Name: _____ TA: _____

CHEM 3331 **Midterm**
Dr. Minger **July 25, 2017**

Step 1. Circle your recitation section and TA:

211	Brendan	221	Matthew
212	Aaron	222	Ed
213	Eric	223	Rachel
214	Will	224	Jake (12pm)
215	Jake (3pm)		

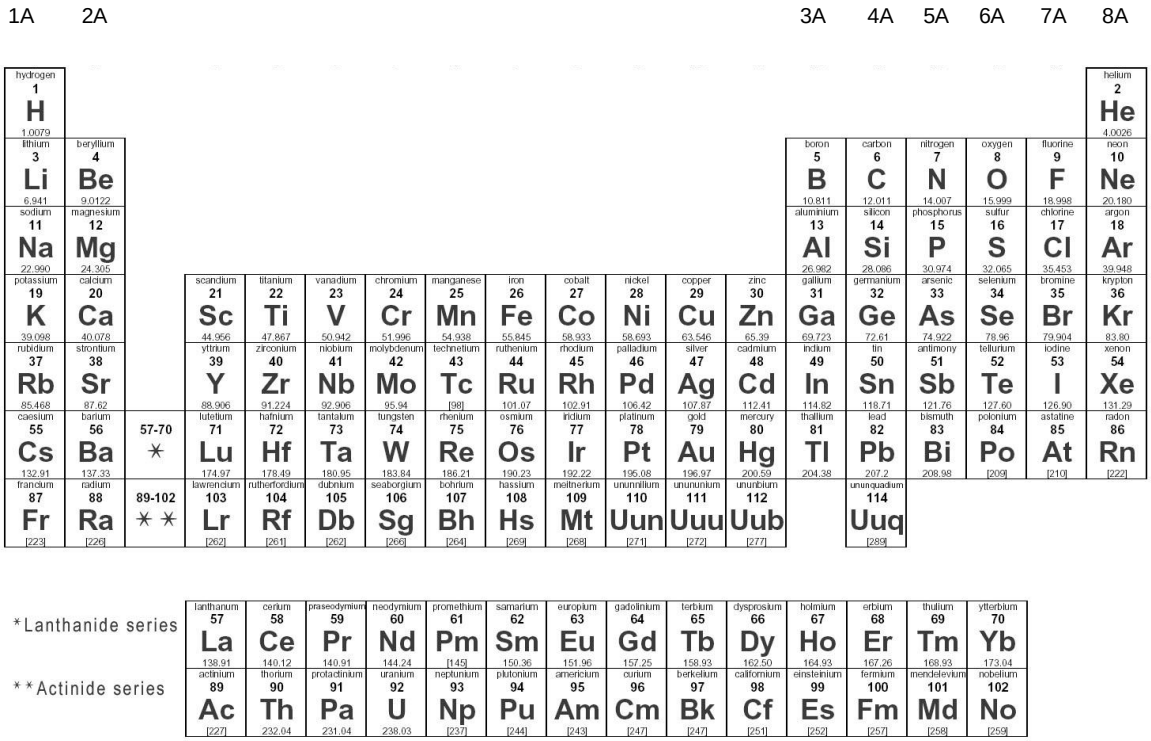
Step 2. Write your CU Student ID number here: _____

Step 3. Read and sign the Honor Code Statement:

I pledge that on my honor, as a University of Colorado at Boulder student, I have neither given nor received unauthorized assistance on this exam.

_____
Signature

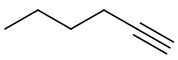
General Instructions: There are 7 pages of questions plus this cover page. Be sure you have them all. **Read each question carefully so that you know exactly what is being asked.** Although the midterm is worth 100 points, this exam has 103 points possible (plus 10 points of extra credit). Good luck!

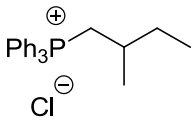


Name: _____ TA: _____

1. **Extremely short answer.** Provide the requested information for each transformation. (10 pts)

a) Write the formulas of **three bases** that are used for quantitative deprotonations of each of these compounds.





1._____2._____3._____

b) Give ONE set of conditions (reagents, solvents, workup) that can be used to make an alcohol from a ketone.

_____

c) Write two specific methods/approaches that can be used to remove water from a reaction.

_____ or _____

d) State the purpose of using an acetal protecting group in a multi-step synthesis. One sentence only, not an essay. Use only the lines.

_____

_____

e) What kind of organic molecule is an organocuprate made from? (Two possible reasonable answers. Write only ONE)

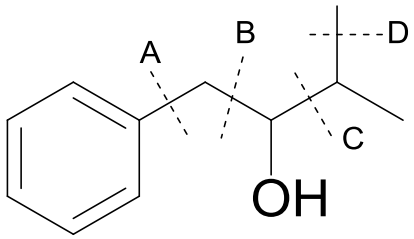
_____

f) What type of product results when you react an unstabilized phosphorous ylide with an aldehyde?

_____

Name: _____ TA: _____

2. **Retrosynthesis.** (24 pts) Here is an alcohol with four different bond disconnections labeled (A, B, C and D).

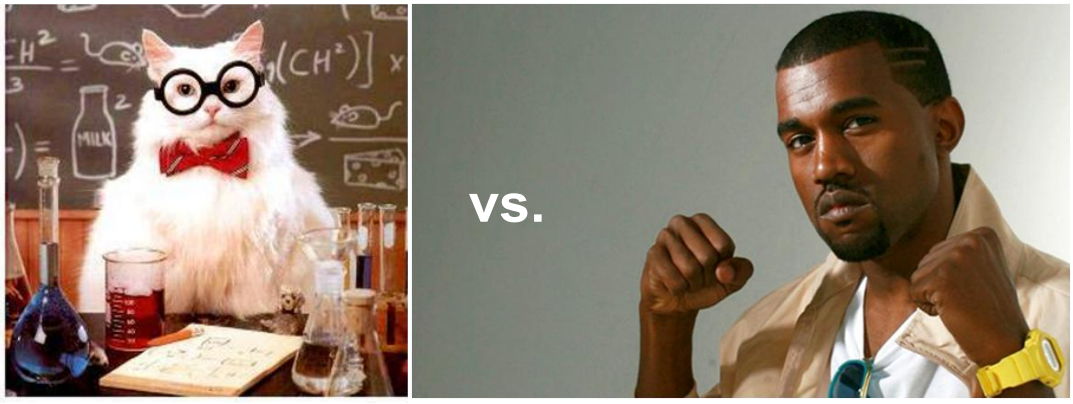


For each disconnection, indicate whether the alcohol could be made as the <u>major product</u> of one synthetic step (plus appropriate aqueous workup, which you should explicitly write where necessary).

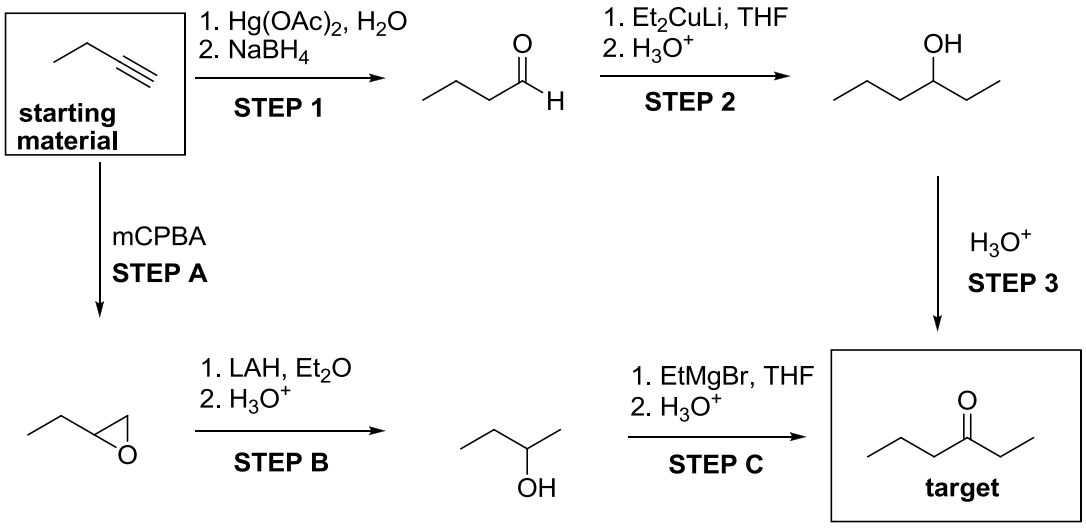
		Can alcohol be made successfully by making the indicated bond?	If "yes", draw reagents and precursor(s) here. If "no", explain why not.
A	⟹	____Yes ____No	
B	⟹	____Yes ____No	
C	⟹	____Yes ____No	
D	⟹	____Yes ____No	

Name: _____ TA: _____

3. **Synthesis Showdown.** (18 pts) For the last few years, Kanye West has lost decisively to the Chemistry Cat in the world-famous Synthesis Showdown.



This year, determined to finally vanquish the Cat, Kanye outlined two different 3-step syntheses (Steps 1-3, and Steps A-C) in the hope that at least one of them would win. The starting material for each synthesis is 1-butyne (upper left) and the target is 3-hexanone (lower right).



Question continues on the next page.

Name: _____ TA: _____

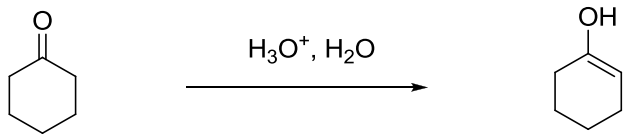
Analyze each of Kanye's two proposals (Steps 1 through 3, and Steps A through C). State whether each synthetic step, as proposed, would work. If not, indicate the reagents Kanye should use instead of the ones he has listed. Treat each step independently of the others; e.g.. if the first step in a sequence doesn't work, just pretend it did when you examine the second step. If a particular step is impossible to do in ONE synthetic operation (i.e. ONE reaction, plus appropriate workup), just write "Not possible" in the third column.

Step	**Would it work as proposed?** **Circle Yes or No**	**If "No", what reagents should Kanye use? OR write "Not possible"**
Step 1	Yes No	
Step 2	Yes No	
Step 3	Yes No	
Step A	Yes No	
Step B	Yes No	
Step C	Yes No	

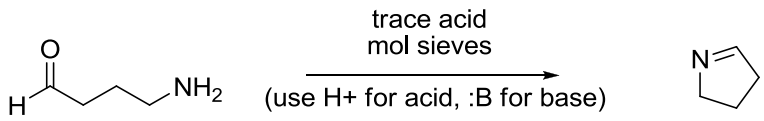
Name: _____ TA: _____

4. **Mechanism.** Draw a mechanism for each of the following transformations. Include all necessary curved arrows, lone pairs of electrons, and nonzero formal charges for full credit. If your drawings are unclear or ambiguous, you will lose points, so draw carefully! (24 pts)

a)



b)

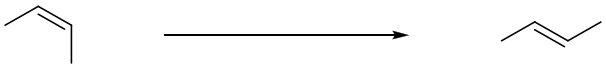


(Hint: This will be exactly the same mechanistic pattern that you would draw if the aldehyde and the amine were in separate molecules.)

Name: _____ TA: _____

5. **Multi-step synthesis.** Propose a multi-step synthesis for each of the following transformations. Show the reagents needed for each step and the product of each step. Do not show any mechanisms. Do not just show a list of reagents without showing products or you will lose credit. If you use an organometallic reagent, you do not need to show how you made it. (27 pts)

a)



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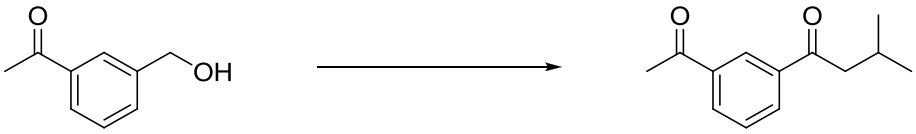
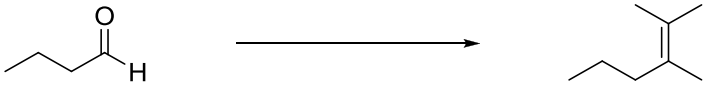


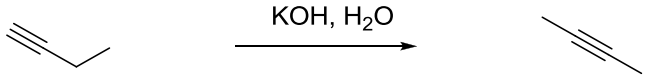
c)



Name: _____ TA: _____

6. **Extra credit.** (10 pts max) Do one or the other, but not both. No extra extra credit for doing both. Write your answer at the bottom of the page.

a) Draw a mechanism to show the isomerization of the terminal alkyne to the internal alkyne using KOH as the base and water as the proton source. Include all lone pairs, curved arrows, and nonzero formal charges.



b) Design <u>two different</u> multi-step syntheses of the target from the given starting material. Show the reagents needed for each step and the product of each step. Do not draw any mechanisms. Conditions: One synthesis must have an alkene as an intermediate. The other must have a carboxylic acid as an intermediate.