CHEM 3311 (Richardson) Third Hour Exam – Nov. 28, 2017

Your Name: _____

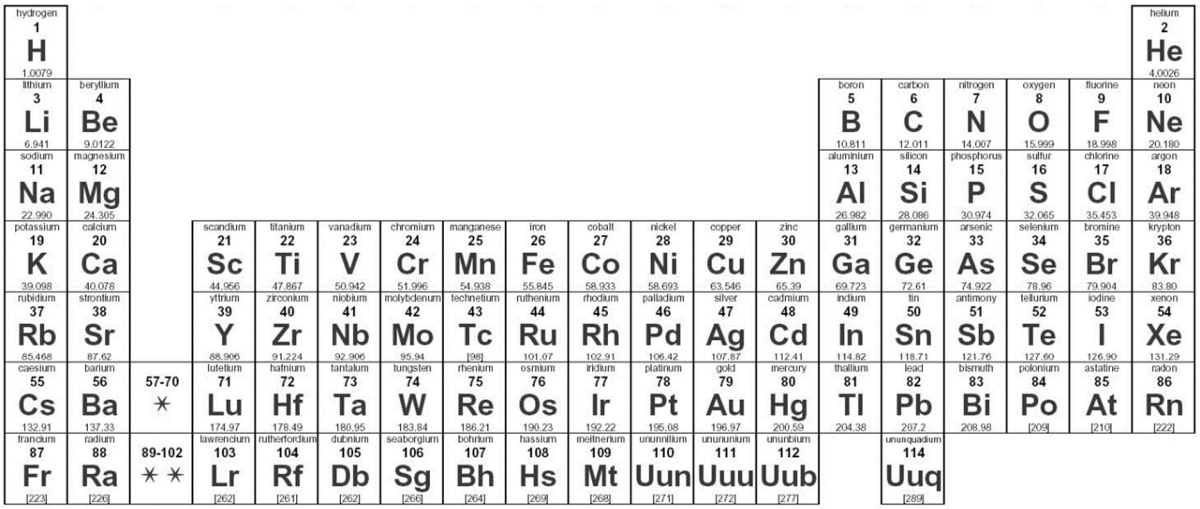
Student ID: _____

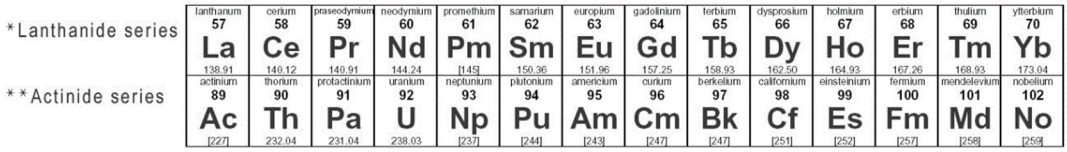
Recitation (check one)

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		10
2		20
3		15
4		10
5		15
6		15
7		15
8		10 e.c.
Total		

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		

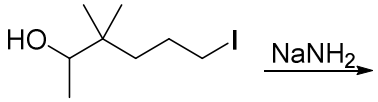
1) Arrange these compounds in order of increasing solubility in water (1 = most soluble). In under ten words per compound, explain what properties of each compound are responsible for increasing its solubility. (10 pts)
   a. Cyclohexanethiol

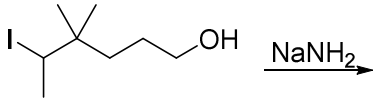
   b. Cyclohexane

   c. Cyclohexanol

   d. Methoxycyclohexane

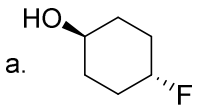
2) Predict the products of the following reactions, and show reasonable mechanisms for each of them. Each of them forms a product of formula $C_8H_{16}O$. (20 pts)

a. 

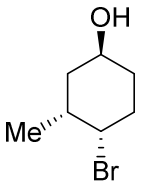
b. 

3) 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. (15 pts; 5 pts each)

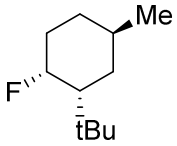
a.



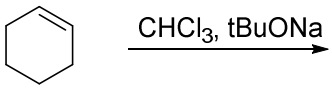
b.



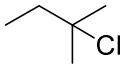
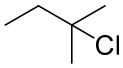
c.

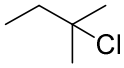
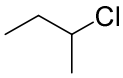


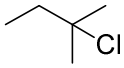
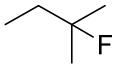
4) Show the mechanism and product of the following reaction. (10 pts)



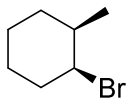
5) For each of the following pairs of reactions, circle the one that would be faster at E1 and explain why in under ten words. If both are equal, do not circle an option. (15 pts; 3 pts each)

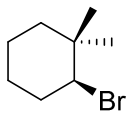
a.  + DMF + Br^-  + DMF + F^-

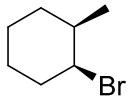
b.  + CH_3OH  + CH_3OH

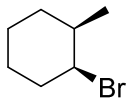
c.  + CH_3OH  + CH_3OH

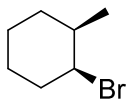
6) For each of the reactions shown below, **circle the mechanism(s)** you would expect to see, if any, and **draw the product(s)**. If a product has stereocenters, show its configuration using wedges and dashes. If two stereoisomers are formed, show both of them. If an elimination occurs, show only the major alkene product. If none of the mechanisms would take place in a reasonable time frame, write NR for No Reaction. (15 pts; 3 pts each)

a.  MeOH → | E2 | S_N2 | E1 | S_N1 |

b.  PrONa, DMF → | E2 | S_N2 | E1 | S_N1 |

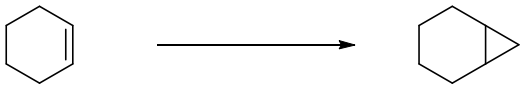
c.  NaCl, MeOH → | E2 | S_N2 | E1 | S_N1 |

d.  tBuONa, THF → | E2 | S_N2 | E1 | S_N1 |

e.  PrONa, DMSO → | E2 | S_N2 | E1 | S_N1 |

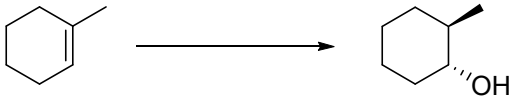
7) Each of these reactions can be done in a single step. On each arrow, show the reagents needed to accomplish each one. In each case, the target product should be the major product of the reaction. (15 pts – 3 pts each)

a. 

b. 

c. 

d. 

e. 

8) Extra credit! The Wurtz reaction, shown below, is capable of forming extremely strained bicyclic compounds. Show a reasonable mechanism for this reaction. Hint: sodium, Na, behaves similarly to lithium, Li. You do not have to show the mechanism for the formation of any organometallic species but you should show the mechanism for all other steps. (10 pts ec).