

CHEM 3311-200 (Ellison/Richardson) 2nd Exam – March 12, 2013

Your Name _____

Student ID No. _____

Recitation Day/Time _____

Recitation TA (circle one) **Katelyn Chando,**
Setareh Azarnoush

Question	Score	Out of
1		15
2		8
3		10
4		10
5		12
6		10
7		10
8		15
9		10
Total		100

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. Please put all your final answers on the test in pen, not pencil. 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	beryllium 4 Be 9.0122																	helium 2 He 4.0026															
lithium 3 Li 6.941	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																	argon 18 Ar 39.948										
sodium 11 Na 22.990	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	potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.867	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 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	seleเนียม 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	palladium 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	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
francium 87 Fr [223]	radium 88 Ra [226]	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 [288]	nobelium 102 No [259]	bohrium 103 Bh [264]	hassium 104 Hs [265]	meitnerium 105 Mt [268]	darmstadtium 106 Ds [271]	roentgenium 107 Rg [272]	copernicium 108 Cn [285]	flerovium 109 Fl [289]	tennessium 110 Ts [294]	oganeson 111 Og [294]	unbinilium 112 Uub [289]	ununilium 113 Uui [289]	unununium 114 Uuq [289]	unbibium 115 Uub [289]	unbium 116 Uub [289]	unhexium 117 Uuh [289]	unseptium 118 Uus [289]	unoktium 119 Uuo [289]	unennium 120 Uue [289]

* Lanthanide series

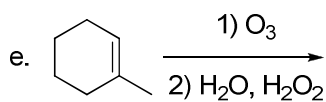
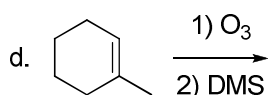
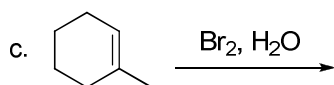
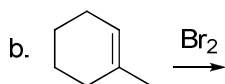
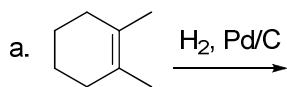
** Actinide series

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 [288]	nobelium 102 No [259]

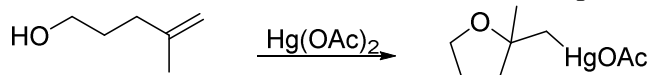
pKa Values

HI	-10.1	H ₂ O	15.7
HCl	-3.9	Alcohol (ROH)	16-18
H ₃ O ⁺	-1.7	HC≡CH	26
CH ₃ COOH	4.7	NH ₃	36
NH ₄ ⁺	9.3	H ₂ C=CH ₂	45
Phenol	10	CH ₄	60

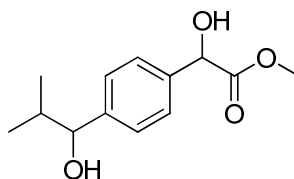
- 1) For each reaction shown below, predict the product(s). If a mixture of stereoisomers is formed, show all stereoisomers using wedges and dashes to indicate configuration, and **specify whether they are enantiomers or diastereomers**. (3 pts each)



- 2) Suggest a reasonable mechanism for the reaction shown below. (8 pts)

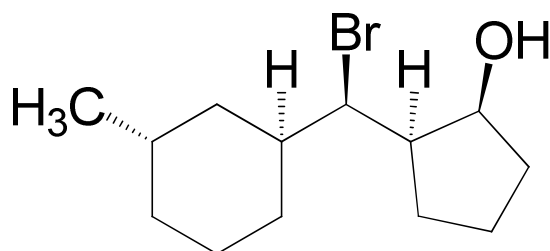


- 3) Using bold and dashed bonds, show all possible stereoisomers of the structure shown below. (4 pts)

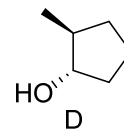
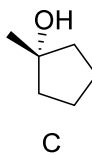
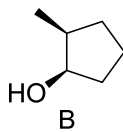
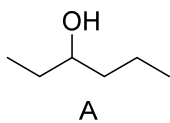


What is the stereochemical relationship (enantiomers, diastereomers, identical) between each possible pairing of these four molecules? (Hint: there are six possible pairings). (6 pts)

- 4) In the structure shown below, label each stereocenter as R or S. (10 pts)

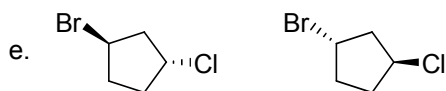
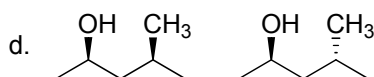
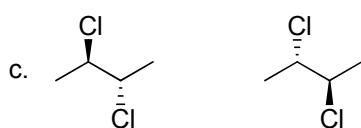
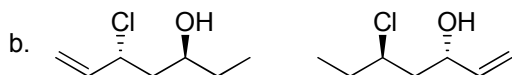
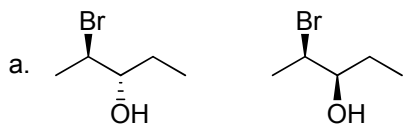


5) Four compounds are shown below.

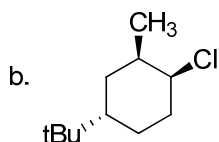
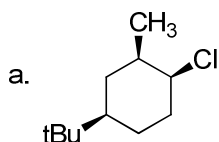


- a. Which of these compounds can be synthesized as the major product of hydroboration-oxidation? Show the precursor alkene for each alcohol that can be prepared this way. (6 pts)
- b. Which of these compounds can be synthesized as the major product of oxymercuration-reduction? (i.e., $\text{Hg}(\text{OAc})_2$, H_2O , THF, followed by NaBH_4) Show the precursor alkene for each alcohol that can be prepared this way. (6 pts)

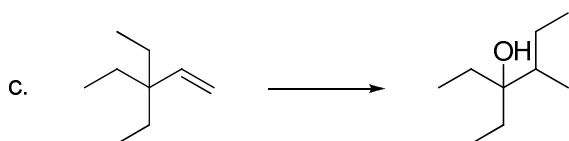
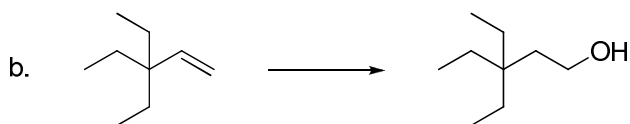
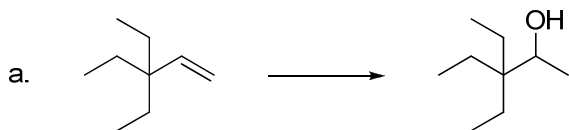
- 6) For each of the following pairs of molecules, are they identical, enantiomers, diastereomers, or constitutional isomers? (2 pts each)



- 7) For each of the following structures, show both chair conformations. (Make sure your bond angles clearly indicate whether each group is equatorial or axial.) Circle the more stable ring-flip form for each molecule. (5 pts each)

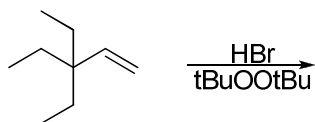


- 8) Fill in the reagents above the arrow to convert the starting material to each of the products. (15 pts)



- 9) Radical HBr addition mechanism (10 pts)

- a. Predict the major product of the reaction shown below, ignoring stereochemistry. (2 pts)



- b. Write an arrow-pushing mechanism for this reaction. Clearly label the initiation, propagation, and termination steps. Show at least two examples of termination. (8 pts)