

CHEM 3311-200
Exam 2
October 25, 2007
ANSWER KEY

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 _____ (Doug Bevan,Carolynn Chin)

Recitation Day & Time _____

Grading Information

| Page # | Points Possible | Your Score |
|--------|-----------------|---------------------------------|
| 2 | 15 | — |
| 3 | 25 | — |
| 4 | 20 | — |
| 5 | 14 | — |
| 6 | 16 | — |
| 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.
- (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.

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1. Multiple Choice (15 points)

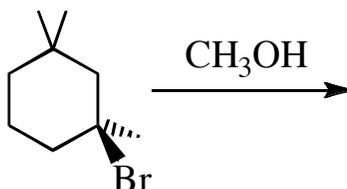
(i) Identify the relationship between the products in this reaction.

(A) constitutional isomers

(B) diastereomers

(C) enantiomers

(D) meso form



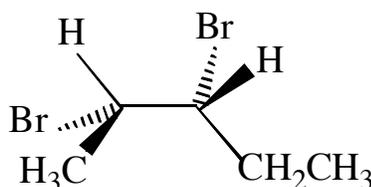
(ii) Select the correct IUPAC name of this compound.

(A) (2S, 3S)-2,3-dibromopentane

(B) (2R, 3S)-2,3-dibromopentane

(C) (2S, 3R)-2,3-dibromopentane

(D) (2R, 3R)-2,3-dibromopentane



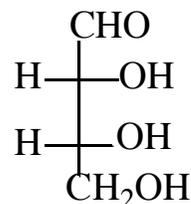
(iii) Identify the absolute configurations of carbons 2 and 3 in this Fischer projection.

(A) 2R, 3R

(B) 2R, 3S

(C) 2S, 3R

(D) 2S, 3S



(iv) Which constitutional isomer of C₆H₁₄ forms FOUR different monochlorinated products?

(A) 2-Methylpentane

(B) 3-Methylpentane

(C) 2,2-Dimethylbutane

(D) 2,3-Dimethylbutane

(v) Which substrate reacts fastest with NaSCH₃ in DMSO under the same conditions?

(A)

(B)

(C)

(D)

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2. (15 points) Circle the CORRECT answer that applies to each statement.

(A) The compound that reacts at a relatively faster rate in an S_N1 reaction is:

Cyclopentyl iodide

1-Methylcyclopentyl iodide

(B) When an alkane is halogenated under free radical conditions, the more selective process is:

Bromination

Chlorination

(C) The strongest base listed below is:

HO^-

CH_3O^-

$(\text{CH}_3)_3\text{CO}^-$

$\text{CH}_3\text{CH}_2\text{O}^-$

(D) Under S_N2 conditions, the compound that reacts at the fastest rate is:

sec-butyl bromide

butyl bromide

neopentyl bromide

(E) Backside attack by HO^- in the S_N2 reaction with $\text{CH}_3\text{CH}_2\text{Br}$ may be described using "frontier orbital" (HOMO-LUMO) theory. The LUMO is:

nonbonding MO of HO^-

$\sigma_{\text{C-Br}}$

$\sigma_{\text{C-Br}}^*$

3. (10 points) Show the detailed mechanism for the propagation steps in the free radical halogenation of methane to form chloromethane. Clearly show each step in the correct sequence and include lone pairs and arrows depicting electron flow. **If your work is illegible, it will NOT be graded!**

Please refer to page 167 in your textbook (Mechanism 4.3 (b) Chain propagation Steps 2 and 3.

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4. (20 points) True or False

Place a T(true) or F(false) in the spaces provided to the left of each statement.

T (A) Sulfonates are better leaving groups than halides.

F (B) S_N2 reactions are generally faster in solvents such as water and methanol.

F (C) The rate of an S_N1 reaction depends on both the concentration and nature of the nucleophile.

T (D) The azide ion, N_3^- , is a better nucleophile than the acetate ion.

F (E) A Fischer projection is normally drawn with the carbon chain vertical, with the highest numbered carbon at the top.

F (F) When a molecule has two chirality centers, and these two chirality centers are equivalent, four stereoisomers are possible.

F (G) Stereoisomers that are related as nonsuperimposable mirror images are classified as diastereomers.

F (H) The alkyl radical-forming step is endothermic for chlorination and exothermic for bromination in the free radical halogenation of C_2H_6 .

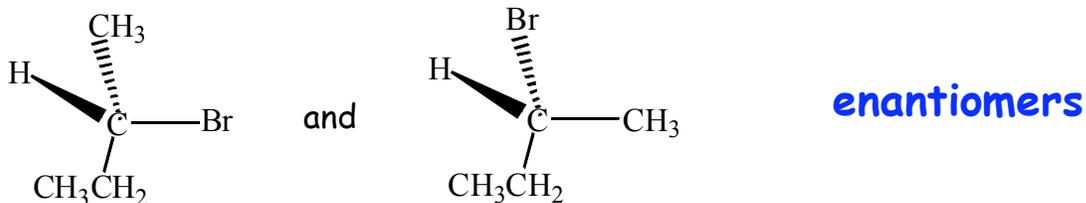
T (I) Carbocations are strong electrophiles and react with Lewis bases.

T (J) Primary alcohols and CH_3OH react with hydrohalic acids (hydrogen halides) via the S_N2 pathway.

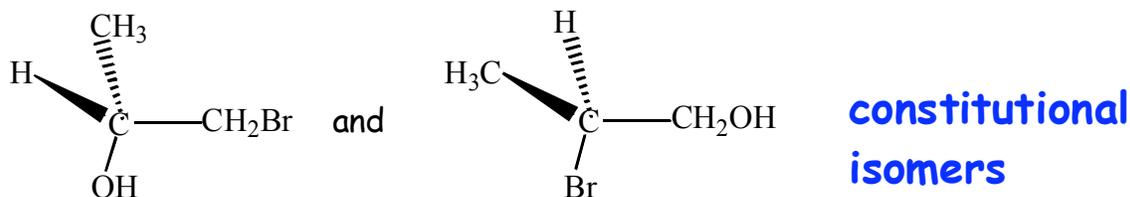
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5. (14 points) Identify the relationship in each of the following pairs as constitutional isomers, enantiomers, diastereomers, or identical (different ways of drawing the same compound). Write your answer on the line for each pair.

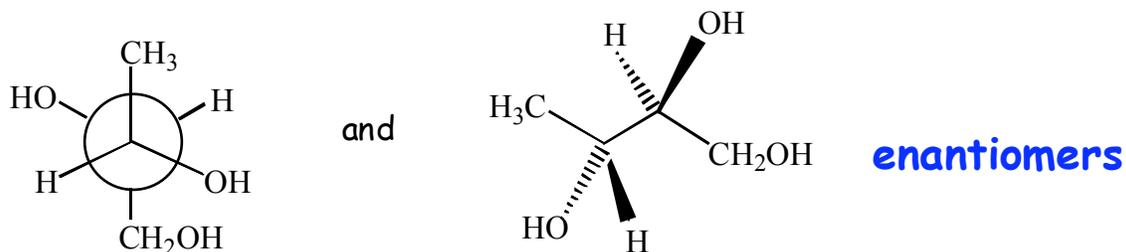
(A)



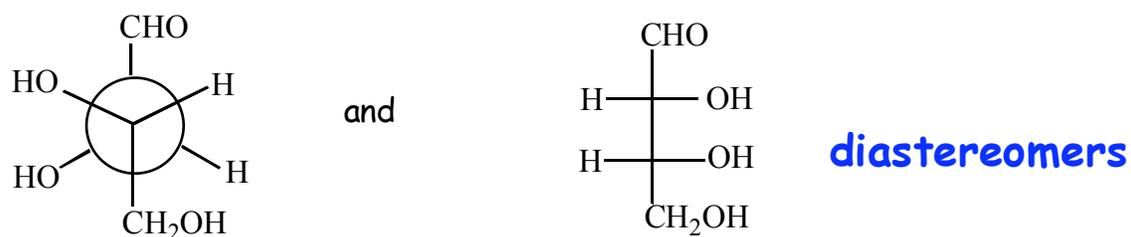
(B)



(C)



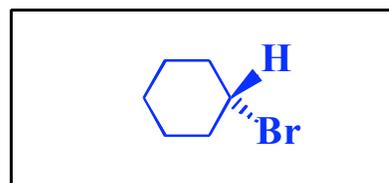
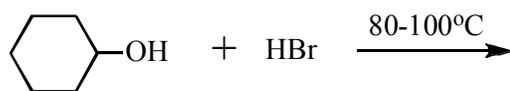
(D)



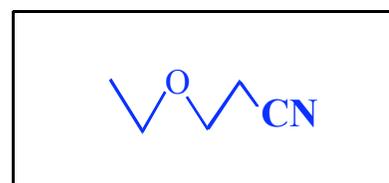
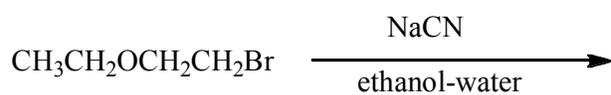
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6. (16 points) Draw the structure of the major organic product of each reaction in the box provided. Show appropriate stereochemistry where applicable.

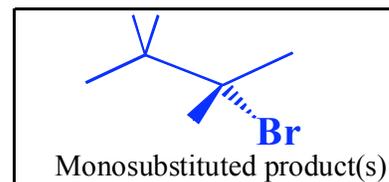
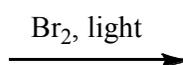
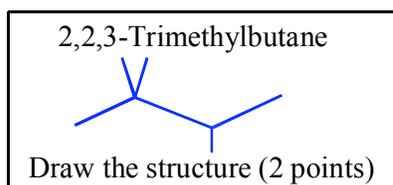
(A)



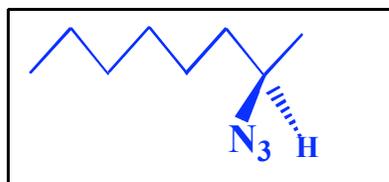
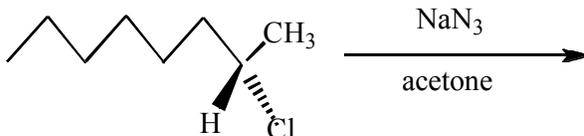
(B)



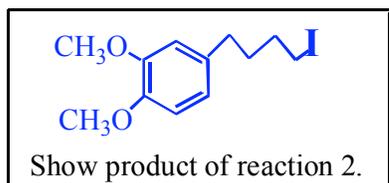
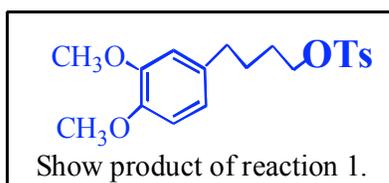
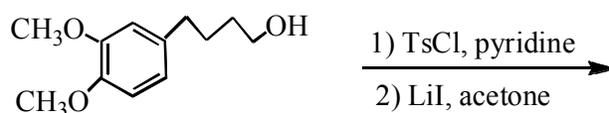
(C)



(D)



(E)



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7. (10 points) Hydrolysis of 2-bromo-3-methylbutane yields 2-methyl-2-butanol in 93% yield. Clearly AND NEATLY show each step in the mechanism for this reaction. Label your steps in sequence as Step 1, Step 2, etc. Show all lone pairs and arrows to receive credit. Identify the slow and fast steps! **If your work is illegible, it will NOT be graded!**

Please refer to page 336 in your textbook (Mechanism 8.3)