

CHEM 3311 (Richardson) Second Hour Exam – October 23, 2012

Your Name _____

Student ID No. _____

Recitation Day/Time _____

Recitation TA (circle one) Thomas Carey, Adam Csakai,
Jake Greenberg, Maria Kolber,
Tim Rochelle, Mike Springer

Question	Score	Out of
1		24
2		22
3		10
4		10
5		16
6		18
7		0
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																				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																				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																				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 *																			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 * *																			unquadim 114 Uuq [289]						
			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															
			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															
			lutetium 71 Lu 174.97	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	wolfram 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															
			lawrencium 103 Lr [262]	rutherfordium 104 Rf [261]	dubnium 105 Db [262]	seaborgium 106 Sg [266]	bohrium 107 Bh [264]	hassium 108 Hs [269]	meitnerium 109 Mt [268]	unnilium 110 Uun [271]	ununium 111 Uuu [272]	unubium 112 Uub [277]															

* Lanthanide series

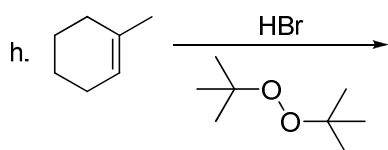
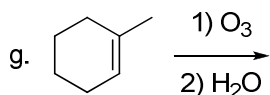
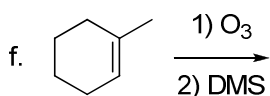
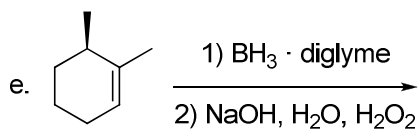
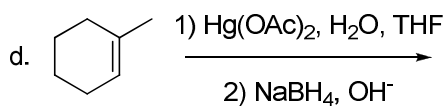
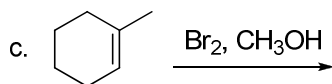
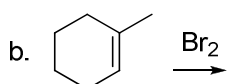
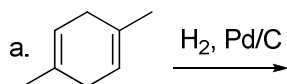
lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 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

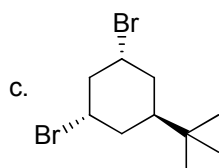
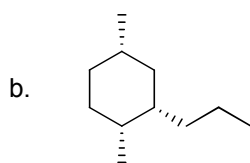
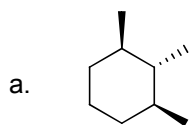
pKa Values

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

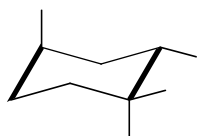
- 1) For each reaction shown below, predict the product(s). If a mixture of stereoisomers is formed, show all stereoisomers using wedges and dashes to indicate configuration, and **specify whether they are enantiomers or diastereomers**. If more than two products are created, you should specify the relationship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



- 2) For each of the following structures, show **both** chair conformations. Circle the more stable of the two ring-flip forms. (5 pts each)



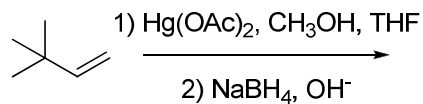
- d. For the structure shown below, draw a double Newman projection, sighting along the bolded bonds. (5 pts)



- e. How many total gauche interactions between carbons does the structure shown in part d. have? (2 pts)

3) Addition mechanism 1:

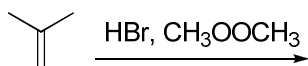
- a. Predict the major product(s) of the reaction shown below, showing stereochemistry if necessary. Note that it uses CH_3OH instead of H_2O . Hint: we've seen other reactions where an alcohol can perform exactly the same mechanistic steps as water, such as halohydrin formation vs. haloether formation. (2 pts)



- b. Write an arrow-pushing mechanism for the first half of this reaction, up until the reagents for step 2 are brought in. (8 pts)

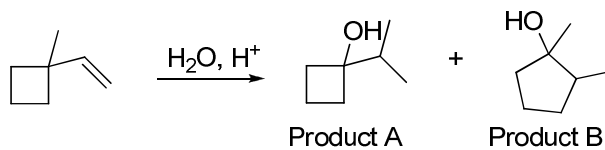
4) Addition mechanism 2:

- a. Predict the major product(s) of the reaction shown below, showing stereochemistry if necessary. (2 pts)



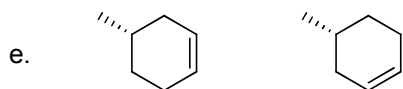
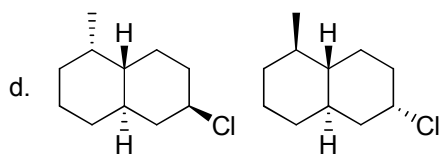
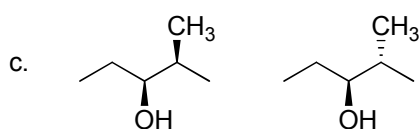
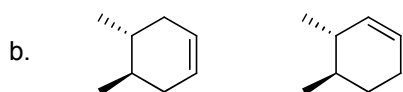
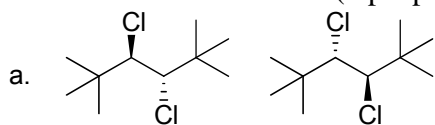
- b. Write an arrow-pushing mechanism for this reaction. Clearly label your initiation, propagation and termination steps, and show at least two examples of termination. (8 pts)

- 5) When an acid-catalyzed hydration was performed on the molecule shown below, some unexpected products were created.

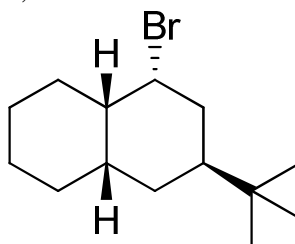


- a. Show the mechanism for the formation of Product A, ignoring stereochemistry. (6 pts)
- b. Show the mechanism for the formation of Product B, ignoring stereochemistry. Hint: It's almost identical to the formation of Product A, but methyl is not the only type of alkyl group that can shift. (8 pts)
- c. Based on what you know of ring size, is Product A or B more stable? (2 pts)

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



f. For the structure shown in below, label each stereocenter as R or S. (8 pts)



7) Extra credit! Write the mechanism for the following reaction. (5 pts extra credit)

