Name: _____

Whittier College

Organic Chemistry: CHEM 231B

Test # 1

115 Points Total

February 24, 2004

1. Multiple Choice Questions: Circle the letter corresponding to the single, most appropriate answer. (15 points = 3 pts each)

1a. Which of the following methyl groups will exhibit the highest chemical shift in 1H-NMR spectroscopy?

a) methyl amine
b) methanol
c) acetone (2-propanone)
d) propane
e) methylbenzene (toluene)

1b. How many proton NMR singlets will 2-bromo-3-methyl-2-butene exhibit?

a) 1
b) 2
c) 3
d) 4
e) 0

1c. Which of the following alkenes reacts with aqueous hydrochloric acid at the slowest rate?

a) 3-methyl-1-butene
b) 2-methyl-1-butene
c) 2-methyl-1-pentene
d) 2-methyl-2-butene
e) 2,3-dimethyl-2-pentene

1d. Which of the following electromagnetic waves are used in NMR Spectroscopy?

a) X-ray
b) infrared
c) ultraviolet
d) radio
e) microwave

1e. What is the major product for the reaction of 1-methylcyclopentene with hydrochloric acid?

a) 1-chloromethylcyclopentene
b) 1-chloro-1-methylcyclopentane
c) 1-chloro-2-methylcyclopentane
d) 1-chlorocyclohexane
e) 1-chloro-2-methylcyclopentene

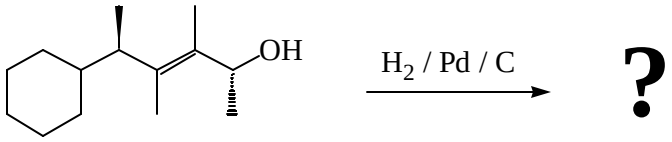
2. Provide answers to the following questions: (24 pts total = 8 pts each)

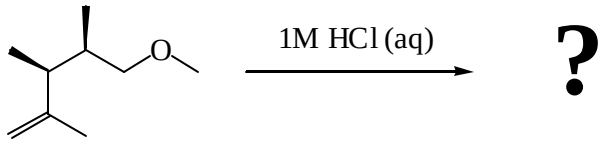
2a. Why does coupling exist in NMR spectroscopy? Explain in both general and specific terms.

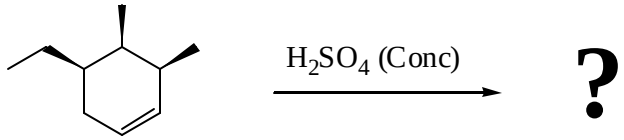
2b. What is IR Spectroscopy? What information does it provide for us? Briefly explain the theory behind it.

2c. What is the structure/shape of an alkene? Draw it. How does this structure explain the reactivity of alkenes? Explain briefly.

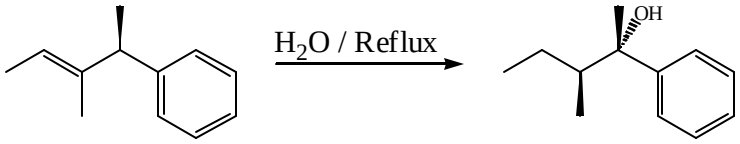
3. Consider the following reactions. Predict the single MAJOR product and briefly explain your answer. Mechanisms are NOT required, but may be used. Pay close attention to stereochemical issues: (24 points – 8 points for each)

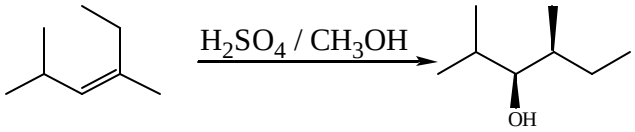
3a. 

3b. 

3c. 

4. Consider the following reactions. For each reaction, discuss whether the reaction will occur as drawn. Explain your rationale. If the reaction will not occur as drawn, suggest an alternate outcome and explain briefly. (20 points, 10 points each)

4a. 

4b. 

5. On the backside of each test page are spectral data for Z-3-hexen-1-ol. Using these data, correlate the data with the structure of the molecule by answering the following questions (32 points)

5a. How does the mass spectrum of Z-3-hexen-1-ol relate to the structure? Explain very briefly (2 pts)

5b. What specific information does the IR spectrum provide for Z-3-hexen-1-ol? Explain briefly (4 pts).

5c. How does the experimental ^{1}H-NMR correlate with the theoretical predictions for Z-3-hexen-1-ol? Be specific, ensuring that each piece of data is accounted for. If the theoretical does not match the experimental results, briefly explain why this may be the case. Look at question 5d when answering this question, as the two questions are related to each other. (8 pts)

5d. Are you sure this molecule is the Z alkene and not the E alkene? How can you be sure? Demonstrate your proficiency using all appropriate means. (aka: assess all data that will allow one to differentiate between the two, including a drawing of an accurate coupling tree for each alkene) (6 pts)

5e. What specific information does the ^{13}C NMR and DEPT spectra provide? Ensure that you are extremely specific about what information it provides. You should be able to correlate each peak with a specific facet of the structure. (4 pts)

5f. What specific information does the COSY spectrum provide? Does this information help explain any other oddities of the 1D ^{1}H-NMR? Explain briefly. (4 pts)

5g. What specific information does the HETCOR spectrum provide? Explain briefly (4 pts)