CHEM 3311 (Richardson) Third Hour Exam – April 12, 2016

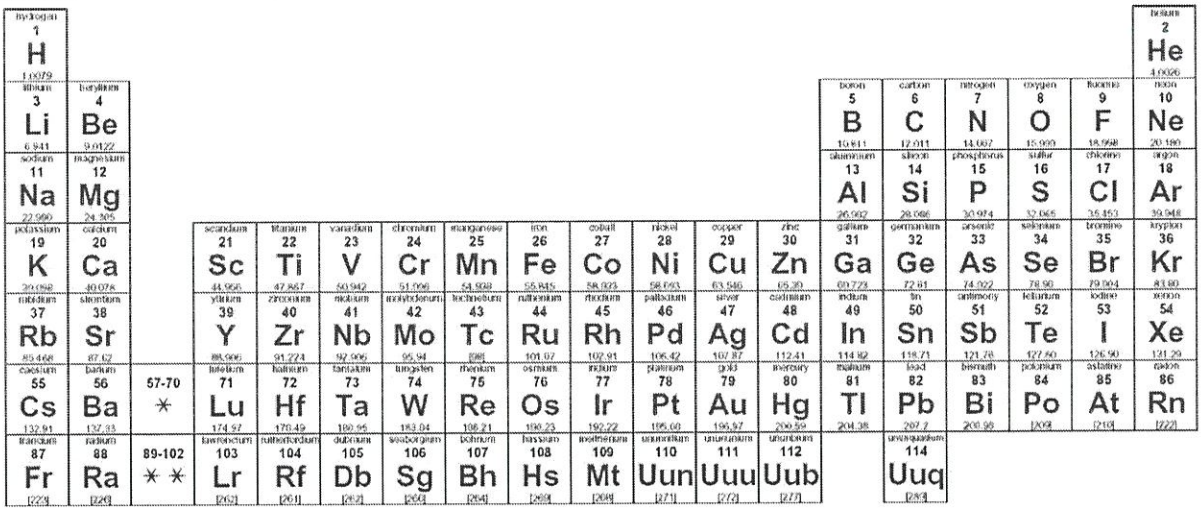
Your Name Key

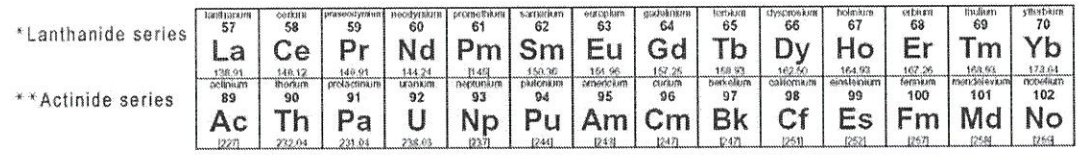
Student ID _____

Recitation Time (check one)
- O 3:00 Monday w/ Blaine McCarthy
- O 11:00 Tuesday w/ Thomas Carey
- O 1:00 Wednesday w/ Garrett Cairo
- O 8:00 Thursday w/ Blaine McCarthy
- O 3:00 Thursday w/ Garrett Cairo

Question	Score	Out of
1		20
2		20
3		10
4		20
5		10
6		20
7		6 e.c.
Total		100

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

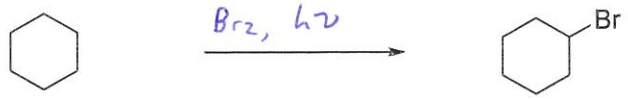
HI	-10	HF	3.2	HCN	9.4	HC≡CH	26
HBr	-8	CH_3COOH	4.7	PhOH	10	H_2	35
HCl	-6	HN_3	4.7	RSH	10-12	NH_3	36
H_3O^+	-1.7	H_2S	7.0	H_2O	15.7	$H_2C{=}CH_2$	45
ROH_2^+	-2	NH_4^+	9.3	ROH	15-19	CH_4	60

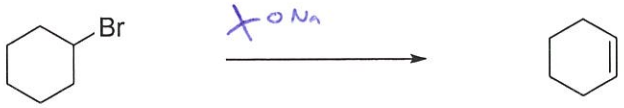
Average = 68.1
St. Dev = 21.1
Max = 102
Min = 5

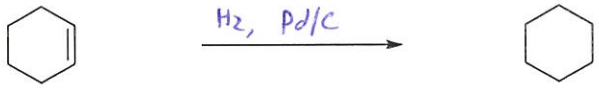
(Add 10-point curve to these numbers)

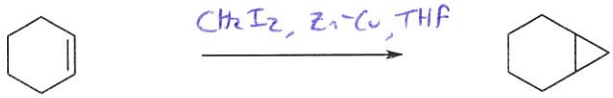
 Name_____

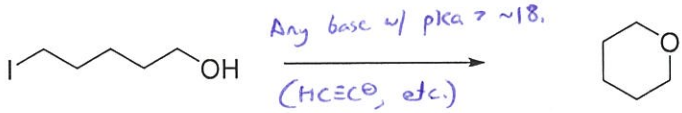
1) For each reaction shown below, write the necessary reagents on the arrow. The product shown should be the only major product. (20 pts)

a. 

b. 

c. 

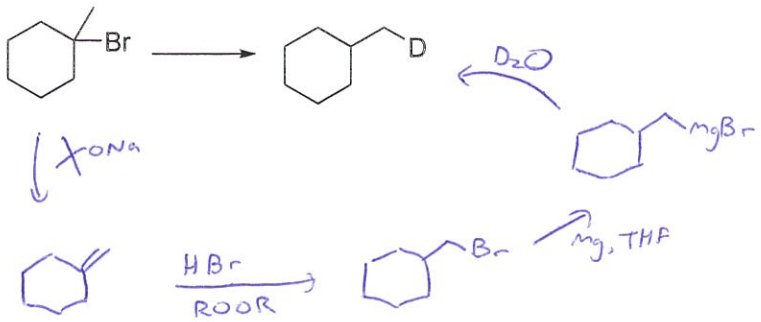
d. 

e. 

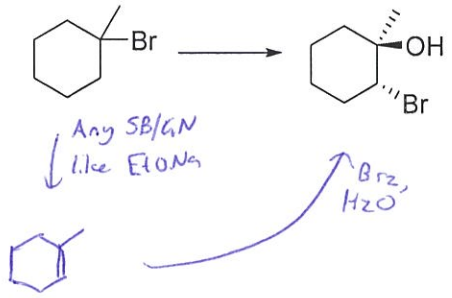
 Name_____

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. (20 pts)

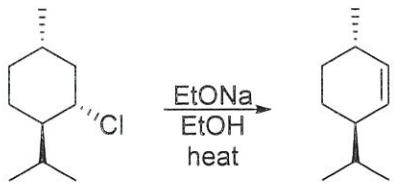
a.



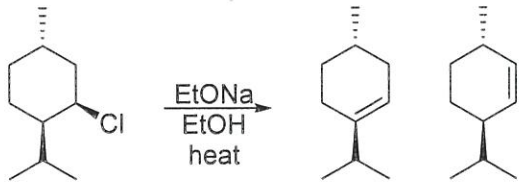
b.



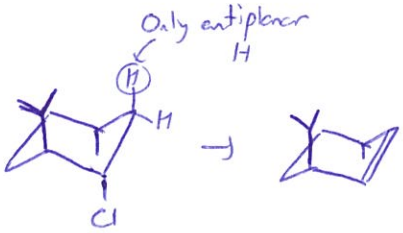
3) When the two alkyl chlorides shown below react with sodium ethoxide in ethanol at high temperatures, they give the products shown. Using 30 words or less, plus any necessary structures or mechanisms, explain why this happens. (10 pts)

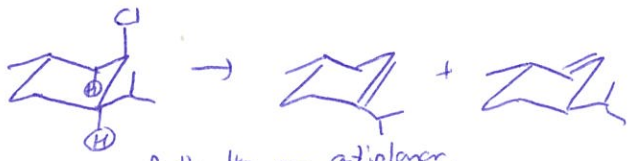


Only product



Major product Minor product

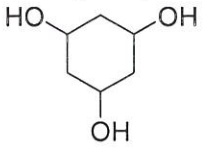




Both Hs are antiplanar, so Zaitsev's rule controls regiochemistry.

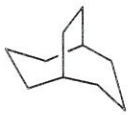
 Name_____

4) Provide an IUPAC name for each of these molecules (you do not need to include R/S or E/Z descriptors) and give the dominant intermolecular force for each one. (20 pts)



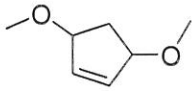
1,3,5-cyclohexanetriol
(or cyclohexane-1,3,5-triol

H-bonding



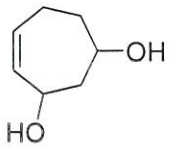
bicyclo[3.3.2]decane

van der Waals



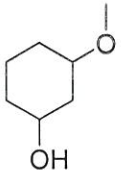
3,5-dimethoxy-1-cyclopentene
(or 3,5-dimethoxycyclopent-1-ene

Dipole-dipole



Cyclohept-4-ene-1,3-diol
↑ ok if missing this "e" due to error in notes

H-bonding

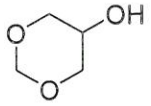


3-methoxycyclohexanol
(or 3-methoxy-1-cyclohexanol)

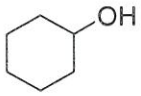
H-bonding

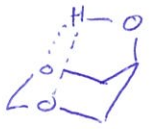
5) Two compounds are shown below. Compound B exists mostly in the chair form with its OH group equatorial, but compound A exists mostly in the chair form with its OH group axial. Using 30 words or less, plus any necessary structures, explain why this happens. Hint: What intermolecular forces are available to one molecule, but not the other? (10 pts)

A



B



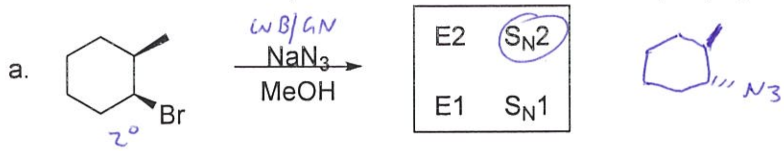


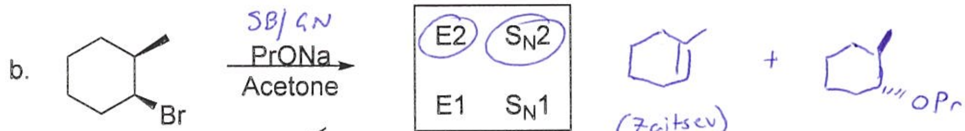
For A, when OH is axial, H can H-bond to O atoms in ring.

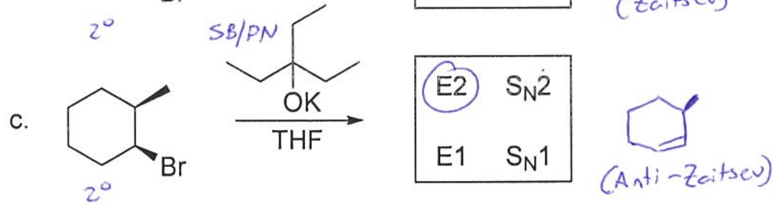
B has no similar benefit for axial OH.

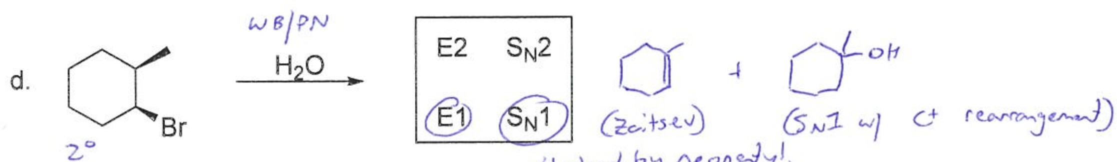
Name____________________________

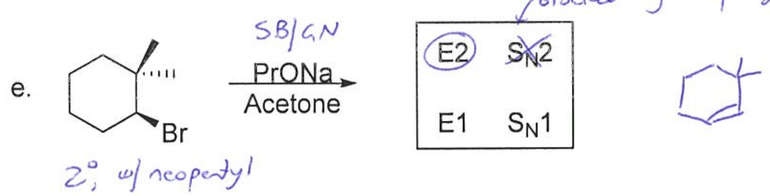
6) For each of the reactions shown below, **circle the mechanism(s)** you would expect to see, if any, and **draw the product(s)**. If a product has stereocenters, show its configuration using wedges and dashes. If two stereoisomers are formed, show both of them. If an elimination occurs, show only the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

a.


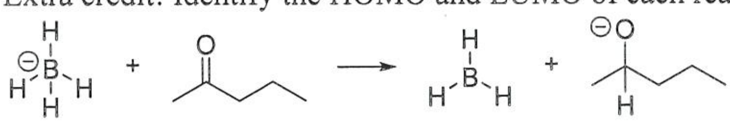
b.


c.


d.


e.


7) Extra credit! Identify the HOMO and LUMO of each reaction. (6 pts e.c.)



HOMO= B–H σ
LUMO= C=O π*

$H_2\overset{\oplus}{C}-CH_3$ + ⊖ Br → Br–H_2C-CH_3

HOMO= n.b. on Br
LUMO= n.b. on C

$H_2C=CH_2$ + $H-\overset{\oplus}{O}H_2$ → $H_2\overset{\oplus}{C}-CH_3$ + H_2O

HOMO= C=C π
LUMO= H–O σ*