CHEM 203

Midterm Exam 2
November 18, 2008

A N S W E R S

Your name: _____

This a closed-notes, closed-book exam

You may use your set of molecular models

This exam contains 8 pages

Time: 1h 30 min

1. _____ / 15
2. _____ / 15
3. _____ / 15
4. _____ / 15
5. _____ / 20
6. _____ / 20

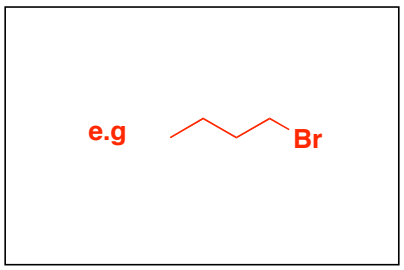
TOTAL _____ / 100

This exam counts for 15% of your CHEM 203 final grade

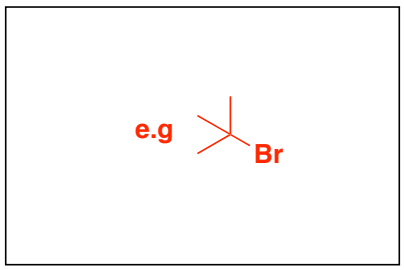
1. (15 pts.) Write accurate structures of:

1. An alkyl halide that is likely to undergo nucleophilic substitution by the S_N2 mechanism, and one that is likely to undergo nucleophilic substitution by the S_N1 mechanism (write your answers in the appropriate boxes):

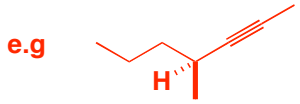
likely to react by S_N2 mechanism



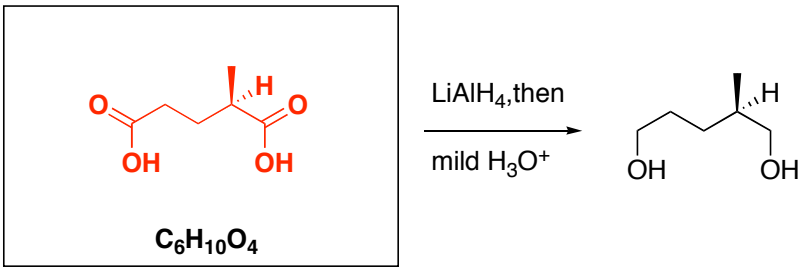
likely to react by S_N1 mechanism



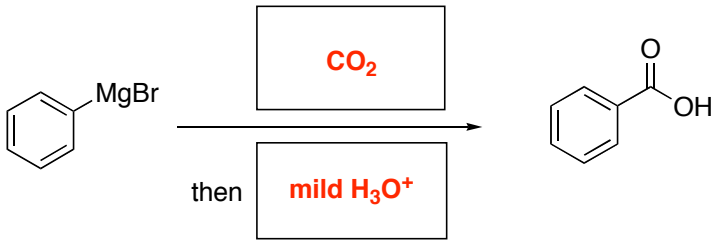
2. A chiral alkyne that produces a chiral product upon reaction with metallic Na in liquid NH_3 but an achiral product upon reaction with H_2 in the presence of metallic Pt.



3. The organic compound of formula $C_6H_{10}O_4$ that reacts with $LiAlH_4$ followed by mild H_3O^+ to yield the product shown below:



4. The reagents necessary to achieve the conversion of phenylmagnesium bromide into benzoic acid (complete the reaction diagram below):

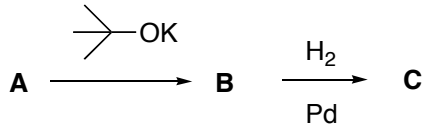


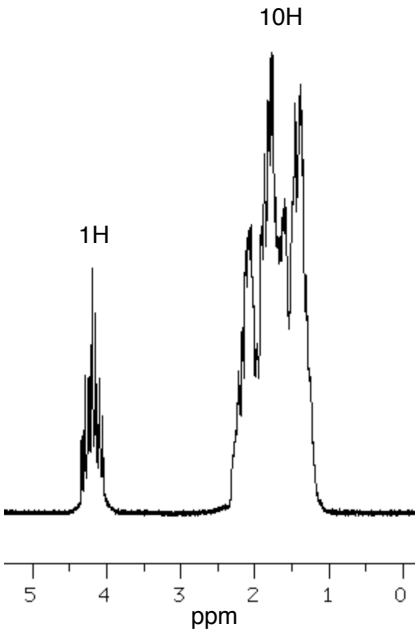
5. An alkyl halide containing at least 3 carbon atoms that CANNOT undergo E2 reaction

any alkyl halide that lacks a β-H, e.g.

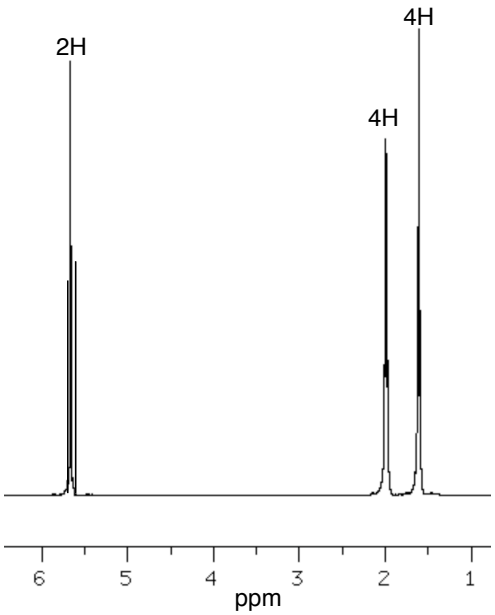
etc.

2. (15 pts.) Appropriate analytical techniques determined that an unknown organic compound **A** contained bromine and had a molecular mass between 160 and 170 daltons. Treatment of **A** with potassium *tert*-butoxide as per the scheme below produced **B**, hydrogenation of which furnished **C**. The ^{1}H NMR spectra of **A** – **C** are shown below. Deduce the structures of the three compounds and write your answers in the appropriate boxes.

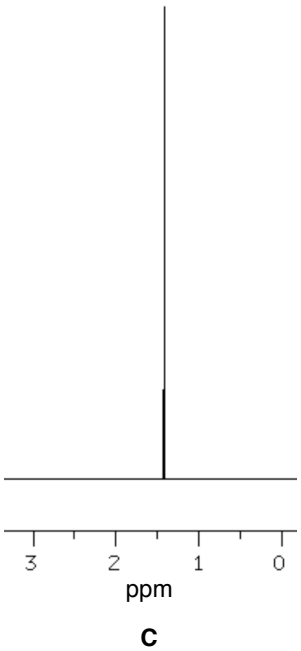




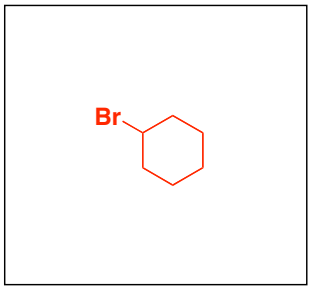
A



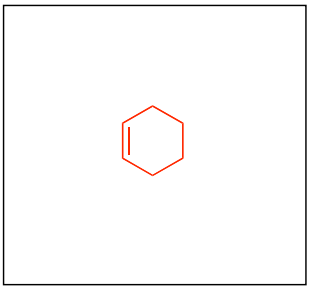
B



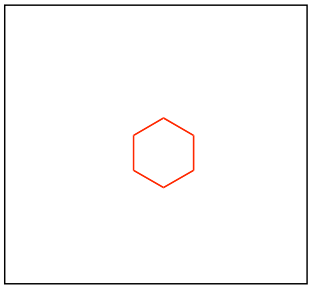
C



structure of compound A



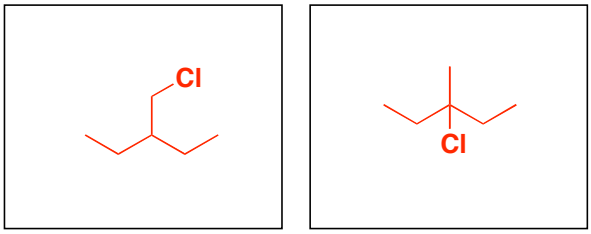
structure of compound B



structure of compound C

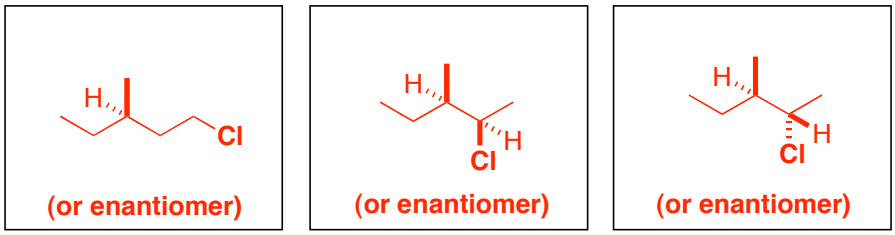
3. (15 pts.) Radical chlorination of 3-methylpentane, **D**, afforded a complex mixture of products, from which five different substances, **E** – **I**, of formula $C_6H_{13}Cl$ were isolated. Appropriate analytical methods revealed that **E** and **F** were achiral, while **G**, **H**, and **I**, were racemic mixtures. Write the structures of compounds **E** – **I** in the boxes below.

achiral products



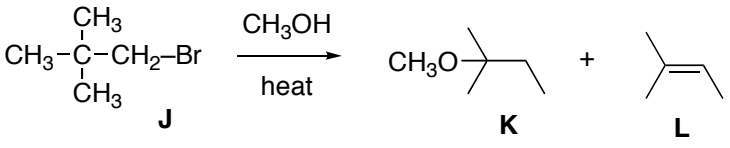
structure of product E **structure of product F**

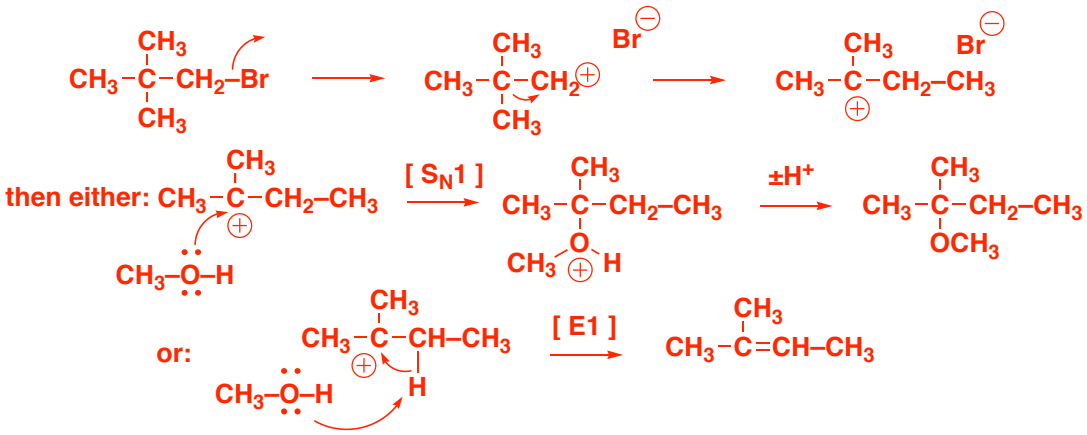
racemic products



structure of product G **structure of product H** **structure of product I**

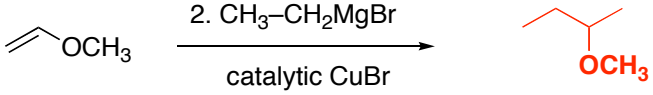
4. (15 pts.) Write a detailed reaction mechanism to account for the fact that heating a solution of **J** in CH_3OH causes the formation of **K** and **L**.

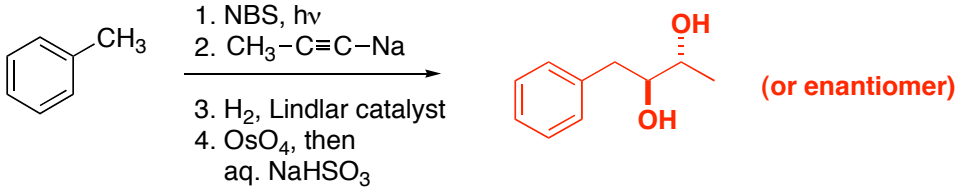




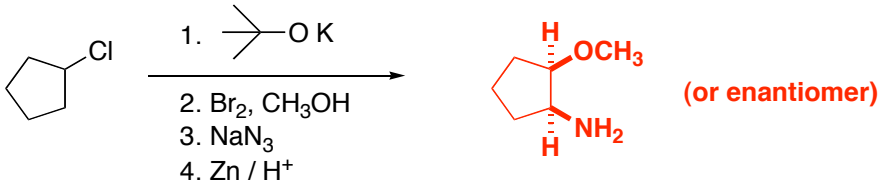
5. (20 pts.) Provide the structure of the major product expected from the following reaction sequences. **Important**: compounds incorporating multiple stereogenic centers must be drawn with the correct relative configuration.

Note: it is understood that chiral compounds will be obtained as racemic mixtures.

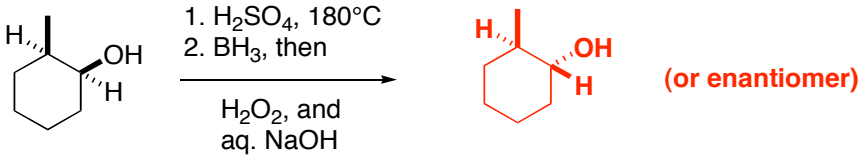
a. 

b. 

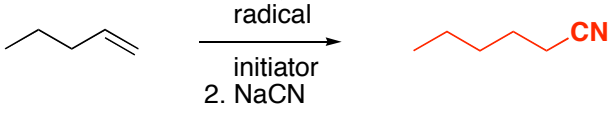
(or enantiomer)

c. 

(or enantiomer)

d. 

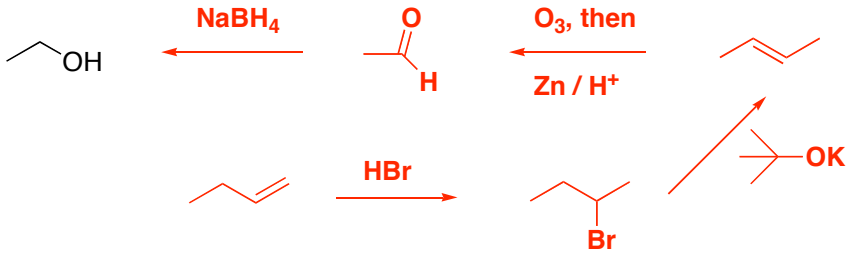
(or enantiomer)

e. 

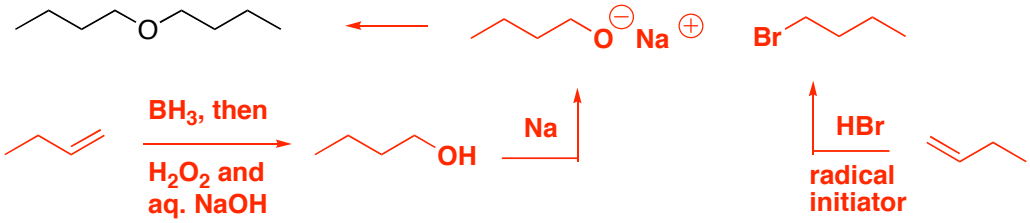
6. (20 pts.) Propose a method for the preparation of compounds a. – e. below starting ONLY with 1-butene as the source of carbon atoms. You may use any additional reagent that might be needed (e.g., borane, HCl, Mg, H_2O_2, potassium tert-butoxide, etc.). Present your answer as a clear flowchart that shows all intermediate steps and products. Substances obtained in one sequence may be used as components of a later sequence.

It is not necessary to draw mechanisms

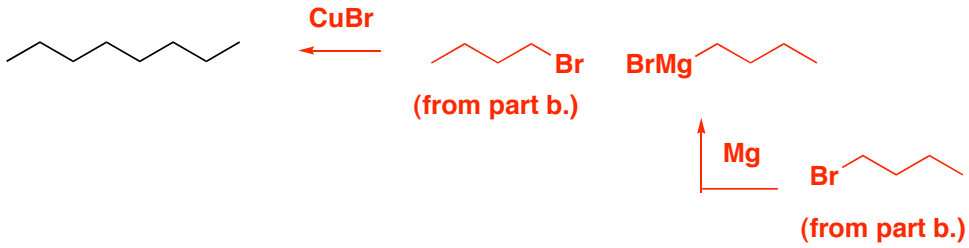
a.

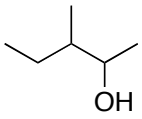


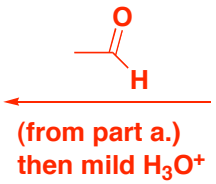
b.



c.

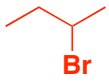


d. 

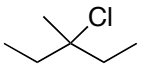


(from part a.)
then mild H_3O^+

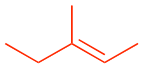
Mg



(from part a.)

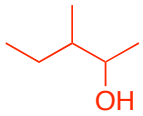
e. 

HCl



(& / or geom. isomer)

H_2SO_4,
heat



(from part d.)