CHEM 3311-200 (Ellison/Richardson) Final Exam – May 4, 2013

Your Name Key

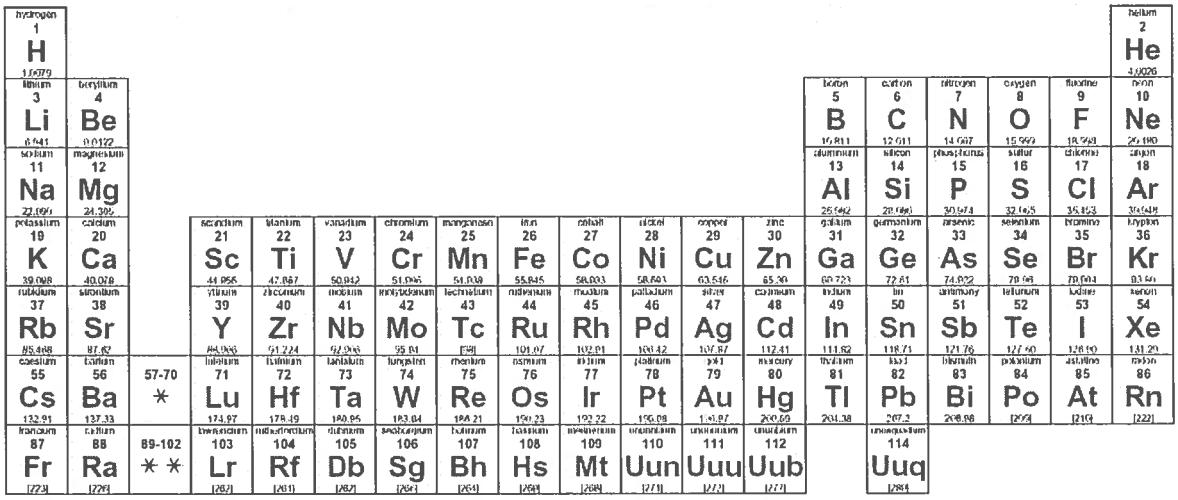
Student ID No. _____

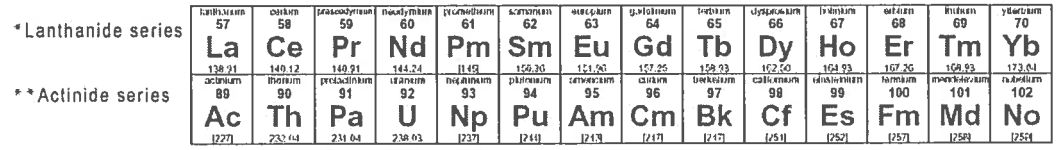
Recitation Day/Time _____

Recitation TA (circle one) Katelyn Chando, Setareh Azarnoush

Question	Score	Out of
1		24
2		10
3		16
4		20
5		40
6		30
7		10
8		(10 ec)
Total		150

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 sets brought in a clear ziplock bag. Use the backs of the pages for scratch work. If your final answer is not clearly specified, you will lose points. For mechanisms, show all intermediates including correct formal charges, but do not show transition states.



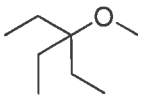


pKa Values

HI	-10	HN_3	4.7	H_2O	15.7
HBr	-8	H_2S	7.0	Alcohol (ROH)	16-18
HCl	-6	NH_4^+	9.3	HC≡CH	26
H_3O^+	-1.7	HCN	9.4	Amines (e.g. LDA)	36
HF	3.2	Phenol	10	$H_2C{=}CH_2$	45
CH_3COOH	4.7	RSH	10-12	CH_4	60

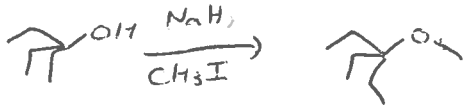
Name Key

1) **Show what reagents** you would use to synthesize this ether by each of the following methods, and **show the mechanism** by which the ether forms in each reaction. (8 pts each)

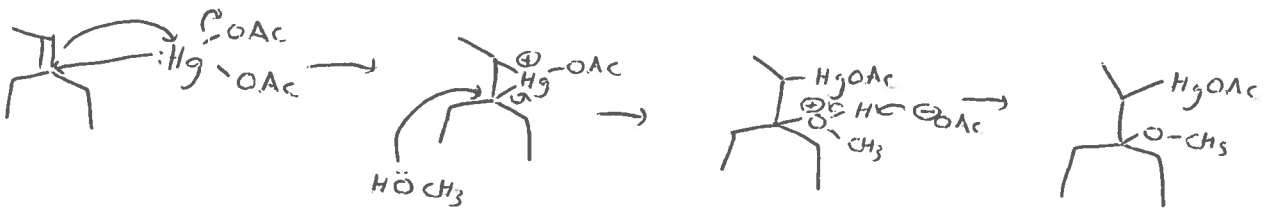


a. Williamson ether synthesis

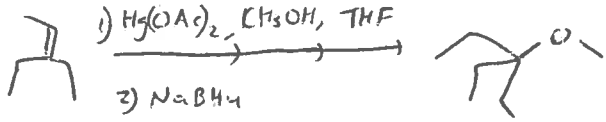
Overall:



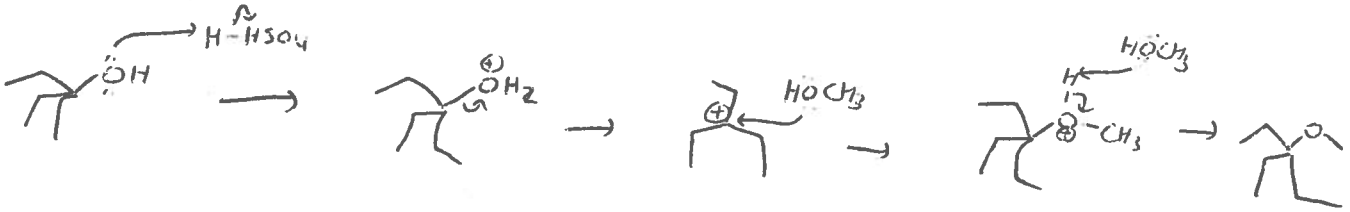
b. Alkoxymercuration-reduction (do not show mechanism for reduction step)



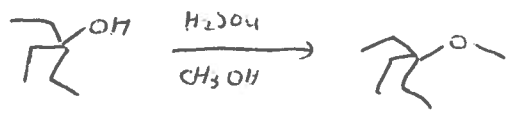
Overall:



c. Acid-catalyzed ether formation from alcohols



Overall:



 Name Key

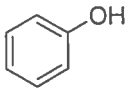
2) Write the names of the following functional groups. (1 pt each)


aromatic ring


alkene


alkyne


alcohol

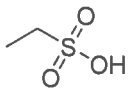

phenol


ketone


ether

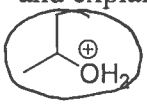
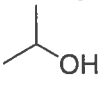

sulfide


epoxide

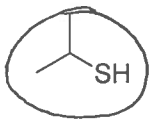
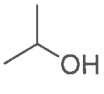

sulfonic acid

3) Acids and bases (16 pts)

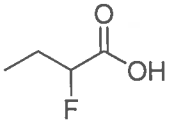
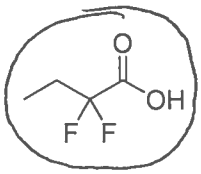
a. For each pair of compounds shown below, select the more acidic of the two compounds and explain your reasoning in under ten words. (2 pts each)


vs.


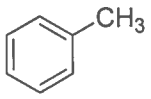
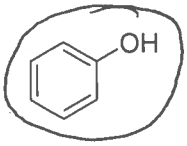
Reason: Bigger ⊕ charge = more acidic.


vs.


Reason: In same column of periodic table, larger atom = more acidic.


vs.


Reason: Stronger inductive effect stabilizes charge better.


vs.


Reason: In same row of periodic table, more EN = more acidic.

b. For each of the following reactions, does the equilibrium favor the reactants or products? (2 pts each)

$HC{\equiv}CH + CH_3^- \rightleftharpoons HC{\equiv}C^- + CH_4$ (pKa = 26; pKa = 60) — Products

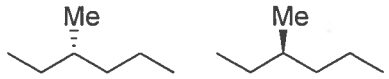
$HF + H_2O \rightleftharpoons F^- + H_3O^+$ (pKa = 3.2; pKa = −1.7) — Reactants

$HCN + CH_3O^- \rightleftharpoons CN^- + CH_3OH$ (pKa = 9.4; pKa = 16–18) — Products

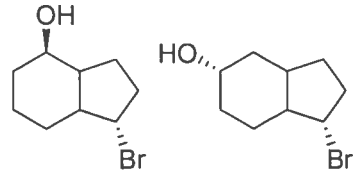
$CH_3S^- + CH_3NH_2 \rightleftharpoons CH_3SH + CH_3NH^-$ (pKa = 36; pKa = 10–12) — Reactants

 Name Key

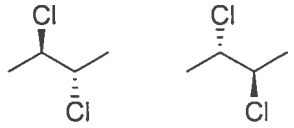
4) **Parts a – d:** Describe each of the following pairs of molecules as identical, enantiomers, diastereomers, or constitutional isomers. (2 pts each)

a. 

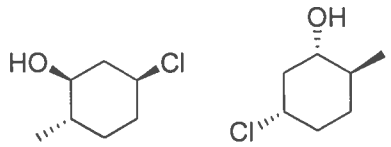
Enantiomers

b. 

Constitutional isomers.

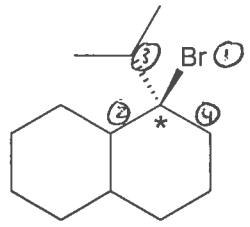
c. 

Identical (meso).

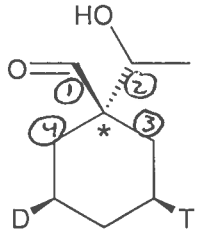
d. 

Identical

Parts e-f: Describe each molecule as R or S at the stereocenter labeled with a *. (2 pts each)

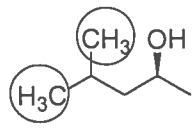
e. 

R

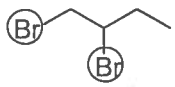
f. 

R

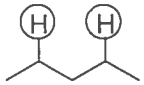
Parts g – j: Describe each of the following groups as homotopic, enantiotopic, diastereotopic, or constitutionally nonequivalent. (2 pts each)

g. 

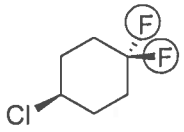
Diastereotopic.

h. 

Const. nonequivalent.

i. 

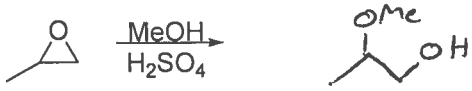
Homotopic

j. 

Diastereotopic.

Name Key

5) **Predict the product** of the following reactions, and **choose the appropriate descriptor** (reduction, oxidation, or neither) for what happens to the organic molecule during each reaction. (4 pts each)

a. 

Neither

b. 

Neither

c. 

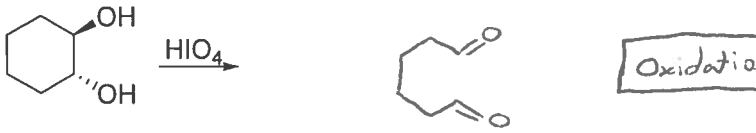
Reduction

d. 

Neither

e. 

Oxidation

f. 

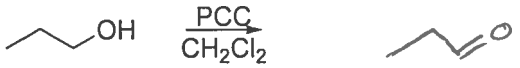
Oxidation

g. 

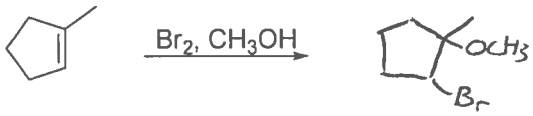
Neither

h. 

Reduction

i. 

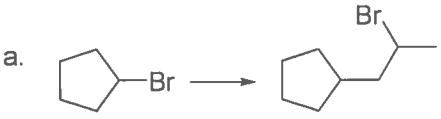
Oxidation

j. 

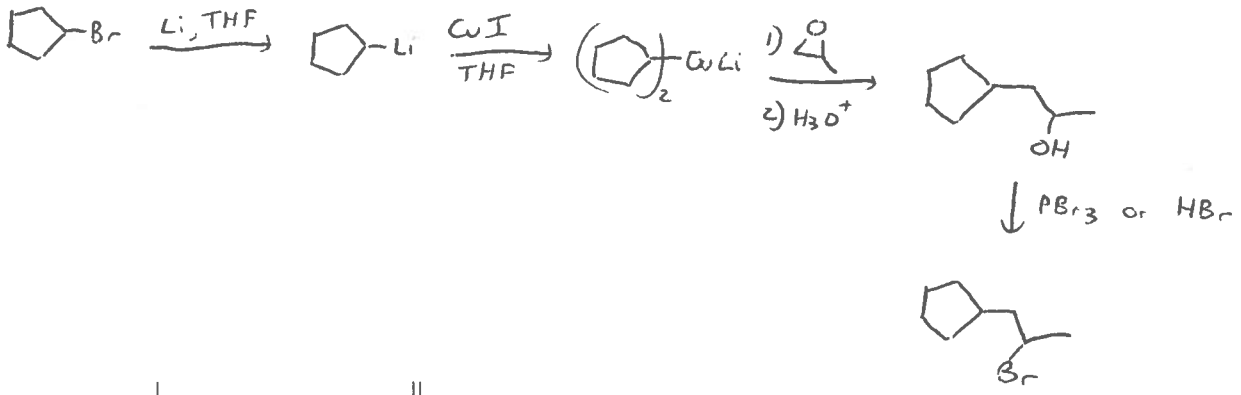
Oxidation

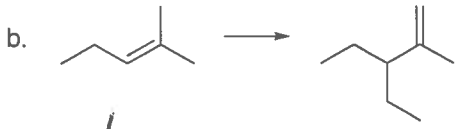
 Name Key

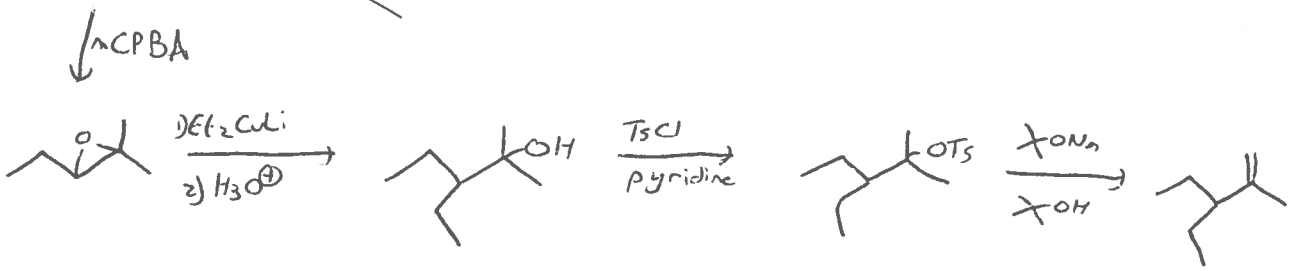
6) Synthesize the desired product from the given starting material. If more than one step is necessary, show the product of each step. Do not show mechanisms. (10 pts each)

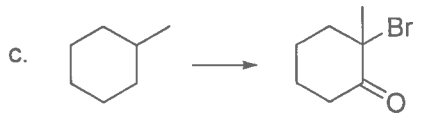
a. 

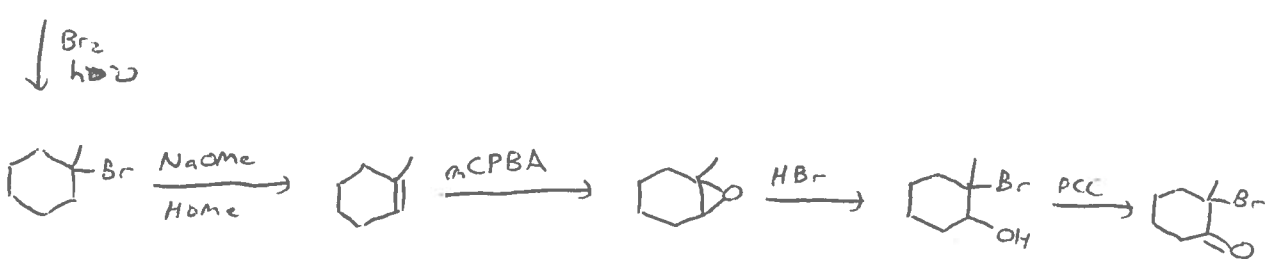
Need to make a new C-C bond by attacking an epoxide, probably using a cuprate.



b. 



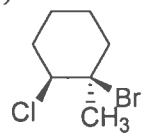
c. 

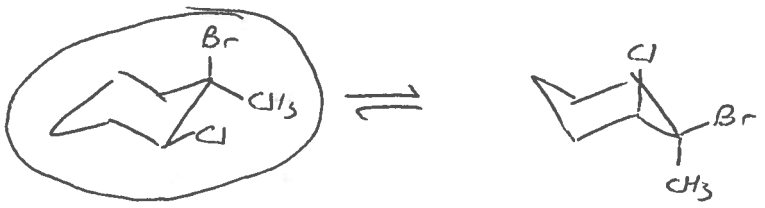


Name Key

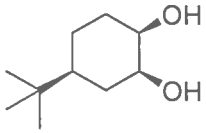
7) Draw the following molecules in **both** chair conformations, and circle the most stable. (5 pts each)

a.





b.



Name Key

8) Extra credit! Write the mechanism for the following reaction. (10 pts extra credit)