

CHEM 3311-100 Fall 2007

## Final Exam

Professor R. Hoenigman

High = 256

Low = 26

Average = 146

I pledge to uphold the CU Honor Code:

Signature \_\_\_\_\_

Name (printed) \_\_\_\_\_

Last four digits of your student ID number \_\_\_\_\_

Recitation TA \_\_\_\_\_

Recitation number, day, and time \_\_\_\_\_

**You have 2.5 hours to complete this exam.**

No model kits or calculators allowed.

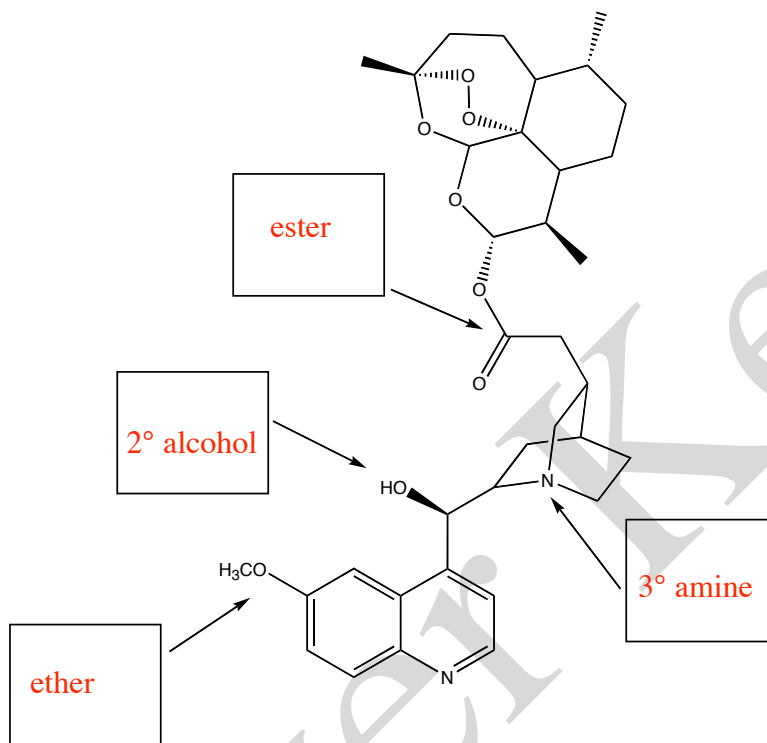
Periodic table and scratch paper are attached.

**DO NOT TURN THIS PAGE UNTIL INSTRUCTED TO DO SO.**

### Recitation Sections:

#	Day	Time	TA	Score	
111	Monday	8 am	Noel		
151	Monday	2 pm	Noel	Page 1 _____/14	Page 6 _____/36
191	Monday	5 pm	Noel		
113	Tuesday	8 am	Noel	Page 2 _____/28	Page 7 _____/45
193	Tuesday	5 pm	Noel		
112	Wednesday	8 am	Doug	Page 3 _____/36	Page 8 _____/42
152	Wednesday	11 am	Jon		
192	Wednesday	5 pm	Doug	Page 4 _____/18	Page 9 _____/10
153	Thursday	8 am	Noel	Page 5 _____/31	
					TOTAL _____/250

1. (8 pts) On the third exam, you were shown the structure of a drug hybrid of quinine and artemisinin, two drugs used to treat malaria. In the boxes below, label each indicated functional group. Label any alcohols, amines, or amides as 1°, 2°, or 3°.



2. (6 pts) One or more of the following names do not follow the IUPAC rules. Circle the incorrect name(s) and provide a correct IUPAC name.

A. (E)-4,4,5-trimethyl-5-hepten-2-yne

(E)-3,4,4-trimethyl-2-hepten-5-yne

B. (4R,2Z)-3-propyl-2-penten-4-ol

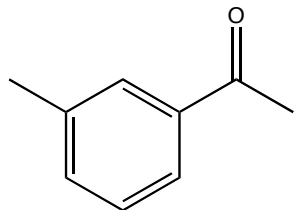
(2R, 3Z)-3-propyl-3-penten-2-ol

C. 4-sec-butylpentane

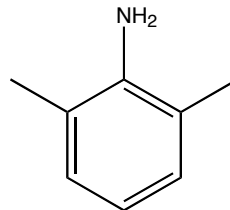
3,4-dimethylheptane

D. cis-1,2-dimethylcyclobutane

3. (8 pts) In the box below each compound write the IUPAC acceptable common name.

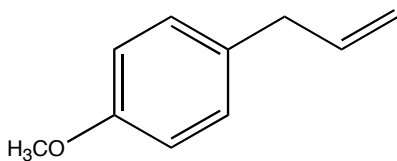


*meta*-acetophenone



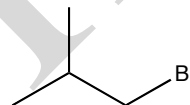
2,6-dimethylaniline

Book Problem 11.32c



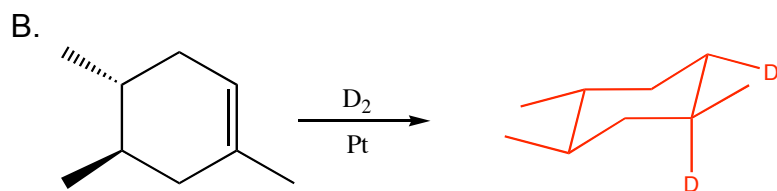
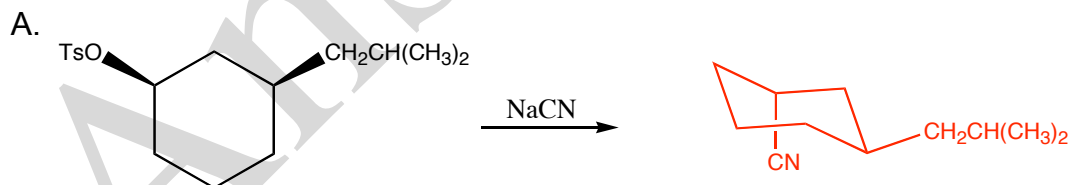
*para*-allylanisole

Book Problem 11.32a



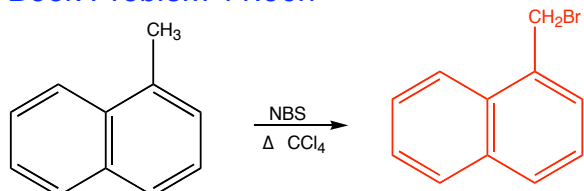
isobutyl bromide

4. (20 pts) Draw the most stable chair conformation of the product(s) for each of the following reactions. If a pair of enantiomers is formed, draw one enantiomer and write "+ enant".

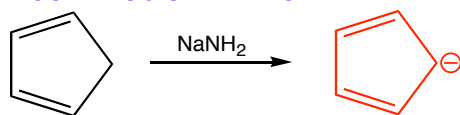


5. (36 pts) Draw the major organic product(s) of each of the following reactions. If necessary, clearly show the stereochemistry of the products. If no reaction occurs, write NR. Write "meso" under any meso compounds. If a pair of enantiomers is formed, draw one enantiomer and write "+ enant".

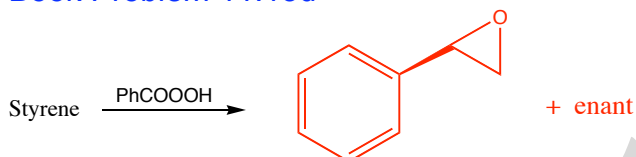
A. Book Problem 11.36h



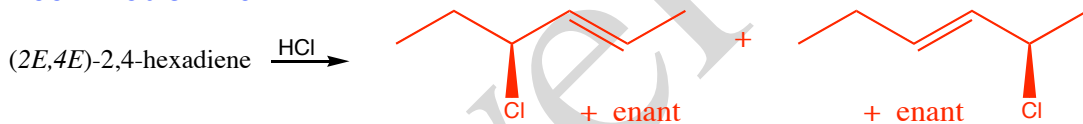
B. Book Problem 11.45



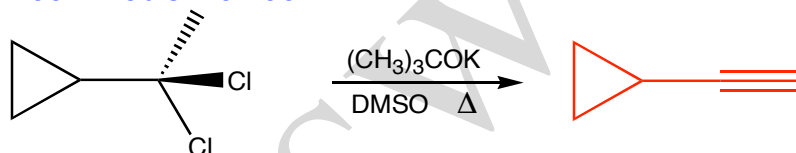
C. Book Problem 11.13d



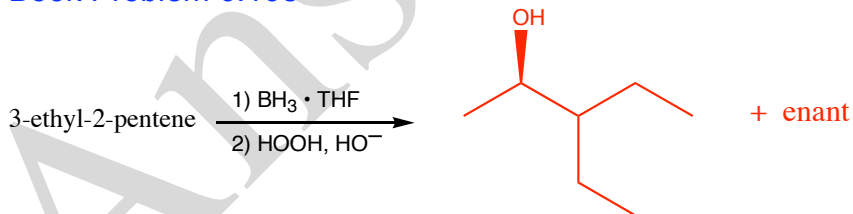
D. Book Problem 10.14



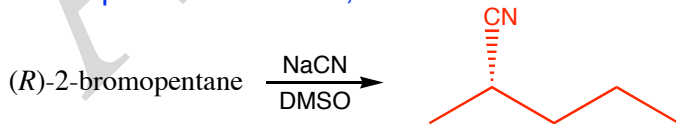
E. Book Problem 9.29c



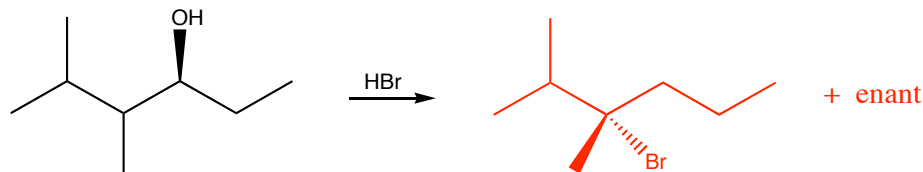
F. Book Problem 6.16e



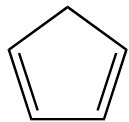
G. Concept Test on Nov. 9, 2007



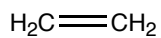
H.



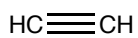
6. (5 pts) Rank the following in terms of increasing acidity (1 = most acidic, 5 = least acidic)



1



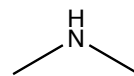
4



2



5

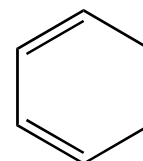
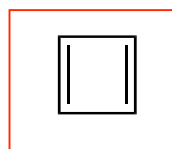
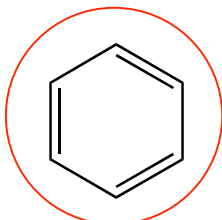
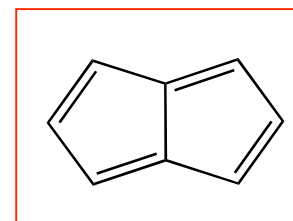
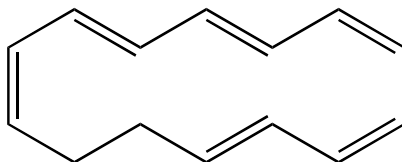
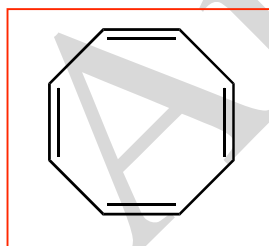
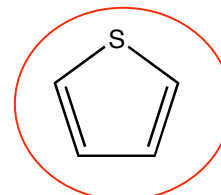
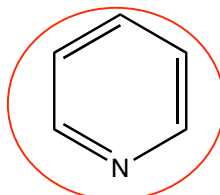
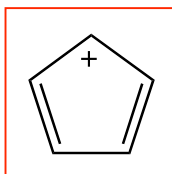


3

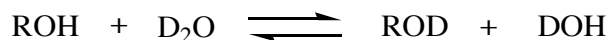
7. (5 pts) Explain your reasoning for problem 6.

Cyclopentadiene is the most acidic since it has an aromatic anion. Acetylene is next, since the  $sp$  hybridized C-H bond results in an anion stabilized by excess  $s$ -character (more  $s$ -character = more stable anion). The N-H bond is more acidic than the remaining C-H bonds, since nitrogen is more electronegative than carbon.

8. (8 pts) Circle the aromatic compound(s) below. Draw a box around the anti-aromatic compound(s).

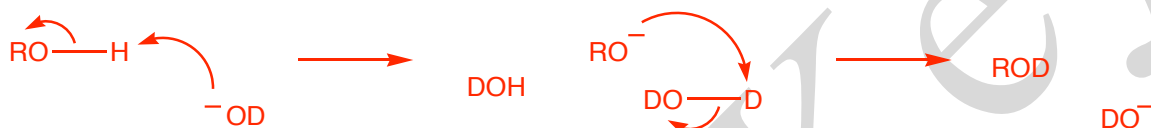


9. (15 pts) Deuterium oxide ( $D_2O$ ) is water in which the protons ( $^1H$ ) have been replaced by their heavier isotope deuterium ( $^2H$ ). When  $D_2O$  is added to an alcohol ( $ROH$ ), deuterium replaces the proton of the hydroxyl group.



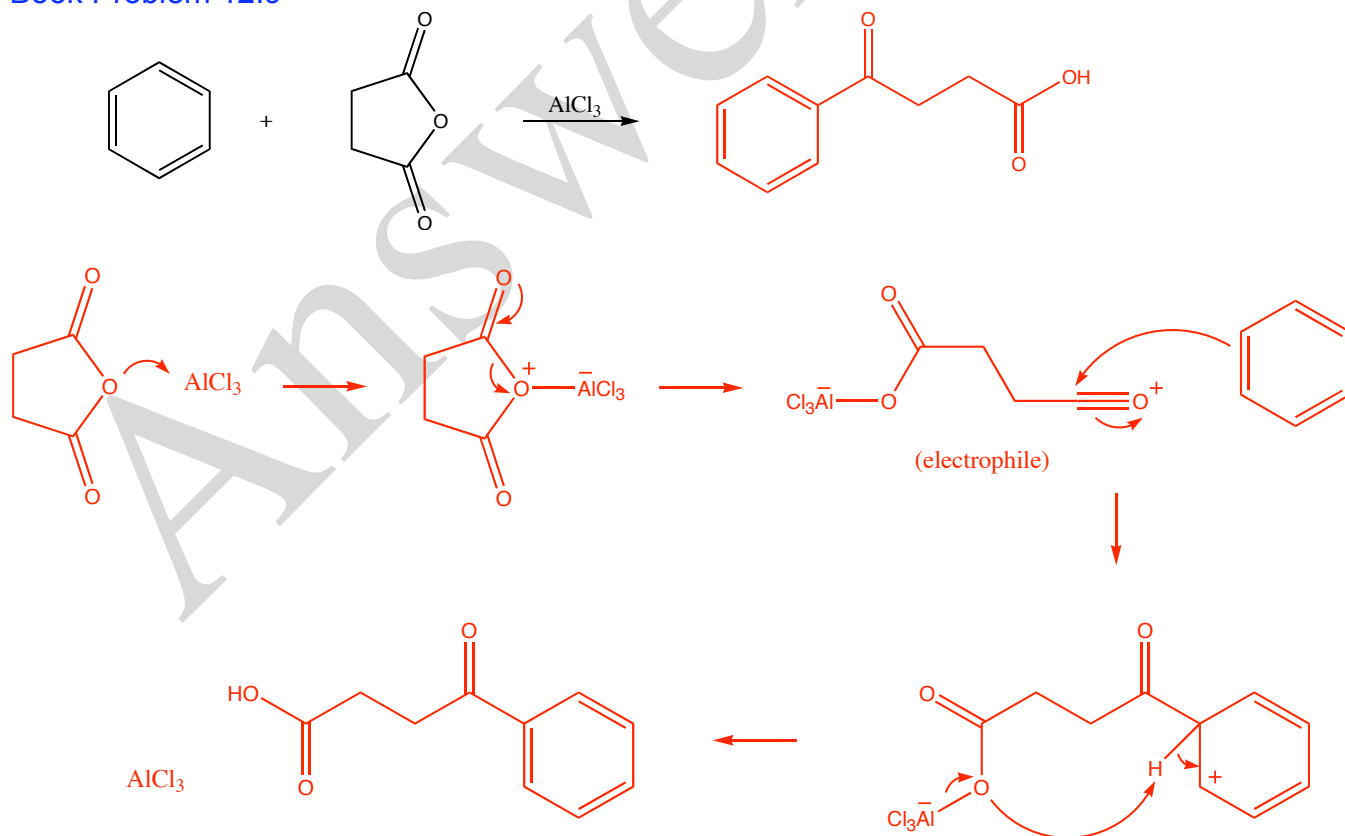
The reaction takes place extremely rapidly, and if  $D_2O$  is present in excess, all the alcohol is converted to  $ROD$ . This hydrogen-deuterium exchange can be catalyzed by either acids or bases. If  $DO^-$  is the catalyst in base, write a reasonable mechanism for the conversion of  $ROH$  to  $ROD$  under basic conditions.

Book Problem 4.53 and Exam 2 question

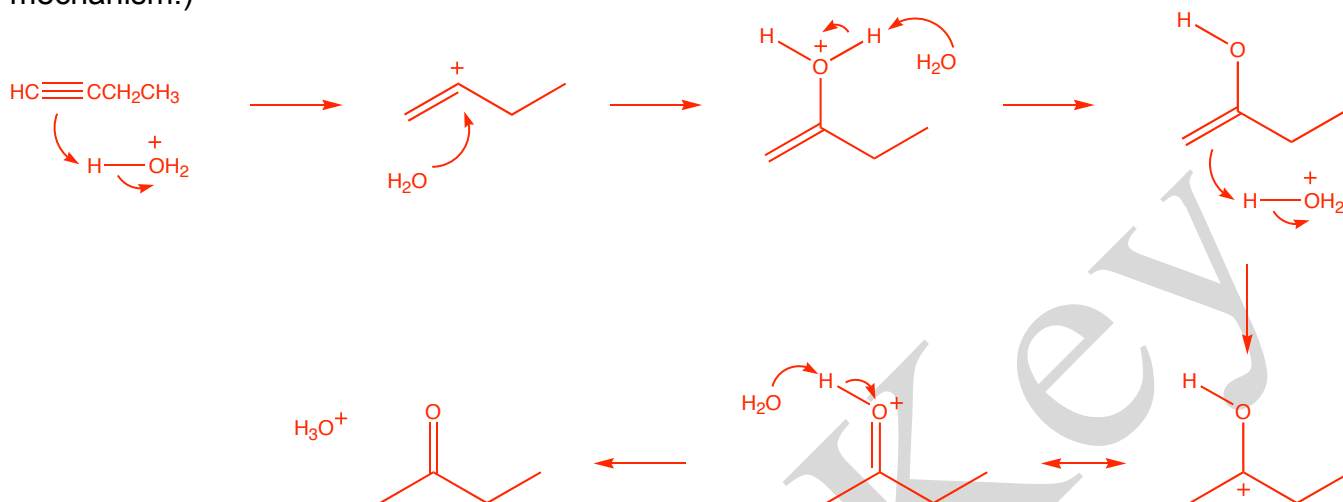


10. (16 pts) Using curved arrows to show the flow of electrons, draw a mechanism to account for the Friedel-Crafts acylation of benzene with succinic anhydride.

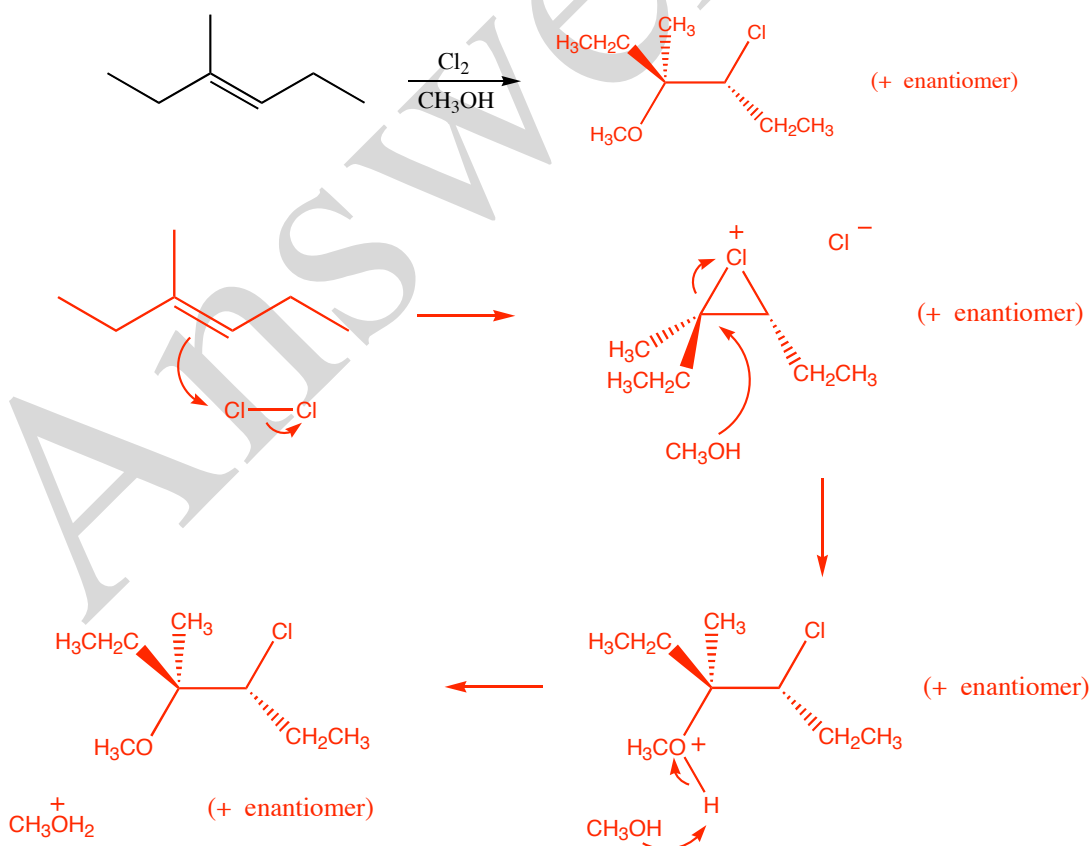
Book Problem 12.9



11. (20 pts) Using arrows to show the flow of electrons, draw a mechanism for the hydration of 1-butyne with aqueous sulfuric acid and mercury(II) sulfate. (Do not show  $\text{HgSO}_4$  in your mechanism.)



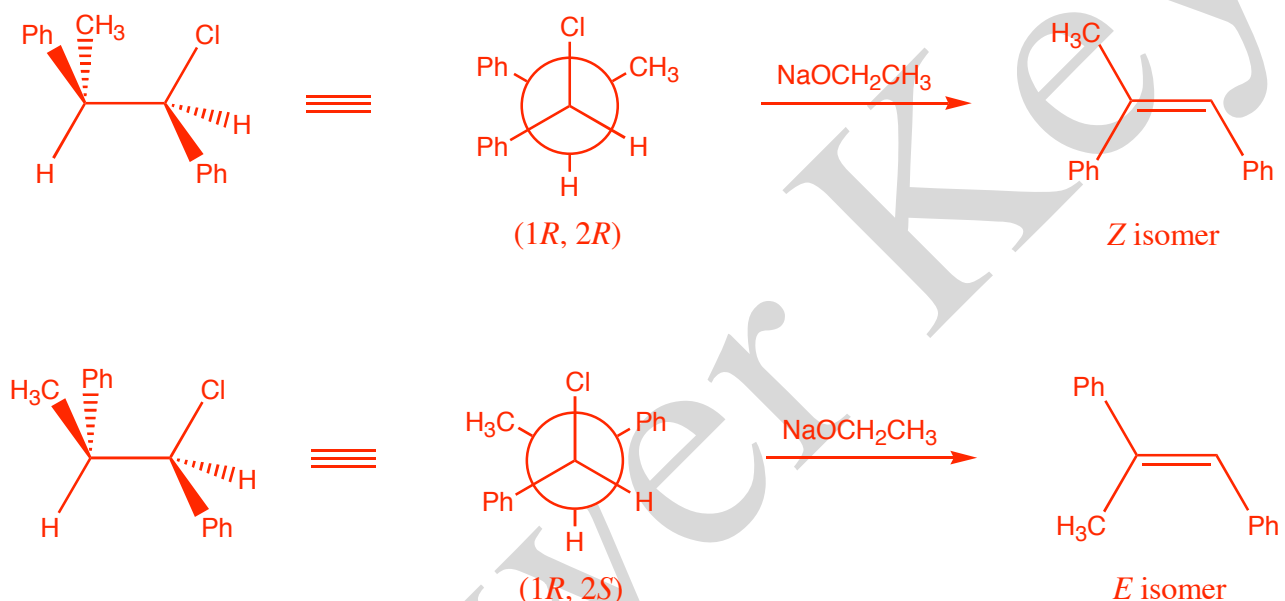
12. (16 pts) Fill in the product(s) of the following reaction. Using arrows to show the flow of electrons, draw a mechanism for the reaction. Be sure to show any necessary stereochemistry.



13. (30 pts) Dehydrohalogenation of the diastereomeric forms of 1-chloro-1,2-diphenylpropane with sodium ethoxide is stereospecific. One diastereomer yields (*E*)-1,2-diphenylpropene, and the other yields the *Z* isomer. Which diastereomer yields which alkene? Why? Draw a Newman projection for each of the diastereomers to show the correct orientation of the reaction. Label all chirality centers as *R* or *S*, and all alkenes as *E* or *Z*. (Abbreviate phenyl, C<sub>6</sub>H<sub>5</sub>, as Ph)

Book Problem 11.40

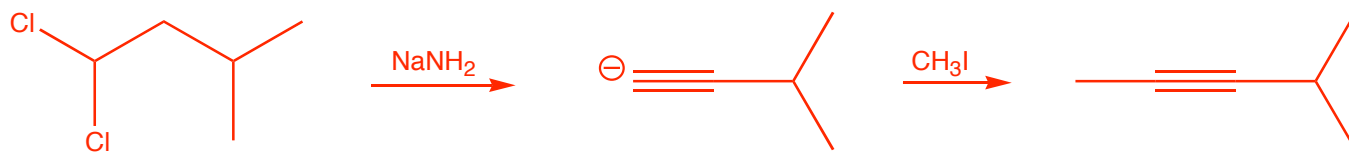
This is an E2 reaction and must go through an anti-periplanar geometry.



14. (15 pts) Assume that you need to prepare 4-methyl-2-pentyne and you discover that the only alkynes on hand are acetylene and propyne. You also have available methyl iodide, isopropyl bromide, 1,1-dichloro-3-methylbutane, and sodium amide. Which of these compounds would you choose in order to perform your synthesis? Why? Write out each step of your proposed synthesis.

Book Problem 9.34

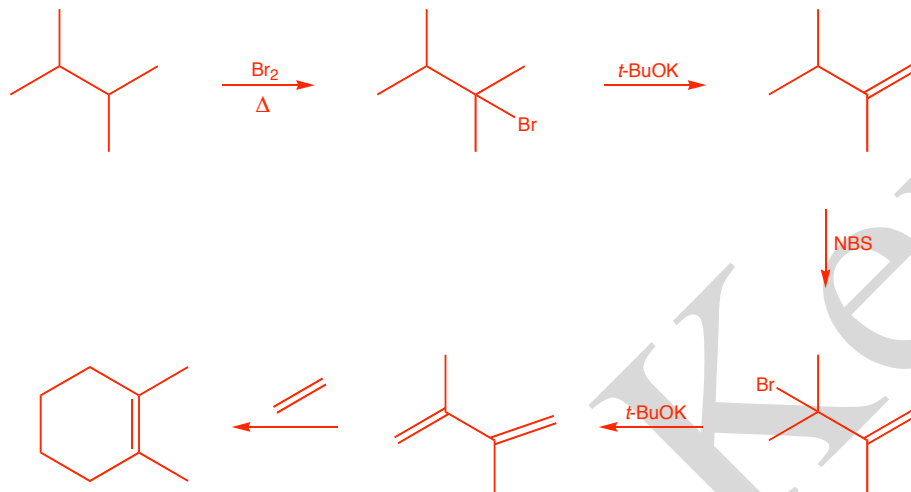
The reaction of propyne with  $\text{NaNH}_2$ , followed by isopropyl bromide will lead to an E2 reaction and the formation of propyne and propene. To get the desired product, use methyl iodide in an  $\text{S}_{\text{N}}2$  reaction.





15. Propose an efficient synthesis for each of the following transformations. You may use any reagents you like. Be sure to show all intermediates. (Do not draw a mechanism.)

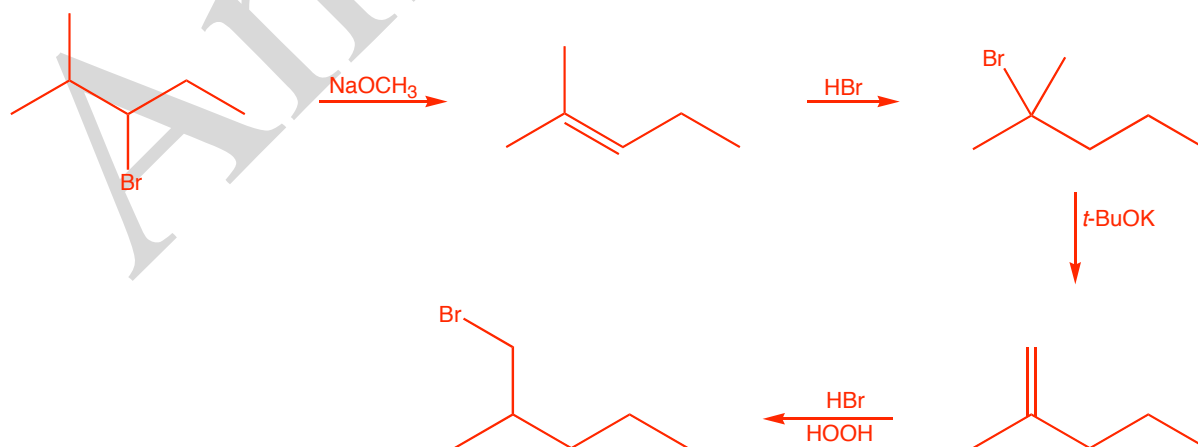
A. (16 pts) 1,2-dimethylcyclohexene *starting from* ethene and 2,3-dimethylbutane



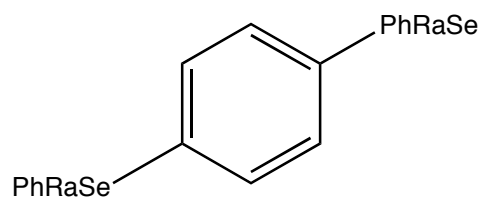
B. (10 pts) *meso*-2,3-dibromobutane *starting from* 2-butyne  
 Book Problem 9.33i



C. (16 pts) 1-bromo-2-methylpentane *starting from* 3-bromo-2-methylpentane



Extra Credit: (10 pts) Draw a parody of organic nomenclature. For example, below is paraphrase. (You don't have to use elements.)



Answer Key