If you encounter any technical problems during the entire exam period, Zoom Danny Huang at https://berkeley.zoom.us/j/8716114511
Label the final pdf file with your name and the words "3AExam2" (namely: Last Name, First Name, 3AExam2) and upload it to Gradescope.

To complete this page in AcrobatPro, click on "Comments" and use the "Text" function.

EXAMINATION 2
Chemistry 3A

Name:_____ **SID #:_____**
Print first name before second! ***Make sure the number is correct!***
Use capital letters!

GSI (if you are taking Chem 3AL): _____

Peter Vollhardt
April 10, 2021

Please provide the following information if applicable.

Making up an I Grade _____
If you are, please indicate the semester during which you took previous Chem 3A and the instructor:

_____ _____
Semester Instructor

Auditor _____

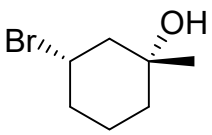
This test should have **14** numbered pages. A good piece of advice: **Read carefully over the questions (at least twice); make sure that you understand exactly what is being asked; avoid sloppy entries. *Good Luck*!**

To answer the questions in AcrobatPro, click on "Comments" and use the "Add Text" or "Draw" functions, as applicable. For the latter, you will only need the "Line", "Rectangle", and "Oval" options.

Please write the answer you wish to be graded in the boxed spaces provided.

I. [30 Points] Name (complete the drawing, or choose one given answer, as appropriate) the following molecules according to the IUPAC rules.

a.



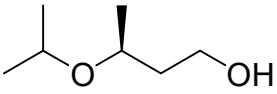
This enantiomer

b.

3,3-Bis[(methylthio)methyl]cyclobutane-1-thiol

1 2

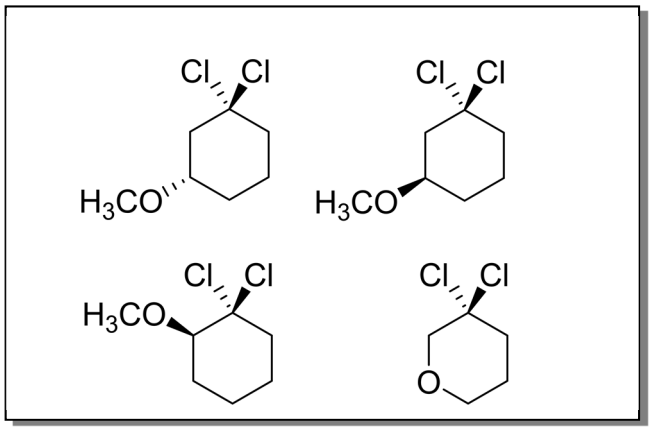
c.



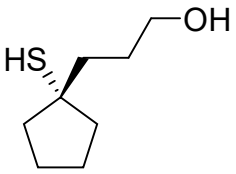
This enantiomer

d.

(*R*)-1,1-Dichloro-3-methoxycyclohexane

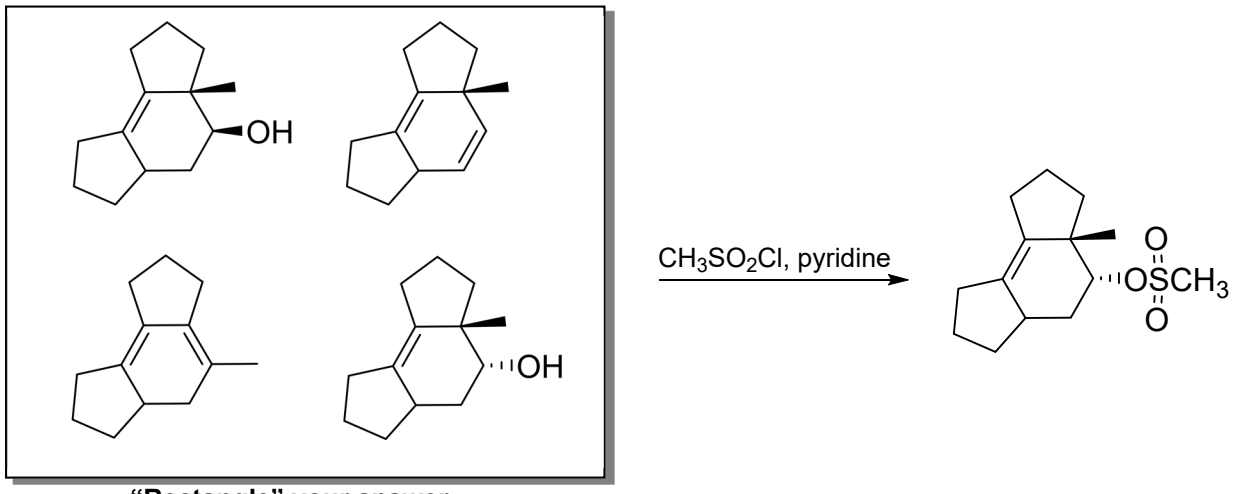


e.



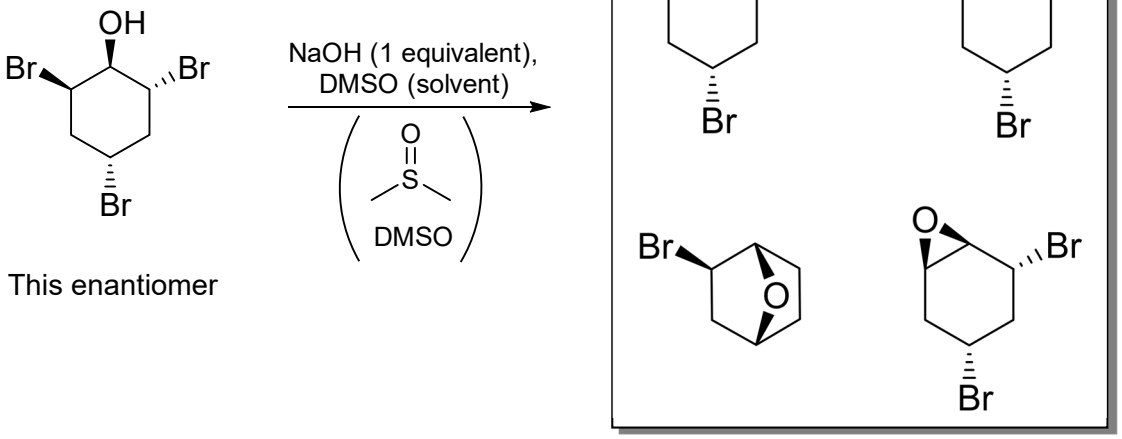
II. [80 Points] Add or identify the missing starting materials, reagents, or products (aqueous work-up is assumed where necessary). **Caution:** Do not forget to consider ***stereochemistry***!

a.



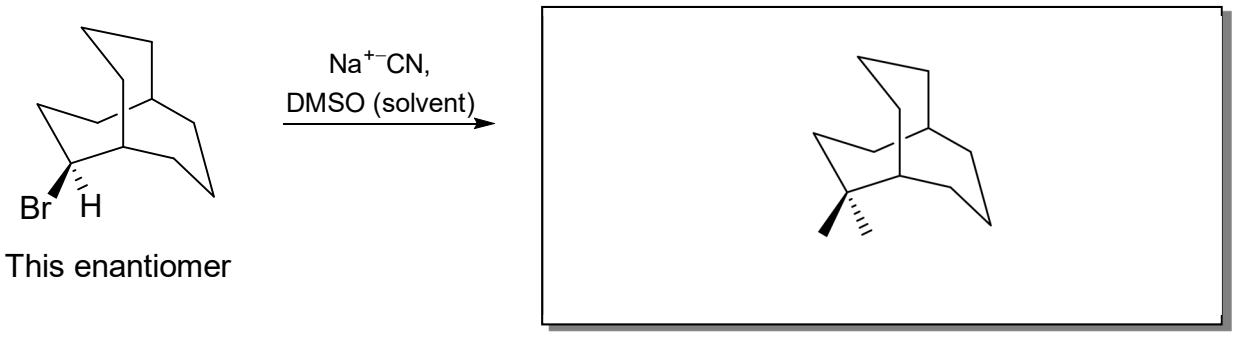
"Rectangle" your answer

b.



"Rectangle" your answer

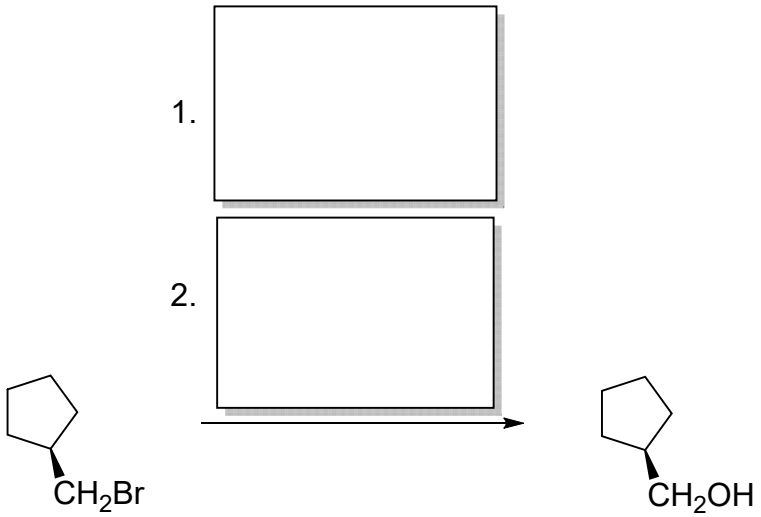
c.



Place the missing substituents at the end of the dashed/wedged dangling bonds

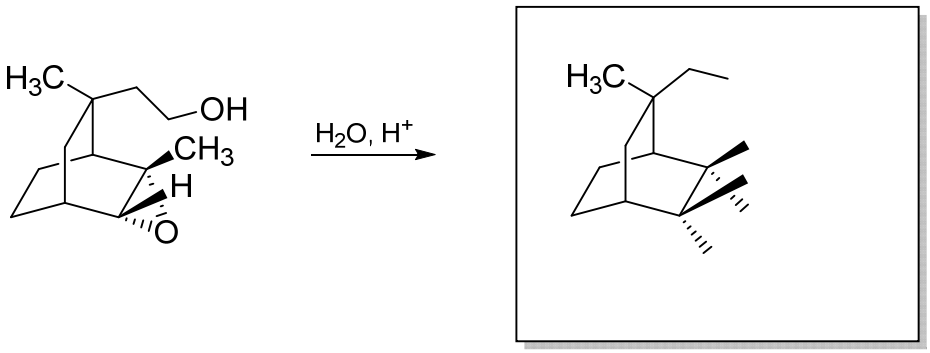
"Oval" your choice of an answer: Is the product optically active? Yes No

d.



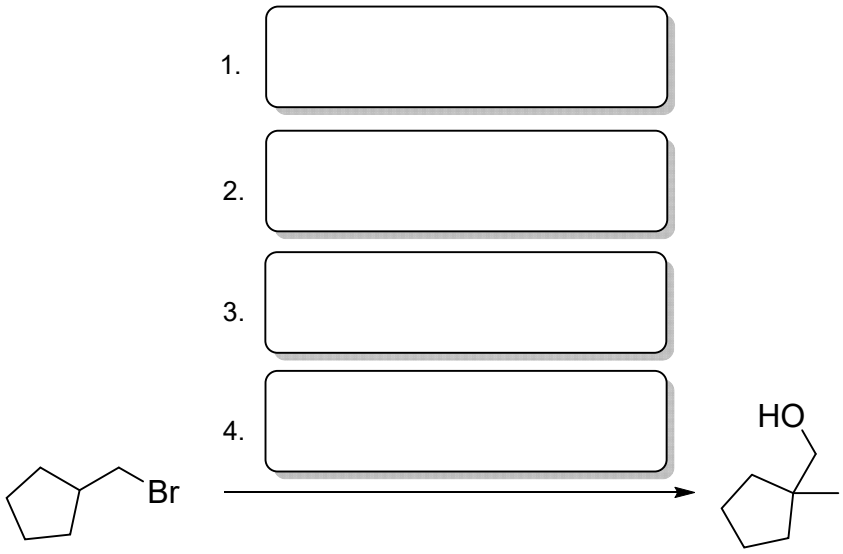
Type your answers in the respective boxes using the "Text" tool. Ignore super- and subscripts if applicable [as in, for example, tert-butyl cation = (CH3)3C+]

e.



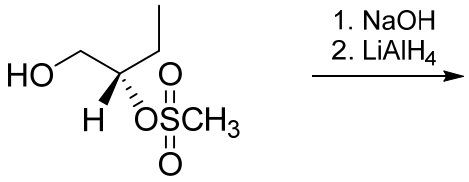
Complete the structure by adding bonds ("Line" tool) and atoms ("Text" tool) as appropriate

f.

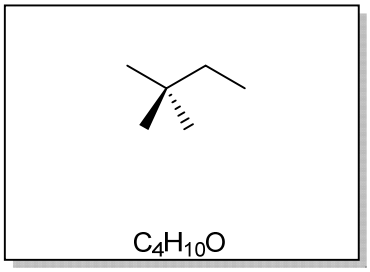


Type your answers in the respective boxes using the "Text" tool. Ignore super- and subscripts [as in, for example, tert-butyl cation = (CH3)3C+].

g.



This enantiomer



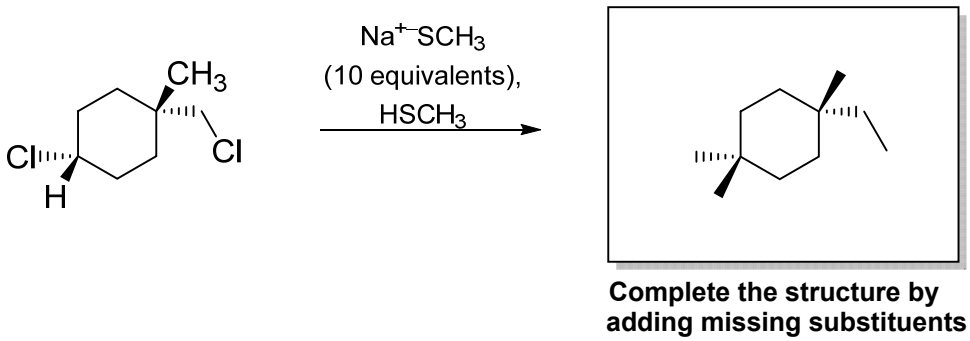
Complete the structure by adding missing substituents

"Oval" your choice of an answer:

Is the product chiral? Yes No

Is the product optically active? Yes No

h.



“Oval” your choice of an answer:

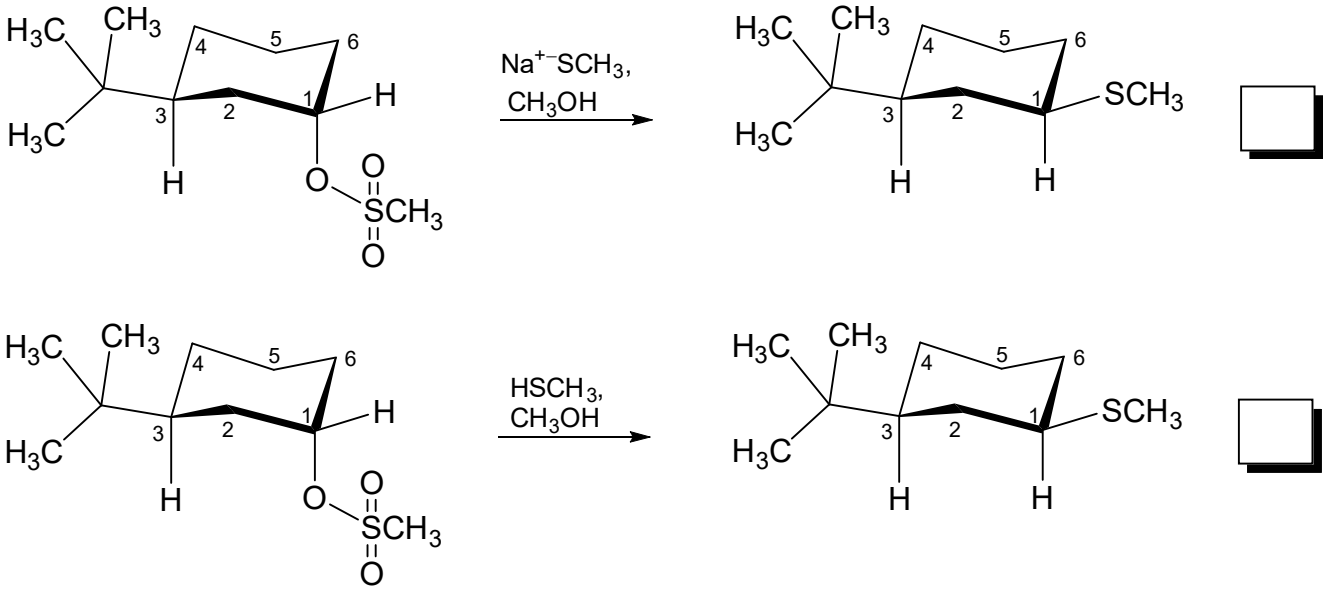
Is the product chiral? Yes No

Is the product optically active? Yes No

III. [40 Points] For each pair of reactions shown below, mark the box on the right with an "X" indicating which will go faster and “rectangle” the mechanism by which it proceeds (e.g. S_N2, S_N1, E2, E1). In one sentence, provide a brief explanation for the rate acceleration in each case in the bottom box provided.

a.

1.

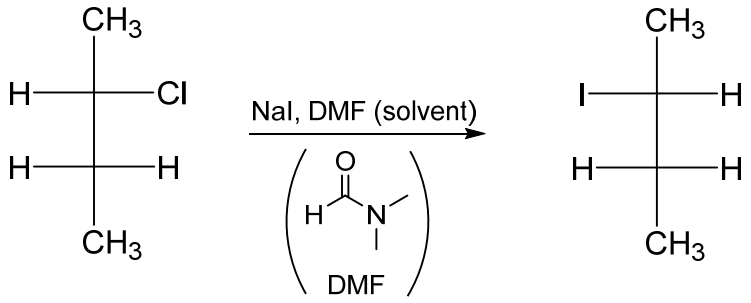


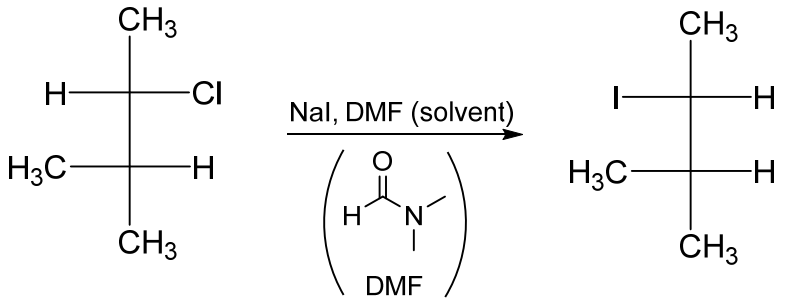
2. Mechanism: S_N2 S_N1 E2 E1

3. Explain your choice of the faster reaction in one sentence.

b.

1.



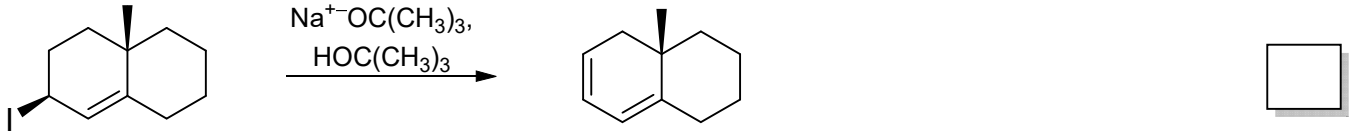


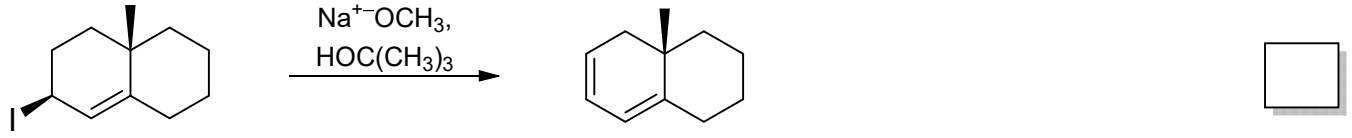
2. Mechanism: S_N2 S_N1 E2 E1

3. Explain your choice of the faster reaction in one sentence.

c.

1.



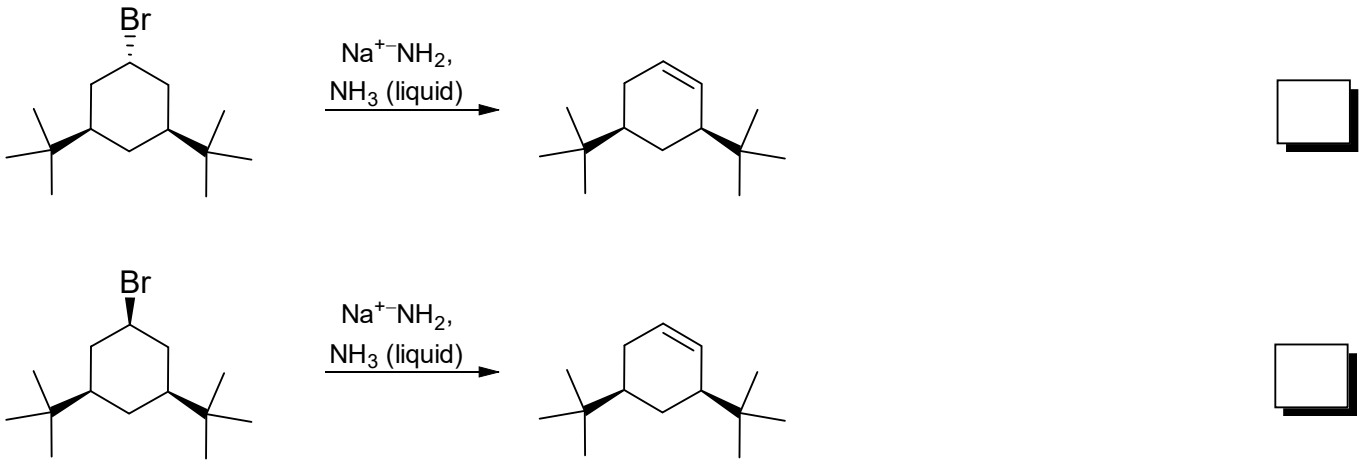


2. Mechanism: S_N2 S_N1 E2 E1

3. Explain your choice of the faster reaction in one sentence.

d.

1. **Hint:** Draw the most stable chair conformations for the respective starting bromides.



2. Mechanism: S_N2 S_N1 E2 E1

3. Explain your choice of the faster reaction in one sentence.

IV. [20 Points]

a. Place an ***X mark*** ("Text" tool) in the box preceding a true statement. There will be several such statements. Leave blank those that you deem untrue. Note: An incorrect X mark will count against your total score, but the minimum is zero (i.e., no negative points).

☐ Along the radical series–primary to secondary to tertiary–hyperconjugation decreases.

☐ Hybridization of an atom is advantageous when it increases overlap to attached other atoms and minimizes electron repulsion.

☐ The number of stereoisomers in a compound with two stereocenters is always four.

☐ Leaving group ability increases along the series HO^-, $CH_3\overset{\overset{O}{\|}}{C}O^-$, $CH_3SO_3^-$, because the oxygen accommodates the negative charge increasingly better.

☐ The rate of the reaction A + B → C + D is always proportional to the concentrations of both A and B.

☐ In R/S nomenclature, the 1-methylethyl substituent has higher priority than ethyl.

☐ Nucleophilicity of charged nucleophiles in protic solvents increases down the periodic table.

☐ The chair conformation of cyclohexane is more stable than the boat form, because it minimizes eclipsing and transannular strain.

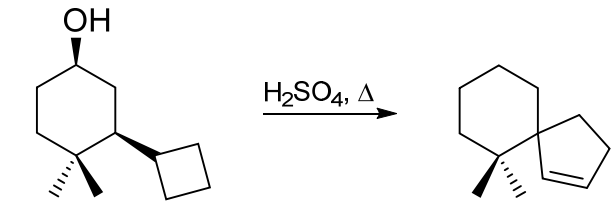
☐ The S_N1 reaction is generally faster than the S_N2 reaction.

☐ The conversion of alcohols to chloroalkanes using PCl_3 requires only catalytic amounts of PCl_3.

The following four problems should be answered on four separate pages of hard copy white paper using a dark (at least #2) pencil. Label these pages "V.a", "V.b", "VI.a", and "VI.b". Ascertain that your drawings are clearly visible. When you are finished, scan the four pages on your device with a suitable scanning app (do not use CamScanner) in the order V.a →VI.b, save the document as a pdf file, and add its contents to this file, using the "Combine Files" feature on AcrobatPro. Make sure to set up the correct order of the two; the combined file should feature your scanned pages at the end.
Label the final combined pdf file with your name and the words "Exam 2" (namely: **Last Name, First Name, Exam 2) and upload it to Gradescope.**

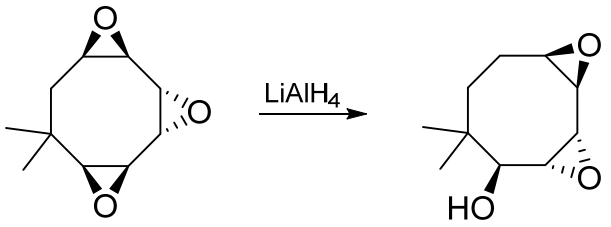
V. [40] Points]
For each of the following reactions, provide a detailed mechanism (i.e., write a scheme with structures, arrow pushing, etc.) Do **not** *add* any reagents! These are **not** synthesis problems!

a.



This enantiomer Racemate

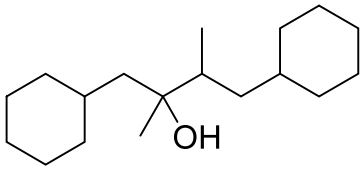
b.



This enantiomer This enantiomer
(after aqueous work-up)

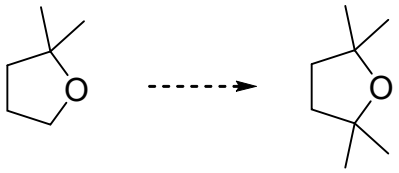
VI. [40 Points]

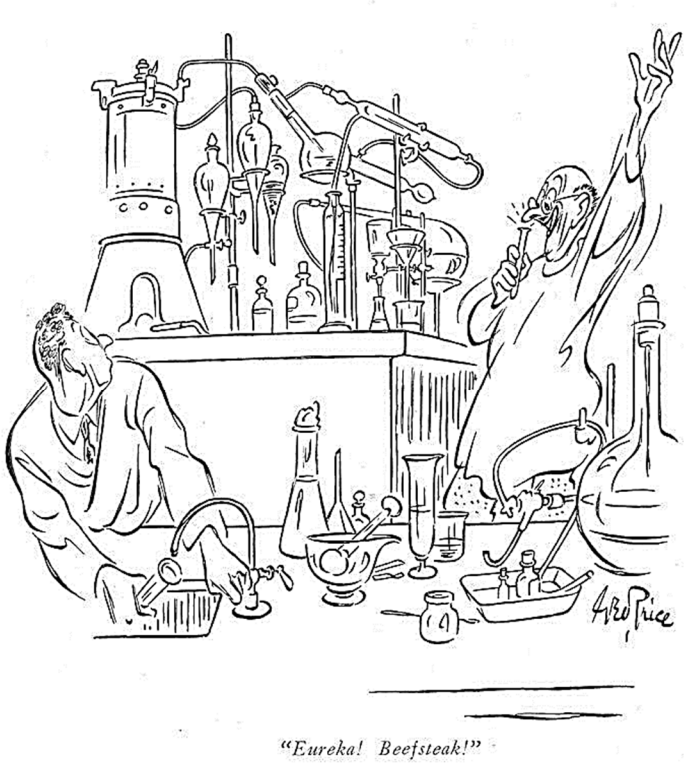
a. Devise the synthesis of compound **A** below, *starting from* ***cyclohexane*** and using additional building blocks containing four carbons or less as the only carbon sources. It will help you if you execute a retrosynthesis on a separate page (not to be submitted).



A
(mixture of diastereomers)

b. Provide a viable conversion of the starting material below to the product. You may use any additional compounds and reagents. It will help you if you execute a retrosynthesis on a separate page (not to be submitted).





"Eureka! Beefsteak!"

♫ The End ♫