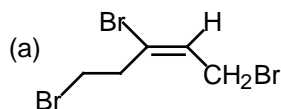


CHEMISTRY 3331
REVIEW EXAM
August, 2009
Dr. Randy Thummel

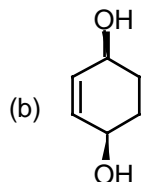
Name ANSWER KEY
S. S. Number 2003-F

Please **read all directions carefully**. Write all answers legibly in the appropriate spaces and **THINK** about what you are doing. Give only **ONE** answer for each question (200 pts total).

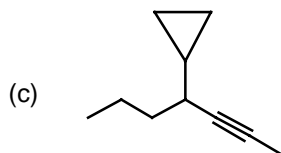
1. (24 pts.) Give a complete and acceptable name for each of the following structures. Indicate the *absolute* stereochemistry *only* for structure 1(h).



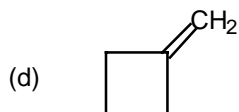
E- 1,3,5- tribromo-2-pentene



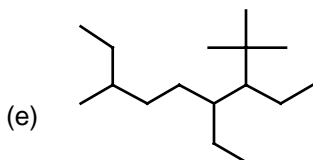
cis- cyclohex - 2- ene- 1,4- diol



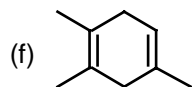
4 - cyclopropyl- 2- heptyne



methylenecyclobutane



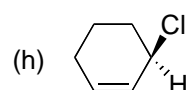
3, 4-diethyl-2,2,7-trimethylnonane



1,2,4-trimethyl-1,4-cyclohexadiene

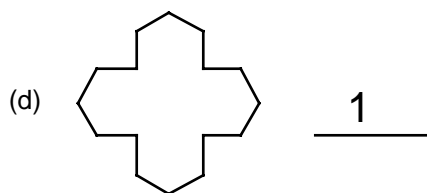
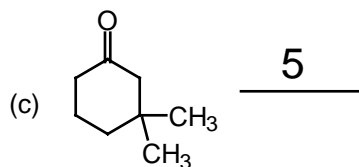
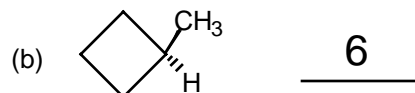
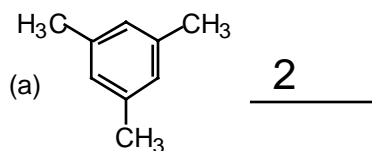


bicyclo [2 .2.0] hexane

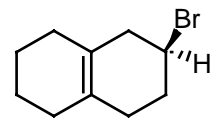
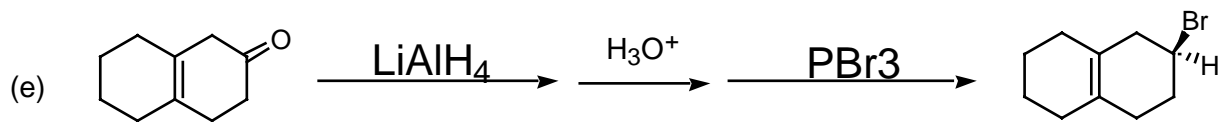
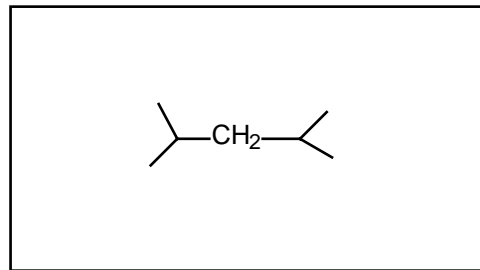
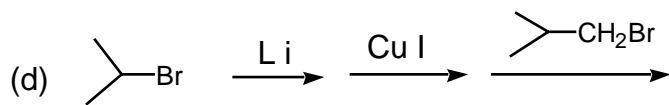
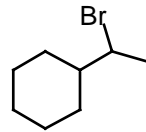
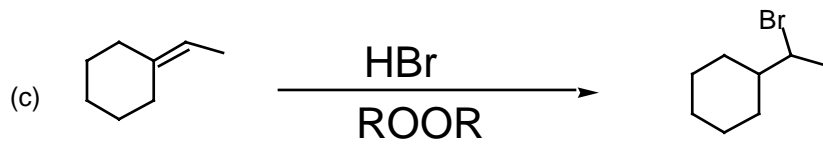
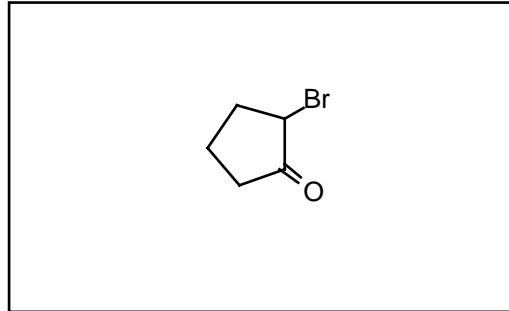
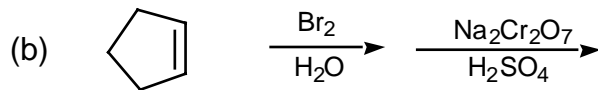
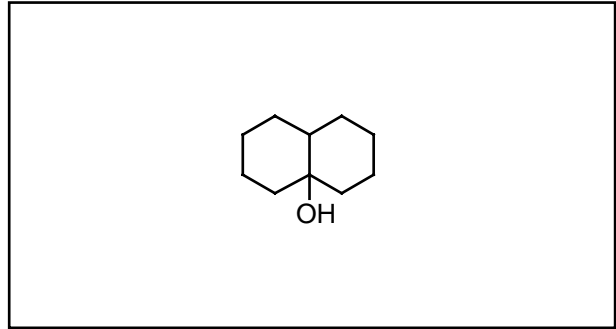
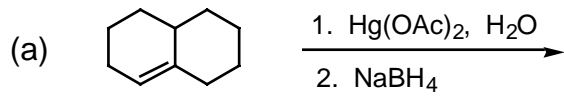


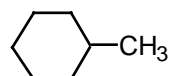
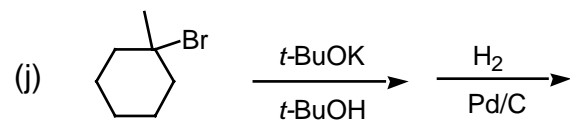
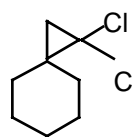
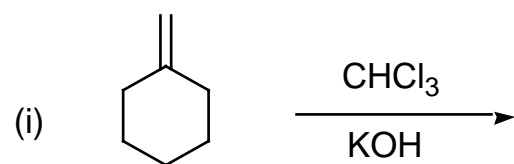
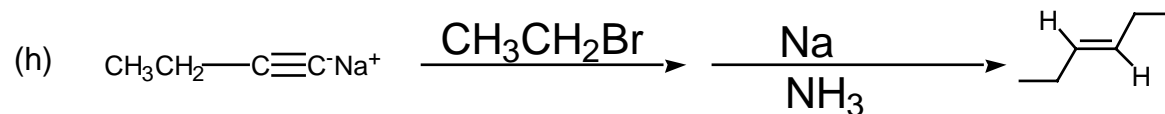
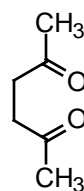
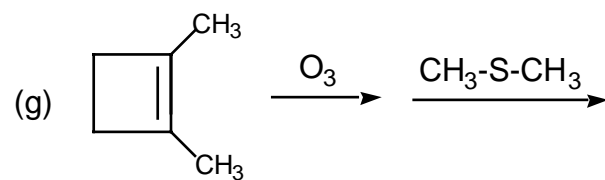
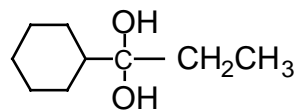
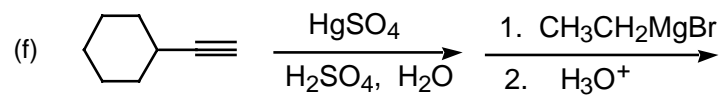
R-3-chlorocyclohexene

2. (8 pts) For each of the molecules shown below, indicate the number of non-equivalent protons (the number of signals you would expect in the proton NMR)

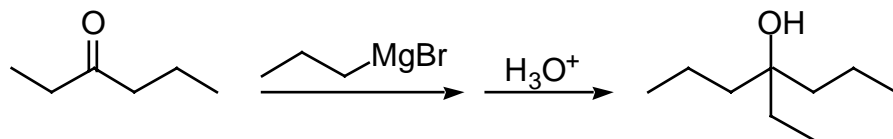
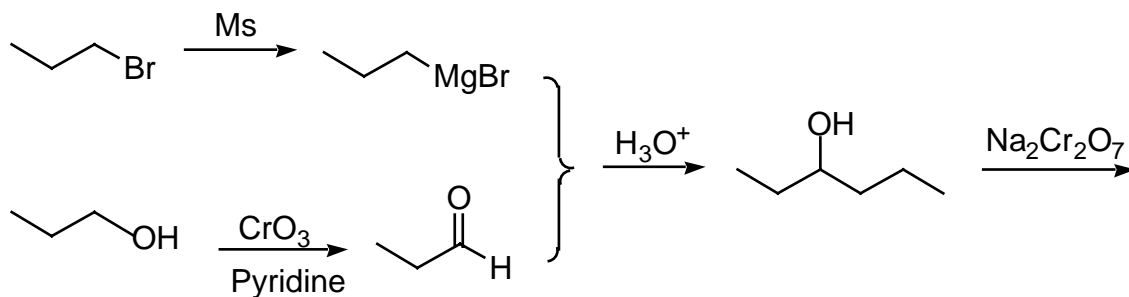
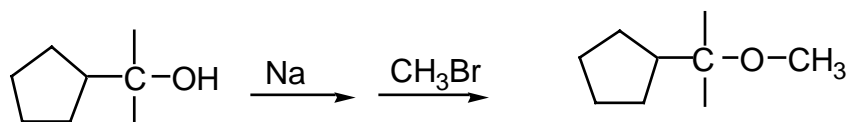
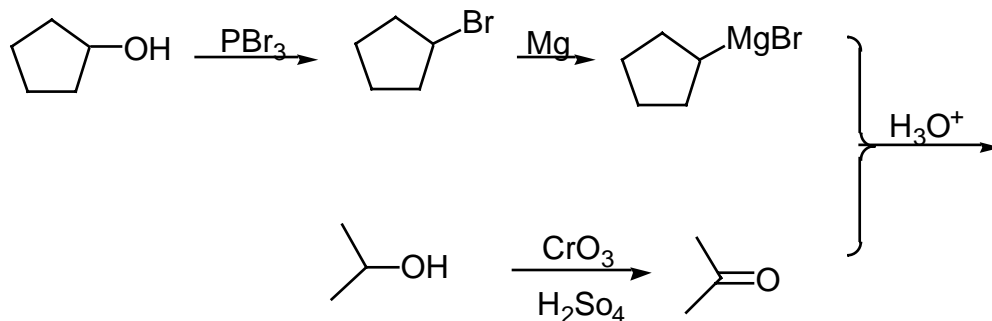
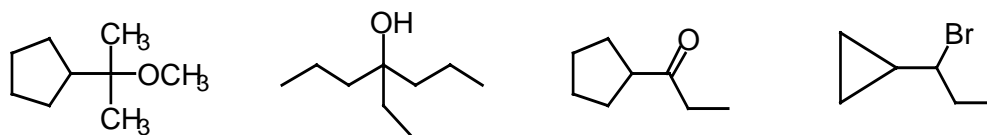


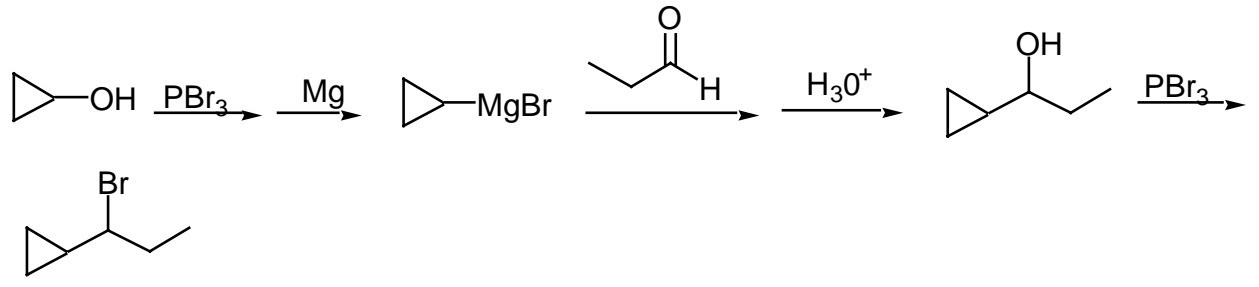
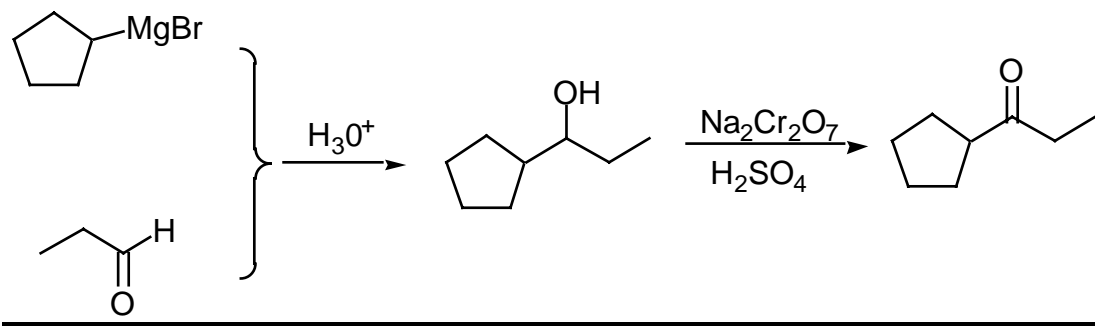
2. (44 pts) For each of the following reactions or series of reactions, draw the structure of the required reagent(s) (over the arrow) or the major organic product (in the box). Be sure to indicate stereochemistry where this is pertinent.



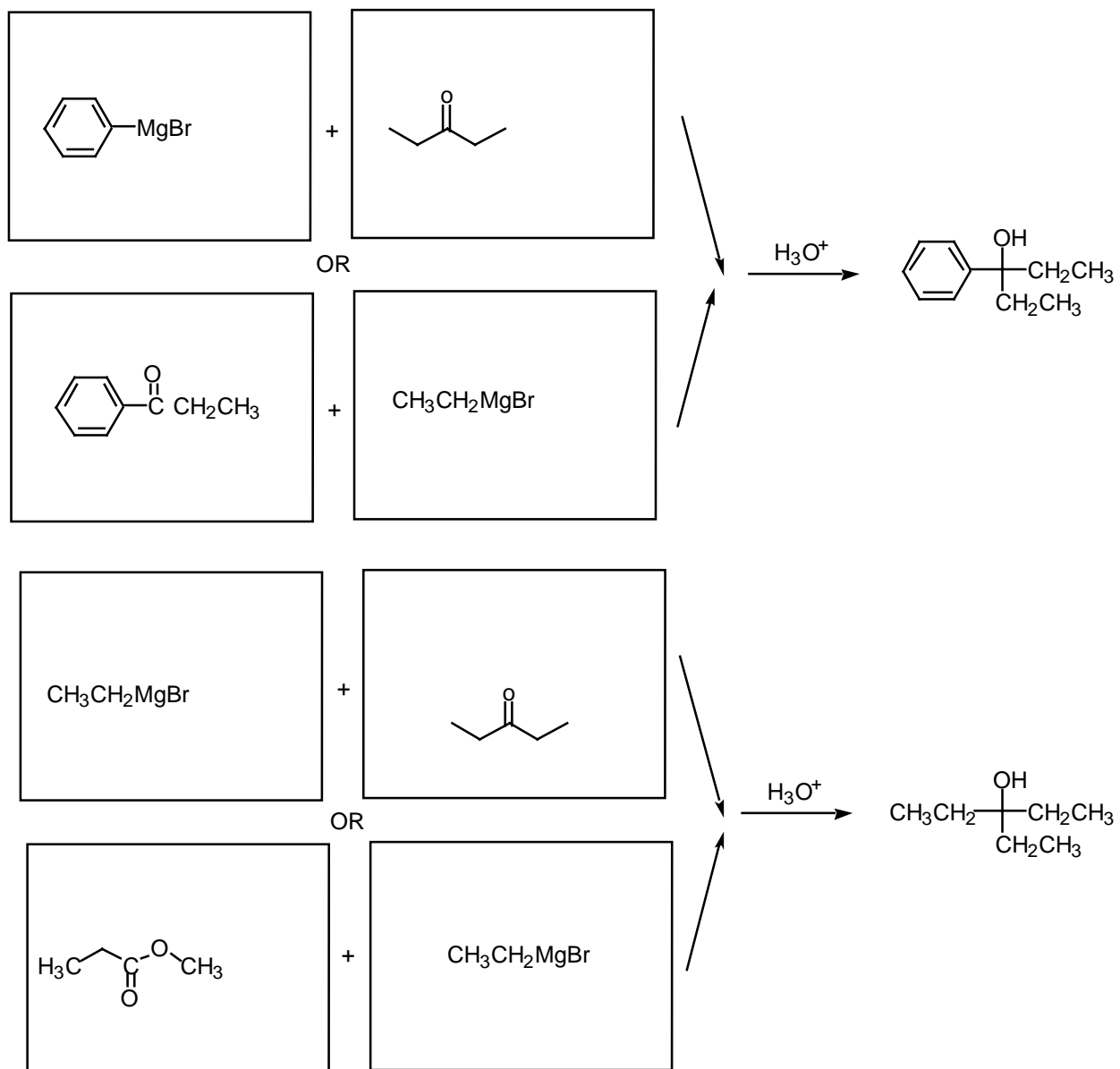


5. (24 pts) Show how you would synthesize **TWO only** of the following four compounds. As starting materials you may use any alcohol of three carbons or less, cyclopentanol, and any necessary solvents and inorganic reagents.

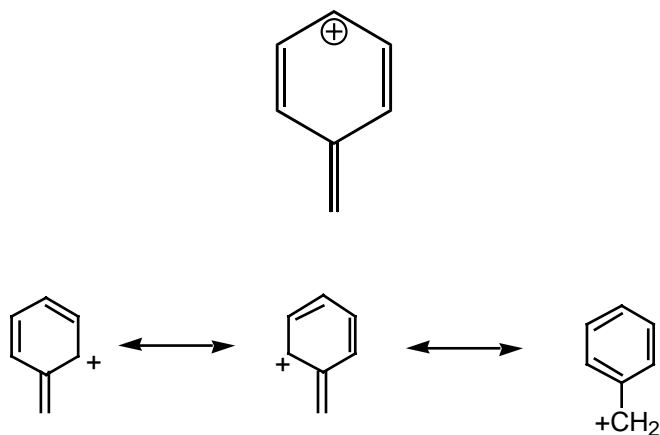




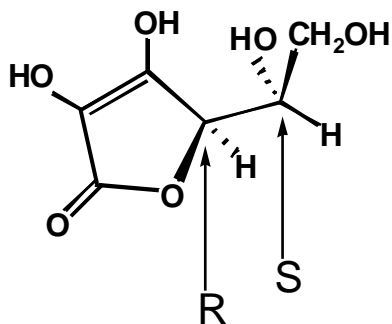
6. (16 pts) The two alcohols shown below can be prepared by Grignard reactions. In the appropriate boxes draw the structure of *two* pairs of molecules which could undergo the Grignard reaction to give these alcohols.



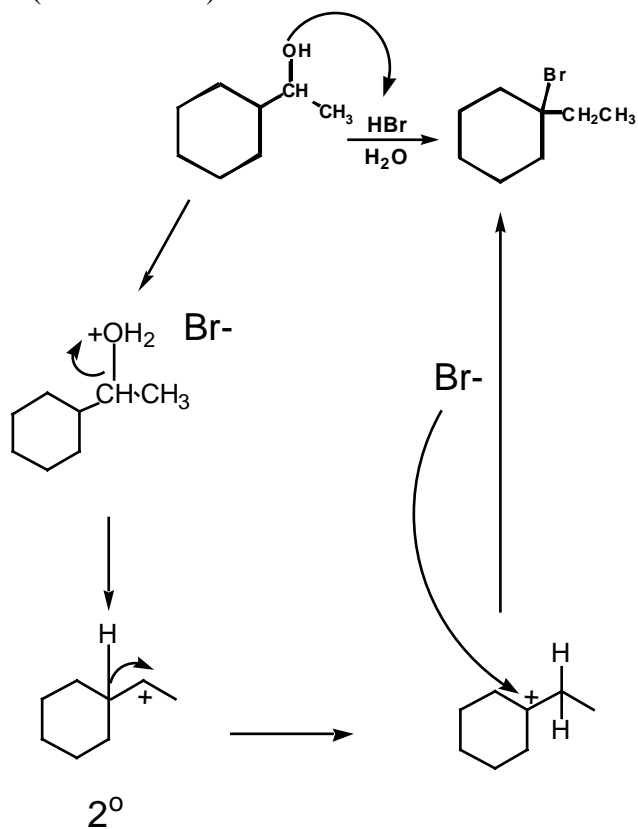
7. (9 pts.) There are three other important resonance structures for the carbocation shown below. Draw them..



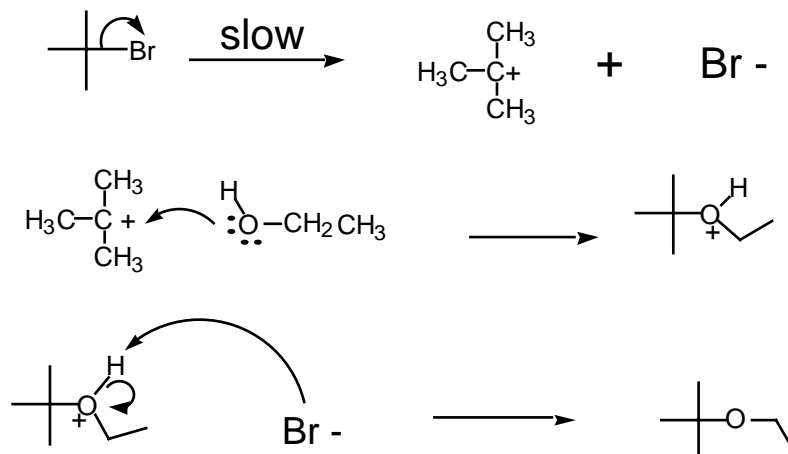
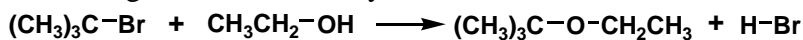
8. (5 pts.) Assign R or S configurations to all chiral centers in ascorbic acid (vitamin C) which is shown below.



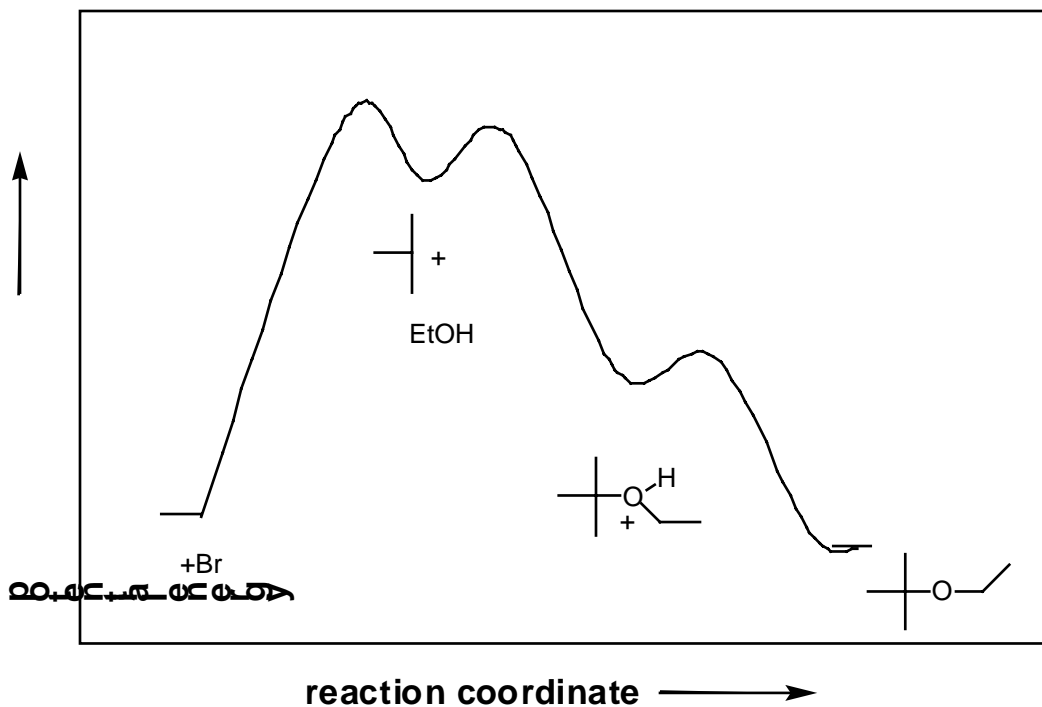
9. (10 pts) When the alcohol shown below is treated with HBr in water a new compound is formed in good yield. Draw out a reaction mechanism to show how it is formed. Show all charges and intermediates, use curved arrows to indicate the flow of electrons and do **not** show transition state structures (dotted bonds).



10. (15 pts.) *t*-Butyl bromide reacts with ethanol to form *t*-butyl ethyl ether. This is an exothermic reaction with three chemical steps associated with the reaction mechanism. Write out each step in the space provided below and draw arrows to show the movement of electrons. Be sure to include formal charges on atoms if they are needed.

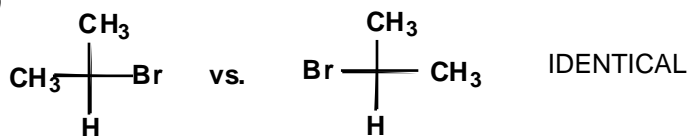


In the box provided below draw out a reaction path (reaction coordinate) versus potential energy diagram. In the drawing be sure to draw out the structure for any intermediates this reaction and pay attention to their relative heights.

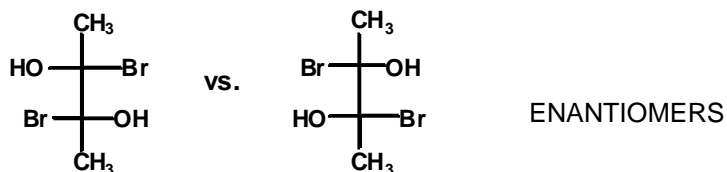


11. (9 pts.) Indicate the relationship between each pair of compounds as either, enantiomers, diastereomers, constitutional (structural) isomers or identical.

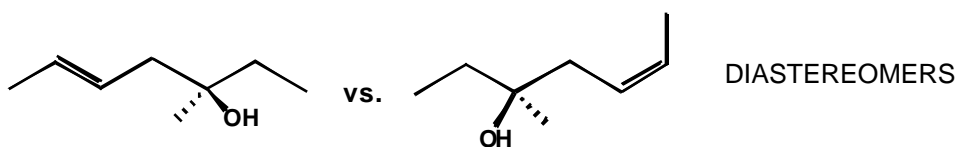
a)



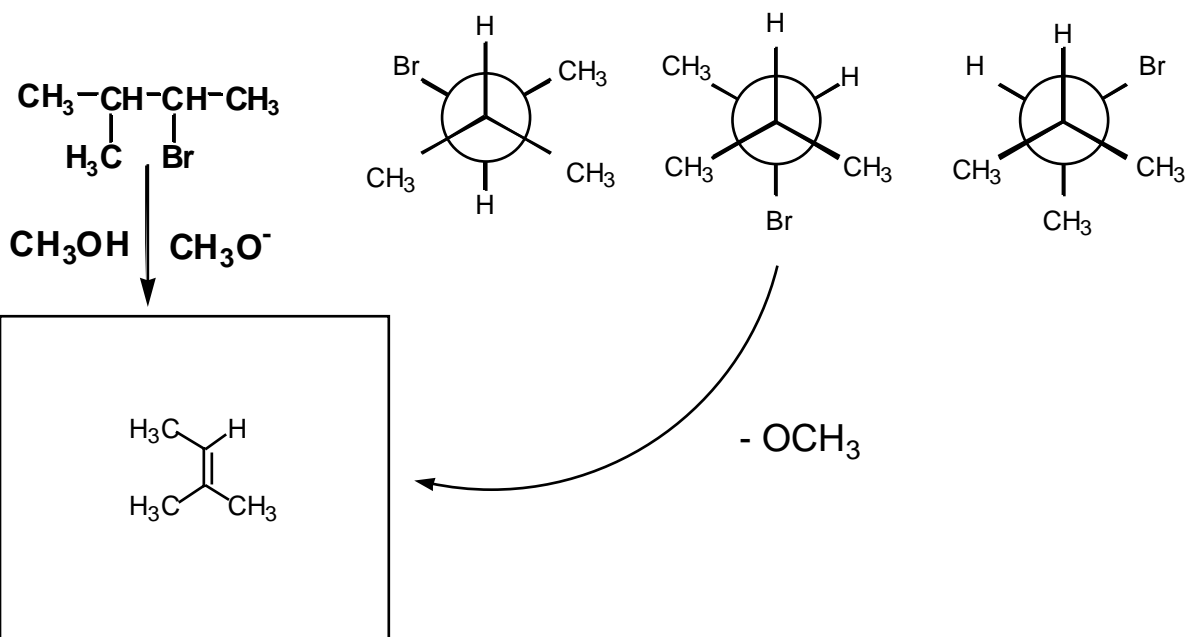
b)



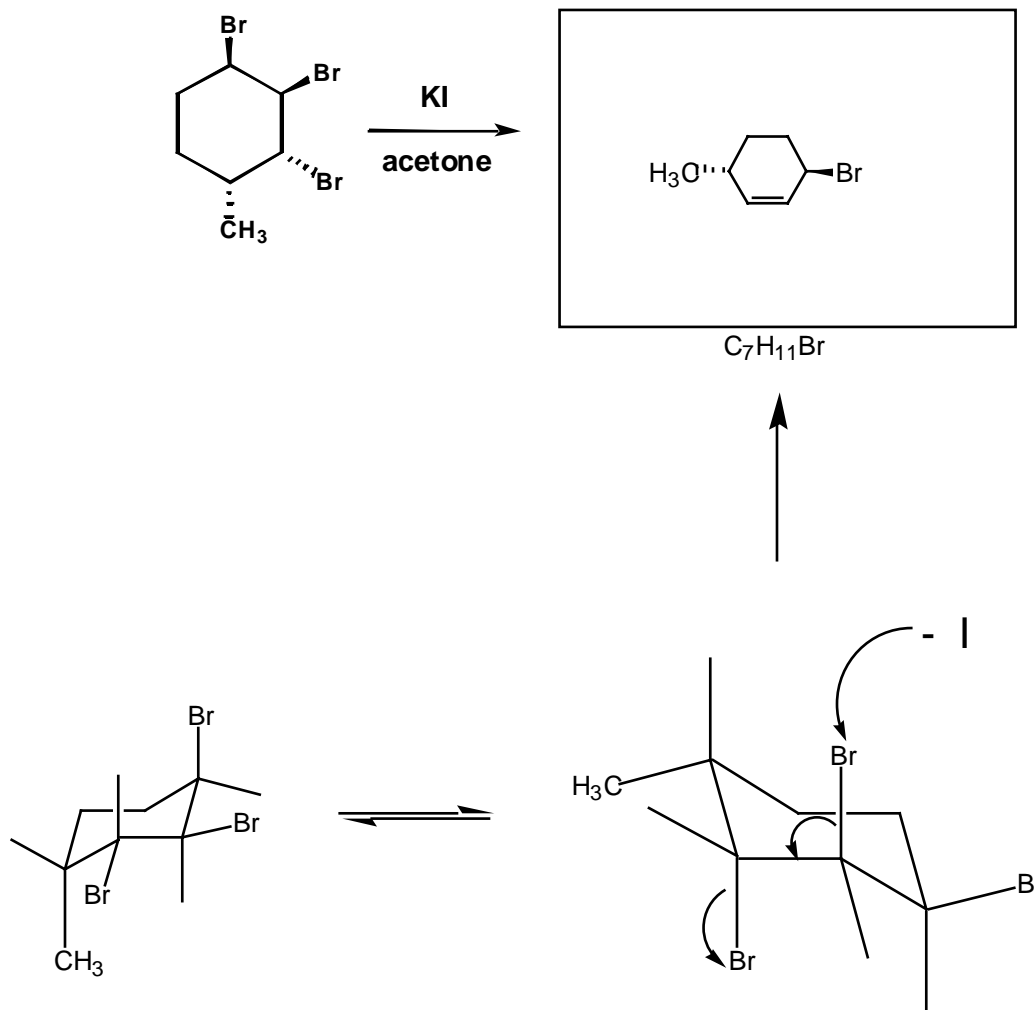
c)



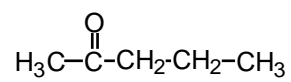
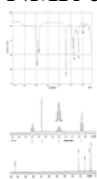
12. (10 pts.) Draw the three rotational isomers for 3-bromo-2-methylbutane looking down the C2-C3 bond using the Newman diagrams on the right. This molecule undergoes elimination cleanly with sodium methoxide in methanol. In the box on the left side draw out the product and indicate the relevant stereochemistry in your drawing.



13. (15 pts.) Draw the **two** chair conformations for the stereoisomer of 1-methyl-2,3,4-tribromocyclohexane shown below. This compound reacts with KI in acetone to produce one product with a molecular formula $C_7H_{11}Br$. Draw it in the box that has been provided and be sure to indicate what stereochemistry exists in the product.

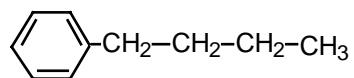
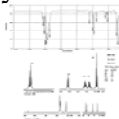


14. (15 pts.) A compound with a formula $C_5H_{10}O$ has the following IR, 1H NMR and ^{13}C NMR spectra. Draw out its structure in the space provided below. Tables of IR, 1H NMR and ^{13}C NMR data are on the last page of this exam.



EXTRA CREDIT (10 pts.) Narcotics officers raided a chemistry lab last Friday night and confiscated a vial containing a colorless liquid. The crack (no pun intended) Houston Forensics

Laboratory ran the IR, ^1NMR , ^{13}C NMR and mass spectra of the compound. The results are given below. What is the structure of the mysterious liquid? Should we send these guys to jail??



Extra Credit (10 pts) A hydrocarbon shows a parent ion in its mass spectrum at $m/e = 120$. It shows three signals in its carbon-13 NMR and only two singlets in its proton NMR. Draw its structure in the box.

