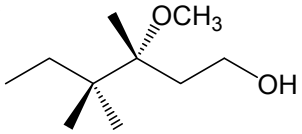
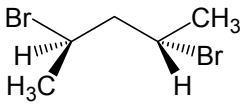
CHEM221 Section 01 Dr. C. Rogers **NAME:**

INTRODUCTORY ORGANIC CHEMISTRY I --- **PROBLEM SET #3**

INSTRUCTIONS: HAND IN STAPLED, COMPLETED ASSIGNMENT (no extra pages please) **AT THE BEGINNING OF CLASS on Tues.Nov.29.** LATE SUBMISSIONS WILL **NOT** BE ACCEPTED (EARLY IS OK). ANSWER ALL QUESTIONS, ALL MATERIAL WILL BE COVERED BEFORE THE DUE DATE.

 # 1. Provide complete systematic (IUPAC) names for the following molecules, including R/S configuration where appropriate. Also, if the molecule is chiral, draw its enantiomer; if it is achiral, indicate why.

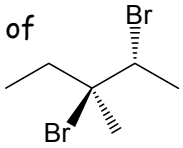
i) 

ii) 

 # 2. Draw skeletal (line) structures of the following molecules, showing stereochemistry. Also, indicate each chiral center in your structures using an asterisk (*).

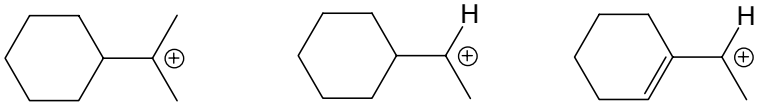
i) (R)-3-bromocyclopentene

ii) the enantiomer of (1S, 2S)-fluorochloropropan-2-ol

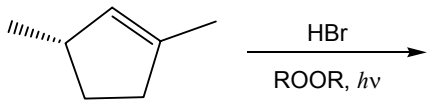
iii) a diastereomer of 

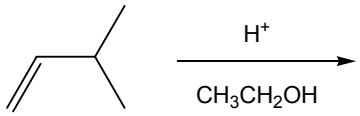
iv) an achiral isomer of 1,3-dimethylcyclohexane

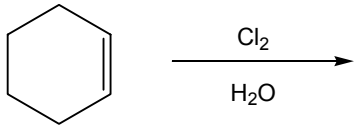
 # 3. Rank these carbocations according to their relative stability. Justify your choice with a few words about <u>each</u> structure.

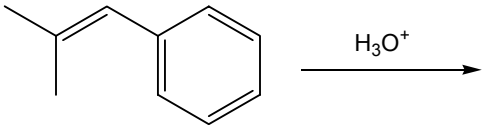


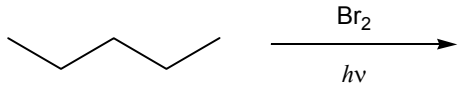
 # 4. Draw structures of the major regiochemical products of the following reactions. If more than one stereoisomer can form, draw them all (use dashes/wedges) and indicate the relationships between them.

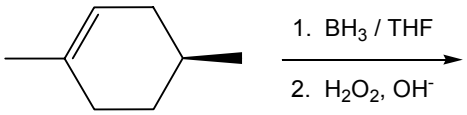
a) 

b) 

c) 

d) 

e) 

f) 

g) 

 # 5. Imagine you are going to brominate cyclopentene in the lab. You plan to use cyclohexane as the solvent for your reaction. Your supervisor told you to cover your flask with foil during the reaction.

a) What reagent and conditions will you use to bring about the bromination of cyclopentane?

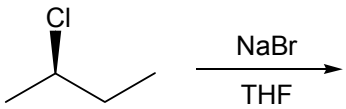
b) What is the desired product(s) of your bromination reaction? Include stereochemistry.

c) Explain why it is a good idea to cover your flask with foil for this reaction.

d) What side product(s) might you obtain if you did not cover your flask with foil? Include stereochemistry.

 # 6. Predict the major products of the following substitution reactions; include stereochemistry. Identify the mechanism (S_N1 *vs.* S_N2) that would lead to the products you have chosen.

a)



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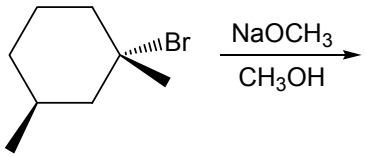
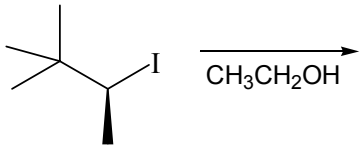
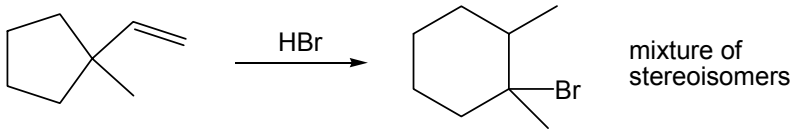


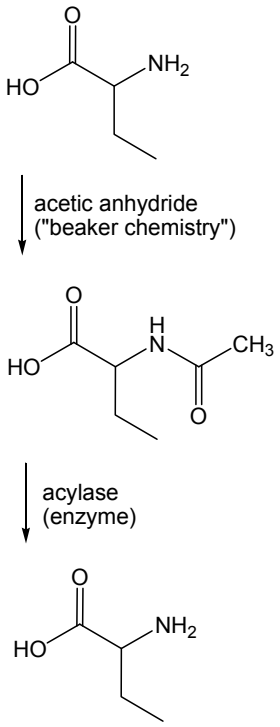
c)



 # 7. Provide a detailed "arrow-pushing" mechanism to explain the outcome of this reaction:



 # 8. Imagine you have prepared an unnatural amino acid (shown at top right) in the lab. The synthetic pathway you used yielded a racemic mixture, and you want to prepare a pure sample of the L enantiomer, as amino acids are found in nature. Instead of taking advantage of reversible acid-base chemistry to separate diastereomeric salts, you have chosen to use a different approach. To resolve the enantiomers, you will first react the racemate with a compound that yields a new set of "acylated" enantiomers (shown at middle right; don't worry about the reaction involved); secondly, you will treat the mixture with an enzyme called *acylase*, which cleaves bonds between N atoms & carbonyl C atoms. This will regenerate the amino acid (shown at bottom right). Because the enzyme is chiral and evolved to react with L amino acids, your D enantiomer will be left in the "acylated" form after the enzymatic step.



a) If you measure the optical rotation of the initial mixture of amino acid enantiomers, what will you observe? Why?

b) Why should you be able to separate the L amino acid and the "acylated" D amino acid using typical physical methods?

c) Describe briefly how you could use optical rotation to help you while separating the L amino acid and the "acylated" D amino acid.