Easily Legible Printed Name:______________________________

CHEM 3451, Spring 2018
Professor Walba
Second Hour Exam
March 13, 2018

scores:

1)

2)

3)

4)

5)

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CU Honor Code Pledge: On my honor, as a University of Colorado at Boulder Student, I have neither given nor received unauthorized assistance.

Signature: ____

Recitation TA Name: ______________________________

Recitation day and time: ____________________________

This is a closed-book exam. The use of notes, calculators, scratch paper, or cell phones will not be allowed during the exam. You may use models brought in a clear Ziploc bag. Please put all your answers on the test in the appropriate place. Use the backs of the pages for scratch (there are two additional blank scratch sheets after the last page of the exam). DO NOT PUT ANSWERS ON THE SCRATCH SHEETS.

PLEASE read the questions very carefully!

Partial Periodic Table

1A	2A	3A	4A	5A	6A	7A	8A
1 H							2 He
3 Li	4 Be	5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
						35 Br	
						53 I	

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1) (20 pts) a) Draw the structure of methyl cation (CH_3^+) with the plane containing all the atoms perpendicular to the page (use wedges and dashes to indicate bonds going back, or coming out of the page). On your structure indicate bonds by overlapping orbitals (spheres or "tear-drop" shaped orbitals), and **include the non-bonding valence orbital (or orbitals)** in your structure using the standard simplified graphical formalism for the orbitals (e.g. an S orbital would be a sphere, and a P orbital would be a "dumbbell," etc.). Indicate the names of the orbitals on the carbon.

b) Draw the structure of ethylene (CH_2=CH_2), oriented such that the plane containing all the atoms is perpendicular to the plane of the page. Show and label the valence orbitals and bonds involved as you did for CH_3^+.

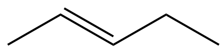
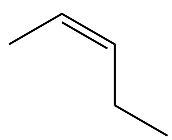
c) Give the hybridization of carbon for the methyl cation and for the two carbons of ethylene.

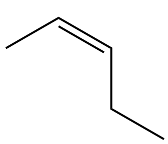
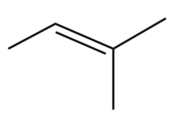
 Total points for this page:

1 - continued

d) Show an "arrow-pushing mechanism" for the addition of HBr to ethylene starting with your ethylene structure (with orbitals) from Q1b (re-drawn below). Note that this is NOT a standard arrow-pushing mechanism. We don't show orbitals in a standard arrow-pushing mechanism, but you can use arrows to show what the electrons in the orbitals are doing in the reaction of HBr with ethylene.

e) For the two pairs of alkenes given below, circle the **more stable** alkene, and **give a very brief explanation for your answer**.

i  

ii  

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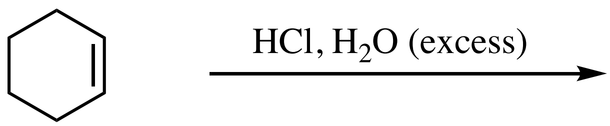
2) (20 pts) Give the single major product (or two major products if two are) for each of the following reactions, carefully showing stereochemistry using wedges and dashes if appropriate. If a racemate is formed, show only one enantiomer and label it "rac." Assume chiral starting materials are single pure enantiomers unless they are labeled "rac."

a)

b)



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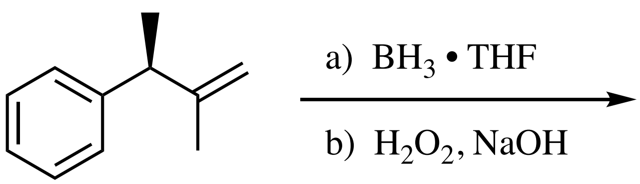
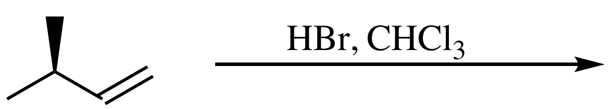


d)



e)

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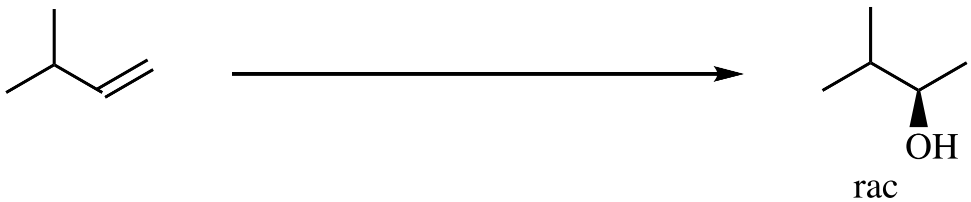
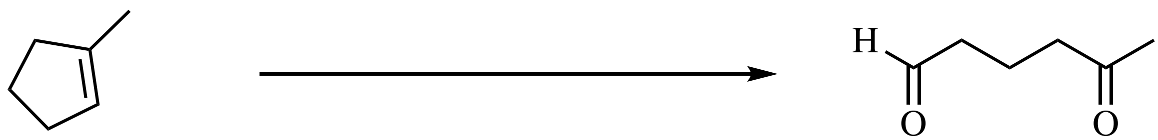
3) (20 pts) (25 pts) Propose reagents for accomplishing each of the following transformations. For reactions involving sequential addition of reagents, label the two steps using letters. Make your synthesis efficient (i.e. the target product should be the major product). Assume chiral starting materials and products are single pure enantiomers unless they are labeled "rac."

a)



b)



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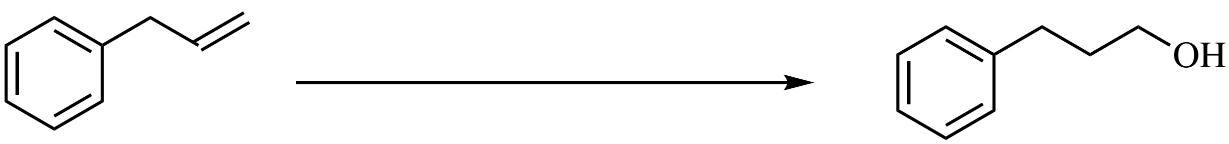

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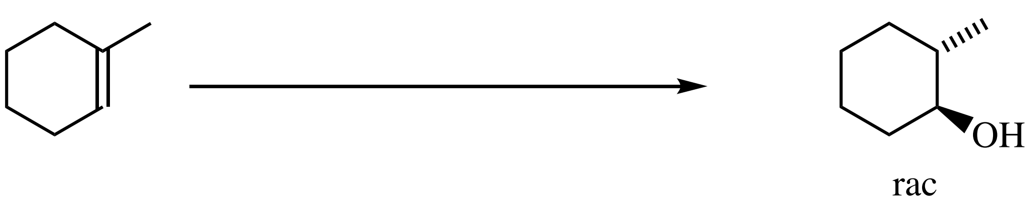

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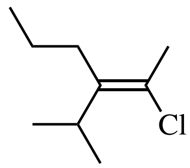
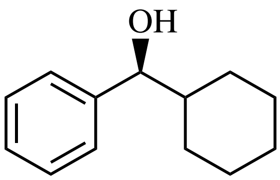
4) (20 pts)

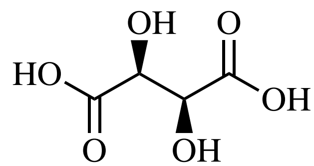
a) Label the stereochemistry of this alkene using the E/Z convention.

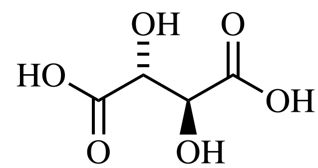


Z

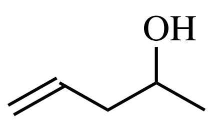
b) For each of the following structures, label the stereochemistry of the stereocenters using the R/S convention. If a molecule has multiple stereocenters, be sure to clearly label each stereocenter. AND, circle the circle the molecules below which are chiral.





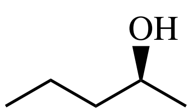


c) Suppose you have isolated compound **1** below from tree bark. You measure the optical rotation of your molecule, and find that in ether solvent, the rotatory power under standard conditions is +10.8°. However, you don't know the absolute configuration of compound **1**, and it's not in the literature**.**



1

However, you find you can purchase optically pure compound **2**, with a standard rotation of +7.39°. The stereochemical structure of compound **2** is known – as indicated in the structure.



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Explain **in the space below (and please, no microscopic writing – the answer should be short)**, how you would determine the stereochemistry of your new compound **1**.

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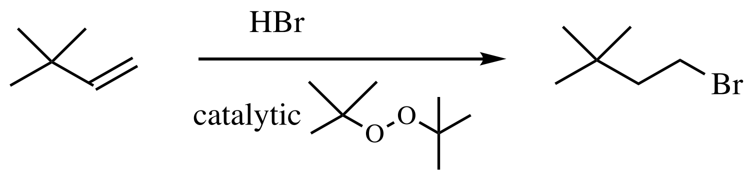
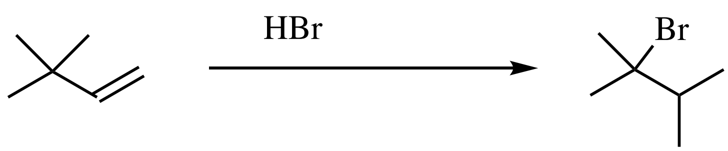
5) (20 pts) Propose an arrow-pushing mechanism for both of the following reactions.

a)



b)



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