

# 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)
<b>Total</b>		<b>150</b>

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.

hydrogen 1 H 1.0079																	helium 2 He 4.0026						
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 28.086	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 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.38	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 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 102.91	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 58 Hf 178.49	tantalum 59 Ta 180.95	tungsten 60 W 183.84	osmium 61 Os 190.23	iridium 62 Ir 192.22	platinum 63 Pt 195.08	gold 64 Au 196.97	mercury 65 Hg 200.59	thallium 66 Tl 204.38	lead 67 Pb 207.2	bismuth 68 Bi 208.98	polonium 69 Po [209]	astatine 70 At [210]	radon 71 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]	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]	unnilium 110 Uun [271]	ununium 111 Uuu [271]	ununium 112 Uub [271]	ununium 114 Uuq [284]			

\* Lanthanide series

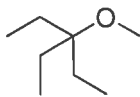
lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
actinium 89 Ac [227]	thorium 90 Th [232]	protactinium 91 Pa [231]	uranium 92 U [238]	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

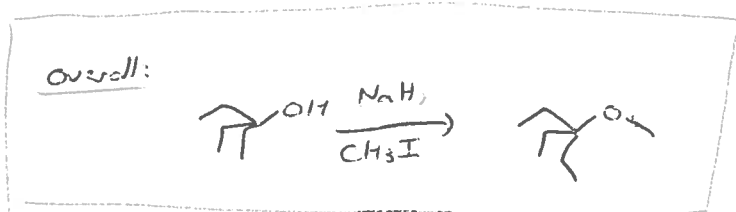
## pKa Values

HI	-10	HN <sub>3</sub>	4.7	H <sub>2</sub> O	15.7
HBr	-8	H <sub>2</sub> S	7.0	Alcohol (ROH)	16-18
HCl	-6	NH <sub>4</sub> <sup>+</sup>	9.3	HC≡CH	26
H <sub>3</sub> O <sup>+</sup>	-1.7	HCN	9.4	Amines (e.g. LDA)	36
HF	3.2	Phenol	10	H <sub>2</sub> C=CH <sub>2</sub>	45
CH <sub>3</sub> COOH	4.7	RSH	10-12	CH <sub>4</sub>	60

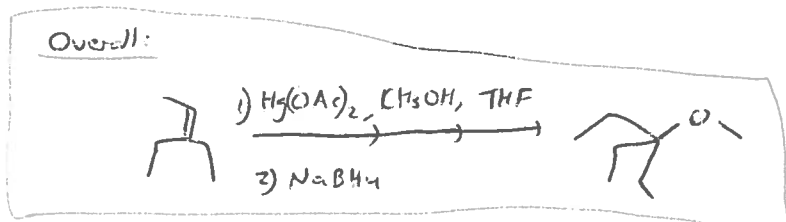
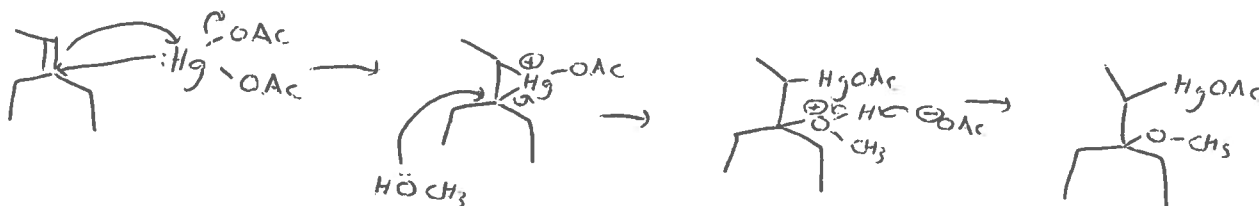
1) Show what reagents you would use to synthesize this ether by each of the following methods, and show the mechanism by which the ether forms in each reaction. (8 pts each)



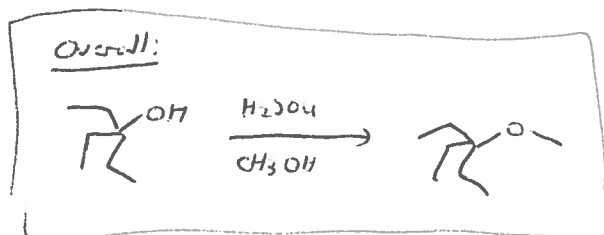
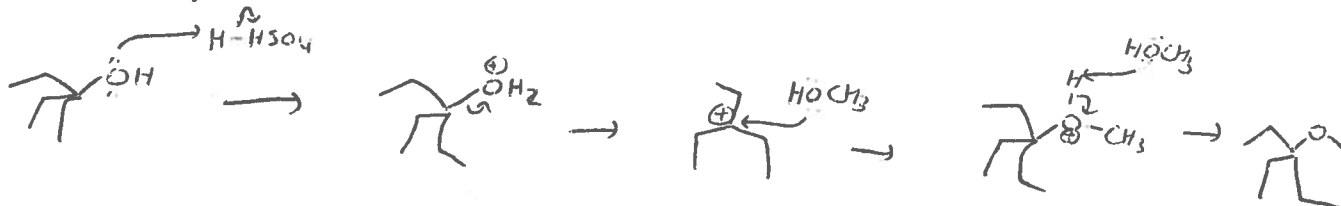
a. Williamson ether synthesis



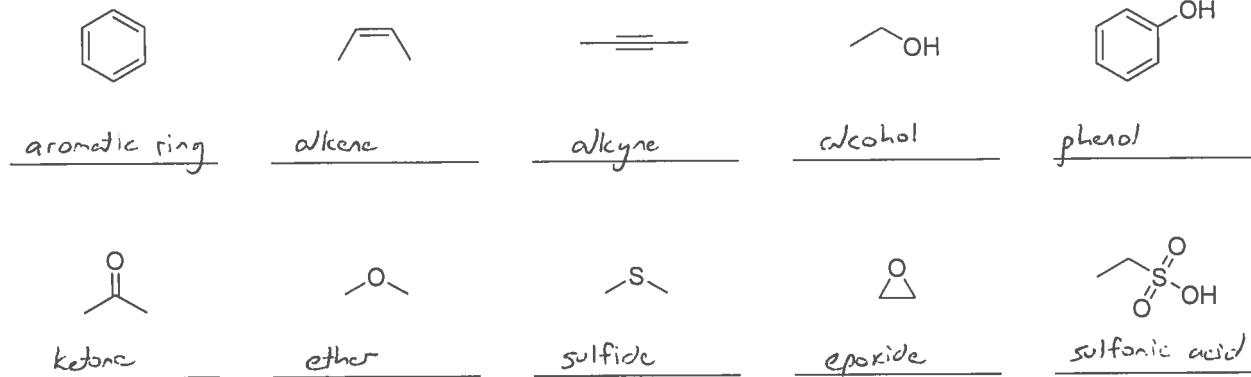
b. Alkoxymercuration-reduction (do not show mechanism for reduction step)



c. Acid-catalyzed ether formation from alcohols

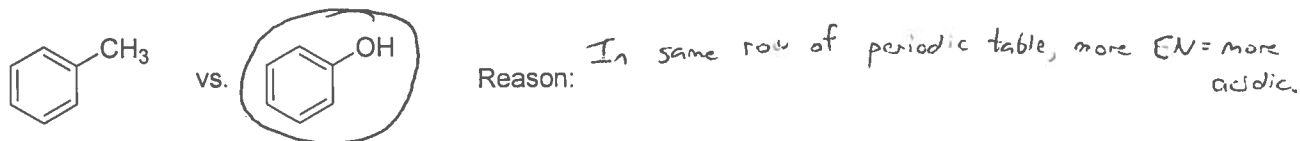
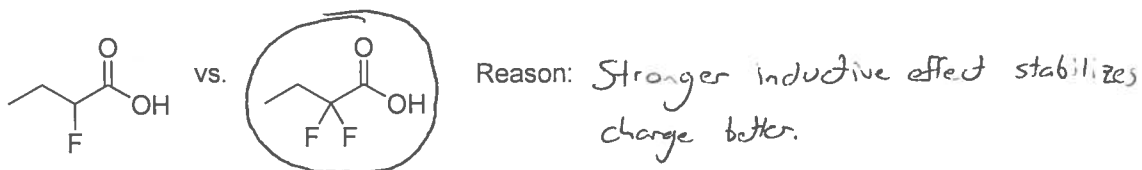
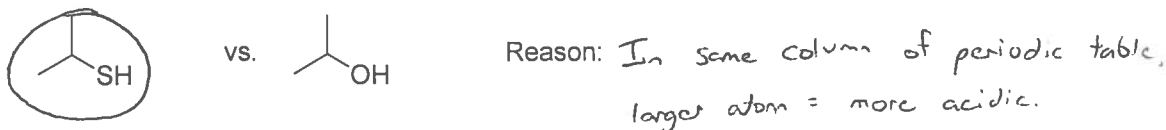


2) Write the names of the following functional groups. (1 pt each)

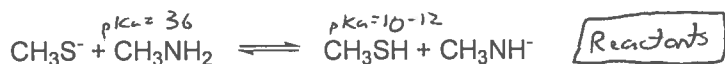
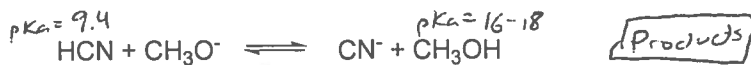
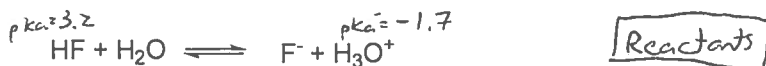


3) Acids and bases (16 pts)

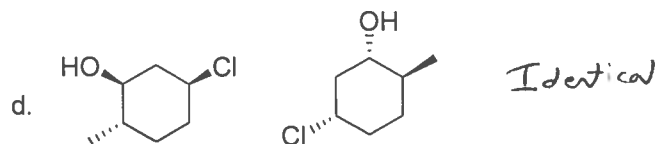
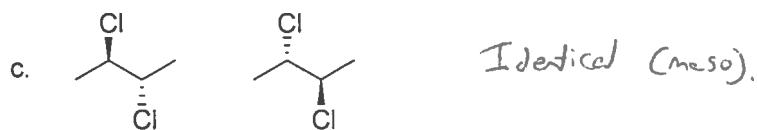
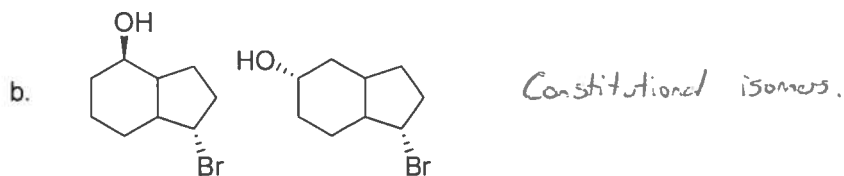
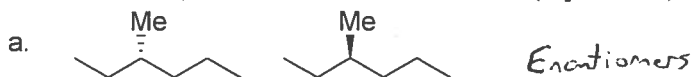
a. For each pair of compounds shown below, select the more acidic of the two compounds and explain your reasoning in under ten words. (2 pts each)



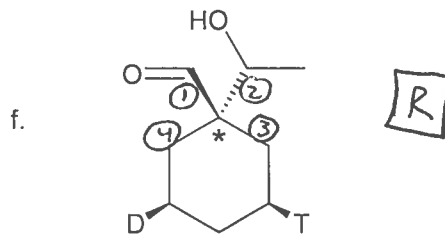
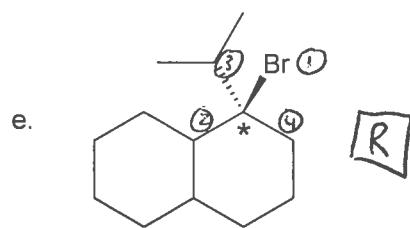
b. For each of the following reactions, does the equilibrium favor the reactants or products? (2 pts each)



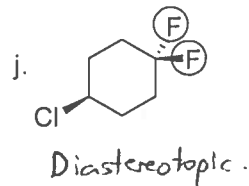
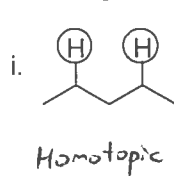
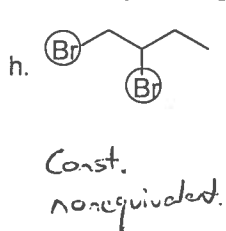
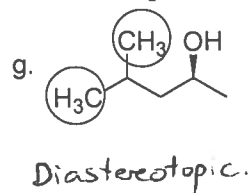
4) **Parts a – d:** Describe each of the following pairs of molecules as identical, enantiomers, diastereomers, or constitutional isomers. (2 pts each)



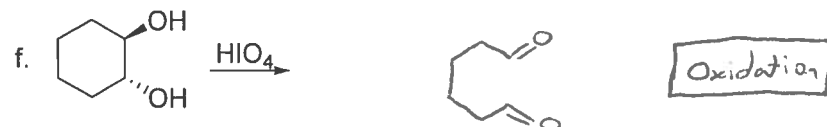
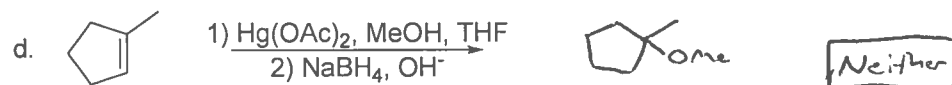
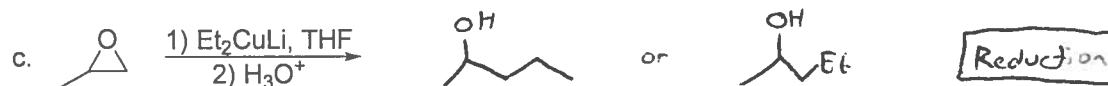
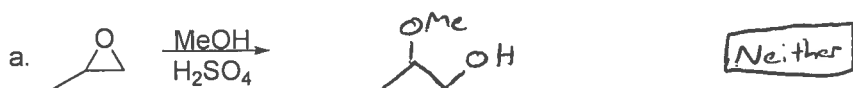
**Parts e-f:** Describe each molecule as R or S at the stereocenter labeled with a \*. (2 pts each)



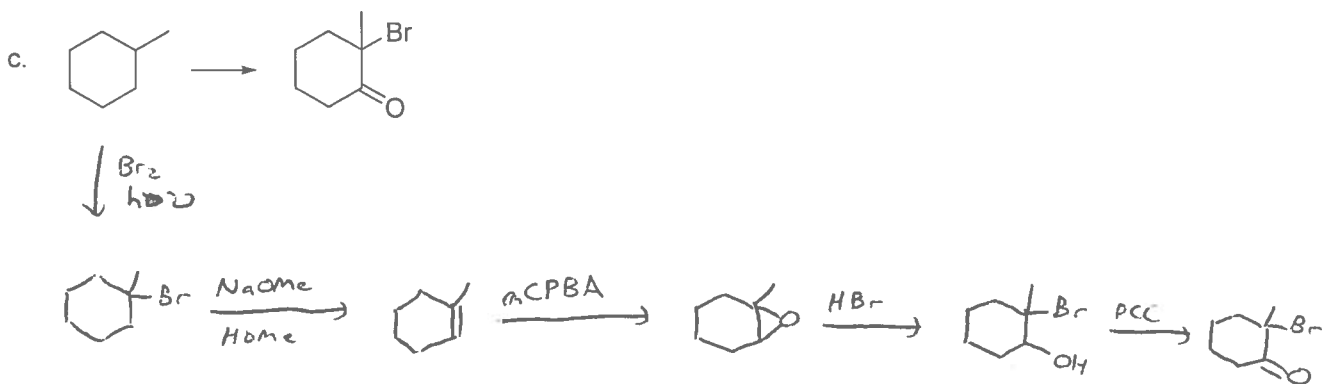
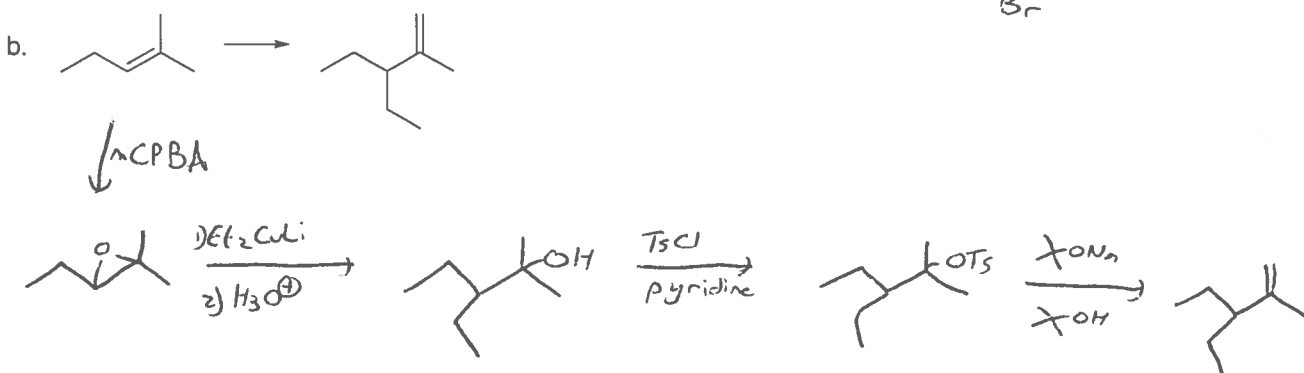
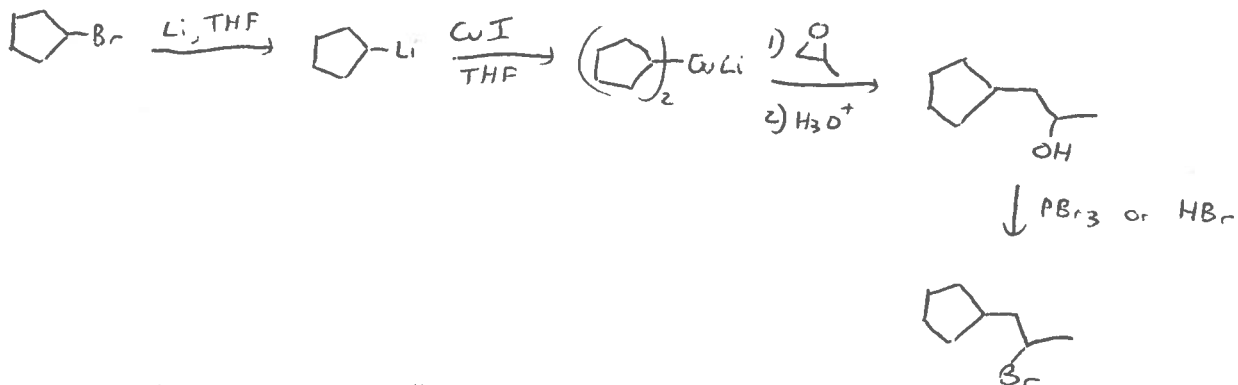
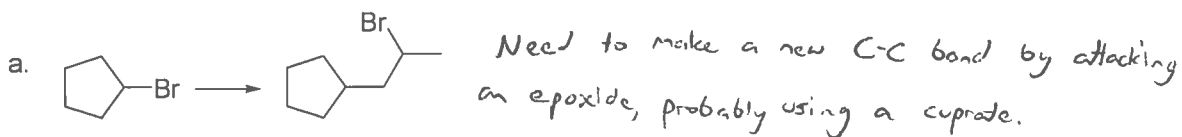
**Parts g – j:** Describe each of the following groups as homotopic, enantiotopic, diastereotopic, or constitutionally nonequivalent. (2 pts each)



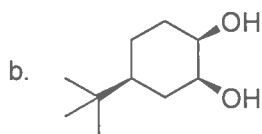
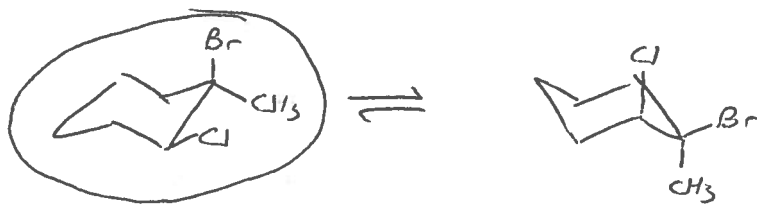
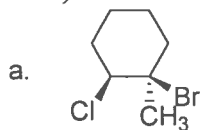
5) **Predict the product** of the following reactions, and **choose the appropriate descriptor** (reduction, oxidation, or neither) for what happens to the organic molecule during each reaction. (4 pts each)



- 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)



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



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

