

Exam 1: Ch 1-5

Name _____

Thursday, September 11th 2008

ID _____

Chem 240
Khuong

Sec 01
100 pts total

PAGE NO.	POINTS POSSIBLE	POINTS EARNED
2	22	
3	30	
4	20	
5	20	
6	11 + 5	
TOTAL	103 + 5	/100

INSTRUCTIONS:

Perform each of the following exercises. Read the question again after you have answered it. Use correct arrow notation on all resonance structures and mechanisms.

1. For each of the following molecules draw a three dimensional representation showing bond angles and hybridization at each non-hydrogen atom. 12 pts

NaCl

CH₃CN

HNO₃

CH₂(CHO)₂

2. The organic compounds in Problem 1 are significantly more acidic than typical sp³ C-H. Explain. 5 pts

3. Predict the IR spectrum of carbon monoxide. Explain. 5 pts

4. Draw at least 5 isomers with the molecular formula, C_5H_9ON . Incorporate as many different functional groups as possible and then predict the isomers with the highest and lowest boiling points. Explain briefly. 10 pts
5. Amides are known to be slightly basic. Draw the structure of an amide containing four carbons. Draw a circle around the basic site(s) of the amide. Explain your choice. 10 pts
6. Draw the three dimensional structures of a carbocation and a carbanion each containing three carbons. Explain why you chose these structures. 10 pts

7. Circle each of the following solvents that should be capable of dissolving ionic compounds. Explain briefly. 10 pts

THF



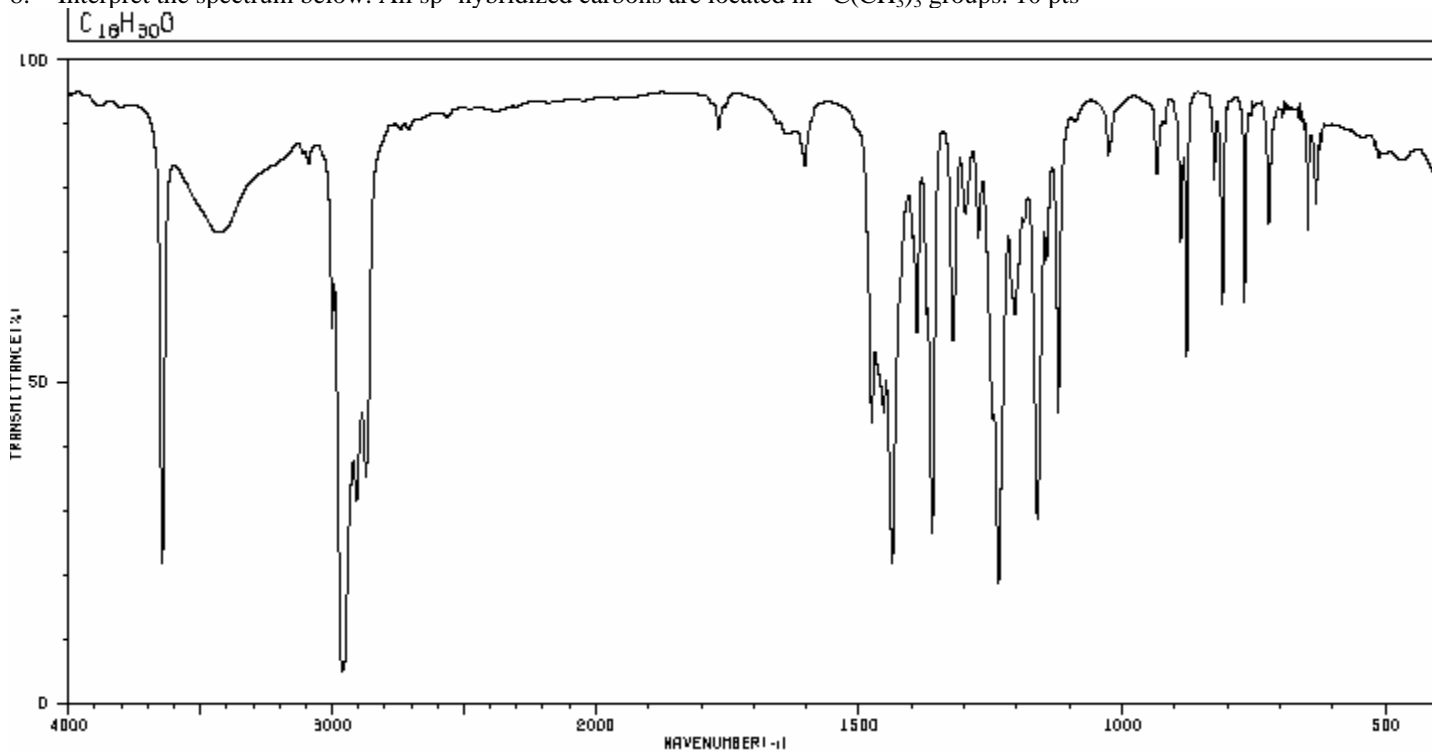
Liquid NH_3

Benzene



CCl_4

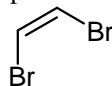
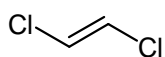
8. Interpret the spectrum below. All sp^3 hybridized carbons are located in $-\text{C}(\text{CH}_3)_3$ groups. 10 pts



9. Draw an energy diagram showing the relative energies of sigma and pi bonding and antibonding molecular orbitals connecting the carbon atoms in ethene (C_2H_4). Which MO's are occupied? Explain. 10 pts

10. Aqueous formaldehyde (CH_2O) exists in an equilibrium with species called an acetal, $CH_2(OH)_2$. Draw a reasonable mechanism for the conversion of formaldehyde to the acetal. 10 pts

11. The melting points of the molecules below are similar (-50 and -53 C, respectively) but their boiling points are quite different (48 and 113 C, respectively). Is this expected? Propose a rationale for this phenomenon. 5 pts



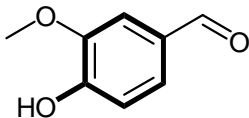
12. Consider a solution prepared by dissolving solid sodium cyanide (NaCN) in water. 6 pts

a) Write the equation for the process.

b) If the pKa of water is 15.7 and that of hydrogen cyanide is 9.2, which species in the equation are favored?

c) Draw the mechanism of the reaction.

- EC. Vanillin (shown below) is the main component of vanilla extract. Predict the relative acidity of vanillin with respect to phenol $\text{C}_6\text{H}_5\text{-OH}$ (part in bold). 5 pts



Exam 2: Ch 4-6
Tuesday, October 14th 2008
Chem 240
Khuong

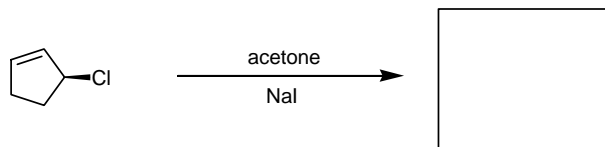
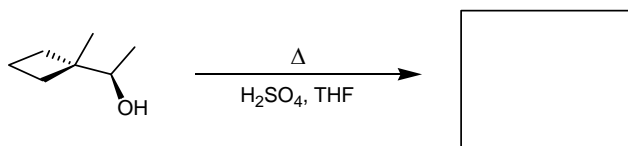
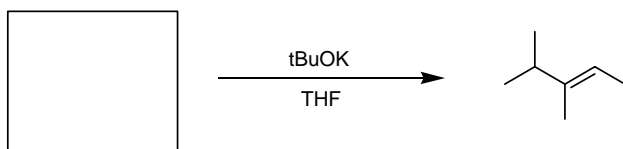
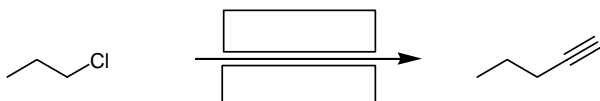
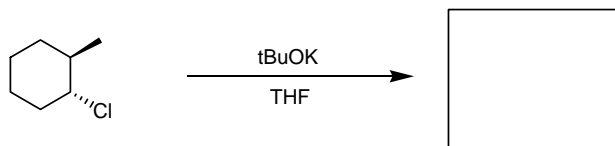
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Sec 01
100 pts total

PAGE NO.	POINTS POSSIBLE	POINTS EARNED
2	30	
3	26	
4	21	
5	26	
6	5	
TOTAL	108	/100

INSTRUCTIONS:

Perform each of the following exercises. Read the question again after you have answered it. Use correct arrow notation on all resonance structures and mechanisms.

1. Complete each reaction below. In cases where products are missing, draw the major product. If necessary, use extra space on the right for brief explanations or possible alternatives. 20 pts



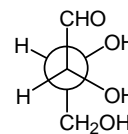
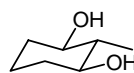
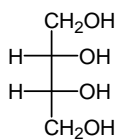
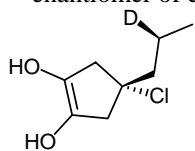
2. Write unambiguous names under each of the structures given in Problem 1. 5 pts
 3. Draw a structure under each of the following names. 5 pts

(R)-5-*sec*-butyl-1-nonanol

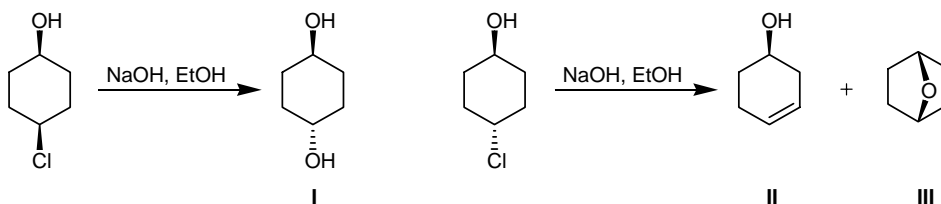
cis-1,3-dimethylcyclohexane

bicyclo[2.2.1]-2-heptene

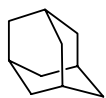
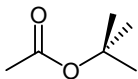
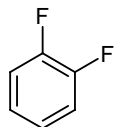
3. Assign the absolute configuration to each stereogenic center in the molecules below. If possible, draw a diastereomer and the enantiomer of each of the following compounds. If it is not possible, explain briefly. 16 pts



4. When cis-4-chlorocyclohexanol is treated with sodium hydroxide in ethanol, it gives mainly the substitution product trans-1,4-cyclohexanediol (1). Under the same reaction conditions, trans-4-chlorocyclohexanol gives 3-cyclohexenol (2) and the bicyclic ether (3). Propose mechanisms for the formation of compounds 1-3. 10 pts



5. Predict the ^{13}C NMR spectra for the compounds below. Label each unique carbon and show the number, intensity and location of the signals. 6 pts

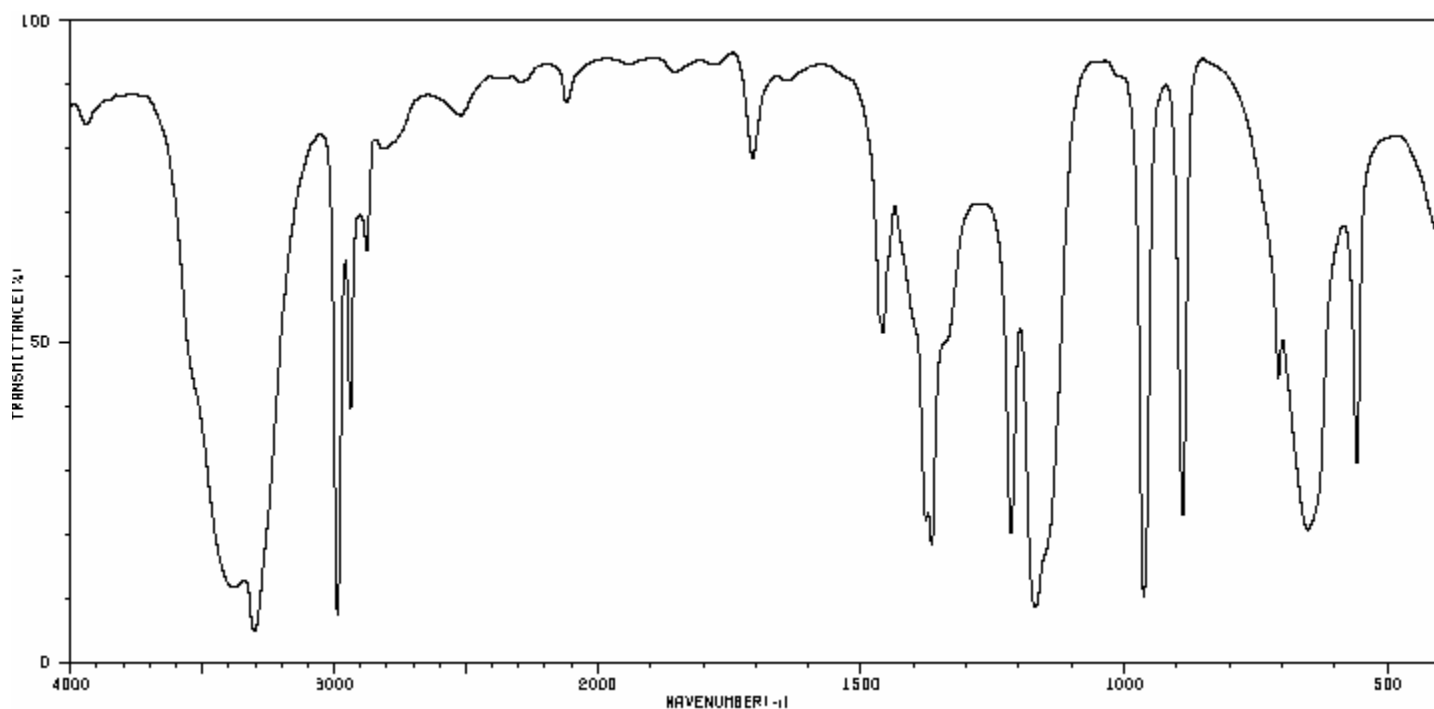


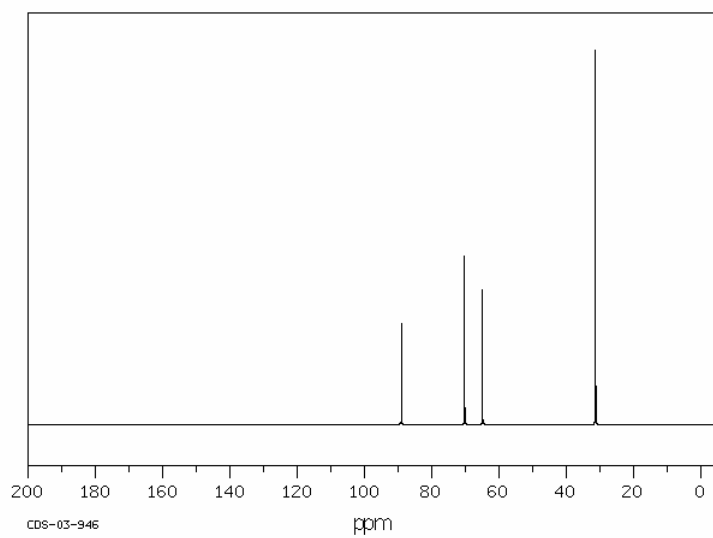
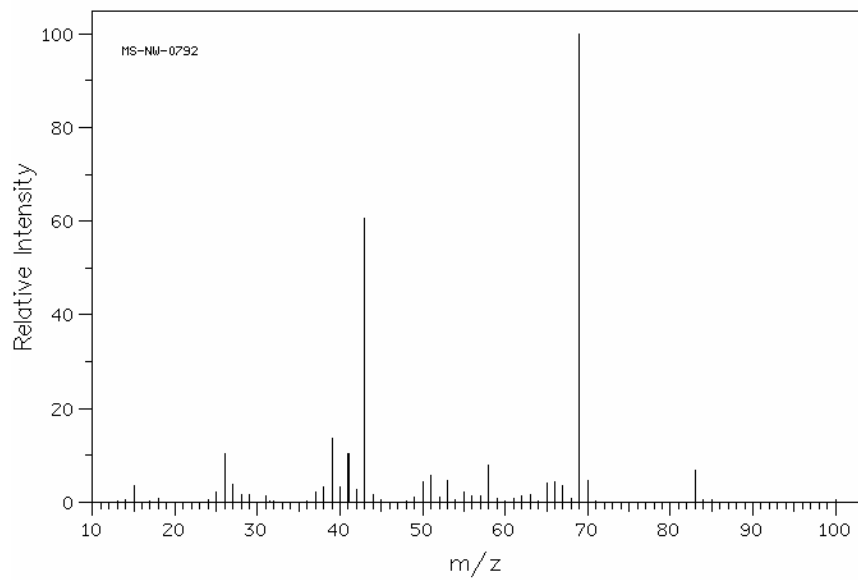
6. The chair conformation of cyclohexane is approximately 30 kJ/mol more stable than the boat conformation. Explain the origin of this energy difference using structural representations. 10 pts

7. A cylinder measuring 1.000 dm in length is filled with a 3.00 M solution made from pure water and a very old sample of D-(+)-glucose ($[\alpha]^{25} = +52.6^\circ$) of questionable origin. The optical rotation is measured at $+42.2^\circ$. Is this a pure sample? What is the ee of the sample? Thoroughly explain your conclusion. 5 pts

8. Draw a detailed mechanism including any transition states and intermediates for the reaction of hydroxide ion and chloromethane. Use an energy diagram to map the mechanism and show the effect of a polar protic solvent versus a polar aprotic solvent on the system. 15 pts

9. Determine the exact structure of the compound corresponding to the following spectra. The compound consists of carbon, hydrogen and oxygen only. The molecular ion is found at 84 mass units. 11 pts





10. Draw a structural formula for the most stable carbocation of each molecular formula. 5 pts



Exam 3: Ch 7-8
Thursday, November 6th 2008
Chem 240
Khuong

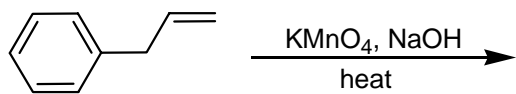
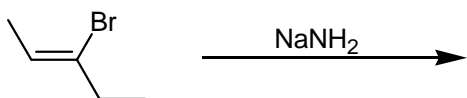
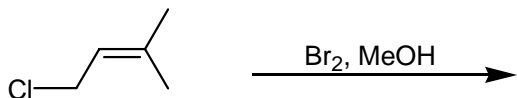
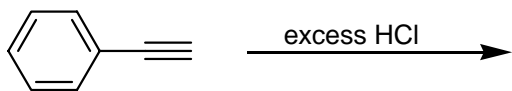
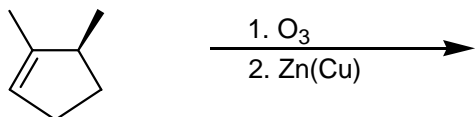
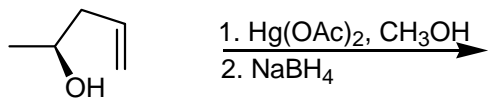
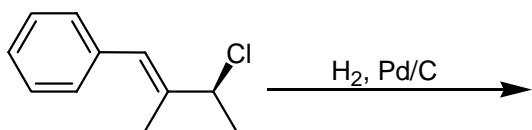
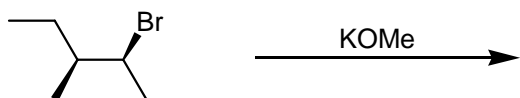
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Sec 01
100 pts total

PAGE NO.	POINTS POSSIBLE	POINTS EARNED
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6	--	
TOTAL	107	/100

INSTRUCTIONS:

Perform each of the following exercises. Read the question again after you have answered it. Use correct arrow notation on all resonance structures and mechanisms.

1. Draw the major product(s) of each reaction below. Use extra space on the right for brief explanations. 32 pts

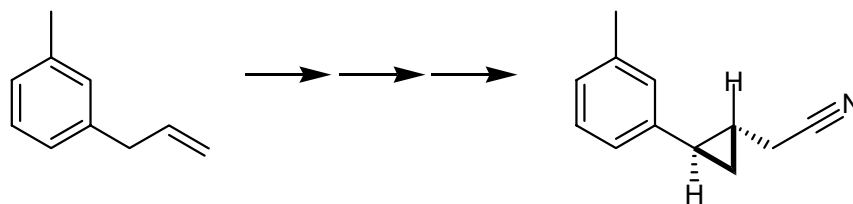


2. Draw a structure under each of the following names. 5 pts

(Z)-3-methyl-2-pentene

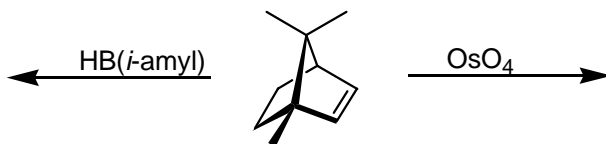
(2E,3Z)-4-bromo-3-methyl-2,3-hexadiene

3. Write a reasonable synthesis for the following: 10 pts

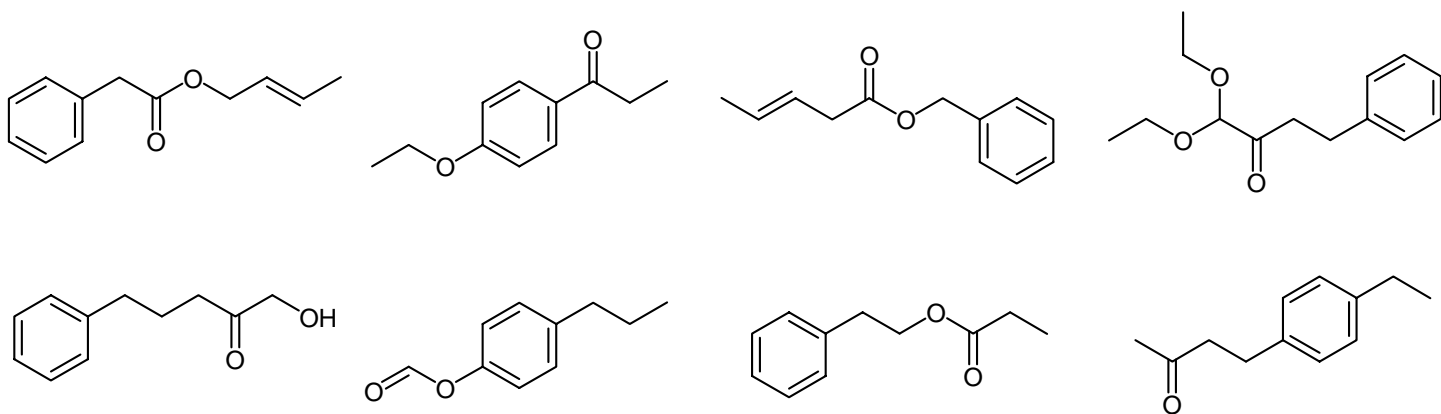
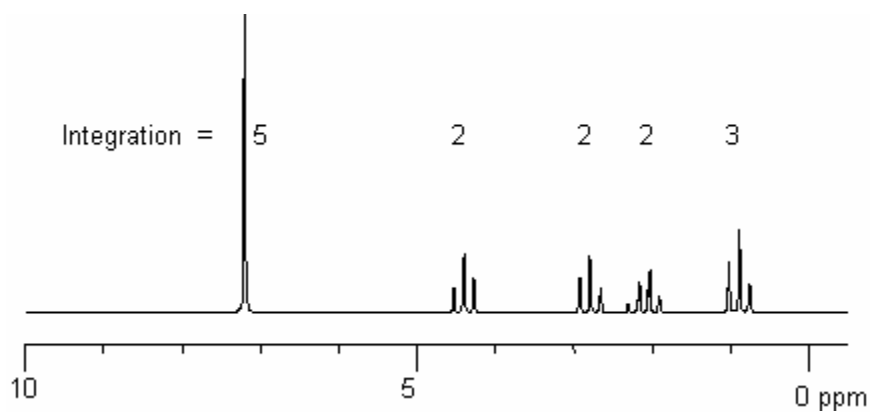


4. Draw an energy diagram comparing the hydrogenation of all of the isomers with the formula C_5H_{10} and showing at least one 1H NMR signal between 6 and 7 ppm. Assume the reactants are much higher in energy than the products. 15 pts

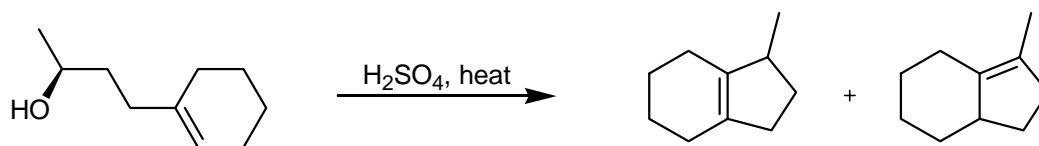
5. Treatment of the compound below with osmium tetroxide or borane reagents yields only one product in each case. Draw the structure of the product of each reaction and briefly explain why additional products are not obtained. 10 pts



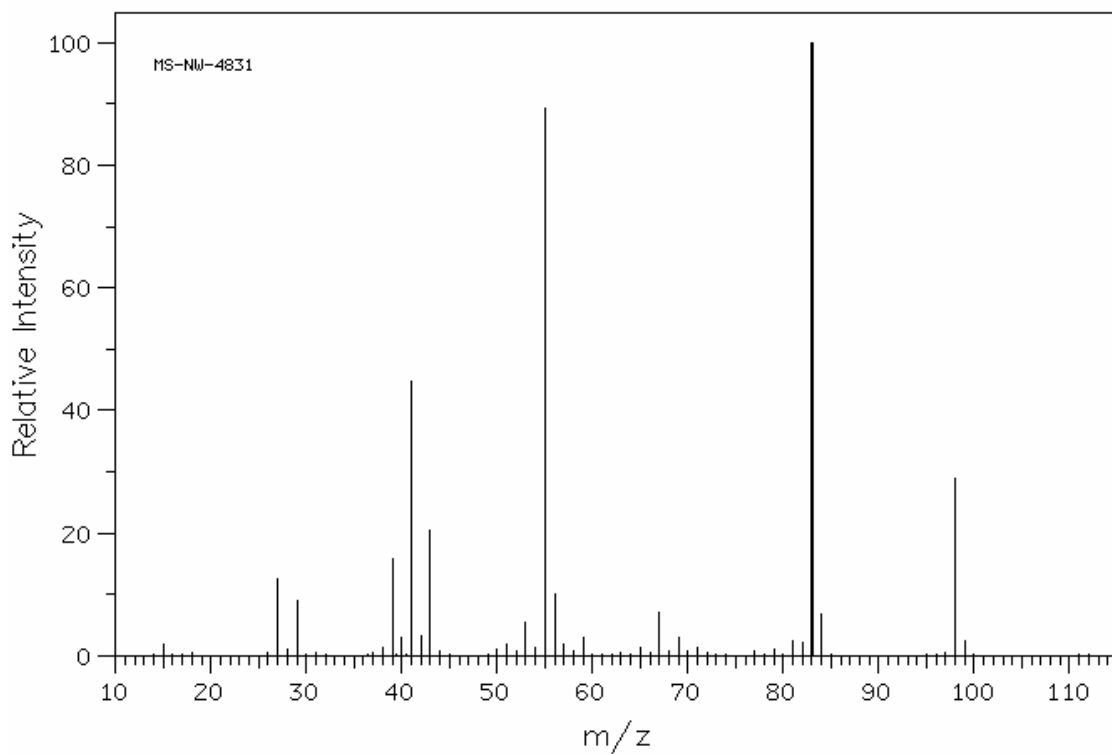
6. Circle the molecule that corresponds best with the following ^1H NMR spectrum. Briefly explain your choice. 10 pts

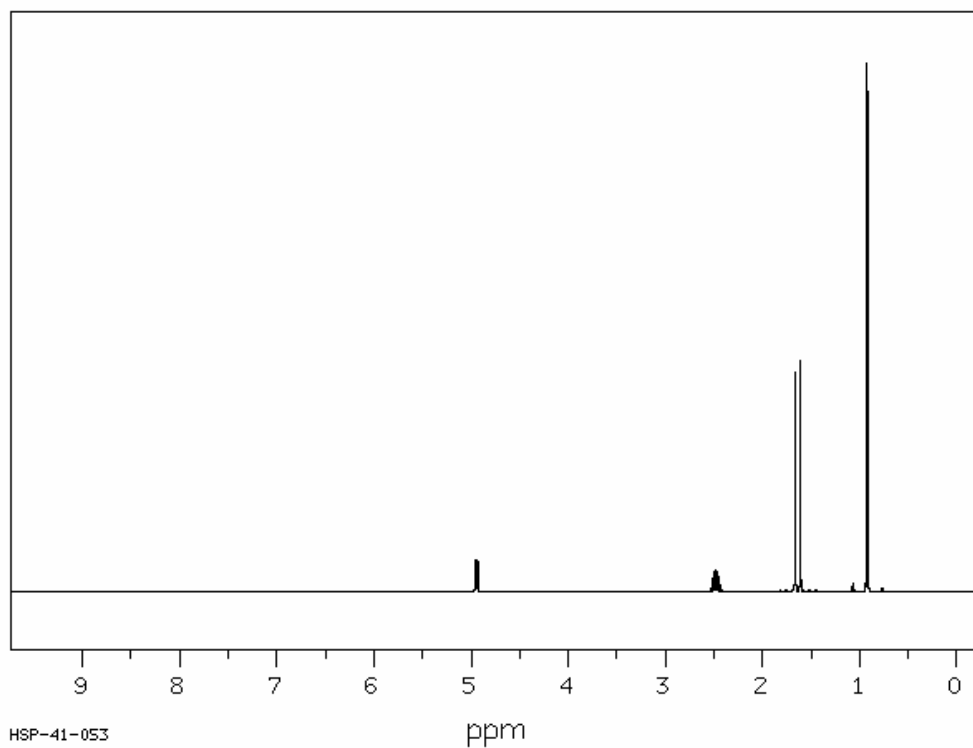
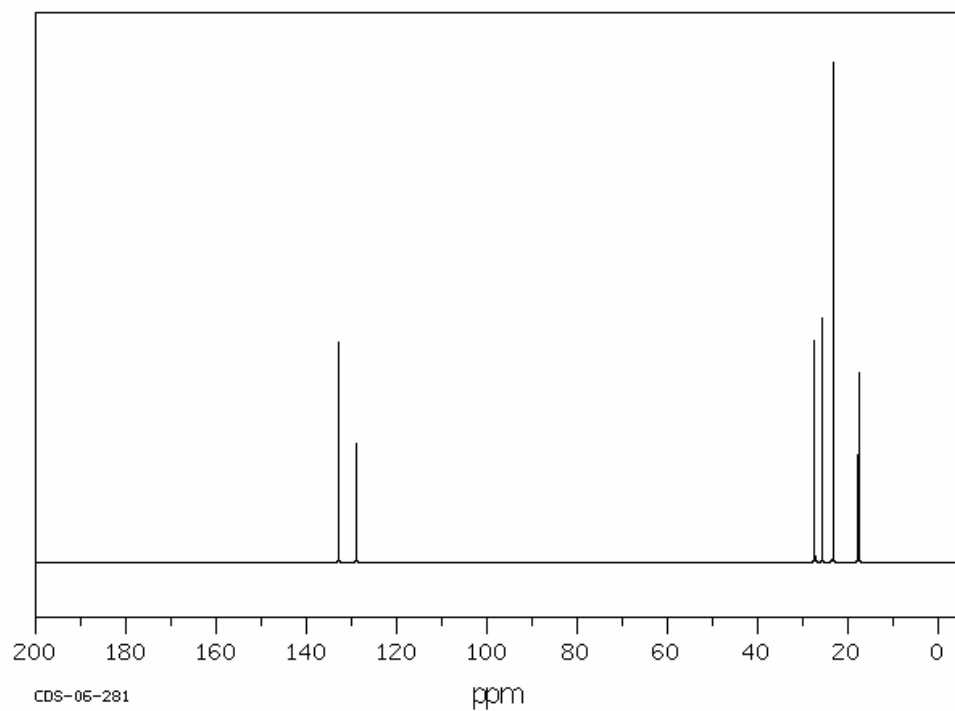


7. Write a reasonable mechanism for the following transformation. 10 pts



8. Determine the exact structure of the compound corresponding to the following spectra. The compound consists of carbon, and hydrogen only. 15 pts





Integrations (left to right): 1H doublet, 1H mult, 6H doublet, 6H doublet.

Exam 4: Ch 10-12
Thursday, December 4th 2008
Chem 240
Khuong

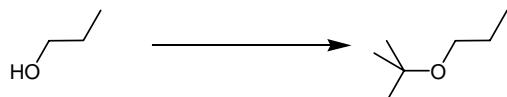
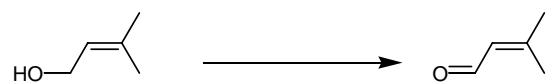
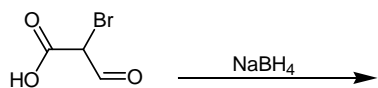
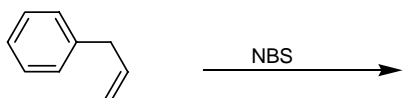
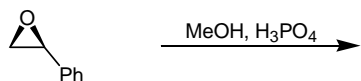
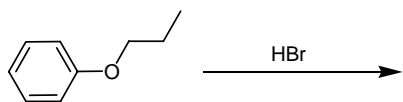
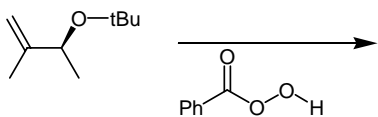
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Sec 01
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PAGE NO.	POINTS POSSIBLE	POINTS EARNED
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3	20	
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6	15	
TOTAL	103 +5	/100

INSTRUCTIONS:

Perform each of the following exercises. Read the question again after you have answered it. Use correct arrow notation on all resonance structures and mechanisms.

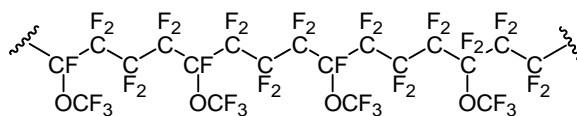
1. Draw the major product(s) of each reaction below. Use extra space on the right for brief explanations. 28 pts



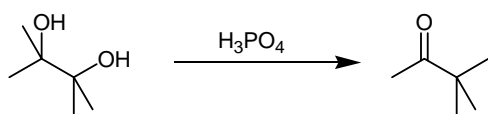
EC. List the potential challenges that the HP inkjet chemists face when formulating an ink. 5 pts

2. Diethylcarbonate ($\text{CO}(\text{OEt})_2$) reacts with methylmagnesium bromide to form a single product that gives a molecular ion at 74 amu and a base peak at 57 amu. The C-13 NMR gives two signals at 64 and 12 ppm, respectively, and the infrared spectrum shows a broad signal centered at 3100 wavenumbers. Deduce the structure of the product and give a reasonable mechanism for its formation. 10 pts

3. One of the polymers marketed as Teflon (see structure below) is derived from a mixture of two units that are combined via radical mechanism. Determine the structures of the two units. 10 pts

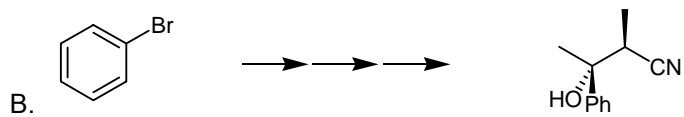
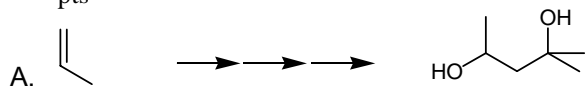


4. Write a detailed mechanism for the transformation below. 10 pts



5. Draw the initiation, propagation and termination steps for the radical addition of hydrobromic acid to 2-methyl-2-butene. 10 pts

7. Give at least one possible sequence of reactions for each of the following transformation. You may use any reagents necessary as long as propene is your only source of carbon in problem A and no reagent you use in problem B has more than four carbons. 20 pts



8. Determine the exact structure of the compound corresponding to the following spectra. 15 pts

