NAME (Print): _____

SIGNATURE: _____

Chemistry 310N
Dr. Brent Iverson
1st Midterm
Feb. 23, 2006

Please print the first three letters of your last name in the three boxes

Please Note: This test may be a bit long, but there is a reason. I would like to give you a lot of little questions, so you can find ones you can answer and show me what you know, rather than just a few questions that may be testing the one thing you forgot. **I recommend you look the exam over and answer the questions you are sure of first**, then go back and try to figure out the rest. Also make sure to **look at the point totals** on the questions as a guide to help budget your time.

For synthesis problems GO FOR PARTIAL CREDIT EVEN IF YOU DO NOT KNOW THE ENTIRE ANSWER!!!WRITE DOWN WHAT YOU DO KNOW IS IN THE REACTION SEQUENCE SOMEWHERE. YOU WILL GET PARTIAL CREDIT IF IT IS CORRECT

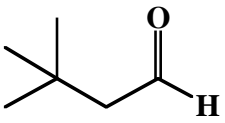
Note: You must have your answers written in pen if you want a regrade!!!!

Page	Points	
1		**(22)**
2		**(22)**
3		**(32)**
4		**(5)**
5		**(5)**
6		**(5)**
7		**(5)**
8		**(5)**
9		**(12)**
10		**(21)**
11		**(19)**
12		**(18)**
13		**(20)**
14		**(13)**
15		**(13)**
16		**(16)**
Total		**(233)**
HW		
T Score		

Type of Hydrogen (R = alkyl, Ar = aryl)	Type of Hydrogen (R = alkyl, Ar = aryl)
R_2NH	RCH_2OH
ROH	RCH_2Br
RCH_3	RCH_2Cl
RCH_2R	$RCOCH_3$
R_3CH	$RCOCH_2R$
$R_2C{=}CRCHR_2$	RCH_2F
$RC{\equiv}CH$	$ArOH$
$RCCH_3$	$R_2C{=}CH_2$
$RCCH_2R$	$R_2C{=}CHR$
$ArCH_3$	$H_2C\overset{O}{\diagup\diagdown}CH_2$
RCH_2NR_2	RCH
RCH_2I	$RCOH$
RCH_2OR	

* Values are relative to tetramethylsilane. Other atoms within the molecule may cause the signal to appear outside these ranges.

1. (4 pts each) In the space provided, write the IUPAC name (including stereochemistry where appropriate) for the following two molecules:



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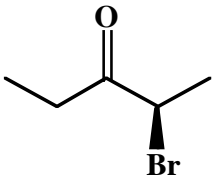
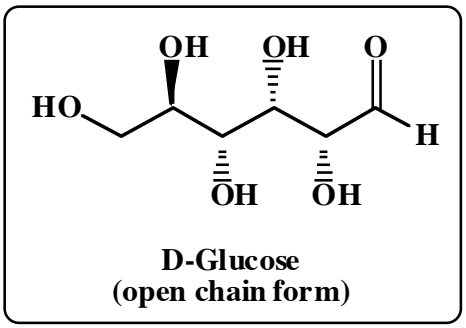


_____

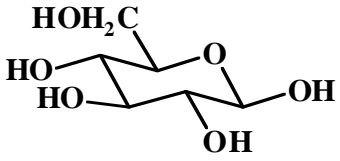
2. (4 pts) In the space provided, draw the following molecule:

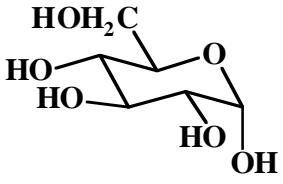
(*E*)-5-Oxo-2-hexenal

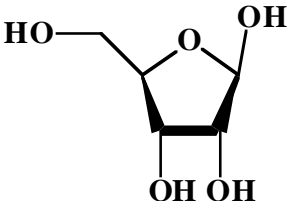
3. (10 pts total) On the lefthand side, D-glucose is drawn in the open chain form. For the four cyclic structures shown, draw a large "X" through the two structures that DO NOT represent the cyclic form of the D-Glucose molecule. Next, for the structures that ARE the cyclic forms of D-Glucose 1) draw small boxes around the anomeric carbon atoms then 2) draw a circle around the structure that is in the alpha (α) form

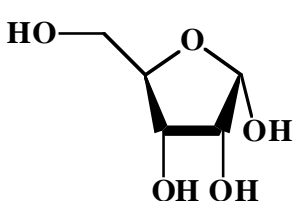


D-Glucose
(open chain form)









4. (2 pts each) In each sentence, fill in the blank with the word that fits the best. You may notice a striking resemblance between these sentences and rules of the day!!!

Atomic nuclei, like electrons, have a quantum mechanical property of _____,

which can be thought of as a small magnetic field around the nucleus created as if the

_____ charge of the nucleus were circulating.

The difference in energy between the +1/2 and -1/2 nuclear spin states is proportional to the strength

of the _____ field felt by the nucleus.

Electron density is induced to _____ in a strong external magnetic field, which

in turn produces a magnetic field that _____ the external magnetic field. The

greater the electron density around a nucleus, the more _____ it is, and the lower

the energy (frequency) of electromagnetic radiation required to flip its nuclear spin.

_____ hydrogen atoms in a molecule give the same NMR signal, because they have an

identical relationship to all the other atoms in the molecule.

THEORY: When there are two sets of adjacent H atoms, the number of peaks _____.

For example, a CH_2 group with a CH_2 group and a CH_3 group on either side shows a theoretical

maxium of _____ peaks in its signal!

PRACTICE: For alkyl groups that can rotate freely, complex splittings simplify because the

_____ constants ("J") are all about the same. In practice, if there are *n* adjacent

H atoms, equivalent or not, you will see _____ peaks in a signal. This is an

approximation, but almost always true on spectra taken with all but the most sophisticated NMR

spectrometers

4. (2 pts each) Fill in each blank with the word that best completes the following descriptions of FT-NMR and MRI.

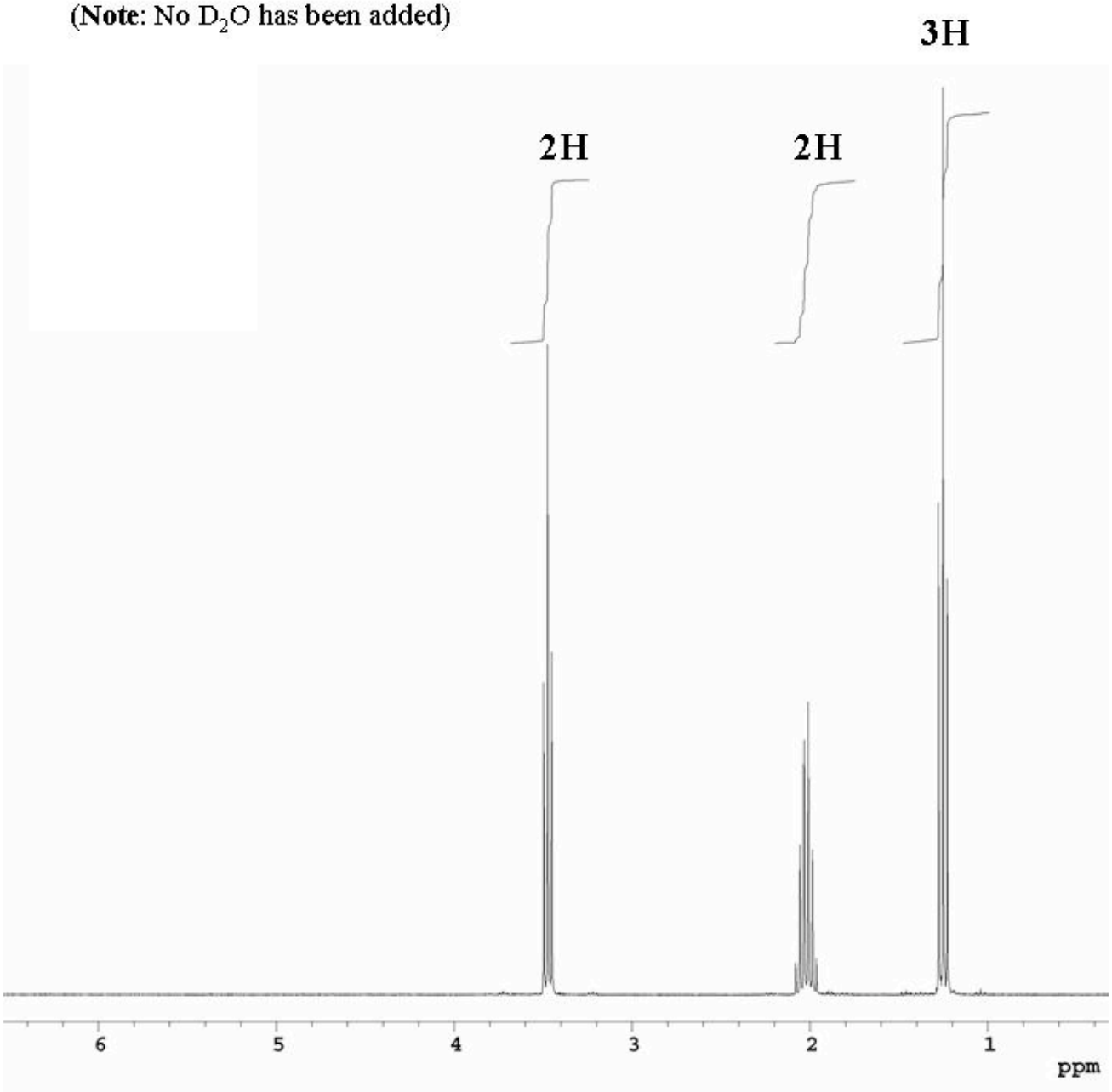
In the FT NMR method, the FT stands for _____ _____.

The basic idea is that a short pulse using a range of radio frequencies are used to flip the spins of all of the hydrogen _____ at once. Then, the nuclear spins _____ back to the +1/2 spin state and when they do, they _____ electromagnetic radiation at the precise frequency at which they absorb. The _____ _____ (FT) analysis of the signals is used to derive the original frequencies characteristic of the resonancce of each type of H atom in the molecule. The important advantage of the FT NMR method is that many spectra can be acquired in a short period of time. The data is averaged, greatly increasing the _____ to _____ ratio of the spectra.

5. (14 points) Suppose a relative of yours is having an MRI. In no more than four sentences, explain to them what is happening when they have the MRI scan. We wil be looking for a minumum of 7 key points here.

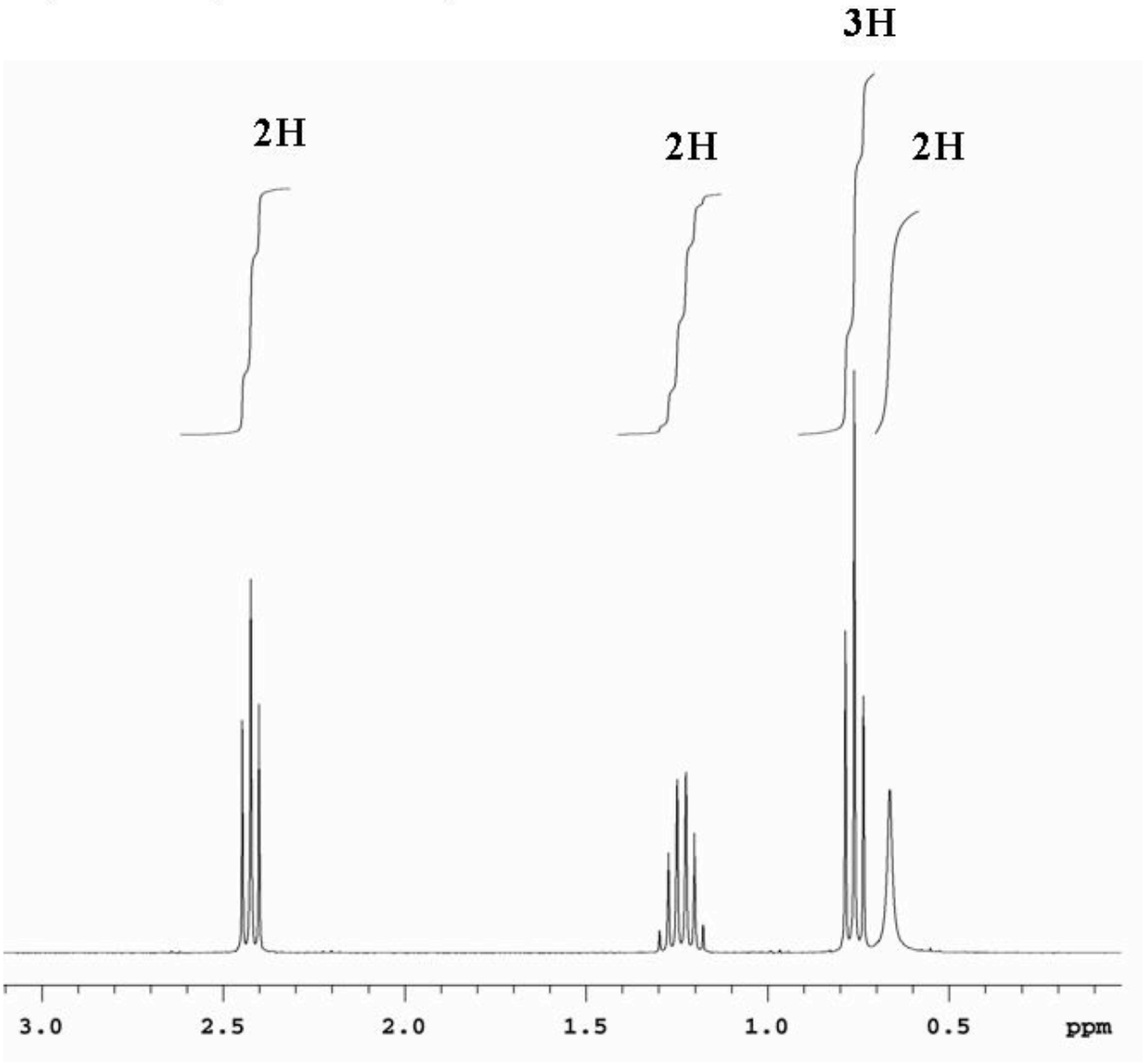
6. (5 pts each) Circle the molecule that corresponds to the spectrum shown.

(Note: No D_2O has been added)

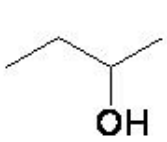


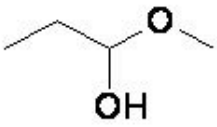
7. (5 pts each) Circle the molecule that corresponds to the spectrum shown.

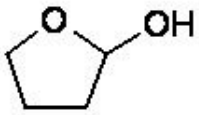
(**Note**: No D_2O has been added)



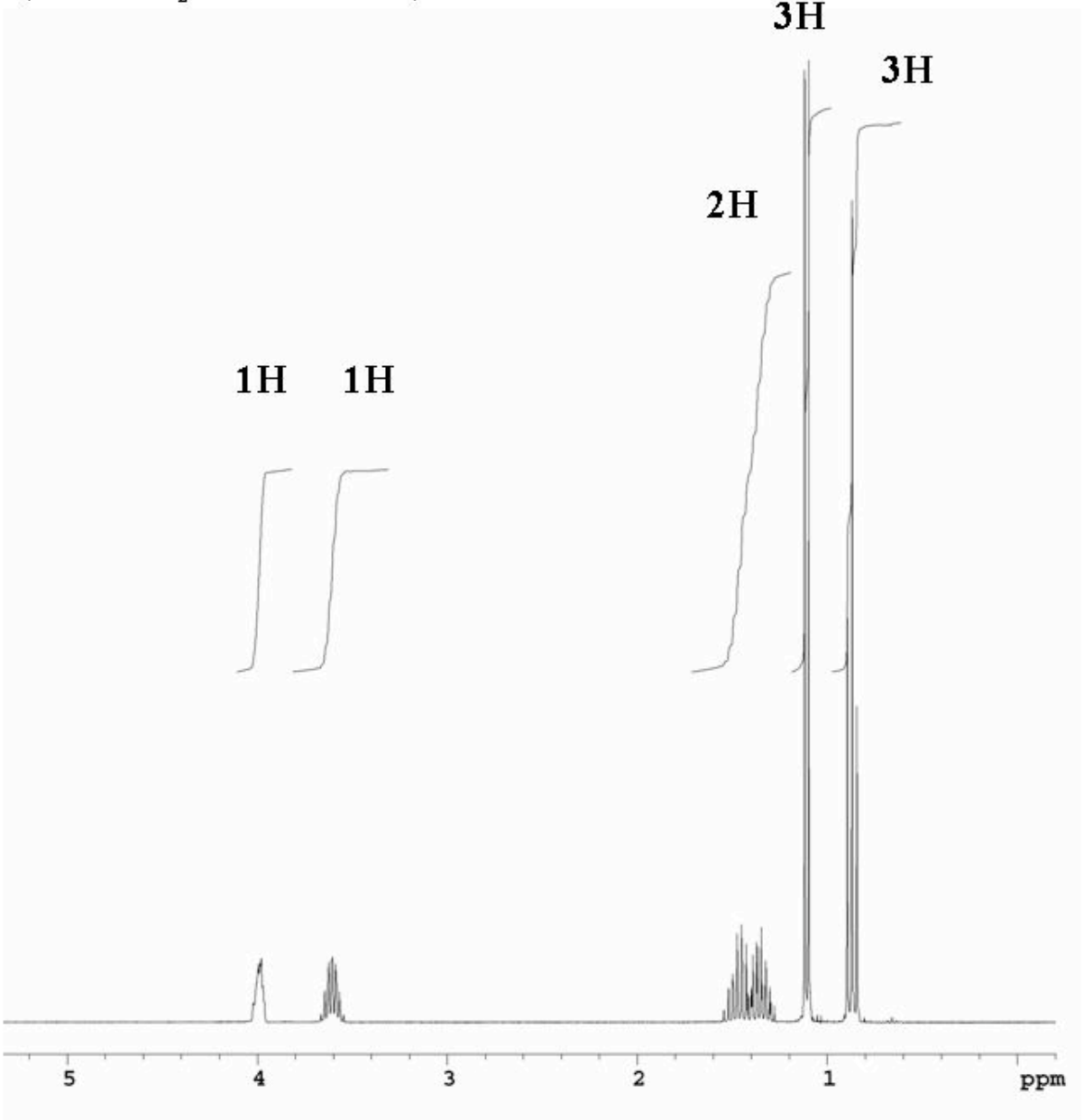
8. (5 pts each) Circle the molecule that corresponds to the spectrum shown.



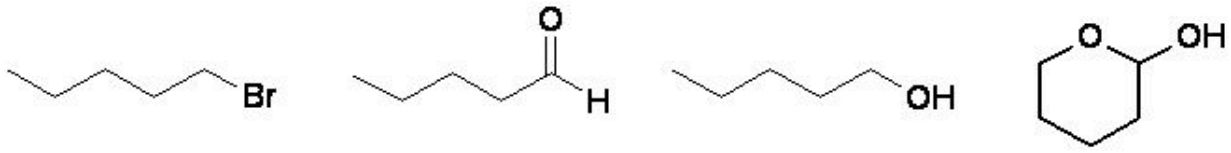


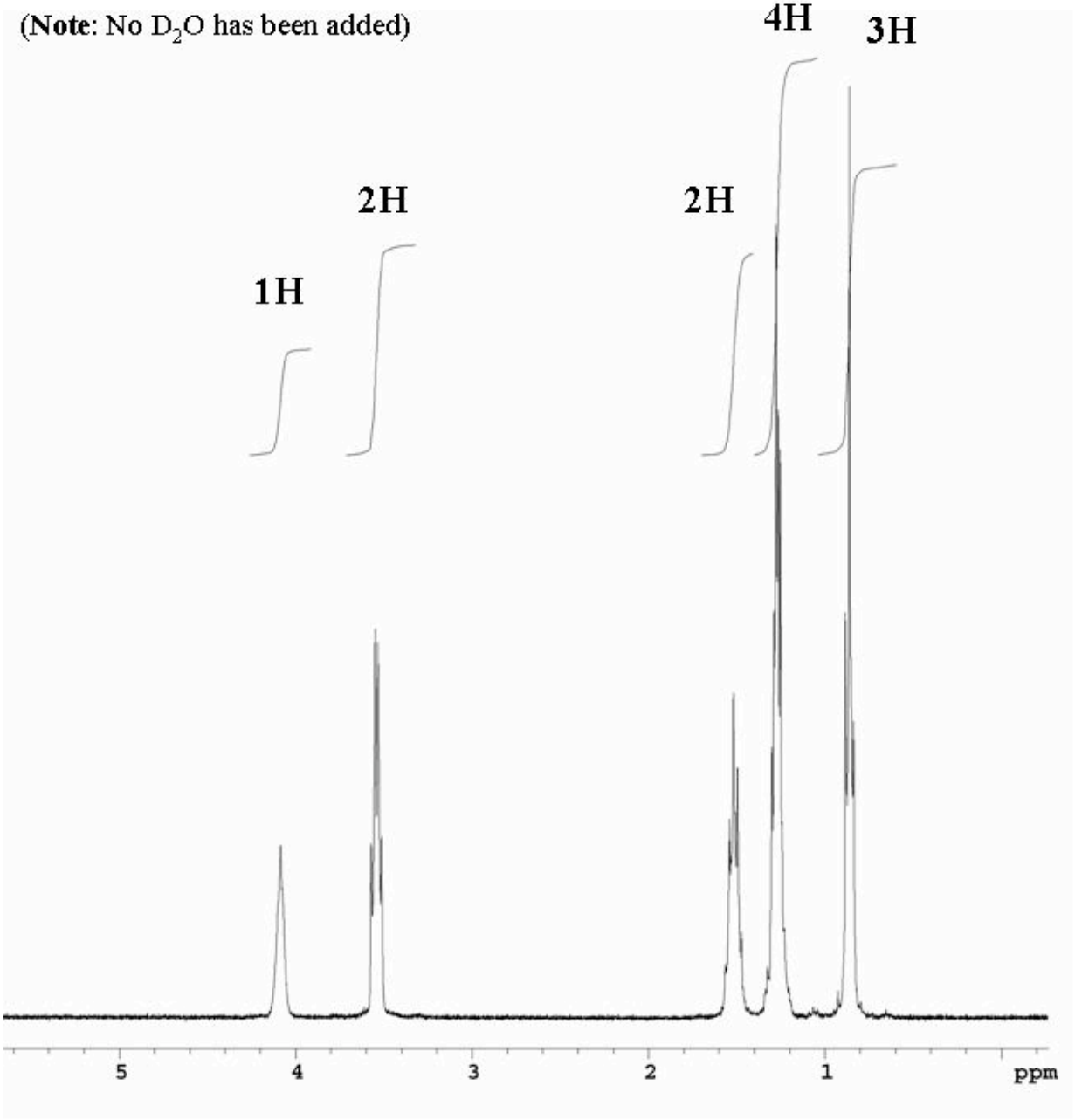


(**Note**: No D_2O has been added)

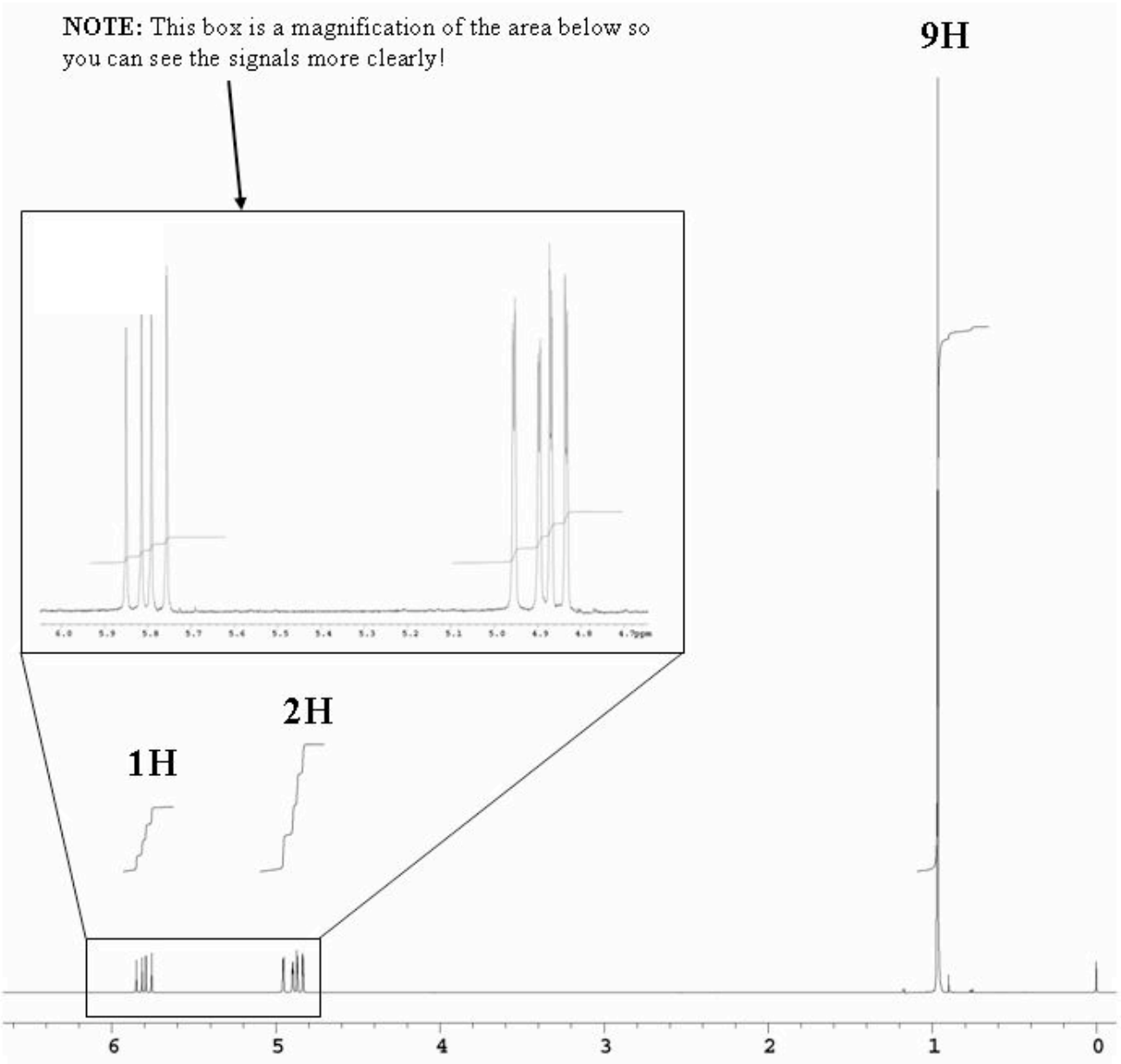


9. (5 pts each) Circle the molecule that corresponds to the spectrum shown.

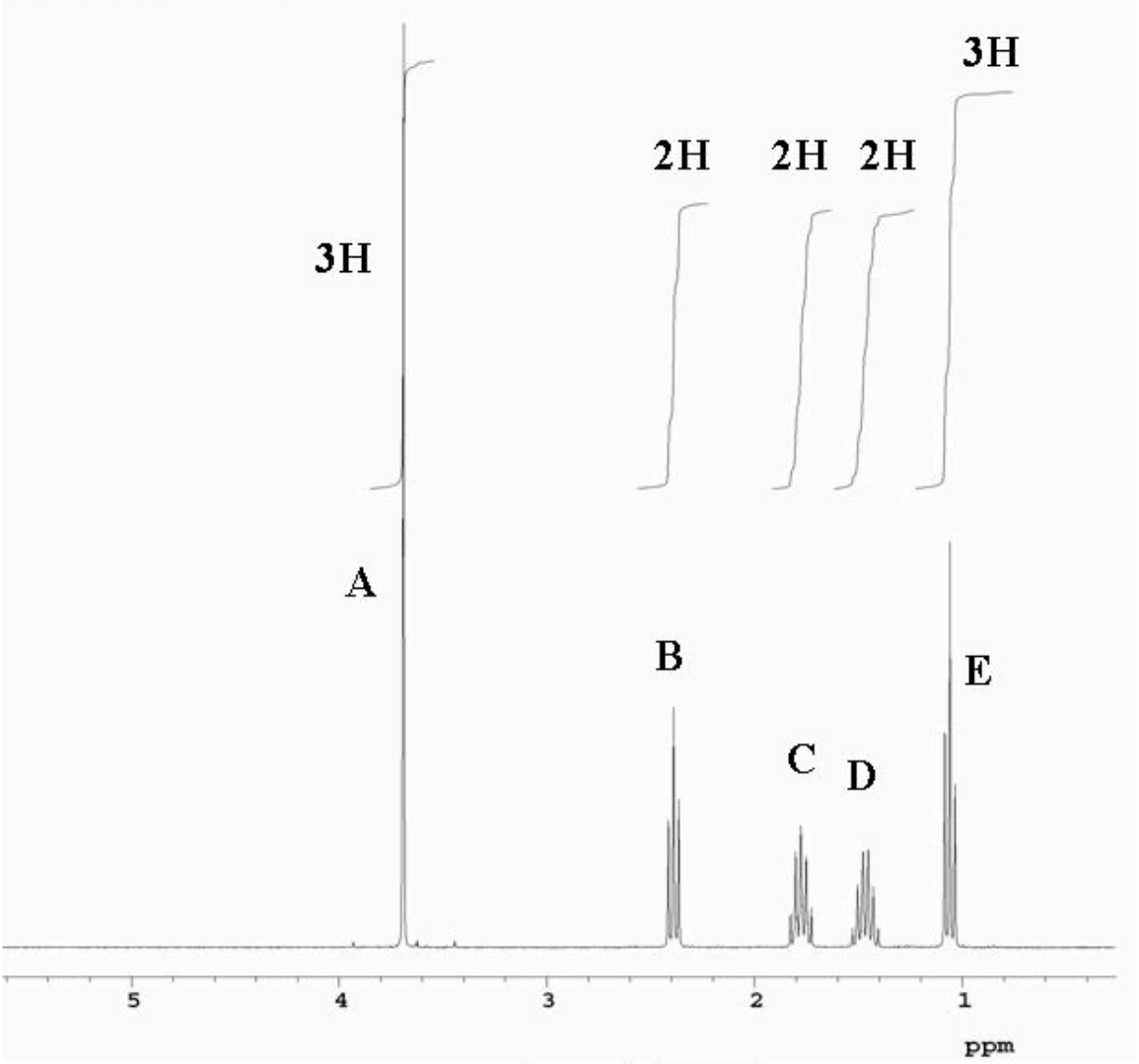


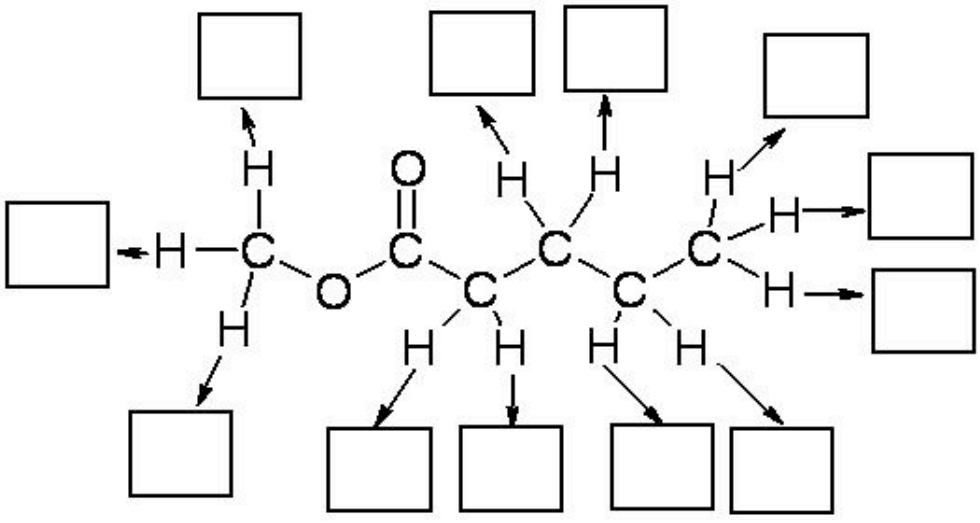


10. (5 pts each) Circle the molecule that corresponds to the spectrum shown.

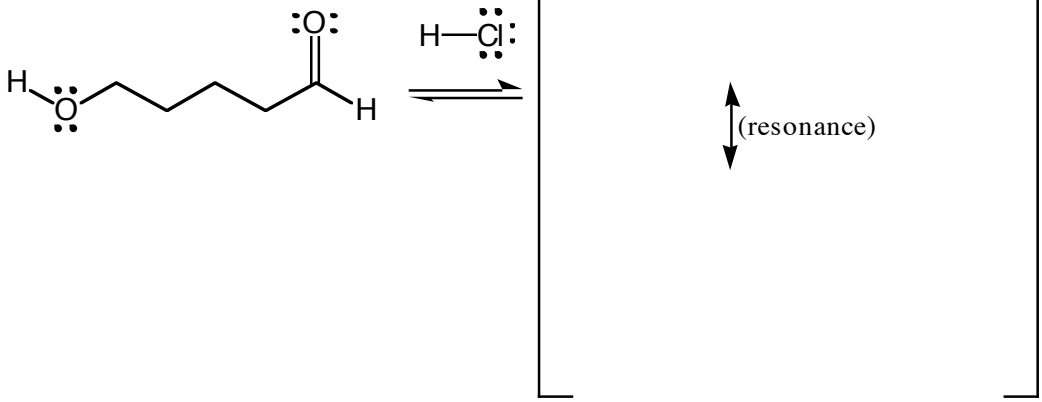


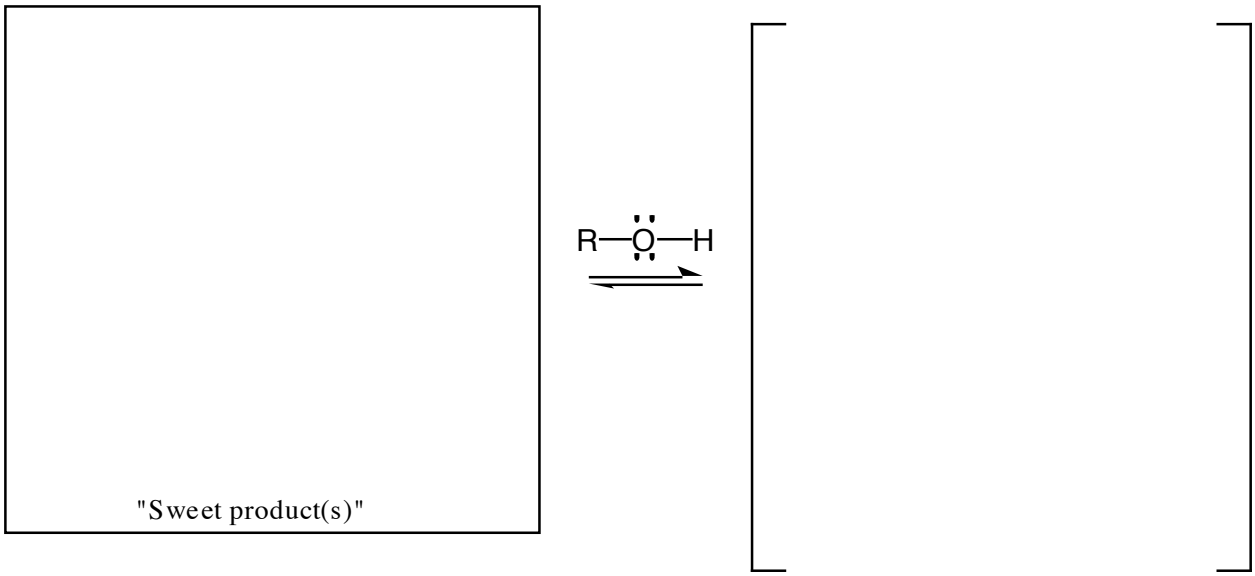
11. (1 pt each) This one is different. In the boxes indicated by the arrows, list the letter of the signal (A, B, C, D, E) that corresponds to the indicated H atoms for the molecule shown below.





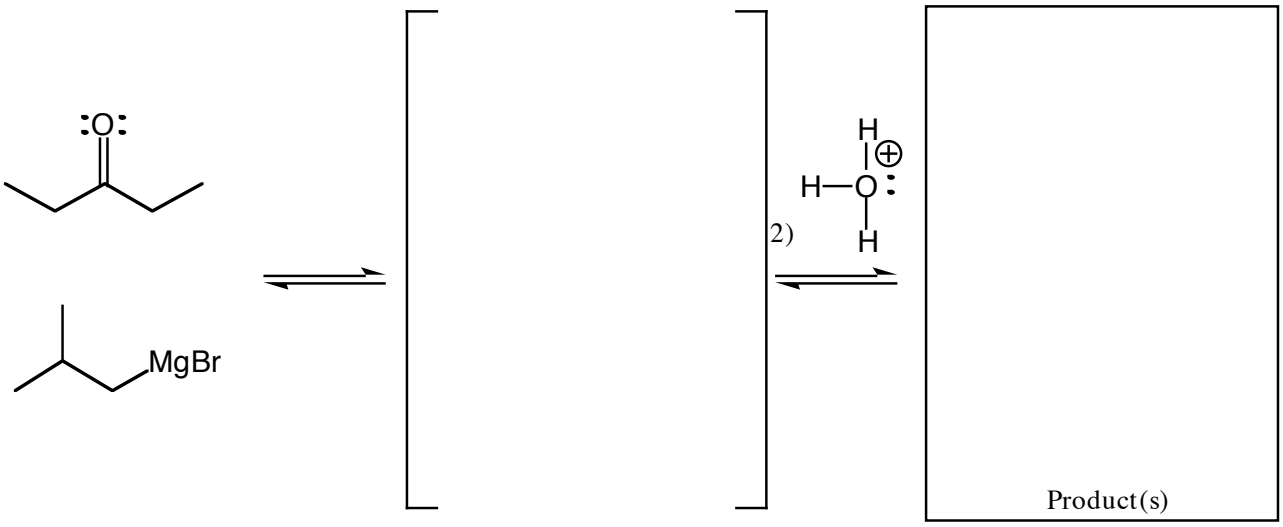
12. (21 pts.) Complete the mechanism for the following cyclic hemiacetal formation reaction. **Be sure to show arrows to indicate movement of <u>all</u> electrons, write <u>all</u> lone pairs, <u>all</u> formal charges, and <u>all</u> the products for each step.** Remember, I said <u>all</u> the products for each step. **In the box with the resonance arrow, you need to draw both resonance contributing structures. IF A RACEMIC MXTURE IS FORMED IN ANY STEP, YOU MUST DRAW BOTH ENANTIOMERS AND LABEL THE MIXTURE AS "RACEMIC".** I realize these directions are complex, so please read them again to make sure you know what we want. You only need to indicate the flow of electrons on one structure (i.e. contributing structure or enantiomer) per intermediate.



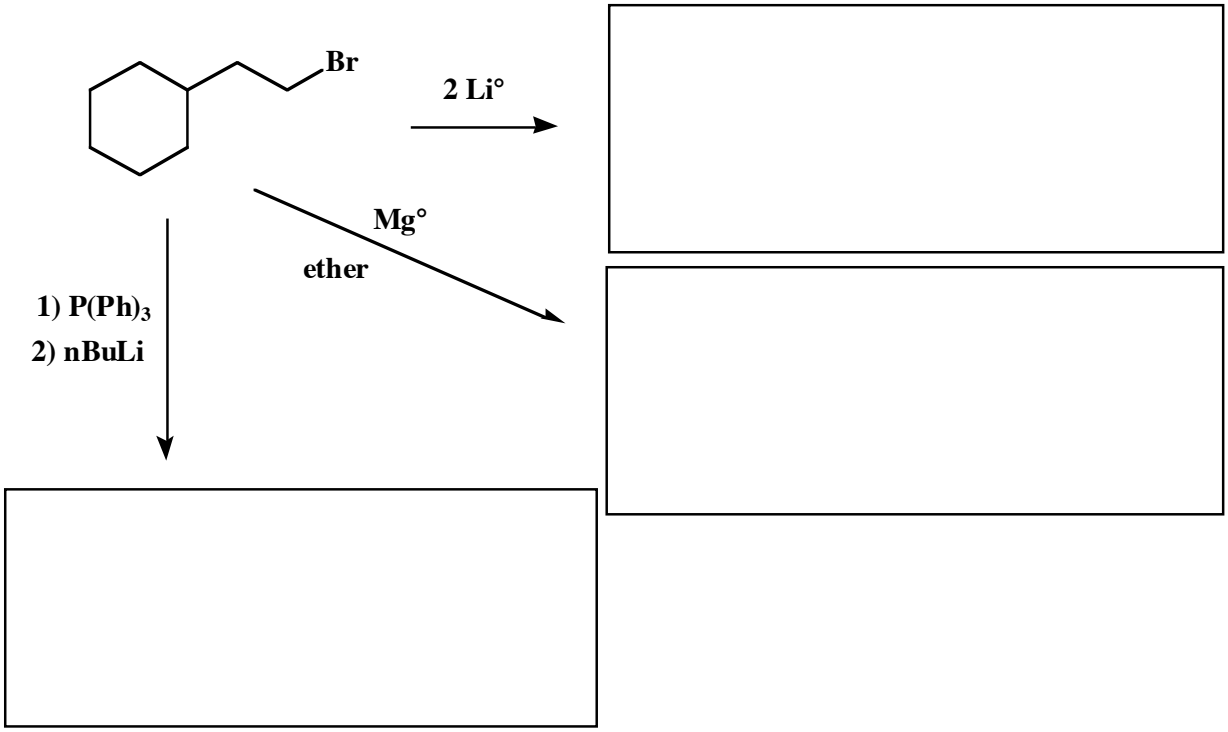


Did you remember to draw both resonance contributing structures and both enantiomers as appropriate?

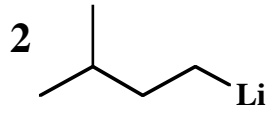
13. (10 pts.) Complete the mechanism for the following Grignard reaction. **Be sure to show arrows to indicate movement of <u>all</u> electrons, write <u>all</u> lone pairs, <u>all</u> formal charges, and <u>all</u> the products for each step.** Remember, I said <u>all</u> the products for each step. **IF A RACEMIC MXTURE IS FORMED IN ANY STEP, YOU MUST DRAW BOTH ENANTIOMERS AND LABEL THE MIXTURE AS "RACEMIC".** I realize these directions are complex, so please read them again to make sure you know what we want.



14. (3 or 5 pts.) Write the predominant product or products that will occur for each transformation. **If a new chiral center is created and a racemic mixture is formed, you must draw both enantiomers and write "racemic" under the structure. Use wedges (◄) and dashes (⋯) to indicate stereochemistry. To get full credit, you only need to write the the major organic product for these. You do not have to worry about the other products.**



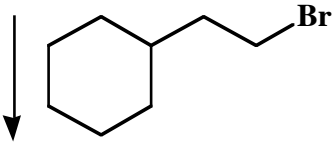
15. (3 or 5 pts.) Write the predominant product or products that will occur for each transformation. **If a new chiral center is created and a racemic mixture is formed, you must draw both enantiomers and write "racemic" under the structure. Use wedges (◄) and dashes (⋯) to indicate stereochemistry. To get full credit, you only need to write the the major organic product for these. You do not have to worry about the other products.**



CuI →

[ ]

[ ]



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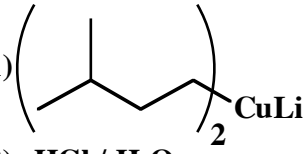
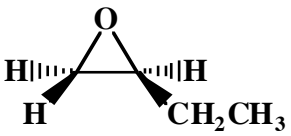
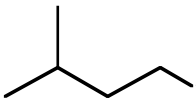
1) 

2) HCl / H_2O



1) 

2) HCl / H_2O

[ ]

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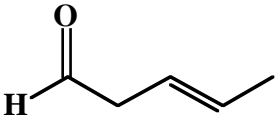
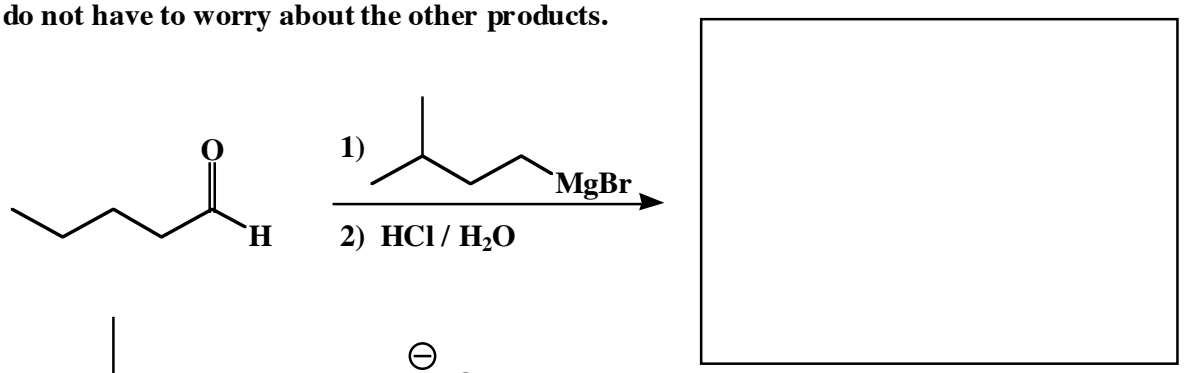


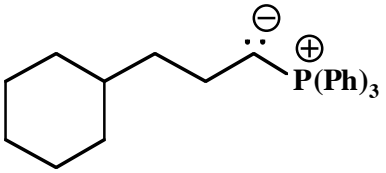
2 H_2 / Pd° →

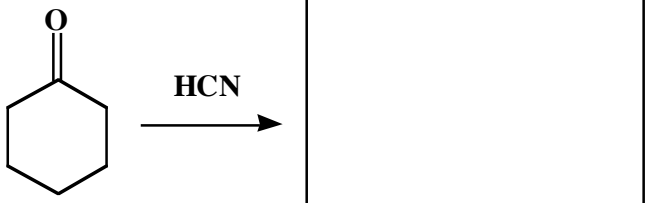
1) $NaBH_4$
2) H_2O

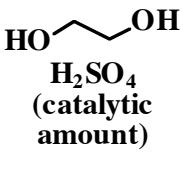
[ ]

16. (3 or 5 pts.) Write the predominant product or products that will occur for each transformation. **If a new chiral center is created and a racemic mixture is formed, you must draw both enantiomers and write "racemic" under the structure. Use wedges (◄) and dashes (⋯) to indicate stereochemistry. To get full credit, you only need to write the the major organic product for these. You do not have to worry about the other products.**

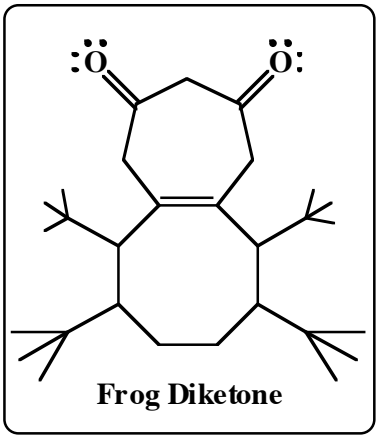








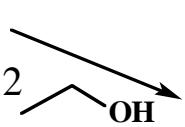
H_2SO_4 (catalytic amount)



Frog Diketone

H_2SO_4 (catalytic amount)

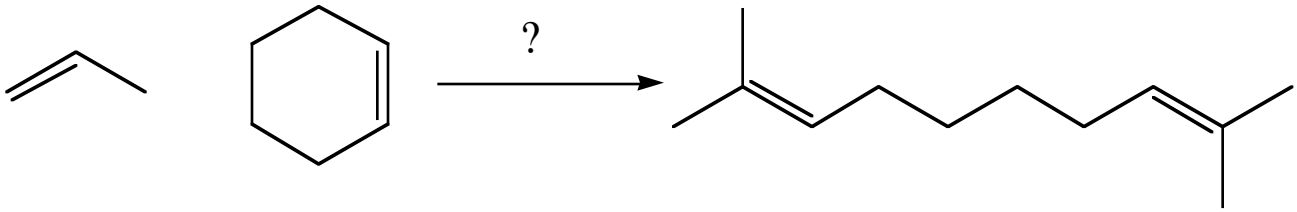
H_2O (large excess)



H_2SO_4 (catalytic amount)

17. These are synthesis questions. You need to show how the starting material can be converted into the product(s) shown. You may use any reactions we have learned. Show all the reagents you need. Show each molecule synthesized along the way and be sure to pay attention to the regiochemistry and stereochemistry preferences for each reaction.

(13 pts) **All of the carbon atoms of the products must come from the starting materials for this one!**



18. These are synthesis questions. You need to show how the starting material can be converted into the product(s) shown. You may use any reactions we have learned. Show all the reagents you need. Show each molecule synthesized along the way and be sure to pay attention to the regiochemistry and stereochemistry preferences for each reaction.

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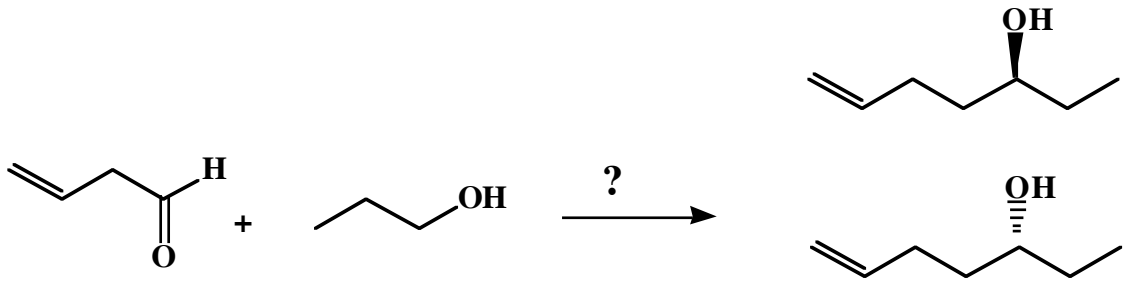
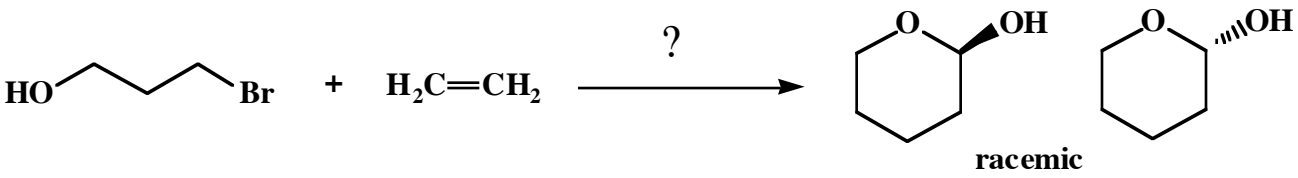


racemic

17. These are synthesis questions. You need to show how the starting material can be converted into the product(s) shown. You may use any reactions we have learned. Show all the reagents you need. Show each molecule synthesized along the way and be sure to pay attention to the regiochemistry and stereochemistry preferences for each reaction.

(16 pts) **All of the carbon atoms of the products must come from the starting materials for this one!**



racemic