

CHEM 3311 (Richardson) Final Exam – Dec. 18, 2019

Your Name: _____

Student ID: _____

Recitation (check one)

- 10:00 Mon (Jonathan Thurston) 9:00 Tue (Chance Brandt)
 11:00 Mon (Andrew Chomas) 10:00 Tue (John Flood)
 1:00 Mon (Shea O’Sullivan) 12:00 Tue (Jonathan Thurston)
 2:00 Mon (Shea O’Sullivan) 2:00 Tue (Andrew Chomas)
 3:00 Mon (Dominique Blackmun) 3:00 Tue (Justin Olson)
 8:00 Tue (John Flood) 4:00 Tue (Justin Olson)

Question	Score	Out of
1		40
2		40
3		30
4		20
5		25
6		15
7		30
8		10 ec
Total		200

This is a closed-book exam. The use of notes, calculators, 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.

Periodic Table of the Elements

The periodic table includes the following series at the bottom:

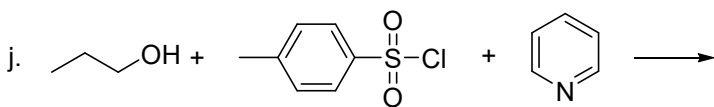
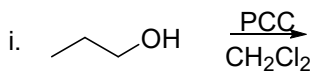
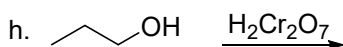
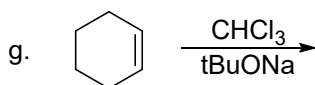
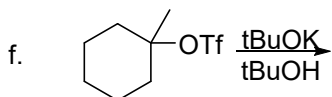
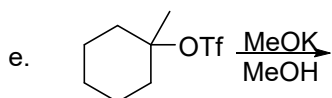
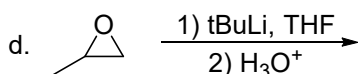
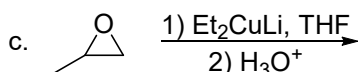
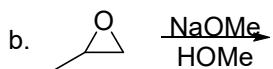
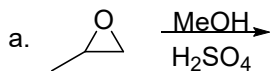
Lanthanide Series: 57 La (138.905), 58 Ce (140.115), 59 Pr (140.908), 60 Nd (144.241), 61 Pm (144.913), 62 Sm (150.36), 63 Eu (151.964), 64 Gd (157.25), 65 Tb (158.925), 66 Dy (162.500), 67 Ho (164.930), 68 Er (167.259), 69 Tm (168.934), 70 Yb (173.055), 71 Lu (174.967).

Actinide Series: 89 Ac (227.029), 90 Th (232.038), 91 Pa (231.036), 92 U (238.029), 93 Np (237.048), 94 Pu (244.064), 95 Am (243.061), 96 Cm (247.070), 97 Bk (247.070), 98 Cf (251.080), 99 Es (254), 100 Fm (257.095), 101 Md (258.1), 102 No (259.101), 103 Lr (262).

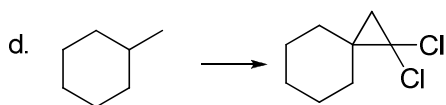
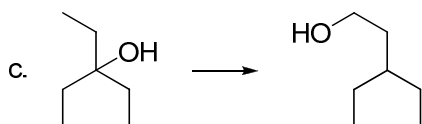
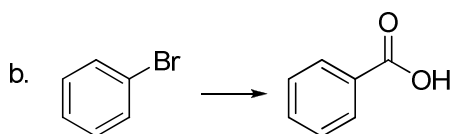
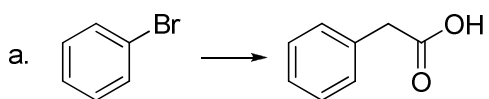
pKa Values

HI	-10	CH ₃ COOH	4.7	ArOH	10	HC≡CH	26
HBr	-8	HN ₃	4.7	RSH	10-12	H ₂	35
HCl	-6	H ₂ S	7.0	H ₂ O	15.7	NH ₃	36
H ₃ O ⁺	-1.7	NH ₄ ⁺	9.3	ROH	16-18	H ₂ C=CH ₂	45
HF	3.2	HCN	9.4	O=C-CH	9-25	CH ₄	60

1) **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. You do not need to show stereochemistry. (40 pts; 4 pts each)

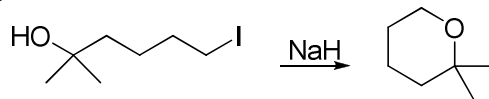


2) Find a way to synthesize the desired product from the given starting material. If more than one step is necessary, show the product of each step. Do not show mechanisms. (40 pts; 10 pts each)

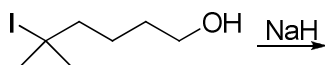


3) Williamson Ether Synthesis (30 pts)

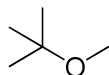
a. Write an arrow-pushing mechanism for the reaction shown below. (10 pts)



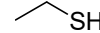
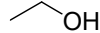
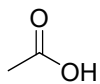
b. Predict the product of the following reaction, and show a mechanism for its formation. (10 pts)



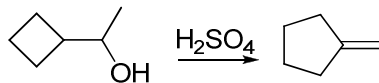
c. How would you synthesize the following ether from any alcohol and any alkyl halide? (10 pts)



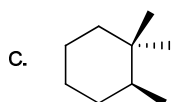
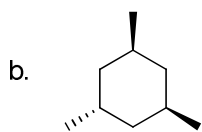
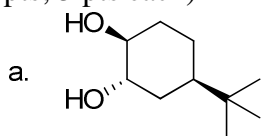
4) Write the names of the following functional groups. (20 pts; 2 pts each)



5) Write an arrow-pushing mechanism for the reaction shown below. (25 pts)

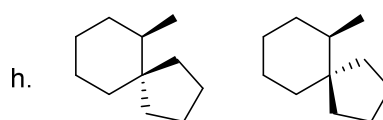
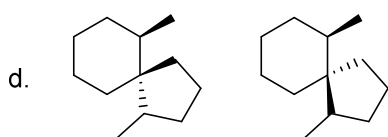
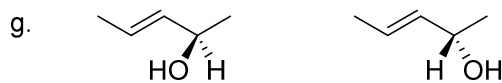
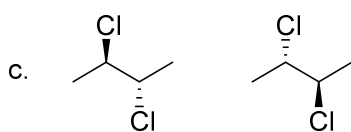
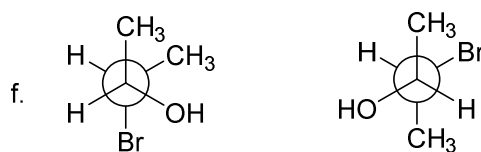
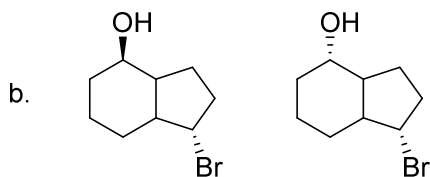
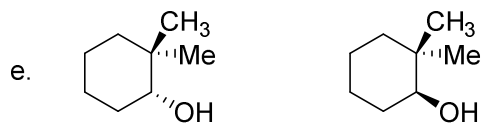
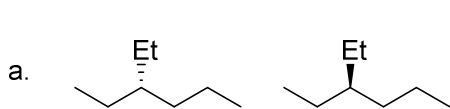


6) Draw the following molecules in **both** chair conformations, and circle the most stable. (15 pts; 5 pts each)

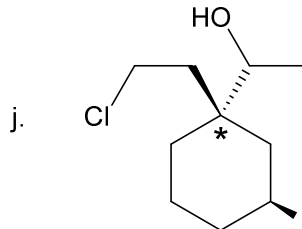
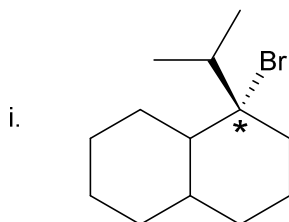


7) Stereochemistry (30 pts; 3 pts each)

Parts a – h: Describe each of the following pairs of molecules as identical, enantiomers, diastereomers, or constitutional isomers.



Parts i-j: Describe each molecule as R or S at the stereocenter labeled with a *.



8) Extra credit! Epoxy glues consist of monomers containing an epoxide group. When mixed with a curing agent, the monomers polymerize into a long chain. An example of this reaction is shown below. Show a reasonable mechanism for this reaction. You can assume that there are trace amounts of water present (for example, due to atmospheric moisture). (10 pts)

