

CHEM 3311 (Richardson) Third Exam – Nov. 19, 2019

Your Name: Key

Student ID: _____

Question	Score	Out of
1		16
2		12
3		25
4		16
5		10
6		21
7		10 ec
Total		100

Recitation (check one)

- | | |
|---|---|
| <input type="radio"/> 10:00 Mon (Jonathan Thurston) | <input type="radio"/> 9:00 Tue (Chance Brandt) |
| <input type="radio"/> 11:00 Mon (Andrew Chomas) | <input type="radio"/> 10:00 Tue (John Flood) |
| <input type="radio"/> 1:00 Mon (Shea O'Sullivan) | <input type="radio"/> 12:00 Tue (Jonathan Thurston) |
| <input type="radio"/> 2:00 Mon (Shea O'Sullivan) | <input type="radio"/> 2:00 Tue (Andrew Chomas) |
| <input type="radio"/> 3:00 Mon (Dominique Blackmun) | <input type="radio"/> 3:00 Tue (Justin Olson) |
| <input type="radio"/> 8:00 Tue (John Flood) | <input type="radio"/> 4:00 Tue (Justin Olson) |

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 shows elements from Hydrogen (1) to Oganesson (118). It includes the Lanthanide series (57-71) and Actinide series (89-103) at the bottom. A legend indicates: Atomic Number (top left), Symbol (center), Name (center), and Atomic Mass (bottom right).

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

Aug: 70.6

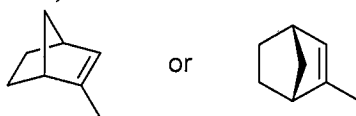
Curve: 4.5

St. Dev: 21.1

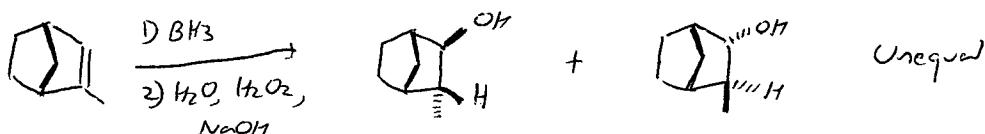
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Min: 4

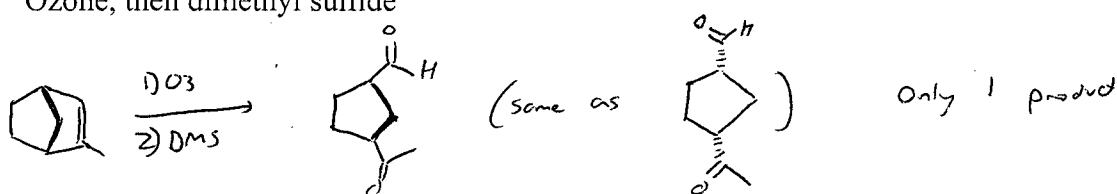
- 1) The compound shown below is one particular enantiomer of 2-methylnorbornene. Draw the product(s) of this molecule reacting under each of the following conditions; show stereochemistry explicitly. If there are multiple products, are they produced in equal or unequal amounts? (16 pts; 4 pts each)



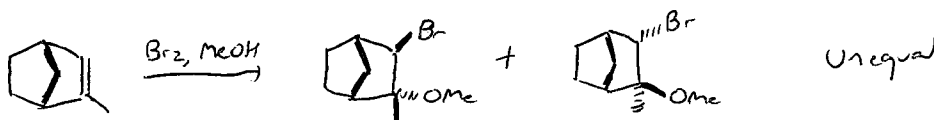
- a. BH_3 , then H_2O , H_2O_2 , and NaOH



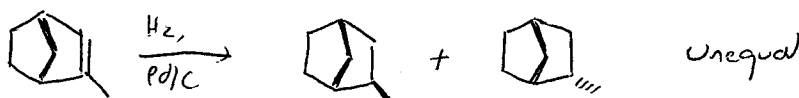
- b. Ozone, then dimethyl sulfide



- c. Bromine and methanol



- d. Hydrogen and palladium on carbon



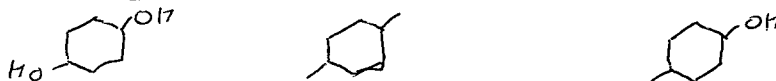
- 2) For each of the following groups of molecules, circle the one with the highest boiling point and explain why it is higher in under ten words. (12 pts; 4 pts each)

- a. cyclohexane; cyclodecane; cyclobutane



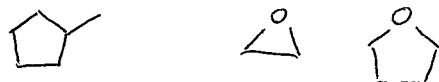
Higher MW = stronger van der Waals

- b. 1,4-cyclohexanediol; 1,4-dimethylcyclohexane; 4-methylcyclohexanol



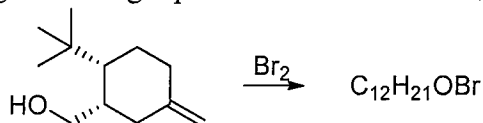
more OH groups = more H-bonding

- c. methylcyclopentane; oxirane; THF



More MW & polar bonds

3) The reaction shown below gives a single product with formula $C_{12}H_{21}OBr$. (25 pts total)



a. How many degrees of unsaturation does the starting material have? (2 pts)

2

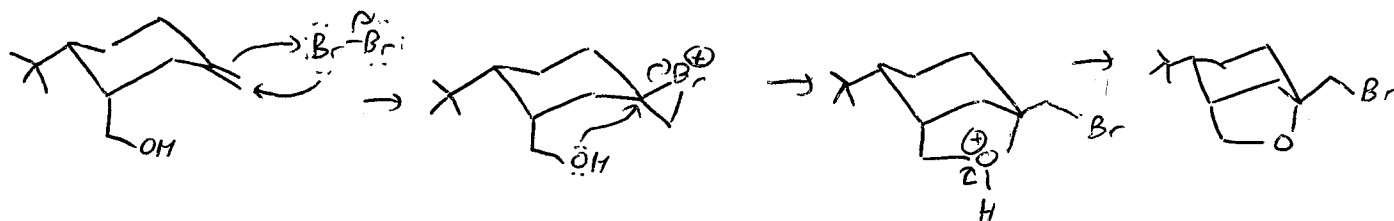
b. How many degrees of unsaturation does the product have? (2 pts)

2

c. Draw the two possible conformations of the starting material and circle the more stable one. Any groups that are double-bonded to the ring (in other words, attached to an sp^2 -hybridized carbon) are neither axial nor equatorial, but midway in between. (6 pts)



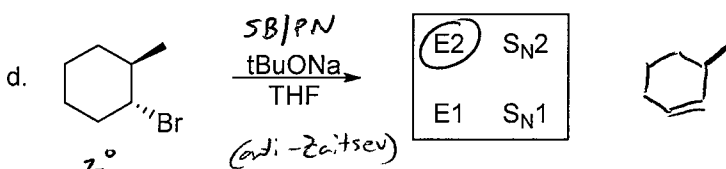
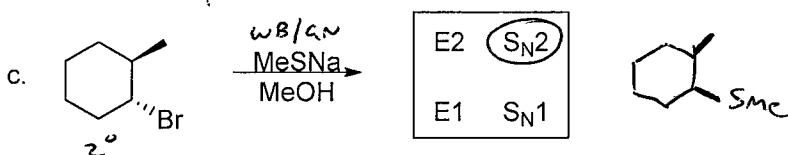
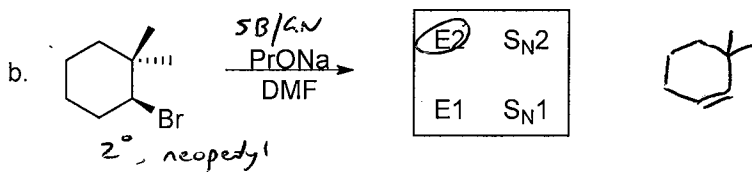
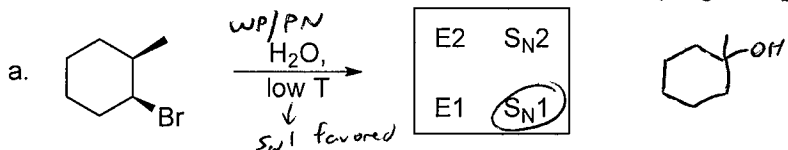
d. Starting with the more stable conformation of this molecule, draw the mechanism and product for this reaction. (10 pts)



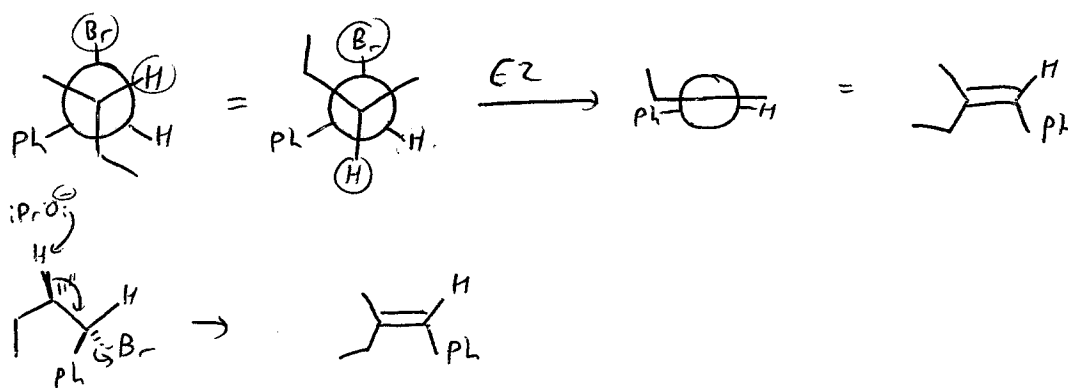
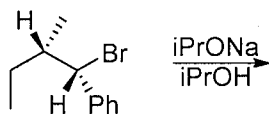
e. Explain in under ~~twenty~~ ^{thirty} words why this is the only product formed. (5 pts)

The $-CH_2OH$ group is locked into an axial position by the t -Butyl's preference for equatorial position, so it must attack from under the ring.

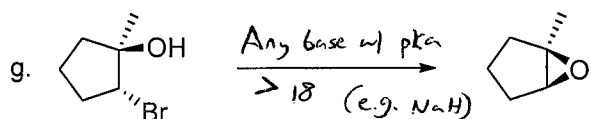
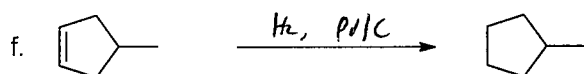
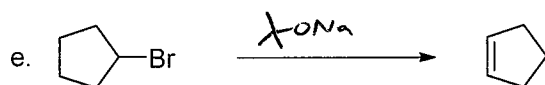
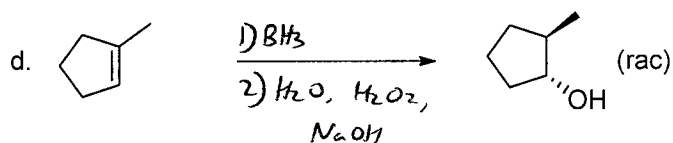
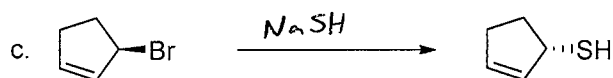
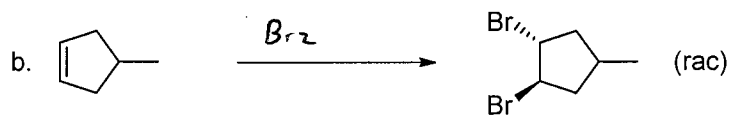
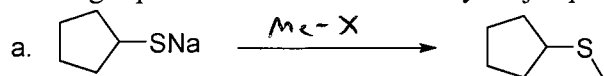
- 4) For each of the reactions shown below, **circle the mechanism(s)** you would expect to see, if any, and **draw the product(s)**. If a product has stereocenters, show its configuration using wedges and dashes. If two stereoisomers are formed, show both of them. If an elimination occurs, show only the major alkene product. If none of the mechanisms would take place in a reasonable time frame, write NR for No Reaction. (16 pts; 4 pts each)



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



6) On each arrow, show the reagents needed to accomplish each reaction. In each case, the target product should be the only major product of the reaction. (21 pts – 3 pts each)



7) Extra credit! One of these reactions gives two possible products, and the other gives only one. Which is which? Explain why in under twenty words. (10 pts e.c.)

