CHEM 3311 (Richardson) Final Exam – Dec. 18, 2017

Your Name: _____

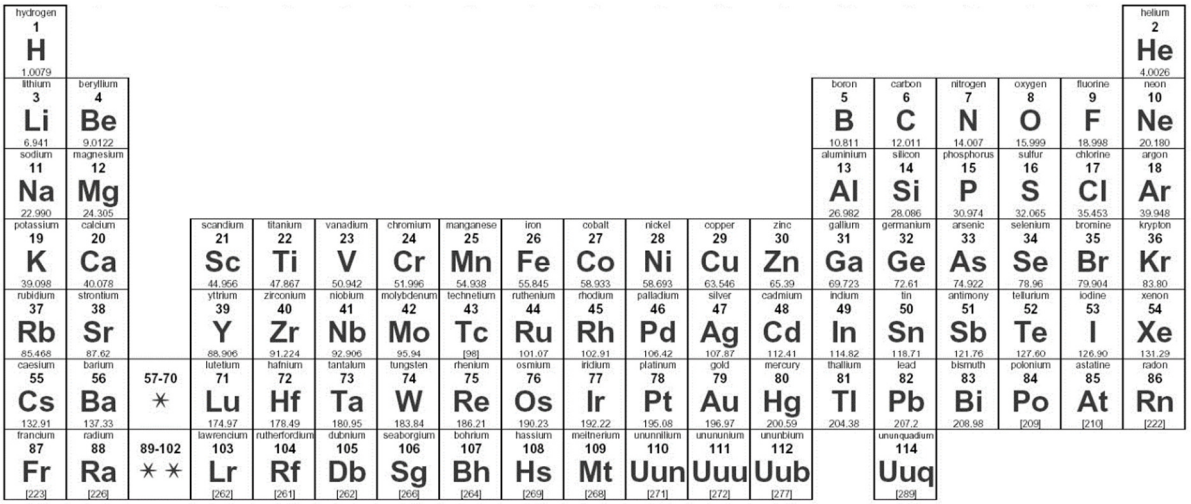
Student ID: _____

Recitation (check one)

O 8:00 Tue (Rachel Weintraub)
O 2:00 Tue (Zhenhao Chen)
O 3:00 Wed (Rachel Weintraub)
O 12:00 Thu (Patrick Li)
O 2:00 Fri (Rachel Weintraub)
O 1:00 Mon (Zhenhao Chen)
O 11:00 Tue (Patrick Li)
O 1:00 Wed (Zepeng Lei)
O 9:00 Thu (Rachel Weintraub)
O 3:00 Thu (Zepeng Lei)
O 3:00 Fri (Rachel Weintraub)

Question	Score	Out of
1		20
2		20
3		45
4		20
5		20
6		40
7		20
8		15
9		15 e.c.
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.

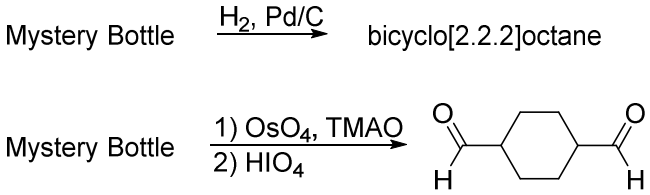


pKa Values

HI	-10	CH_3COOH	4.7	ArOH	10	H_2	35
HBr	-8	HN_3	4.7	RSH	10-12	NH_3	36
HCl	-6	H_2S	7.0	H_2O	15.7	$H_2C{=}CH_2$	45
H_3O^+	-1.7	NH_4^+	9.3	ROH (R=alkyl)	16-18	CH_4	60
HF	3.2	HCN	9.4	HC≡CH	26		

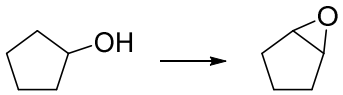
1) Treatment of 1,2,2-trimethylcycloheptanol with H_2SO_4 gives a mixture of 1,7,7-trimethylcycloheptene and 1-*tert*-butylcyclohexene as the two major products. Write a reasonable mechanism to show how each of these products is formed. (20 pts)

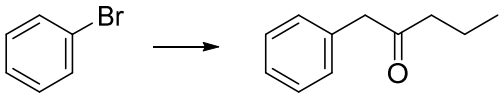
2) You have found a mysterious bottle in your lab bench. The label is too covered in weird stains to be legible, but your research advisor assures you that this compound is vital to the success of your career as a chemistry grad student and you must identify its structure. Since the NMR is not available, you perform a few reactions and observe the following results.

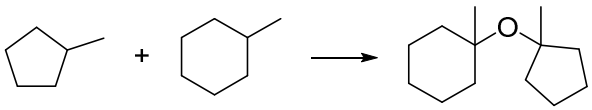


What is the structure of the compound in this mystery bottle? (20 pts)

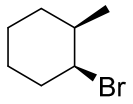
3) Find a way to synthesize the desired product from the given starting material. If more than one step is necessary, show the product of each step. Do not show mechanisms. (45 pts; 15 pts each)

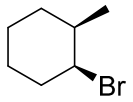
a. 

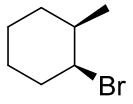
b. 

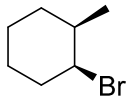
c. 

4) For each of the reactions shown below, **circle the mechanism(s)** you would expect to see, if any, and **draw the product(s)**. If a product has stereocenters, show its configuration using wedges and dashes. If two stereoisomers are formed, show both of them. If an elimination occurs, show only the major alkene product. If none of the mechanisms would take place in a reasonable time frame, write NR for No Reaction. (20 pts total; 5 pts each)

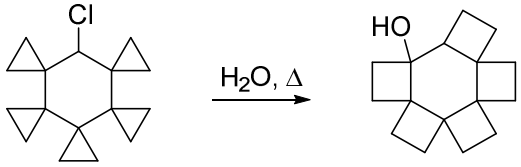
a.  $\xrightarrow[\text{MeOH}]{\text{MeONa}}$ E2 S_N2 E1 S_N1

b.  $\xrightarrow[\text{Acetone}]{\text{MeSNa}}$ E2 S_N2 E1 S_N1

c.  $\xrightarrow{CH_3OH}$ E2 S_N2 E1 S_N1

d.  $\xrightarrow[\text{tBuOH}]{\text{tBuOK}}$ E2 S_N2 E1 S_N1

5) The reaction shown below was observed to occur in water. (20 pts)

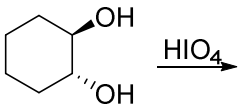


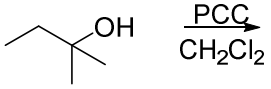
a. Draw a reasonable mechanism for this reaction. (18 pts)

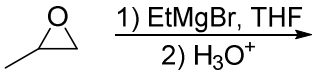
b. Is this reaction awesome? Circle one answer. (2 pts)

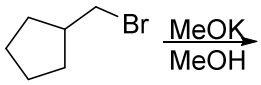
Yes YES VERY YES

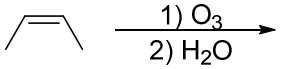
6) **Predict the product** of the following reactions, and **choose the appropriate descriptor** (reduction, oxidation, or neither) for what happens to the organic molecule during each reaction. You do not need to show stereochemistry. (40 pts; 4 pts each)

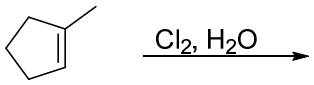
a. 

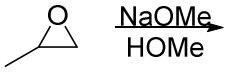
b. 

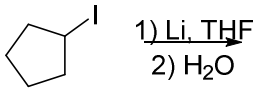
c. 

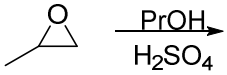
d. 

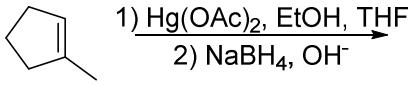
e. 

f. 

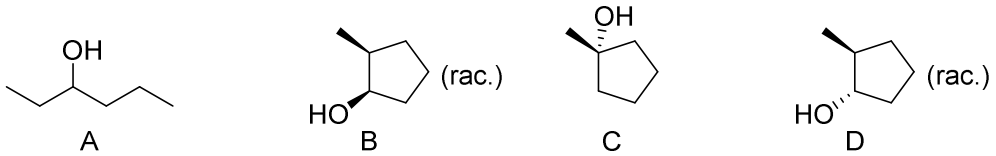
g. 

h. 

i. 

j. 

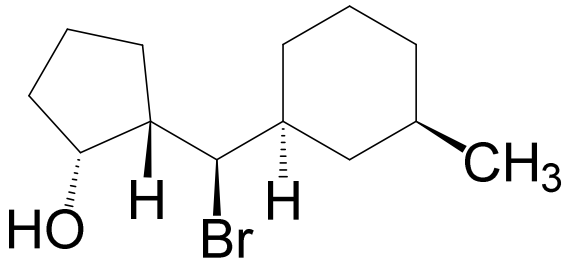
7) Four compounds are shown below. (20 pts)



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. (10 pts)

b. Which of these compounds can be synthesized as the major product of oxymercuration-reduction? Show the precursor alkene for each alcohol that can be prepared this way. (10 pts)

8) In the structure shown below, label each stereocenter as R or S. (15 pts)



9) Extra credit! Three different alkanes are constitutional isomers, all with the formula C_6H_{12}. When treated with chlorine and UV light, under conditions that lead to monochlorination, isomer A gives a single product, isomer B (which contains a quaternary carbon) gives a mixture of three products, and isomer C gives a mixture of four products. Based on this information, draw the structures of all three isomers, and draw each of the monochlorination products that they form. (15 pts extra credit)