EXAMINATION 2
Chemistry 3A

Name:_____ **SID #:_____**

Print first name before second!
Use capital letters!

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

Peter Vollhardt
April 11, 2017

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 _____

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

Do scratch work on the back of the pages. This test should have **13** numbered pages. Check to make sure that you have received a complete exam. 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 structures or phrases. It is better to be pedantic in accuracy now than sorry later!** ***Good Luck*****!**

You will not really need it, but here is a partial periodic table.

TABLE 1-1 Partial Periodic Table

Period							Halogens	Noble gases
First	H^{1}							He^{2}
Second	$Li^{2,1}$	$Be^{2,2}$	$B^{2,3}$	$C^{2,4}$	$N^{2,5}$	$O^{2,6}$	$F^{2,7}$	$Ne^{2,8}$
Third	$Na^{2,8,1}$	$Mg^{2,8,2}$	$Al^{2,8,3}$	$Si^{2,8,4}$	$P^{2,8,5}$	$S^{2,8,6}$	$Cl^{2,8,7}$	$Ar^{2,8,8}$
Fourth	$K^{2,8,8,1}$						$Br^{2,8,18,7}$	$Kr^{2,8,18,8}$
Fifth							$I^{2,8,18,18,7}$	$Xe^{2,8,18,18,8}$

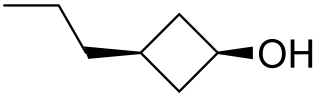
Note: The superscripts indicate the number of electrons in each principal shell of the atom.

I. [30 Points] Name or draw, as appropriate, the following molecules according to the IUPAC rules. Indicate stereochemistry where necessary (*cis*, *trans*, *R*, *S*, or dashed/wedged lines).

a.

(*R*)-4-Methyl-2-pentanol

b.



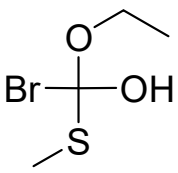
c.

2-Methoxy-2-propyl-1-pentanethiol

d.

(This enantiomer)

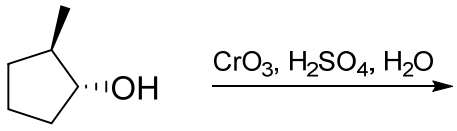
e.



(Fischer projection: this enantiomer)

II. [70 Points] Add the missing starting materials, reagents, or products (aqueous work-up is assumed where necessary). **Caution:** Do not forget ***stereochemistry***!

a.



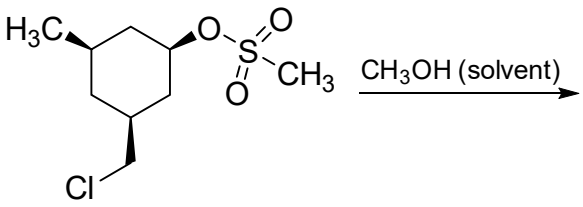
This enantiomer

For the following questions, circle your choice of an answer:

Is the product chiral? Yes No

Is the product optically active? Yes No

b.



Pure enantiomer

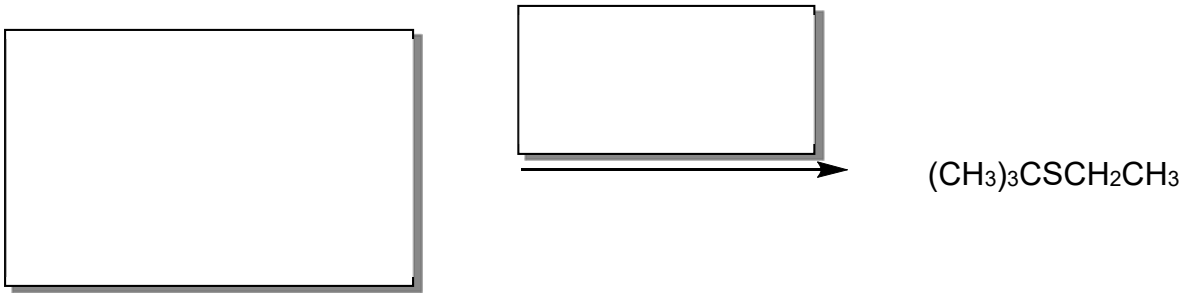
There may be more than one product.

For the following questions, circle your choice of an answer:

Is/are the product(s) chiral? Yes No

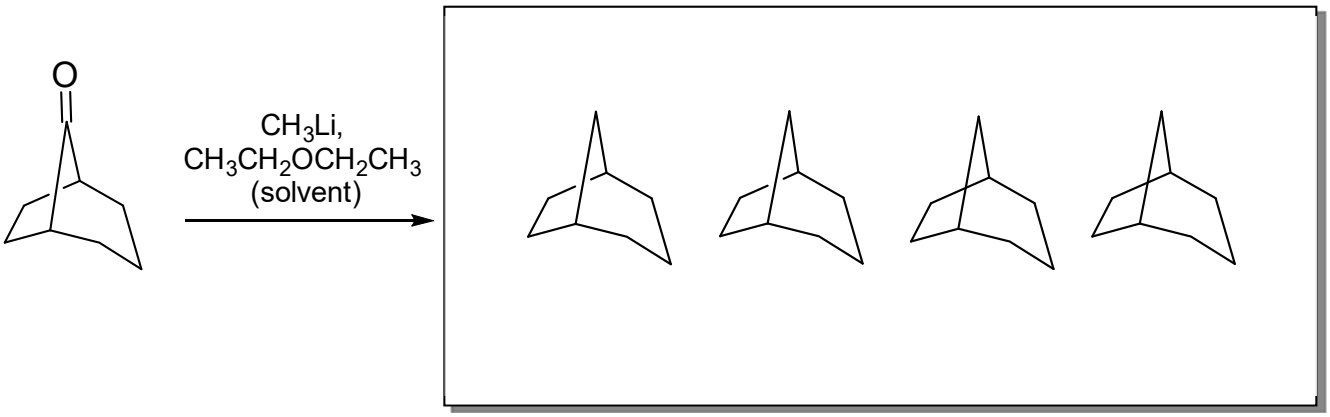
Is/are the product(s) optically active? Yes No

c.



An alcohol $C_4H_{10}O$

d. Complete one or more of the stencils provided.



There may be more than one product.
There are more stencils than you will need.

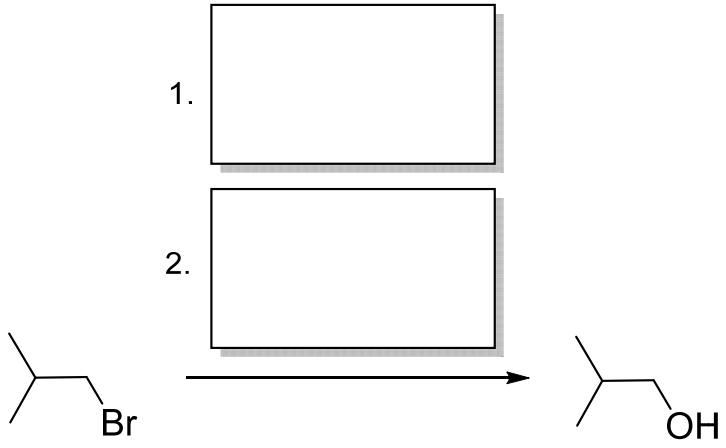
For the following questions, circle your choice of an answer:

Is/are the product(s) chiral? Yes No

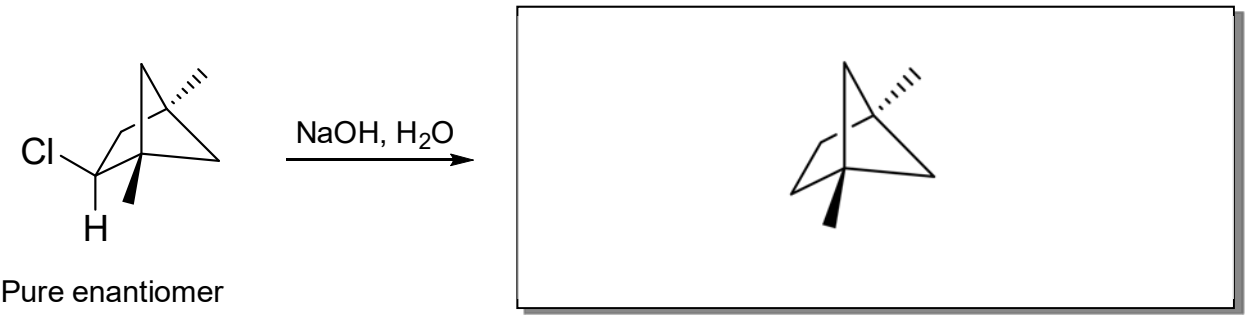
Is/are the product(s) optically active? Yes No

e.

f.



g. Complete the stencil provided.



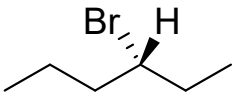
Pure enantiomer

For the following question, circle your choice of an answer:

Is the product optically active? Yes No

III. [40 Points] The following reactions proceed (predominantly) by S_N2, S_N1, E2, or E1 pathways, respectively. Give the major products in each case and answer the questions by ***circling*** the most applicable statement.

a.



Pure enantiomer

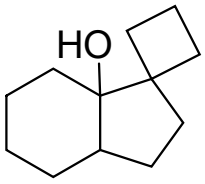
$P(CH_3)_3$ →

Mechanism: S_N2 S_N1 E2 E1

When using $N(CH_3)_3$ instead of $P(CH_3)_3$, which one of the following ratios will increase:

S_N2 / S_N1 S_N1 / E1 E2 / S_N2 S_N2 / E2

b.



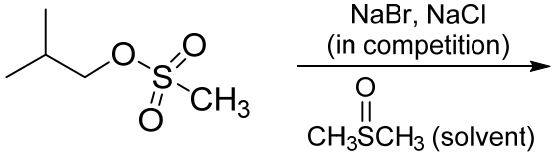
HI, 0°C →

Mechanism: S_N2 S_N1 E2 E1

When using H_2SO_4 instead of HI, which one of the following ratios will increase:

S_N2 / S_N1 E1 / S_N1 E2 / E1 E2 / S_N2

c.



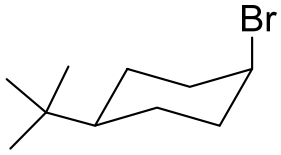
Mechanism: S_N2 S_N1 E2 E1

When changing the solvent to CH_3OH, one of the following changes will occur:

Rate decreases CH_3OH will outcompete NaBr NaBr will outcompete NaCl

The E1 / S_N1 ratio will increase

d. Consider the bromide **A** in methanol at room temperature.



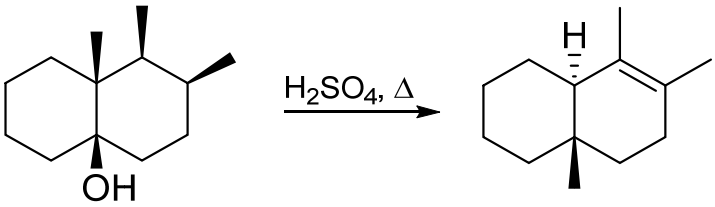
A

Circle your answer to the following statements, in the form of “yes” or “no”.

Addition of NaOH will cause E2 to take place.	Yes	No
Addition of NaI will cause E1 to take place.	Yes	No
Increasing the temperature will increase its rate of disappearance.	Yes	No
Adding acetone will increase the S_N1 / E1 ratio.	Yes	No

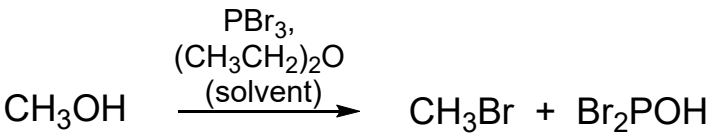
IV. [40] Points] Explain the following observations (on this and the next page) by a detailed mechanism (i.e., write a scheme with structures, arrow pushing, etc.)

a.



Work from left to right in the following spaces. There is much more space than you will need.

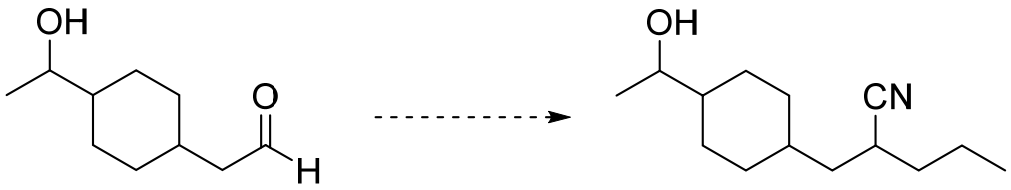
b.



Work from left to right in the following spaces. There is much more space than you will need.

V. [50 Points] Provide a viable conversion of starting materials on this and the next page to the respective products. You may use any additional organic or inorganic compounds in your scheme. It will help you if you execute a retrosynthesis on the back of the preceding page (on your left).

a.



Do not worry about stereochemistry.

Work from left to right in the following spaces. There is much more space than you will need.

b.

This enantiomer This enantiomer

Work from left to right in the following spaces. There is much more space than you will need. It will help you if you execute a retrosynthesis on the back of the preceding page (on your left).

VI. [20 Points]

a. In each pair of nucleophiles shown below, circle the stronger one (in H_2O).

CH_3CH_2OH	CH_3CH_2SH
PH_3	NH_3
$^{+}NH_4$	NH_3
$CH_3SO_3^-$	HO^-
CH_3COO^-	$CH_3CH_2O^-$

b. Place an ***X mark*** in the box preceding the most accurate statement. Only <u>one</u> answer is allowed.

The nucleophilicity of the anions F^-, Cl^-, Br^-, and I^- in CH_3OH increases along the series, because

☐ the atoms get heavier

☐ their electronegativity increases

☐ the atoms are increasing less solvated

☐ the atoms are increasing less polarizable

On $NaBH_4$ reduction, a chiral racemic ketone cannot give

☐ a chiral alcohol

☐ an optically active alcohol

☐ a meso compound

☐ diastereomers

Along the series CH_4, NH_3, OH_2, FH,

- ☐ bond strengths increase
- ☐ acidity decreases
- ☐ electronegativity decreases
- ☐ basicity increases

"Of course the elements are earth, water, fire and air. But what about chromium? Surely you can't ignore chromium."

* The End *