CHM 1321C
Final Exam

April 2007 Alison Flynn

Time: 3 hours

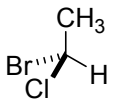
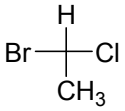
Name: _____

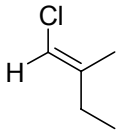
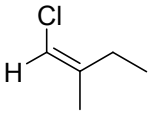
Student Number: _____

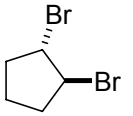
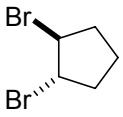
Notes:

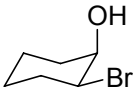
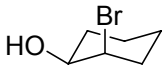
- Attempt all questions
- The marks are given as a guide and are subject to minor changes
- A calculator and molecular models are permitted
- When key ideas such as "resonance" are used in explanations, draw structures to prove your point
- Show relative stereochemistry where applicable
- Total number of pages: 16
- Approximate number of points: 185

1. Identify the stereochemical relationship between the following molecules (enantiomers, diastereomers, constitutional isomers, same molecule, other). (**4 points**)

   a.  and  Relationship: _____

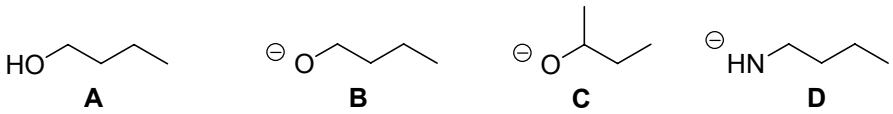
   b.  and  Relationship: _____

   c.  and  Relationship: _____

   d.  and  Relationship: _____

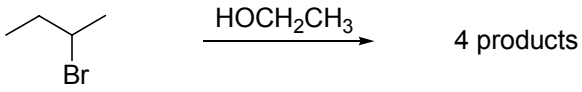
2.

   a. Arrange the following molecules in order of **increasing nucleophilic ability** in an S_N2 reaction. (**1 point**)

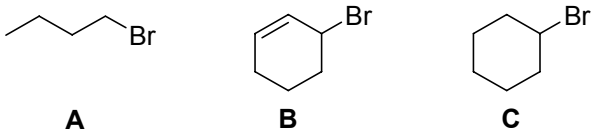


   b. Explain the difference in nucleophilic ability between **B** and **D**. (**3 points**)

3. The following reaction gives four (4) possible products.
    a. Draw mechanisms to account for the formation of each product. (**14 points**)
    b. Circle the major alkene product. (**1 point**)



4. Arrange the following electrophiles in order of increasing reactivity in an $\mathbf{S_N1}$ reaction. (**1 point**)
   a.



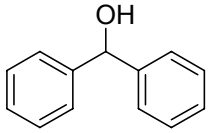
A **B** **C**

   b. Clearly explain the difference in reactivity between **B** and **C**. Your answer should include a reaction coordinate diagram and a discussion of the Hammond postulate. (**10 points**)

5.

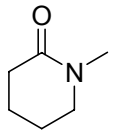
a. Draw a mechanism for the acid/base reaction shown below. (**5 points**)
b. Does the equilibrium favor the starting materials or the products?(**1 point**)
c. Explain your answer in part b. (**4 points**)

6. Suggest **two** different ways to synthesize the following alcohol from a carbonyl compound. Mechanisms are not required. (**5 points**)



7.

a. Draw the resonance structures for the following amide, including arrows showing the movement of electrons. (**5 points**)

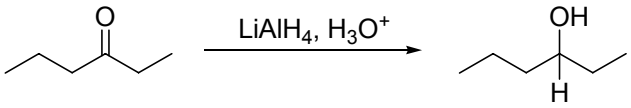


b. Identify the major, minor, and intermediate (if applicable) structures and explain your choices. (**7 points**)

c. Draw the resonance hybrid structure. (**3 points**)

d. What is the physical significance of the resonance hybrid structure? (**2 points**)

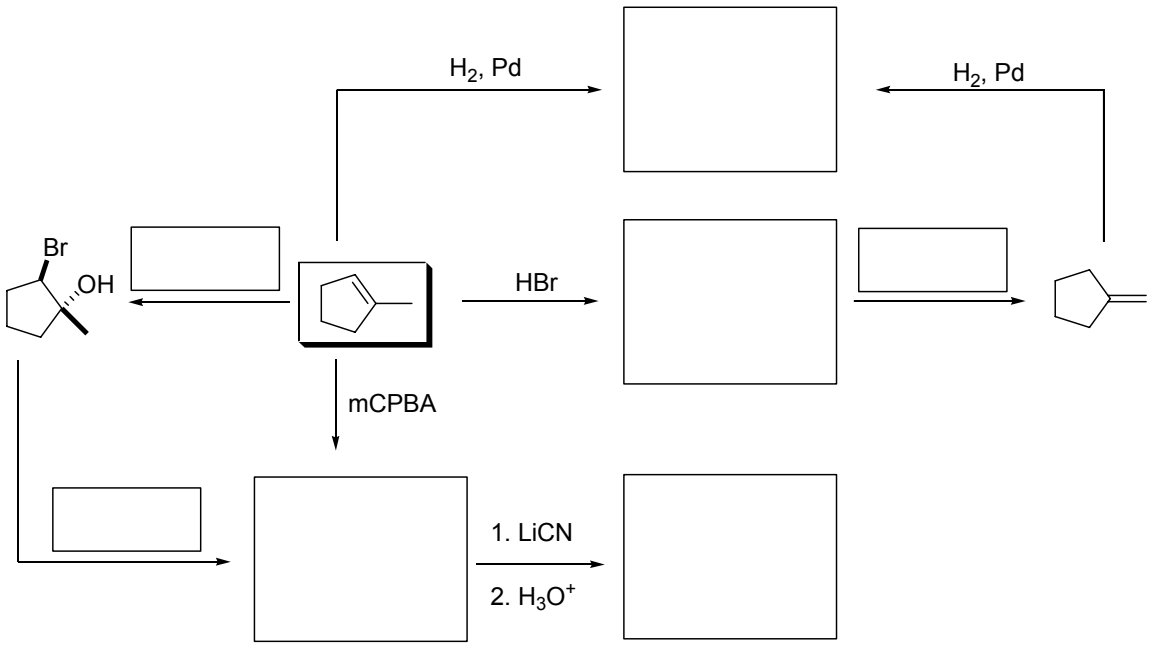
8. The following reaction will **not** give the product shown:



a. Explain why not by showing the reaction that would take place. (**2 points**)

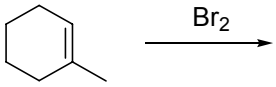
b. Suggest a solution to this problem in order to obtain the desired product. (**2 points**)

9. Fill in the boxes with the missing reagents, starting materials, or products as required. Be sure to show relative stereochemistry where applicable. (**10 points**)



10.

a. Give a mechanism for the following reaction: (**9 points**)



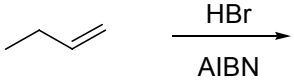
b. Is this reaction regioselective or regiospecific? Explain. (**4 points**)

c. Is this reaction stereoselective or stereospecific? Explain. (**4 points**)

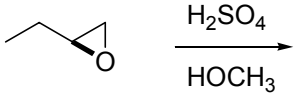
11. Give the products of the following transformations. (**14 points**)

Note: - "No reaction" is **not** a possible answer.
- Mechanisms are not required but part marks might be given for an incorrect answer with a reasonable mechanism.

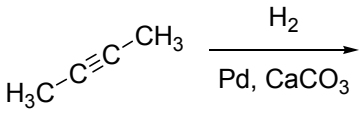
a.



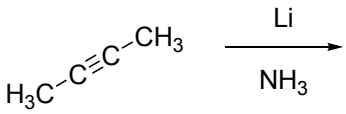
b.



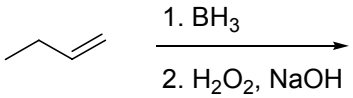
c.



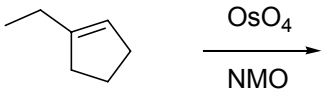
d.



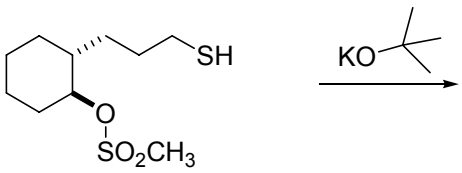
e.



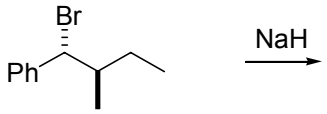
f.



g.



12.



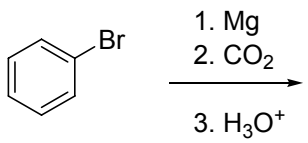
a. Draw a mechanism in **2D** for the elimination reaction shown above, ignoring stereochemistry. (**4 points**)

b. Draw a Newman projection of the starting material in its reactive conformation. (**2 points**)

c. Draw the final product of this reaction with the correct stereochemistry. (**2 points**)

13.

a. Give a mechanism for the following reaction. (**11 points**)



b. Why was it important to use obtain dry ice **immediately before** using it in the laboratory? (**2 points**)

c. Calculate the yield if a student began the experiment with 3.0 mL of bromobenzene (density = 1.5 g/mL, molar mass = 157 g/mol) and obtained 2.9 g of white crystals at the end of the reaction (molar mass of product = 122 g/mol). Please clearly show your calculations. (**3 points**)

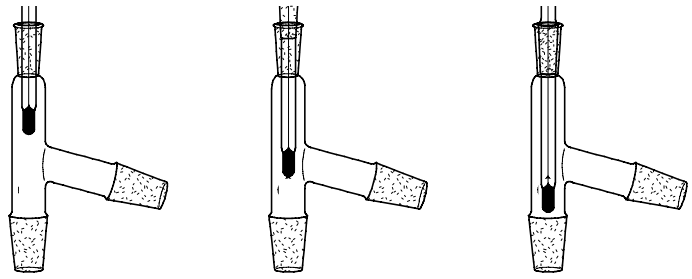
d. How could you verify that the white crystals were the desired product? (**1 point**)

14. Describe how you would separate a mixture of benzyl amine and benzophenone. Both compounds are soluble in EtOAc. (**10 points**)
Be specific – a first year student should be able perform the separation by following your instructions.

15.

a. Draw a diagram for a simple distillation and label all the parts. (**10 points**)

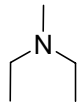
b. Circle the diagram that shows the correct placement of the thermometer during a distillation. (**1 point**)



c. Explain your choice in part b. (**2 points**)

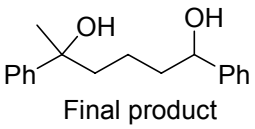
16. Suggest a synthesis of the following molecule from starting materials that possess two carbons or less. (**12 points**)

    Notes:
    - Your answer must include a retrosynthetic analysis as well as a synthesis.
    - Mechanisms are not required.



17. Suggest a synthesis of the following molecule from methylenecyclopentane. (**14 points**)

Notes:
- Your answer must include a retrosynthetic analysis as well as a synthesis.
- Mechanisms are not required.

Synthesize: 

Final product

from: