

# ANSWER KEY

CHEM 3311-200

Exam 3

November 15, 2007

By printing my name below, I pledge that  
"On my honor, as a University of Colorado at Boulder student, I have neither given nor  
received unauthorized assistance on this work."

Name \_\_\_\_\_

Recitation TA's Name \_\_\_\_\_

Recitation Day & Time \_\_\_\_\_

## Grading Information

Page #	Points Possible	Your Score
2	15	—
3	20	—
4	15	—
5	20	—
6	20	—
7	10	—
		_____ TOTAL (out of 100)

## General Instructions

- (1) This is a CLOSED BOOK exam! No notes and molecular models are allowed.
- (2) You have 2 hours to complete the exam. You may not leave the room during the first 90 minutes of the exam.
- (3) Write your name at the top of each page, starting with page 2.
- (4) Use the back of exam pages for scratch paper.
- (5) If caught cheating, you will receive at best an F for this exam. The instructor reserves the right to proceed further in compliance with university policies.

1. Multiple Choice Questions (15 points)

(i) Identify the most stable alkene.

- (A) 1-Hexene
- (B) *cis*-3-Hexene
- (C) *trans*-3-Hexene
- (D) 2-Methyl-2-pentene**

(ii) When 2-methyl-2-butanol is treated with  $H_2SO_4$  at  $80^\circ C$ , 2-methyl-2-butene is the major product. What is the mechanism for this reaction?

- (A)  $S_N1$
- (B) E1**
- (C)  $S_N2$
- (D) E2

(iii) When cyclohexyl chloride was treated with sodium ethoxide in ethanol at  $55^\circ C$ , cyclohexene was obtained in 100% yield. What is the mechanism for this reaction?

- (A)  $S_N1$
- (B) E1
- (C)  $S_N2$
- (D) E2**

(iv) What is the organic product obtained when 1-butene is reacted with HBr in the presence of peroxides?

- (A) 1-Bromobutane**
- (B) 2-Bromobutane
- (C) 3-Bromo-1-butene
- (D) 1,2-Dibromobutane

(v) Consider the addition reactions of alkenes. For (E)-2-butene, which reaction conditions will NOT lead to net syn addition to the double bond?

- (A) Hydroboration-oxidation
- (B)  $Br_2$  in water**
- (C)  $H_2$  in the presence of Pt
- (D) Epoxidation

## 1. Multiple Choice Questions (20 points)

(vi) Which alkene will react at the fastest rate in 50%  $\text{H}_2\text{SO}_4$ ?

(A) 2-Methyl-2-butene

(B) 1-Butene

(C) *cis*-2-Butene

(D) *trans*-2-Butene

(vii) A dimethylcyclopentene was identified by ozonolysis; zinc was included during the hydrolysis step as a precautionary measure. The only product obtained was  $\text{OHC-CH}(\text{CH}_3)\text{-CH}_2\text{-CH}(\text{CH}_3)\text{-CHO}$ . Identify the compound.

(A) 1,2-Dimethylcyclopentene

(B) 1,3-Dimethylcyclopentene

(C) 3,5-Dimethylcyclopentene

(D) 4,4-Dimethylcyclopentene

(viii) Which constitutional isomer reacts fastest with NaI in acetone?

(A) 2-Chloro-2-methylpropane

(B) 2-Chlorobutane

(C) 1-Chloro-2-methylpropane

(D) 1-Chlorobutane

(ix) What is the major product in the reaction between 2-methylpropene and  $\text{Br}_2$  in  $\text{H}_2\text{O}$ ?

(A) 3-Bromo-2-methylpropene

(B) 1,2-Dibromo-2-methylpropane

(C) 2-Bromo-2-methyl-1-propanol

(D) 1-Bromo-2-methyl-2-propanol

(x) Compound X is optically active. Hydrogenation of this compound produced methylcyclopentane. What is the identity of compound X?

(A) Methylene cyclopentane

(B) 1-Methylcyclopentene

(C) 3-Methylcyclopentene

(D) 4-Methylcyclopentene

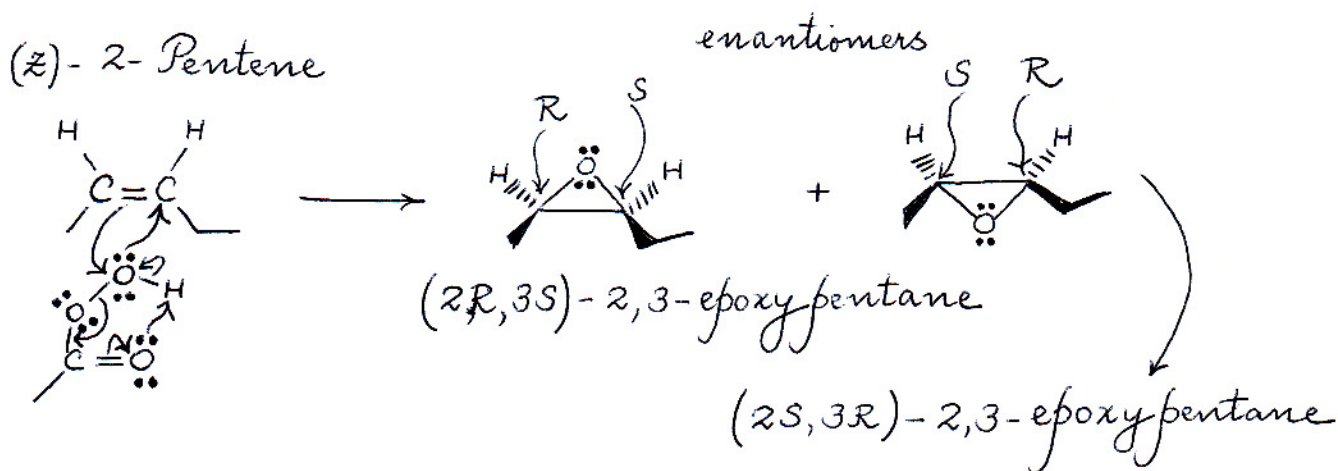
2. (15 points)

Show the arrow-pushing mechanism (including lone pairs and formal charges) for the reaction of **(Z)-2-Pentene** with peroxyacetic acid in  $\text{CH}_2\text{Cl}_2$ .

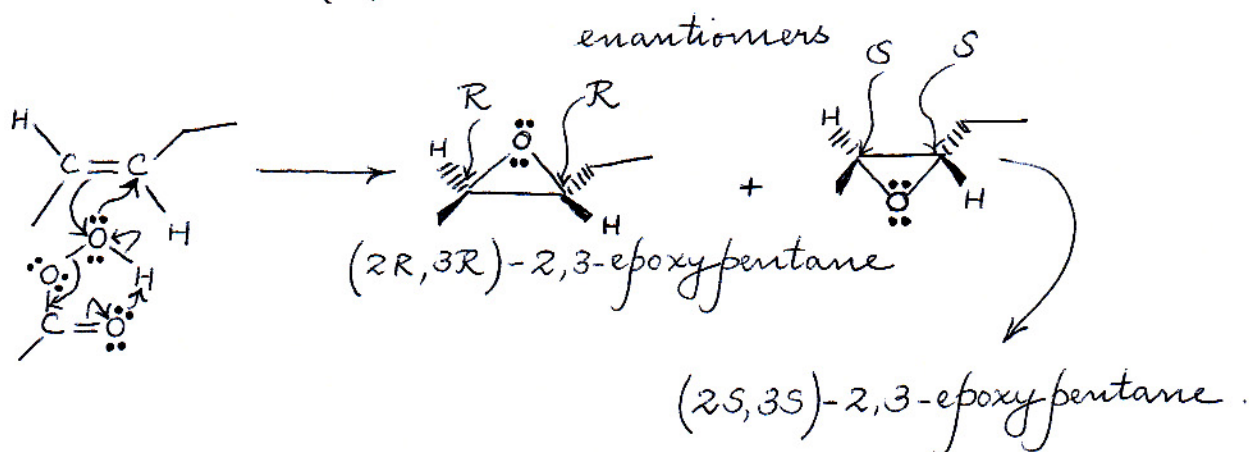
(A) If two stereoisomers are formed, for each product, label all chirality centers R and S as appropriate.

(B) Write a complete IUPAC name for each product.

(C) Clearly state the relationship between the stereoisomeric products as diastereomers, enantiomers, or meso form. **Circle your answer!**

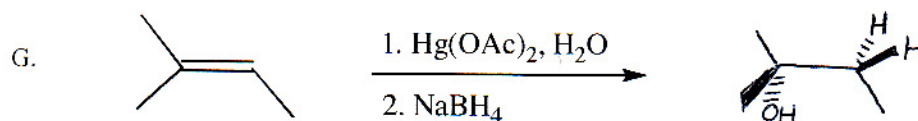
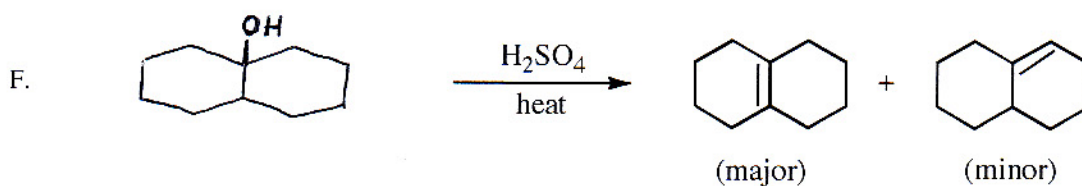
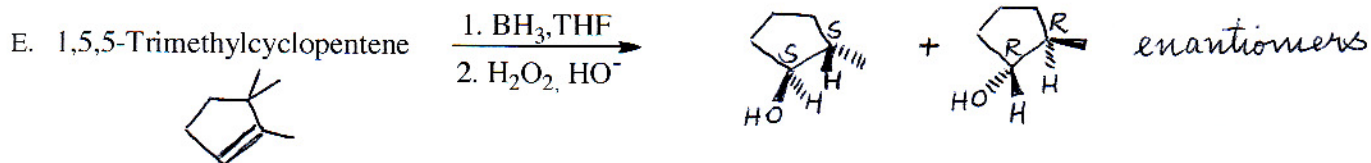
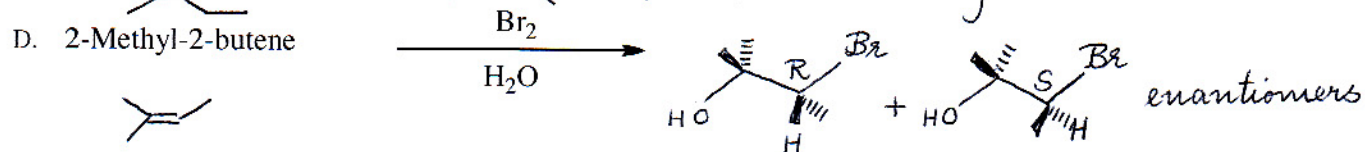
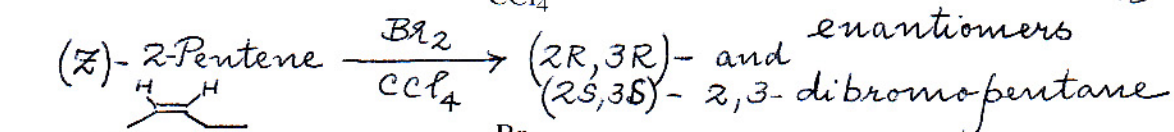
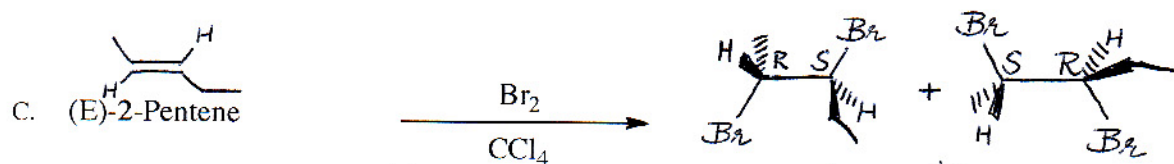
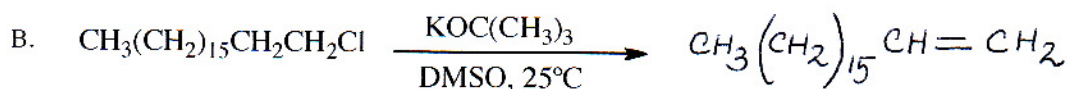
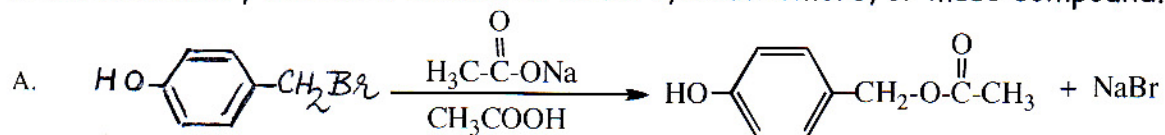


Alternate exam: *(E)-2-Pentene*



3. (20 points)

Complete the reaction by filling in the reactant(s) or product(s) as appropriate. If stereoisomers are formed, show each one with the correct stereochemistry and label as diastereomers, enantiomers, or meso compound.



4. (10 points) Circle the mechanistic symbols ( $S_N1$ ,  $S_N2$ , E1, E2) that are most consistent with each statement.

(A) Reaction of methyl bromide with sodium ethoxide in ethanol proceeds by this mechanism.

$S_N1$        $S_N2$       E1      E2

(B) These reaction mechanisms represent concerted processes.

$S_N1$        $S_N2$       E1      E2

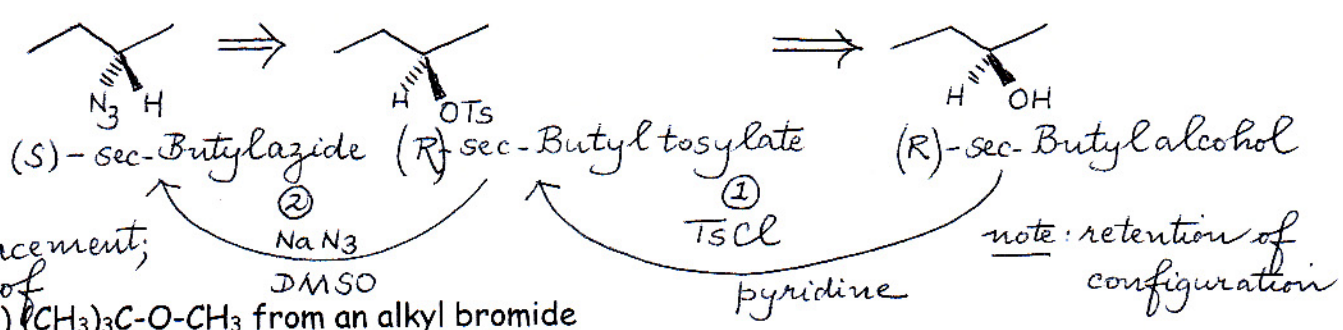
(C) These reaction mechanisms involve carbocation intermediates.

$S_N1$        $S_N2$       E1      E2

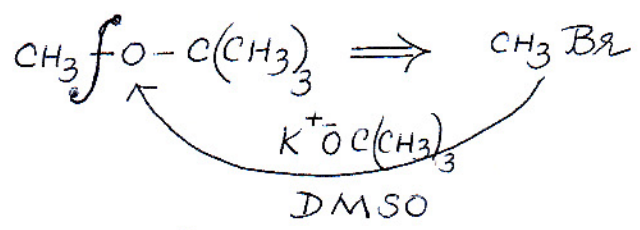
5. Organic Synthesis (10 points) Outline an efficient synthesis of each compound from the indicated starting material and any necessary organic or inorganic reagents.

(A) (S)-sec-Butyl azide from (R)-sec-butyl alcohol

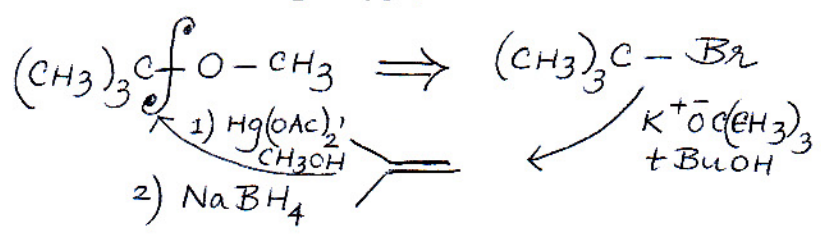
① OH is a poor LG; convert to tosylate, a good LG  
②  $S_N2$  displacement; inversion of configuration



(B)  $(\text{CH}_3)_3\text{C-O-CH}_3$  from an alkyl bromide



OR



6. (10 points) Draw a **stepwise mechanism** for the reaction shown. You must show the arrows, lone pairs, and formal charges to receive credit.

