

CHEM 3331  
Dr. Minger

Hour Exam #1  
July 12, 2022

Name Key

Write your recitation section number: \_\_\_\_\_ and TA name: \_\_\_\_\_

Please sign the Honor Code pledge even though you've taken the quiz:

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 6 pages of questions plus this cover sheet. Be sure you have them all. Read each question carefully so that you know exactly what is being asked and what you need to write or draw. **DO NOT USE COLORED INK.** Your work on scratch pages will not be graded, so be sure everything you want graded is written on the exam itself.

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

hydrogen 1 H 1.008																	helium 2 He 4.002	
lithium 3 Li 6.941	beryllium 4 Be 9.0122											boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180	
sodium 11 Na 22.990	magnesium 12 Mg 24.305											aluminum 13 Al 26.982	silicon 14 Si 28.085	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948	
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.887	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.692	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.64	arsenic 33 As 74.922	selecnium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80	
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 106.50	paladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29	
cesium 55 Cs 132.91	barium 56 Ba 137.33	* 57-70	lanthanum 57 Lu 174.97	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	tungsten 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]
francium 87 Fr [223]	radium 88 Ra [226]	* * 89-102	actinium 89 Ac [227]	thorium 90 Th [232]	protactinium 91 Pa [231]	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]		

\* Lanthanide series

lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]

\* \* Actinide series

**Multiple choice (questions 1-5).** Circle the best answer to each of the following questions. (15 pts)

1. Which of these bases will NOT quantitatively deprotonate both an alcohol and a terminal alkyne?

LDA

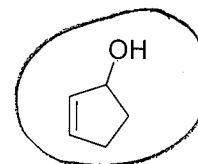
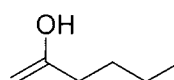
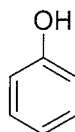
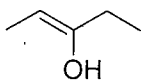
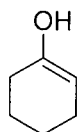
tert-butoxide

NaH

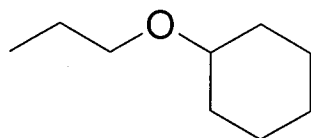
NaNH<sub>2</sub>

BuLi

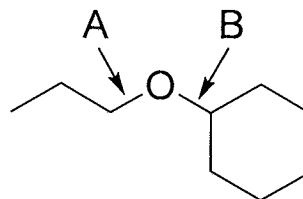
2. Which of these structures is NOT an enol?



3. This ether can be made using a Williamson ether synthesis. The possible bond disconnections are displayed in the structure to the right. Which of the bond disconnections reflects the preferred synthesis of this ether? (The preferred synthesis is the one that produces the ether in higher yields.)



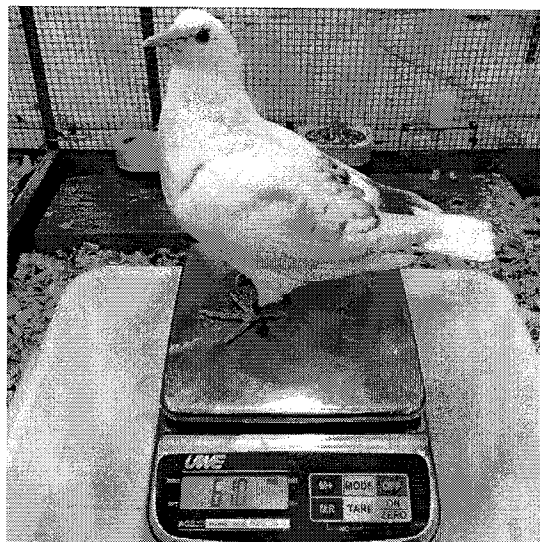
target ether



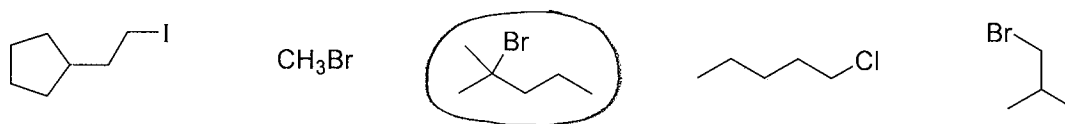
target ether structure  
showing bond disconnections

Circle the bond that would be made in the preferred synthesis: A B

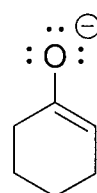
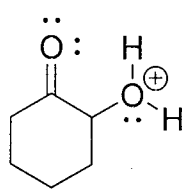
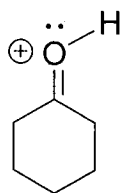
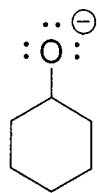
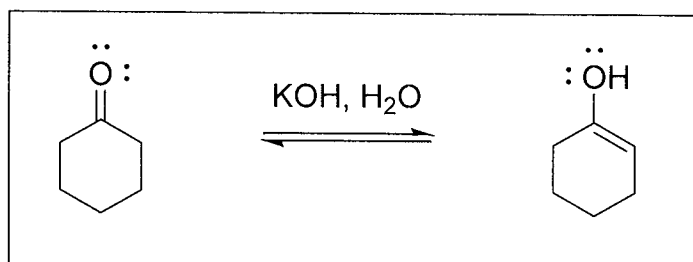
4. A recent incident in the research laboratory of highly esteemed pigeon chemist Professor Burblecoo illustrates the importance of reagent selection. One of the professor's associates, Dr. Cluckpoop, attempted to alkylate an acetylide ion with an electrophile. However, the reaction failed to provide good yields of the alkylation product but instead produced an alkene. Which of these electrophiles did Dr. Cluckpoop use?



*Professor Burblecoo's research assistant, Dr. Cluckpoop, working in the lab*



5. Which of these structures is an intermediate in the keto-enol tautomerization occurring in aqueous base?



None of these structures

**A**

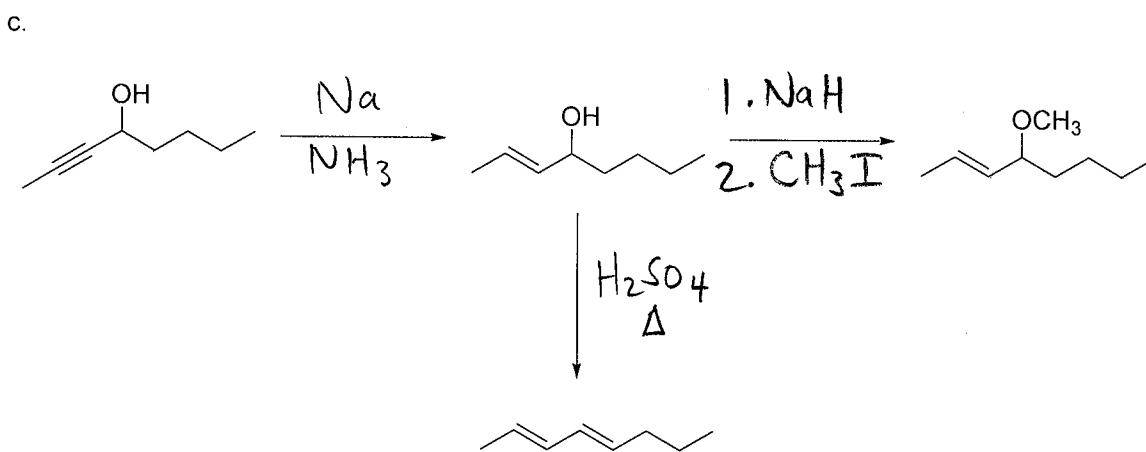
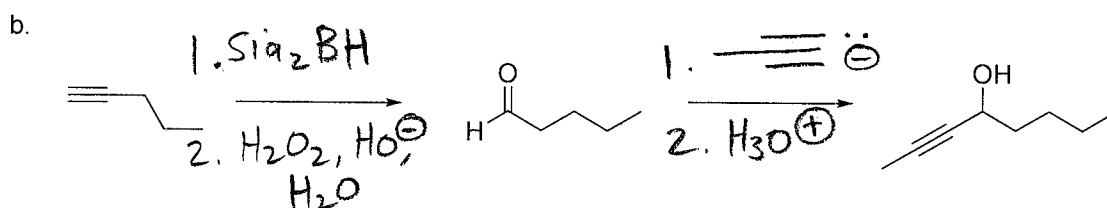
**B**

**C**

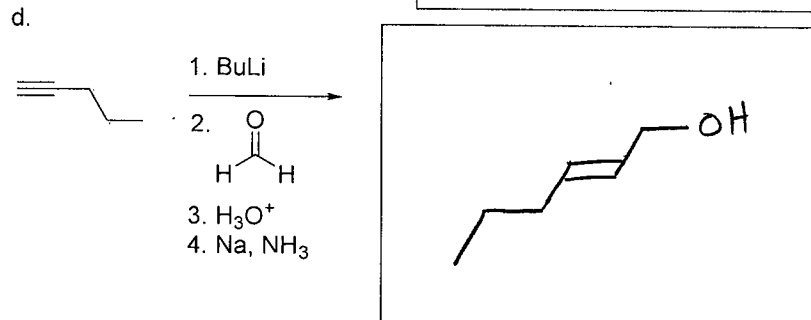
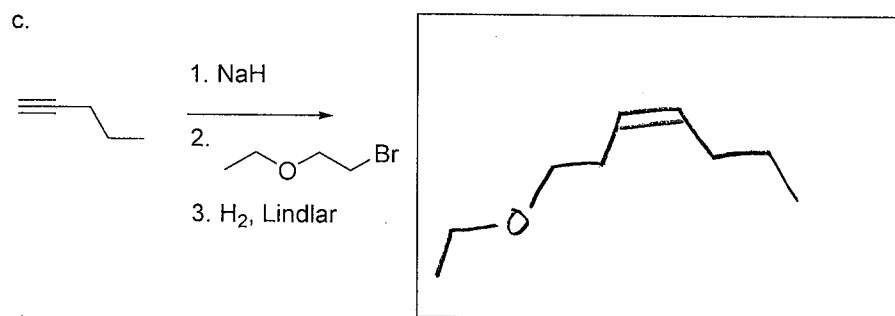
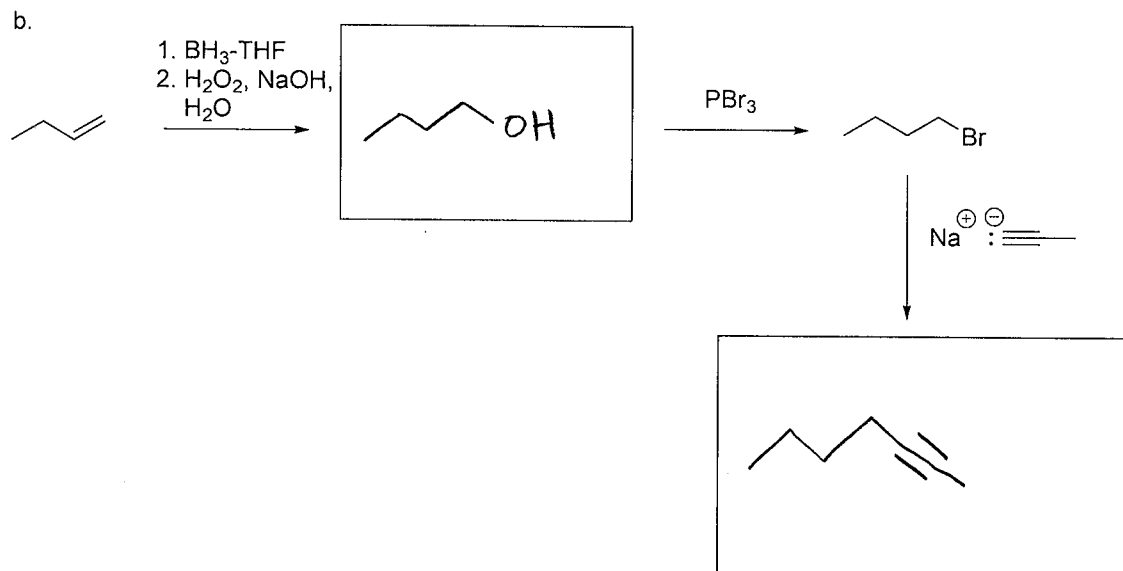
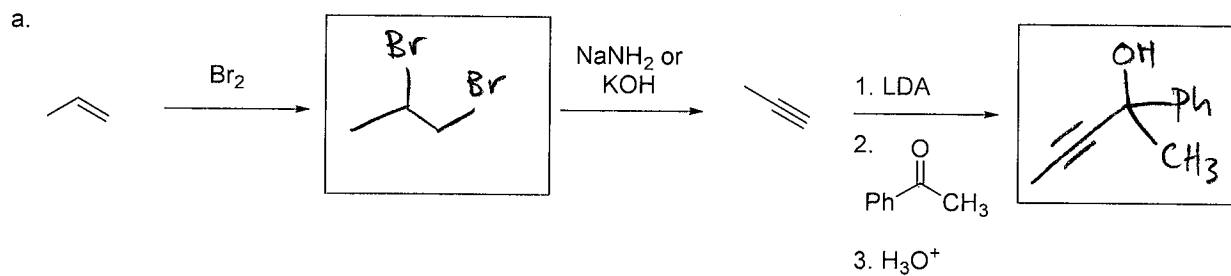
**D**

**E**

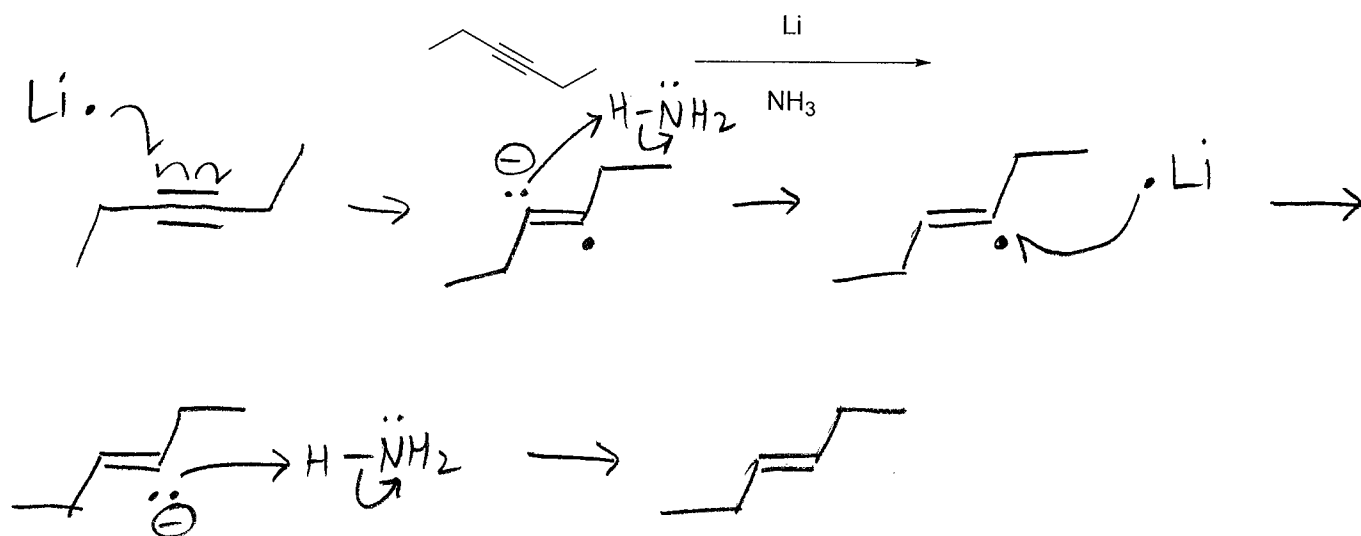
6. Write the missing reagent(s) over each arrow. Some transformations may require more than one reagent, and some transformations may require that the reagents be numbered. (21 pts)



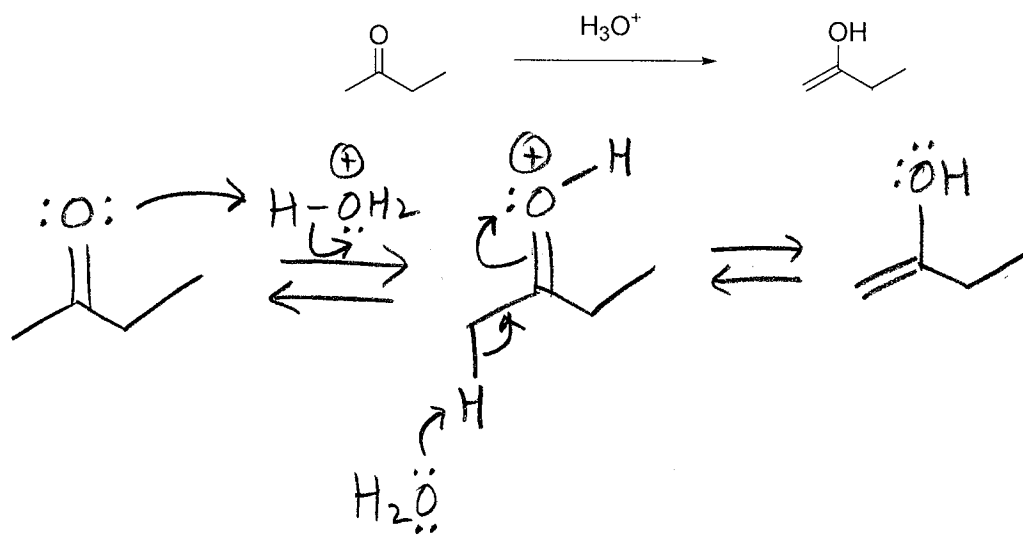
7. Draw the missing products in the boxes for these multi-step syntheses. (30 pts)



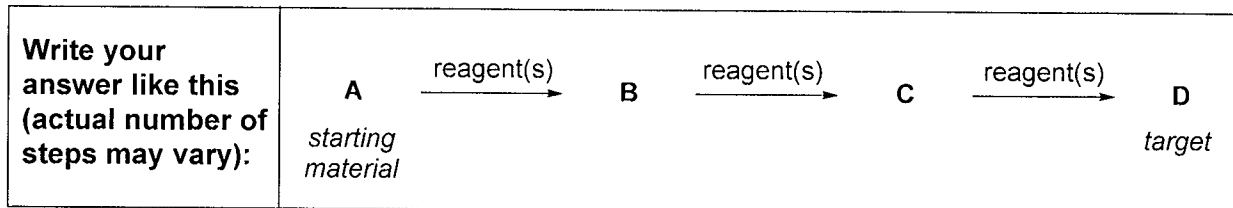
8. Draw the product of the following reaction conditions and draw a mechanism to illustrate its formation. Include all necessary electrons, curved arrows, and nonzero formal charges. (16 pts)



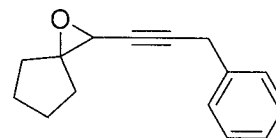
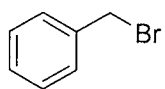
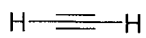
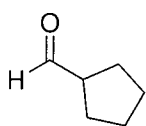
9. Draw a mechanism to illustrate the following transformation. Include all necessary lone pair electrons, curved arrows and nonzero formal charges. (8 pts)



10. Propose a multi-step synthesis of the target molecule shown at the right, using the starting materials on the left and any other reagents you need. Show the reagents needed for each step and the product of each step. Do not show any mechanisms. (12 pts)



Use these starting materials:



target molecule

