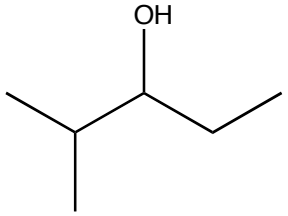
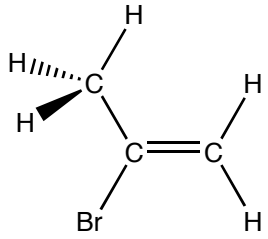
Name _____ Test 4
PHYS 0203 (Organic II) Spring 2006

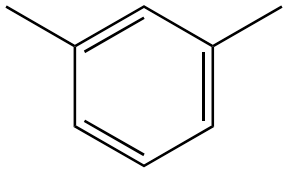
1. (6 pts.) What property of the proton allows the proton to be investigated using NMR?

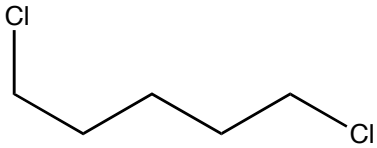
2. (4 pts) What does NMR stand for?

3. (4 pts. each) Identify the chemically inequivalent protons on the following molecules (label them with letters. It is not necessary to correlate lettering with chemical shift).

a. 

b. 

c. 

d. 

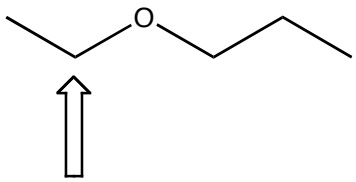
4. (4 pts. each) Using the labeling scheme from question 3, determine the relative area of the peaks that you expect to find in the NMR spectra of the molecules.

a.	b.
c.	d.

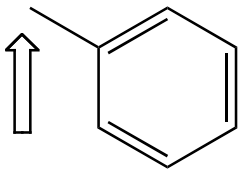
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____

5. (4 pts. each) For each of the indicated hydrogen atoms, determine the multiplicity (the splitting pattern) observed.

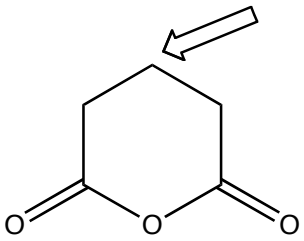
a.



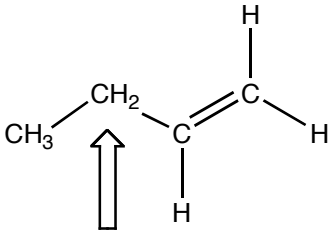
b.



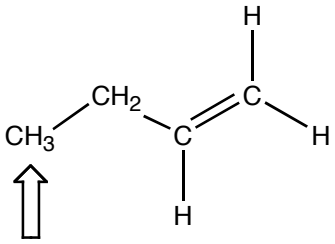
c.



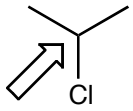
d.



e.



f.



6. On the following page, you will find an IR spectrum and an NMR spectrum for a compound with the following formula C_4H_9Br.

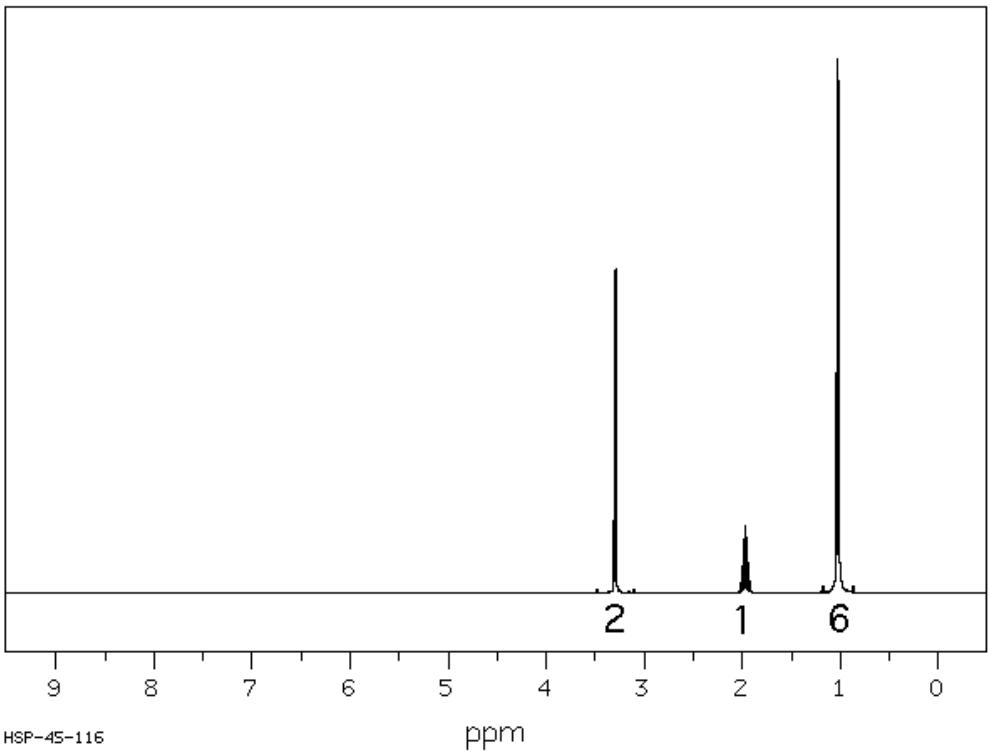
a. (6 pts.) What does the formula tell you about the structure of the molecule? That is, are there any π bonds or rings? Explain.

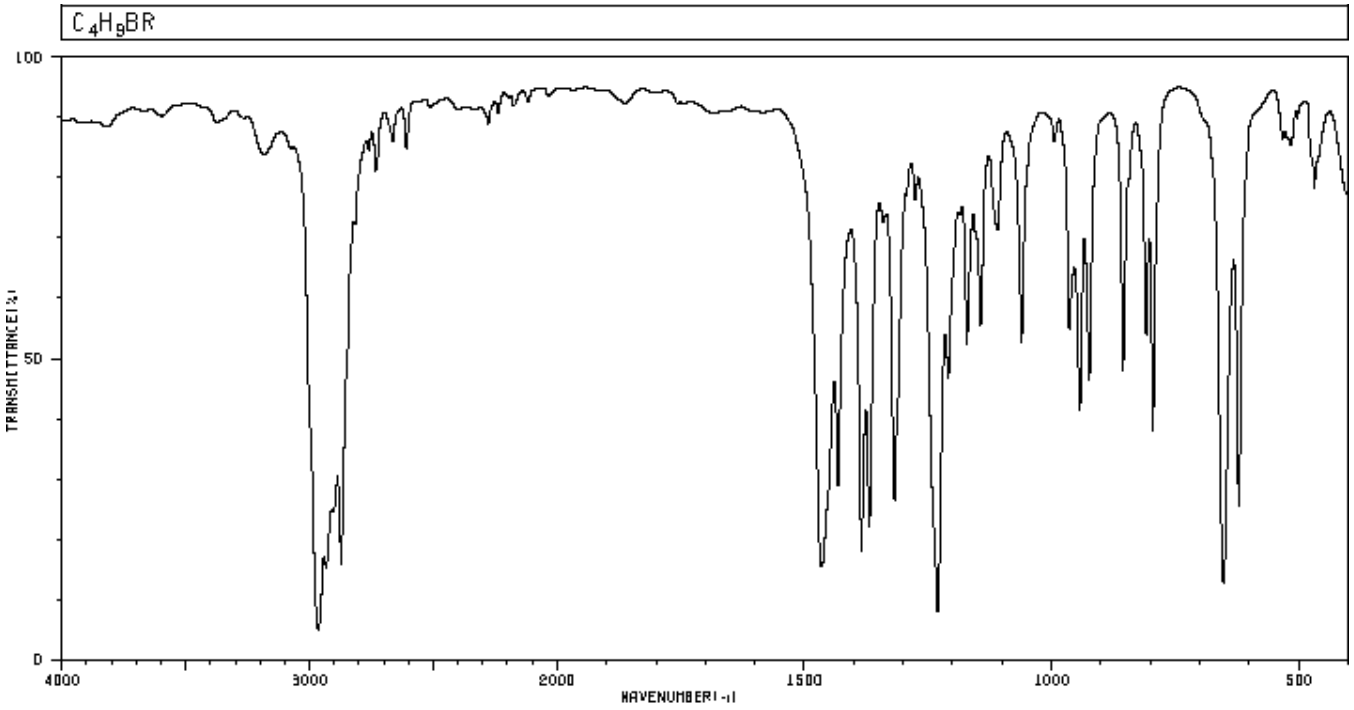
b. (6 pts.) How does the IR spectrum support your response to part a.

c. (12 pts.) Determine the structure of the molecule, and assign the peaks in the NMR spectrum to the appropriate H atoms.

^{1}H NMR

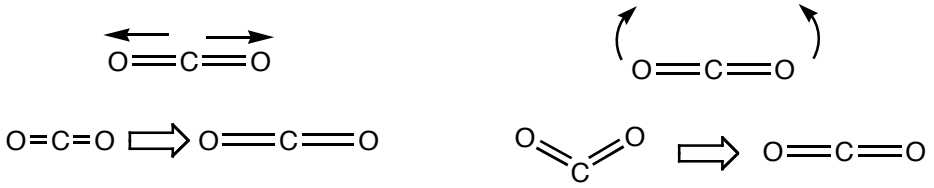
ppm	Int.
3.308	604
3.293	608
2.007	47
2.006	50
1.991	99
1.974	127
1.957	102
1.942	56
1.941	51
1.037	1000
1.02	959





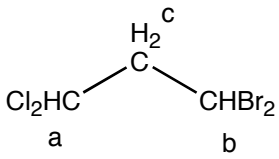
3369	86	2662	81	1318	25	1061	60	796	36		
3184	81	2609	81	1276	74	994	81	653	12		
2964	4	1465	14	1231	7	964	52	622	24		
2933	14	1432	27	1209	44	943	39	533	84		
2872	15	1385	17	1171	50	924	44	523	84		
2760	81	1369	21	1144	53	855	46	516	61		
2733	79	1340	70	1109	68	809	52	470	74		

7. (10 pts.) Drawn below are representations of two vibrational modes for CO_2. To the left is a representation of a symmetrical stretch, and to the right is a representation of a bending mode.



Are either of these vibrational modes IR active (can they be seen in an IR spectrum)? Explain, briefly.

8. (10 pts.) Draw a splitting tree for the protons labeled "c" in the following molecule.



J_{ac} = 10 Hz

J_{bc} = 10 Hz

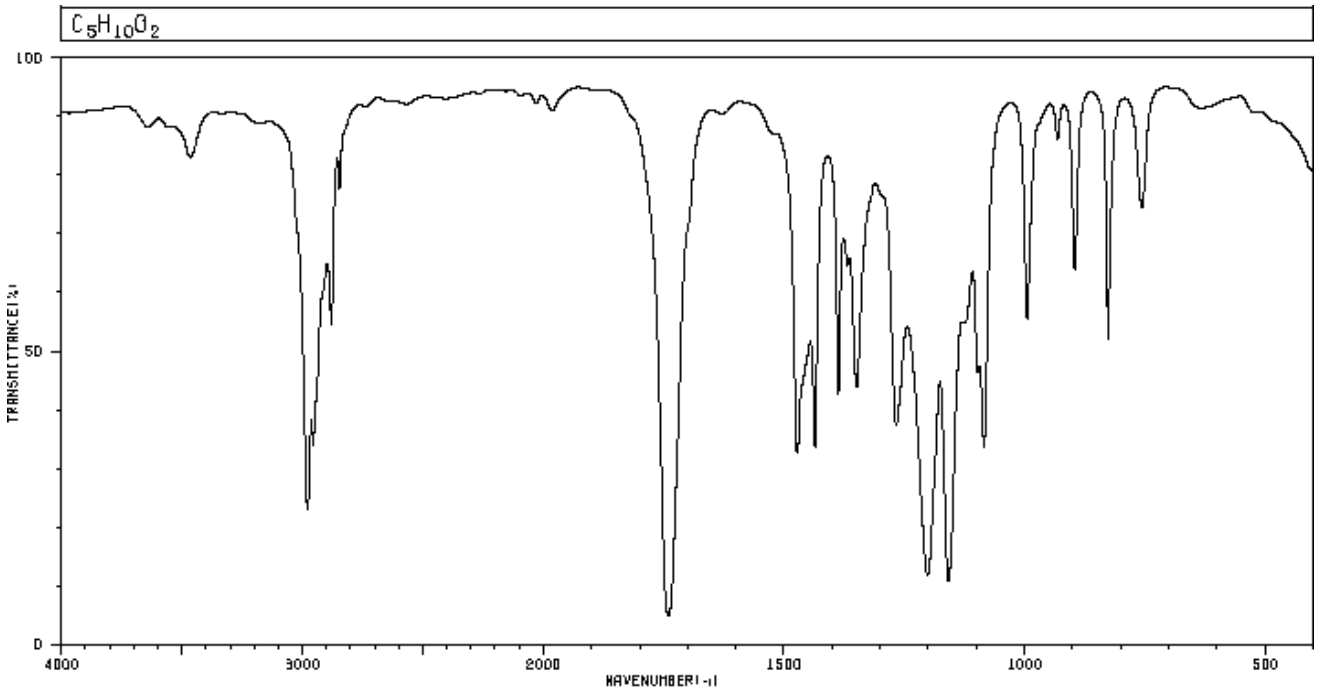
9. On the following page, you will find an IR spectrum and an NMR spectrum for a compound with the following formula $C_5H_{10}O_2$.

a. (6 pts.) What does the formula tell you about the structure of the molecule? That is, are there any π bonds or rings? Explain.

b. (6 pts.) The IR spectrum reveals the presence of what functional groups (label the peak(s) on the spectrum)?

c. (12 pts.) Determine the structure of the molecule, and assign the peaks in the NMR spectrum to the appropriate H atoms.

IR



3638	84	1473	31	1158	10	826	60
3465	79	1436	32	1097	44	756	72
2977	21	1387	41	1084	32		
2955	32	1368	62	994	63		
2880	52	1350	42	937	86		
2846	74	1267	36	931	84		
1740	4	1202	11	896	60		

^{1}H NMR

ppm	Int.
3.669	1000
2.627	5
2.604	28
2.581	68
2.557	92
2.534	72
2.511	31
2.488	5
1.182	994
1.158	957