**Note:** Your exam should consist of 5 pages including the cover page and grade tabulation sheet. Skim the entire exam, and solve the easiest problems first. Exams not returned when time is called will not be graded.

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![Periodic Table](image)

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**PLEASE DO NOT OPEN THIS EXAM UNTIL YOU ARE INSTRUCTED TO DO SO.**
1. (16 pts) Provide the structure of the expected major product(s) in each of the following reactions. You must clearly show stereochemistry where appropriate.

   a. 
   ![Image](image1.png)  
   KOH, MeOH, Δ

   b. 
   ![Image](image2.png)  
   H₂, Pd

   c. 
   ![Image](image3.png)  
   NaCN, acetone

   d. 
   ![Image](image4.png)  
   KBr, MeOH

2. (12 pts) Design an alkyl halide reactant that will give the 2,4-diphenyl-2-pentene (shown below) as the only product upon treatment with potassium t-butoxide. Show stereochemistry where appropriate.

   ![Image](image5.png)
3. (12 pts) The following reaction is called the pinacol rearrangement. Propose a reasonable curved arrow mechanism to account for the product.

![Reaction mechanism](image)

4. (8 pts) Draw the structures of the following alkenes: (E)-2-pentene, (Z)-2-pentene, 2-methyl-2-butene, 1-pentene. Match the alkenes with the following heats of combustion: -807.4 kcal/mol, -806.0 kcal/mol, -805.0 kcal/mol, -802.6 kcal/mol.

5. (14 pts) When (S)-2-bromo-2-fluorobutane reacts with sodium azide, the major product is (S)-2-azido-2-fluorobutane.

(a) Briefly explain why no 2-azido-2-bromobutane is formed. (b) Draw a mechanism for the reaction (S)-2-bromo-2-fluorobutane plus sodium azide to give (S)-2-azido-2-fluorobutane. Has this reaction occurred with retention or inversion of configuration? Briefly explain.
6. (12 pts) Shown below are three proposed methods for synthesizing isopropyl methyl ether using substitution chemistry. Circle the letter of the preferred method. Briefly explain what is bad about the non-preferred syntheses.

(a) \( \text{Br} + \text{CH}_3\text{ONa} \rightarrow \text{OCH}_3 \)  
(b) \( \text{OH} + \text{CH}_2\text{Br} \rightarrow \text{OCH}_3 \)  
(c) \( \text{ONa} + \text{CH}_2\text{Br} \rightarrow \text{OCH}_3 \)

Preferred / not preferred because:

7. (10 pts) Propose a synthesis of pentane starting with 1,1-dibromopropane. You may use any other needed reagents. More than one reaction may be necessary. Mechanisms are not required.

8. (16 pts) Answer the questions below for the reaction shown to the right.

a. Write a kinetic rate expression for the reaction:
   \[ \text{rate of product formation} = \]

b. Draw a labeled reaction coordinate for the reaction. You may assume that the products are lower in energy than the reactants.

c. Will the rate of the reaction change if some water is added to the solvent? Explain. Be specific.
CHEMISTRY 301
11:15 AM Section
EXAM 3
23 Nov 2009

Name: __________________________________________

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<thead>
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<th>Page</th>
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