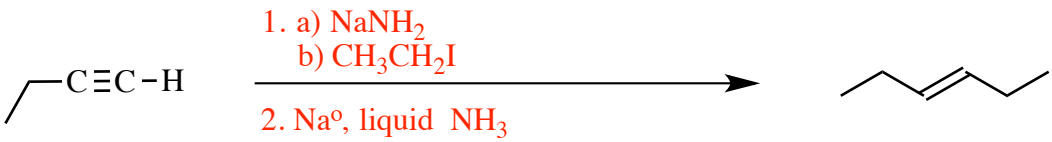
3) (20 pts) Propose reagents for accomplishing each of the following transformations. Make your reactions efficient (i.e. the target product should be the major product). Some of these transformations may require more than one step with isolation of intermediate products in between. Use letters to indicate sequential addition of reagents for one step, and use numbers to indicate multiple steps.

a) 

b) 

c) 

d) 

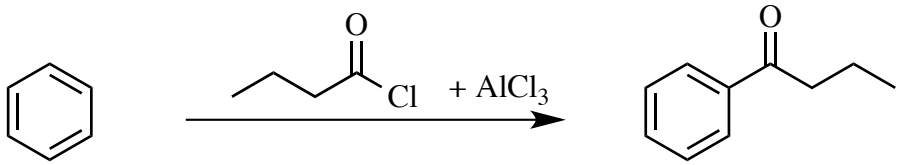
e) 

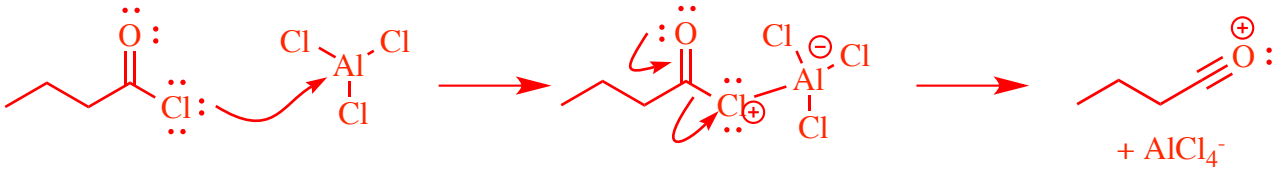
Total points for this page: 10

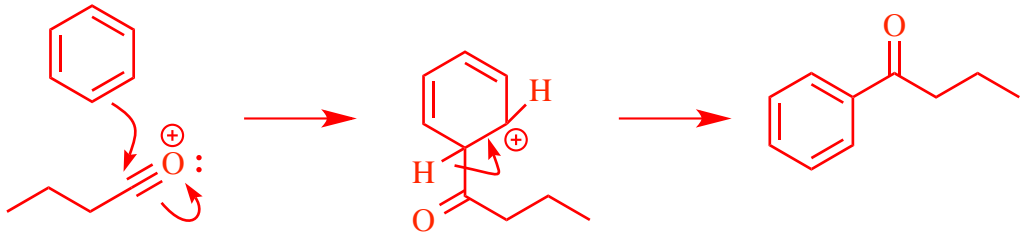
Printed Name:_____

4) (24 pts) Propose an arrow-pushing mechanism for both of the following reactions.

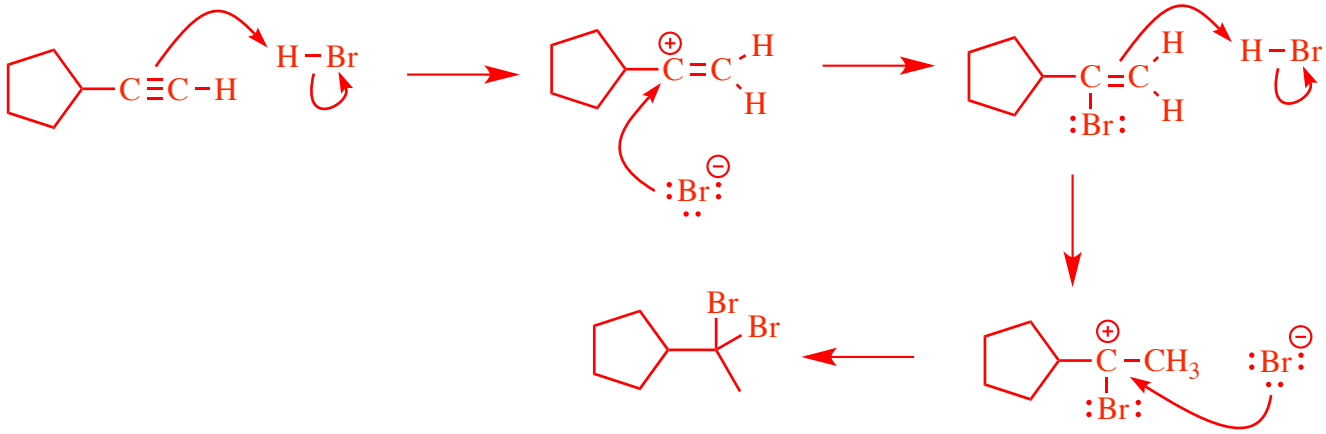
a)







b)

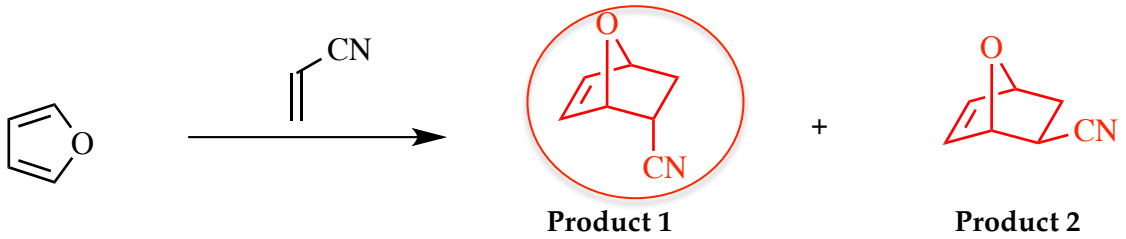


Total points for this page: ____

Printed Name:_____

4) – Continued –

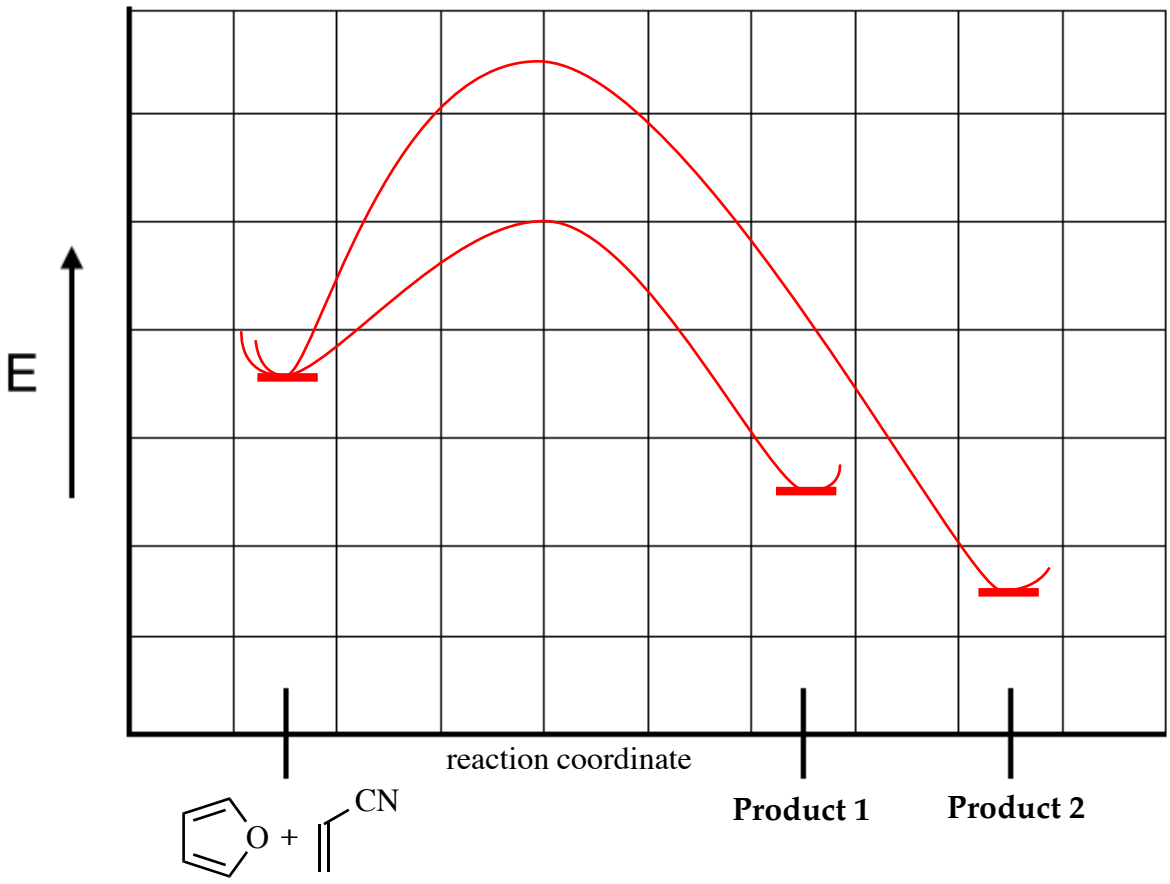
c) Give the two major products (both racemic) expected for the following reaction.



Product 1 **Product 2**

d) For the reaction in part c, circle the major product expected if the reaction is run under "mild" (that is, kinetic, or irreversible) conditions.

e) Complete the energy diagram for the reaction in part c, carefully showing the relative energies of the starting materials, products, and transition states. Be sure to draw the structures of the two product molecules on the energy diagram under the vertical lines to the right on the reaction coordinate. You can use either line to represent either product.

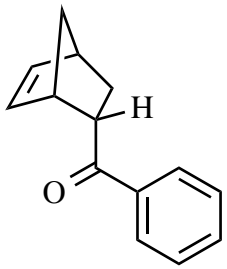


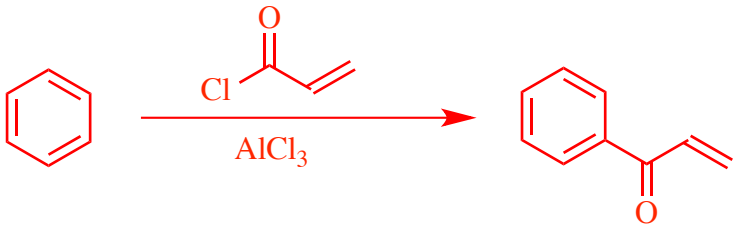
Total points for this page: ____

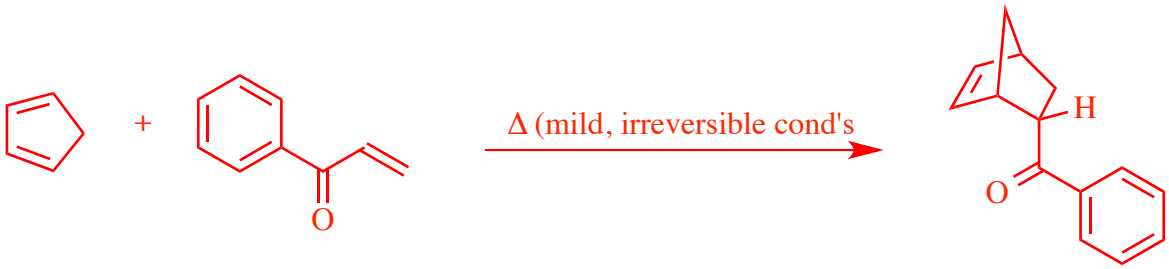
Printed Name:_____

5) (16 pts) Propose a synthesis for each of the following targets. Allowed starting materials include benzene, and/or any other organic molecules containing **five (5) carbons or less**. You may use any necessary inorganic reagents. Try to make your syntheses efficient (i.e. the target should be produced in high yield). More than one step will be required. Please show all the reactions leading from starting materials to product, but do not show mechanisms. 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 one arrow**. (Continued on next page)

a)

rac 

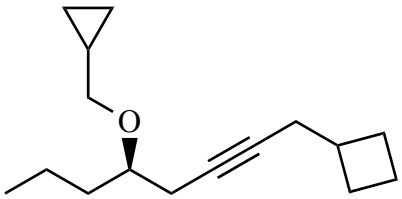




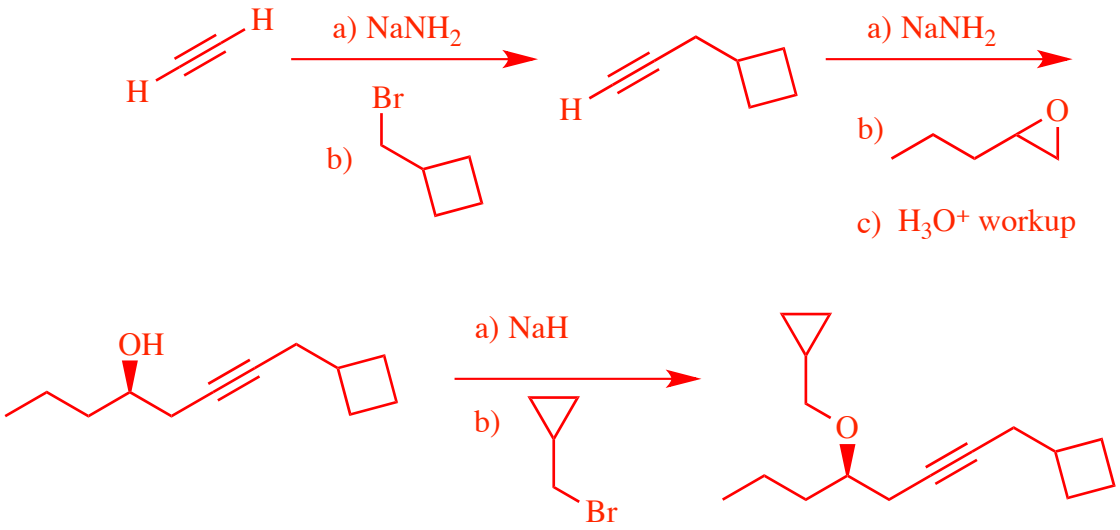
 Total points for this page: ____

5) – Continued –

b)



rac



Total points for this page: ____