

# CHEM 3311 (Richardson) Third Exam – Nov. 27, 2018

Your Name: Key

Student ID: \_\_\_\_\_

- |                              |                             |
|------------------------------|-----------------------------|
| Recitation (check one)       | O 10:00 Mon (Shafer Soars)  |
| O 11:00 Mon (Matthew Farmer) | O 1:00 Mon (Lacey Wayment)  |
| O 2:00 Mon (Shaofeng Huang)  | O 3:00 Mon (Shaofeng Huang) |
| O 9:00 Tue (Lacey Wayment)   | O 10:00 Tue (Josh Kamps)    |
| O 12:00 Tue (Josh Kamps)     | O 2:00 Tue (Lauren Bodkin)  |
| O 3:00 Tue (Lauren Bodkin)   | O 4:00 Tue (Matthew Farmer) |

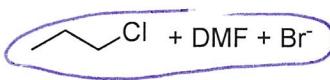
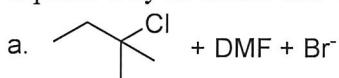
Question	Score	Out of
1		15
2		20
3		15
4		10
5		15
6		10
7		15
8		10 e.c.
Total		100

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.

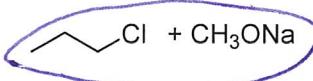
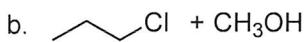
Hydrogen 1 **H** 1.0079 Boron 3 **Li** 6.941 Sodium 11 **Na** 22.990 Potassium 19 **K** 39.098 Rubidium 37 **Rb** 85.468 Cesium 55 **Cs** 132.91 Francium 87 **Fr** (223)	Boron 3 **Be** 9.0122 Magnesium 12 **Mg** 24.306 Calcium 20 **Ca** 40.078 Strontium 38 **Sr** 87.62 Barium 56 **Ba** 137.33 Dektonium 103 **Lr** (262) Rutherfordium 105 **Rf** (261) Seaborgium 106 **Sg** (262) Bohrium 107 **Bh** (261) Hassium 108 **Hs** (261) Meitnerium 109 **Mt** (261) Ununtrium 110 **Uun** (271) Ununhexium 111 **Uub** (271) Ununpentium 112 **Uup** (271) Ununquadium 114 **Uuq** (264)	Scandium 21 **Sc** 44.966 Yttrium 39 **Y** 88.906 Thulium 71 174.97 Lutetium 72 178.49 Dysprosium 73 180.95 Holmium 74 183.84 Erbium 75 186.21 Terbium 76 189.73 Dysprosium 77 192.22 Neodymium 78 195.08 Praseodymium 79 196.97 Iron 56 197.96 Osmium 80 199.96 Rhodium 81 200.59 Platinum 82 201.59 Iridium 83 204.38 Platinum 84 207.2 Osmium 85 208.59 Rhodium 86 209.4 Ununhexium 87 Ununpentium 88 Ununquadium 89 Ununtrium 90 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Ununpentium 80122 Ununquadium 80123 Ununtrium 80124 Ununhexium 80125 Ununpentium 80126 Ununquadium 80127

(2 pts per circle)

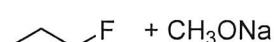
- 1) For each of the following pairs of reactions, circle the one that would be faster at S<sub>N</sub>2 and explain why in under ten words. If both are equal, do not circle an option. (15 pts; 3 pts each) *3 pts per explanation*



*Less substituted / less steric hindrance*



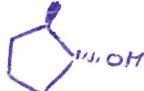
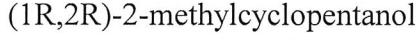
*Stronger nucleophile*



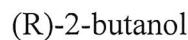
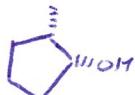
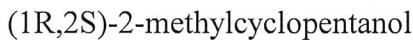
*Better leaving group*

- 2) Structure and reactivity. For parts b. and c., if a reaction forms a racemic mixture that contains the target compound plus its enantiomer, that is an acceptable answer. (20 pts total)

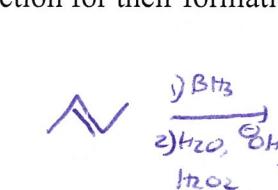
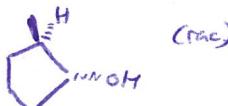
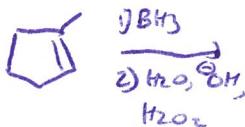
- a. Draw each of the following compounds. (2 pts each)



*1 pt for connectivity,  
1 pt for stereochem.*

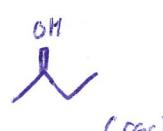
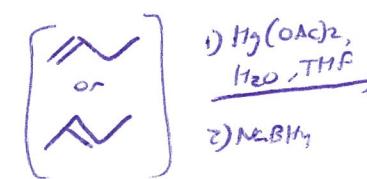
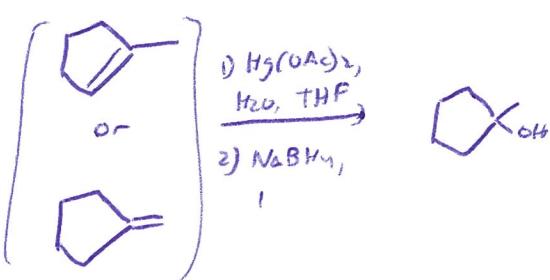


- b. Which of these can be formed as the only major product of hydroboration-oxidation on any alkene of your choice? Show the overall reaction for their formation from this alkene. (6 pts)



*For each  
rxn:  
2 pts for  
alkene,  
1 for reagents*

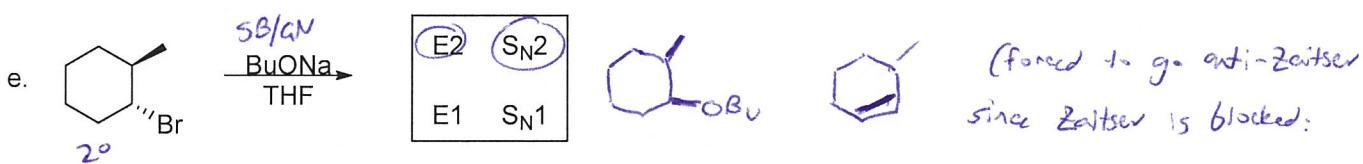
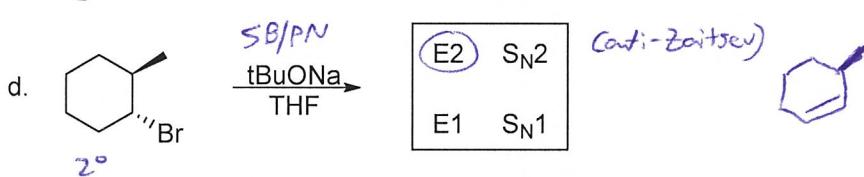
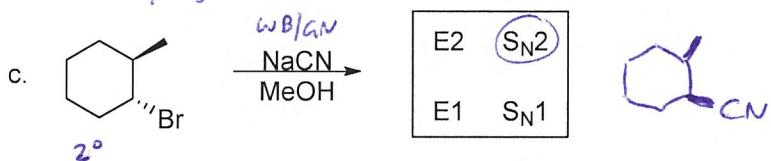
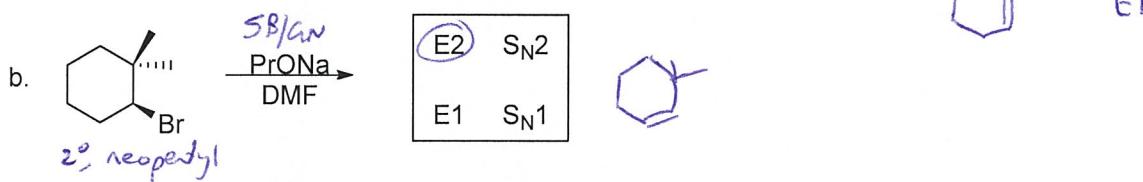
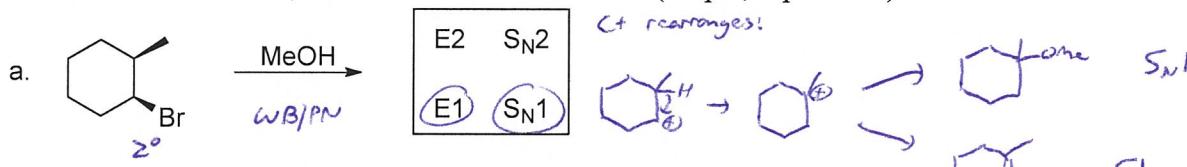
- c. Which of these can be formed as the only major product of oxymercuration-reduction on any alkene of your choice? Show the overall reaction for their formation from this alkene. (6 pts)



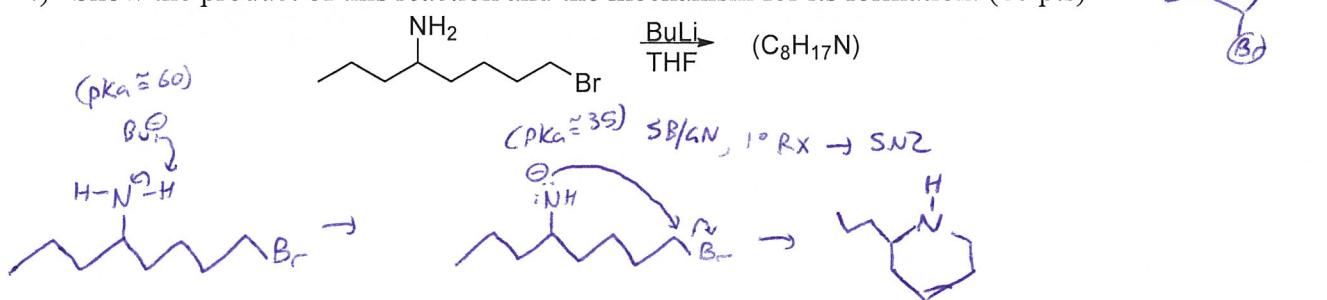
*wrong products  
No pts taken  
except 1 pt for error  
correct form  
if you draw  
wrong structure  
for a.), but b) & c)  
are OK.*

2 pts per circled mech, 2 pts for products

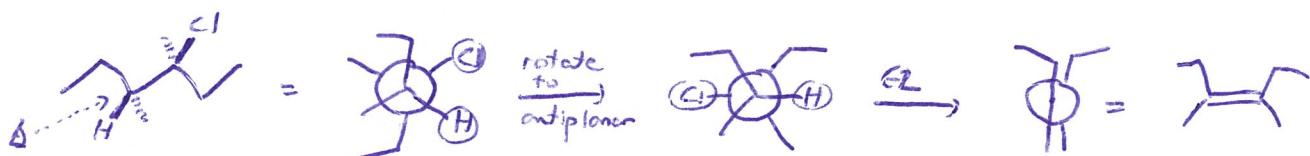
- 3) For each of the reactions shown below, **circle the mechanism(s)** you would expect to see, if any, and **draw the product(s)**. If a product has stereocenters, show its configuration using wedges and dashes. If two stereoisomers are formed, show both of them. If an elimination occurs, show only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



- 4) Show the product of this reaction and the mechanism for its formation. (10 pts)



- 5) Predict the product of the reaction below, including E/Z stereochemistry. Explain the stereochemical outcome in under thirty words, but with as many structures as you need. (10 pts)



Rotating to antiplanar puts the Z ethyl groups on same face of alkene, after E2 occurs.

E2, right stereochem, don't show E2 going antiplanar: 8/10

E2, wrong stereochem (E, not Z): 5/10

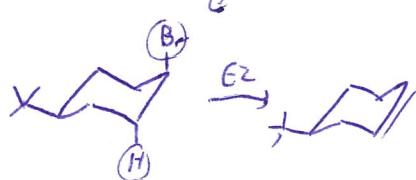
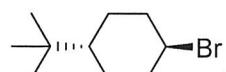
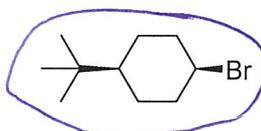
E2, wrong regiochem: 3/10

S<sub>N</sub>Z only: 3/10

S<sub>N</sub>1/E1: 2/10

- 6) One of these molecules undergoes E2 elimination much faster than the other. Circle the faster molecule and explain why it is faster in under thirty words, but with as many structures as you need. (10 pts)

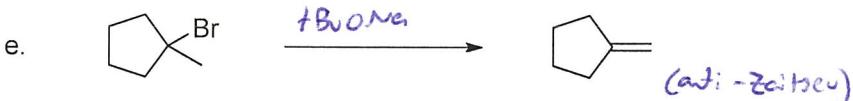
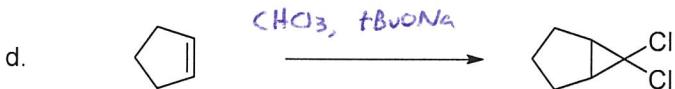
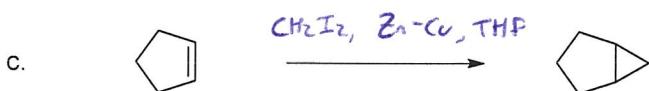
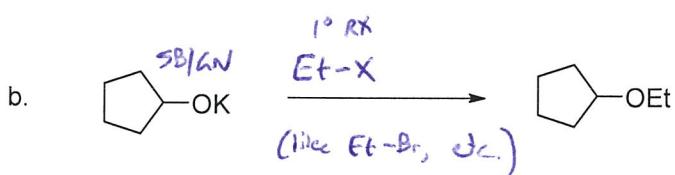
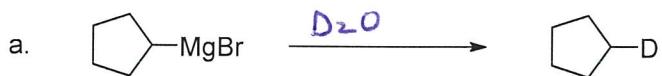
9 pts circle  
2 pts for each chair  
2 pts for explanation



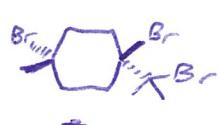
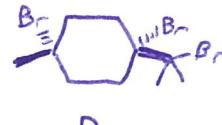
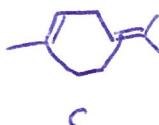
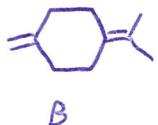
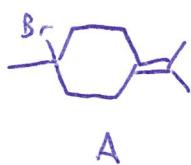
This molecule has Br locked into axial position by t-Bu group, so E2 is very easy. (always antiplanar).

This molecule has Br locked equatorial, so it can't do E2.

- 7) On each arrow, show the reagents needed to accomplish each reaction. In each case, the target product should be the major product of the reaction. (15 pts – 3 pts each)



- 8) Extra credit! In your lab, you have found a mysterious bottle labeled “Compound A - achiral alkyl halide  $C_{10}H_{17}Br$ .” In an attempt to discover its structure, you react it with KOH in ethanol and form two products (**B** and **C**), each with formula  $C_{10}H_{16}$ . Compound **A** rapidly undergoes solvolysis in aqueous ethanol. Ozonolysis of **A** followed by treatment with DMS gives  $(CH_3)_2C=O$  (acetone) as one of the products plus an unidentified halogen-containing material. Catalytic hydrogenation of either **B** or **C** gives a mixture of both *trans*- and *cis*-1-isopropyl-4-methylcyclohexane. Compound **A** reacts with one equivalent of  $Br_2$  to give a mixture of two separable compounds, **D** and **E**, both of which are achiral. Finally, ozonolysis of **B** followed by treatment with aqueous  $H_2O_2$  gives acetone and compound **F**, shown below. Draw compounds **A** through **E**. (10 pts extra credit)



2 pts each.