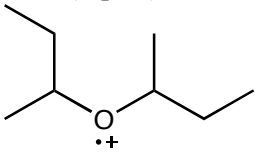
Name _____ Test 3 (4/18)
CHEM 0203 (Organic II) Spring 2008

1. (8 pts.) A mass spectrum of a molecule was obtained. The relative intensity for the molecular ion with a mass to charge ratio of 116.20 *m*/*z* was 21.9%. Its m+1 peak has a relative intensity of 1.7%. How many carbon atoms are in the molecule?

2. a. (5 pts.) Explain why alkyl bromides have *m* and *m* + 2 peaks with 1:1 relative intensities.

b. (5 pts.) Will all the molecular fragments produced by the fragmentation of an alkyl bromide have *m* and *m* + 2 peaks in a 1:1 ratio? Explain your response.

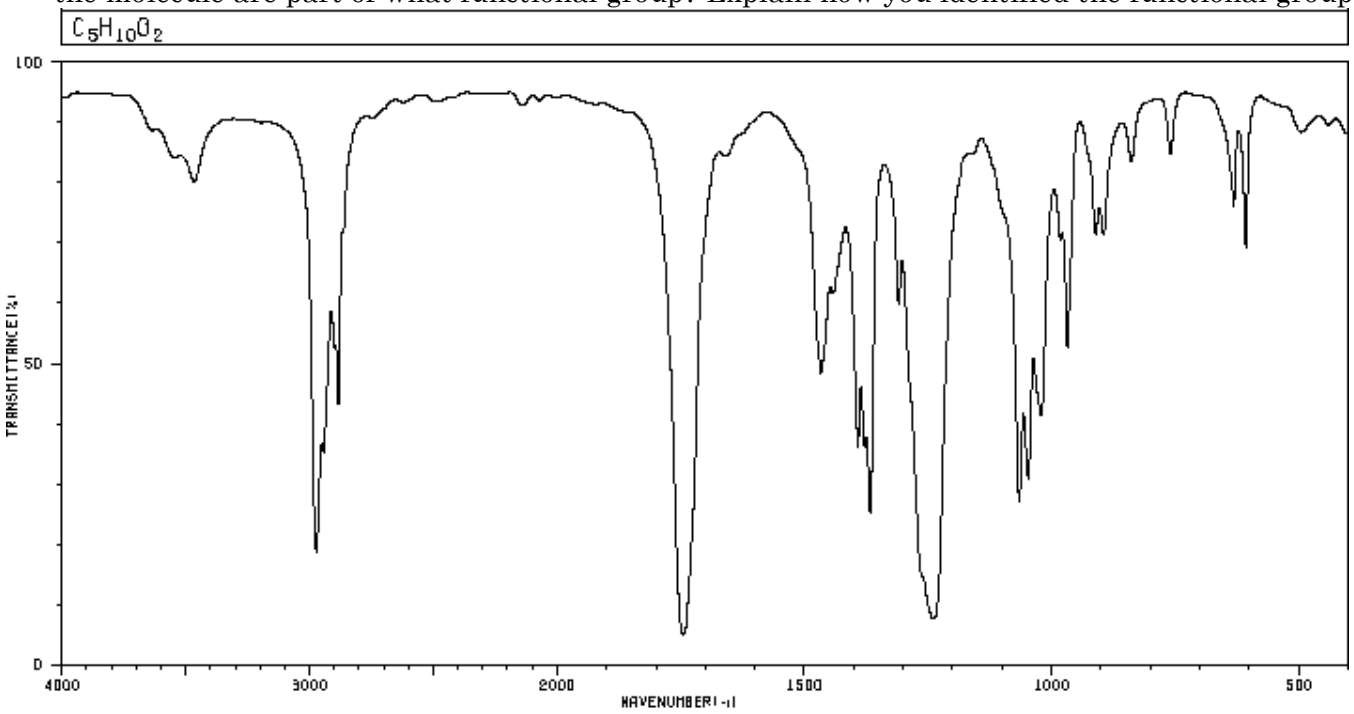
3. a. (8 pts.) Draw the products of a heterolytic cleavage of the following molecular ion.
b. (2 pts.) Circle the fragment that would be observed by the mass spectrometer.



4. (8 pts.) In an IR spectrum, typically peaks caused by O–H vibrations are intense and broad. Explain why O–H peaks are typically broader than other peaks in an IR spectrum.

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

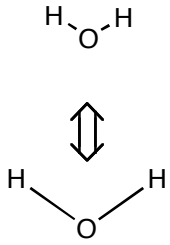
5. (10 pts.) An IR spectrum of a molecule with the formula $C_5H_{10}O_2$ is shown below. The O atoms in the molecule are part of what functional group? Explain how you identified the functional group.



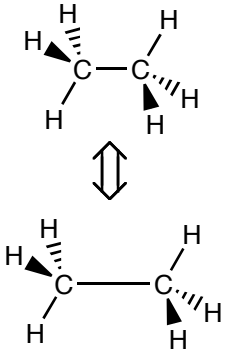
3466	77	1392	34	1021	39	760	81
2973	18	1378	34	982	68	632	72
2942	34	1367	24	968	50	607	66
2898	60	1309	67	911	68	496	84
2883	41	1238	7	895	68	440	86
1745	4	1065	26	845	84		
1467	46	1047	29	839	81		

6. (12 pts.) Which vibrational modes shown below would absorb IR light?

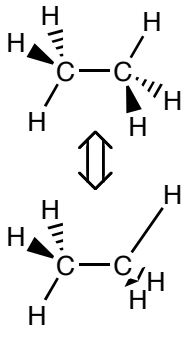
a.



b.

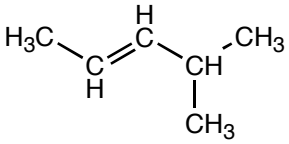


c.

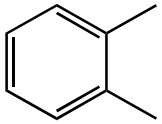


7. (10 pts.) Determine the number of chemically inequivalent protons on the following molecules and label them assigning each set of inequivalent protons a different letter.

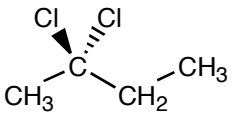
a.



b.



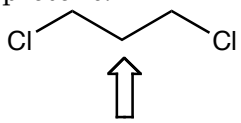
8. (10 pts) Explain why the CH_3 protons labeled A resonate at a higher frequency than the CH_3 protons labeled B.



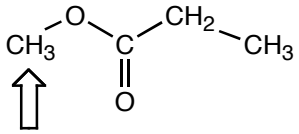
A **B**

9. (12 pts.) Determine the multiplicity (doublet, triplet, doublet of quartets, etc) of the indicated protons.

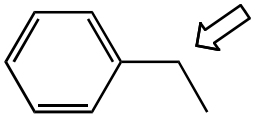
a.



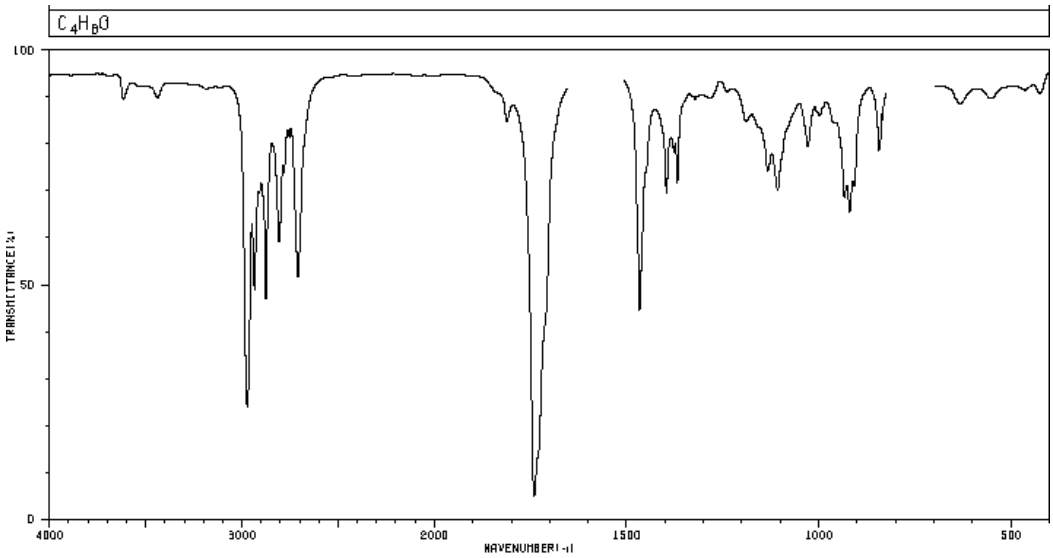
b.



c.



10. a. IR and NMR data is provided below for C_4H_8O. Determine the structure of the molecule and draw that structure below.
    b. Label two peaks with the structures of the groups that are absorbing the IR light; for example O–H, C–H, C=O, C–O, =C–H, O=C–H,C–C, etc.
    c. Assign a letter to each set of chemically inequivalent H atoms on the molecule below and label the corresponding resonance peaks in the ^{1}H NMR spectrum with the same letter.



3616	86	2763	79	1368	68	920	62
3437	86	2709	50	1189	81	843	74
2973	23	1811	81	1132	72	834	81
2934	47	1740	4	1107	68	634	84
2875	44	1467	42	1028	77	552	86
2806	57	1397	66	999	81		
2780	70	1378	74	933	66		

^{1}H NMR

ppm	height
9.572	186
9.568	186
2.439	16
2.435	15
2.416	39
2.412	36
2.392	54
2.389	51
2.369	42
2.366	41
2.346	18
2.342	18
1.072	1000
1.048	953