

Easily Legible Printed Name: _____

CHEM 3351 (100), Fall 2015
Professor Walba
Third Hour Exam
November 17, 2015

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: _____

Recitation day and time: _____

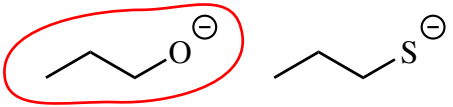
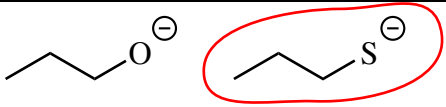
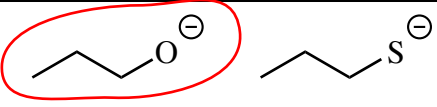
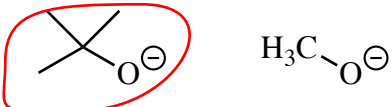
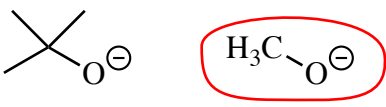
This is a closed-book exam. The use of notes, calculators, scratch paper, or cell phones will not be allowed during the exam. You may use models brought in a clear Ziploc bag. Please put all your answers on the test in the appropriate place. Use the backs of the pages for scratch (there are two additional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

PLEASE read the questions very carefully!

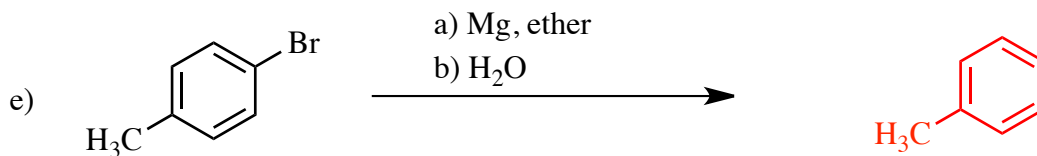
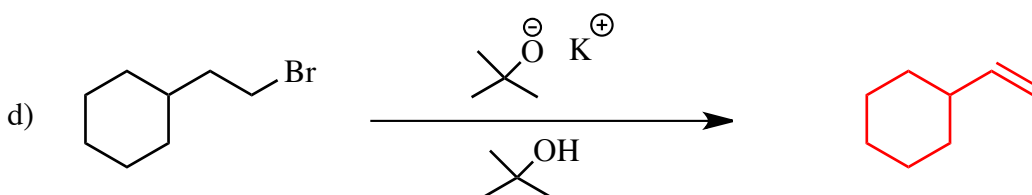
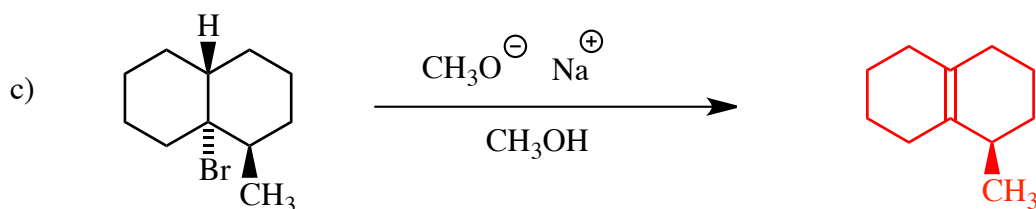
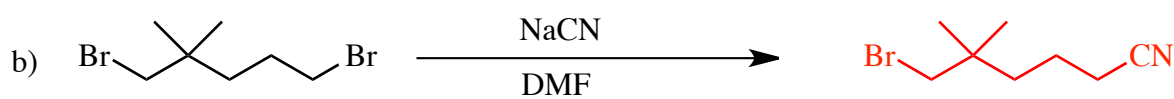
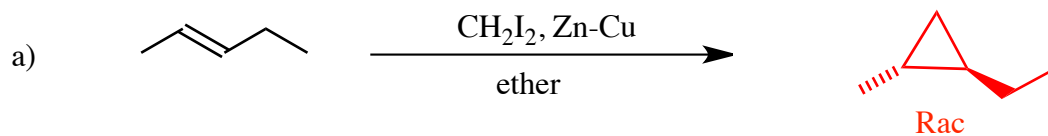
PLEASE legibly print your name on each page of the exam.

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

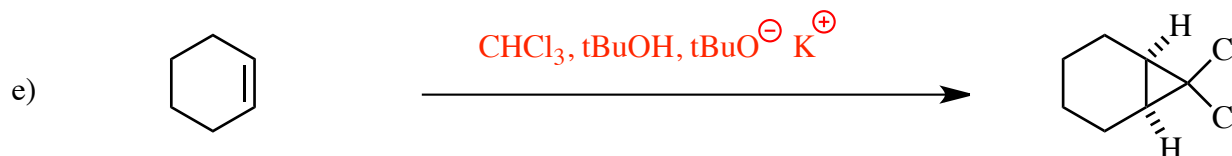
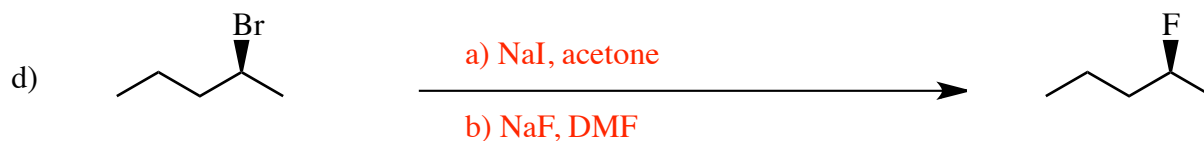
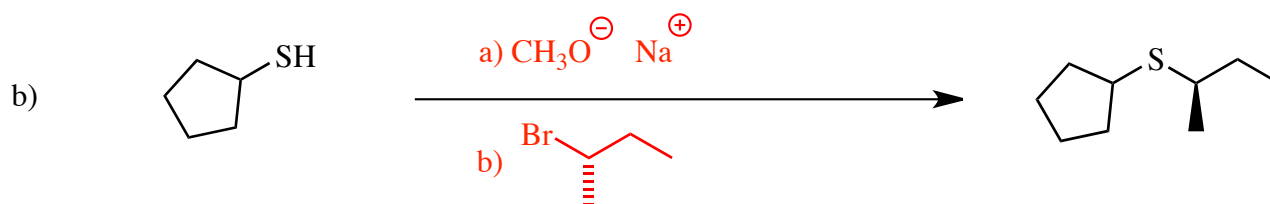
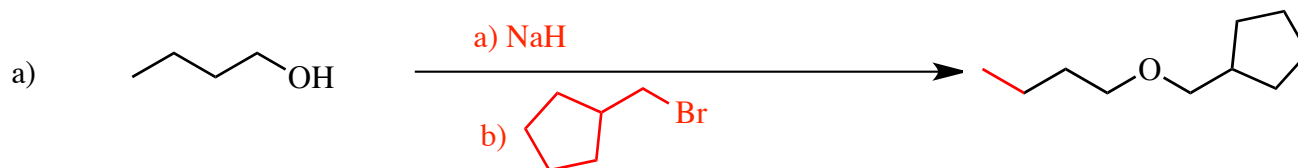
1 (20 pts) For this question, your explanations must fit in the boxes indicated. The answers do not need to be complete sentences, and should be **short** phrases.

 <p>Circle the stronger base in propanol solvent</p>	<p>Intentionally left blank</p>
<p>Explain why</p> <p>Weak S-H bond</p> <p>The thiolate is a weaker base = the thiol is a stronger acid, due to the weak S-H bond</p>	<p>Intentionally left blank</p>
 <p>Circle the stronger nucleophile in propanol solvent</p>	 <p>Circle the stronger nucleophile in propanol solvent DMF solvent</p>
<p>Explain why</p> <p>H-bonding to the alkoxide</p> <p>The alkoxide nucleophilicity is dramatically lowered by hydrogen bonding, making the thiolate the stronger nucleophile in propanol.</p>	<p>Explain why</p> <p>Stronger base is stonger nucleophile</p> <p>DMF is aprotic (no H-bond donor), so the stronger base is the stronger nucleophile.</p>
 <p>Circle the stronger base in propanol solvent</p>	 <p>Circle the stronger base in the gas phase</p>
<p>Explain why</p> <p>Steric inhibition of H-bonding</p> <p>The methoxide is H-bonded, and the tert-butoxide is less H-bonded (steric inhibition of solvation.) This lack of H-bonding destabilizes the tert-butoxide, and makes it a stronger base than methoxide.</p>	<p>Explain why</p> <p>Better delocalization of charge makes the t-butoxide more stable</p> <p>In the gas phase there is no H-bonding. The tert-butoxide is stabilized by delocalization of negative charge onto the CH₃ groups, making the tert-butoxide more stable, and the methoxide a stronger base.</p>

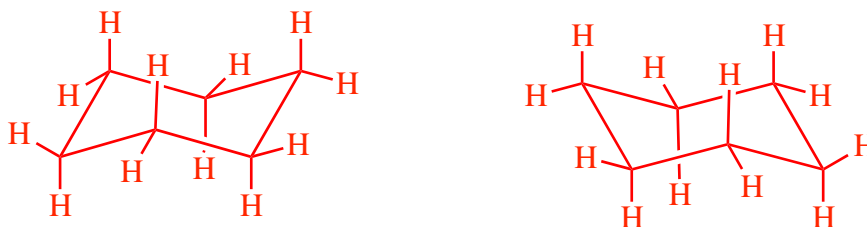
2) (20 pts) Give the **single major product** for each of the following reactions, carefully showing stereochemistry using wedges and dashes if appropriate. If a racemate is formed, show only one enantiomer and label it "rac." Assume chiral starting materials are single pure enantiomers unless they are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



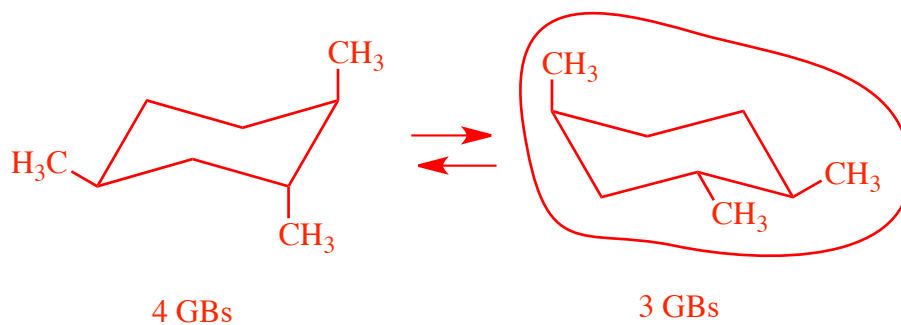
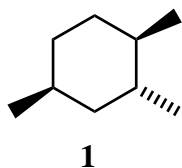
3) (20 pts) Propose reagents for accomplishing each of the following transformations. For reactions involving sequential addition of reagents, label the two steps using letters. **More than one actual step, with isolated products, may be required.** Make your synthesis efficient (i.e. the target product should be the major product). Assume chiral starting materials and products are single pure enantiomers unless they are labeled "rac."



4) (20 pts) a) Carefully draw the two flip-chair conformations of cyclohexane showing all hydrogen atoms.



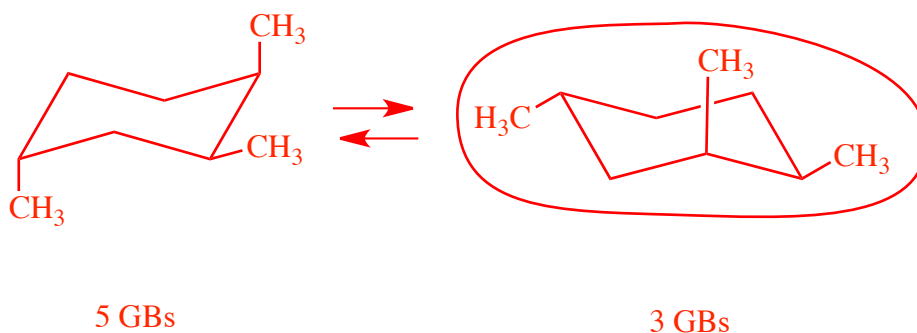
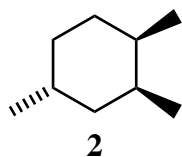
b) Carefully draw both flip-chair forms for compound **1** below. **Please leave out the H atoms.**



c) Indicate under the two chair structures the strain energy for each conformation in units of gauche butane interactions (GBs).

d) Circle the more stable conformation of the trimethylcyclohexane in part 4b. If the two conformations have the same strain energy, indicate they are the same.

4 – Continued

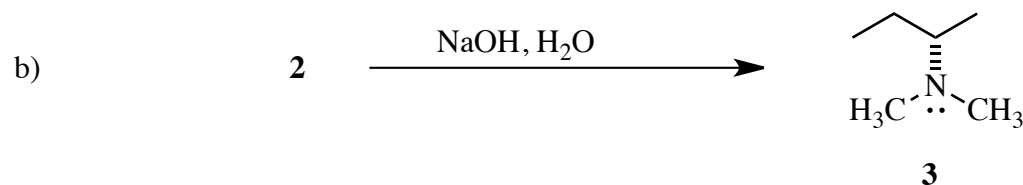
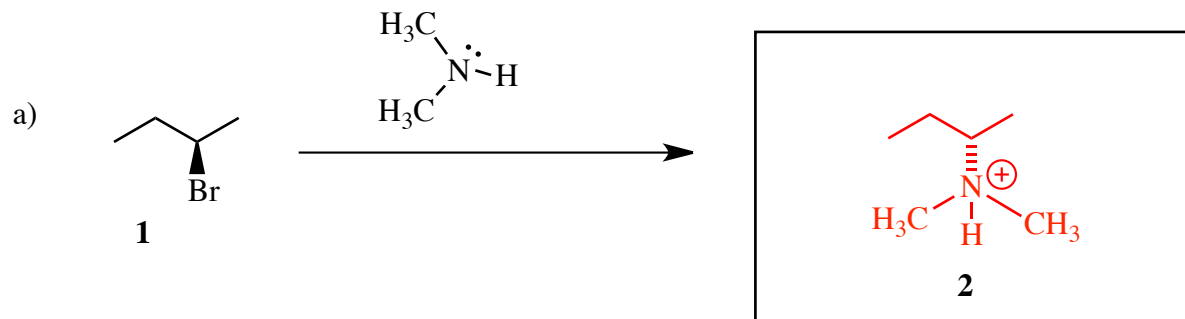
e) Carefully draw both flip-chair forms for compound **2** below. **Please leave out the H atoms.**

f) Indicate under the two chair structures the strain energy for each conformation in units of gauche butane interactions (GBs).

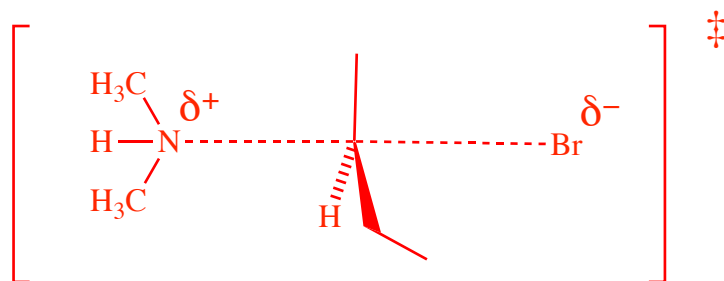
g) Circle the more stable conformation of the trimethylcyclohexane in part 4e. If the two conformations have the same strain energy, indicate they are the same.

h) Which compound is more stable, compound **1** or compound **2**? If the two compounds have equal strain energy, write “**1** and **2** have the same energy.”**1 and 2 have the same energy.**

5) (20 pts) a) Give the major product (compound **2**) for step a) in the two-step (sequential addition of reagents) conversion of (R)-2-bromobutane (**1**) into (S)-2-dimethylaminobutane (**3**).

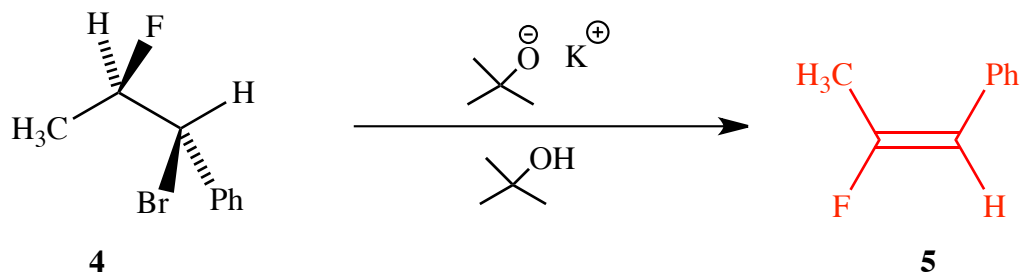


b) Carefully draw the transition state of the reaction leading from **1** to **2**.



5 – Continued

c) Give the single major product (**5**) of the reaction of butane derivative **4** with potassium tert-butoxide (the Ph group is a phenyl group (a benzene ring)).



d) Carefully draw the transition state of the reaction leading from **4** to **5**

