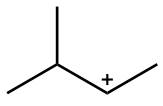
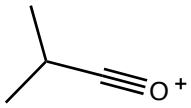
Name _____ Test 4 (5/7)
CHEM 0203 (Organic II) Spring 2012

1. On a low resolution mass spectrometer, the two possible fragments that appear below would have almost identical *m/z* ratios.

a. (6 pts) Determine the *m/z* ratios for the two fragments.

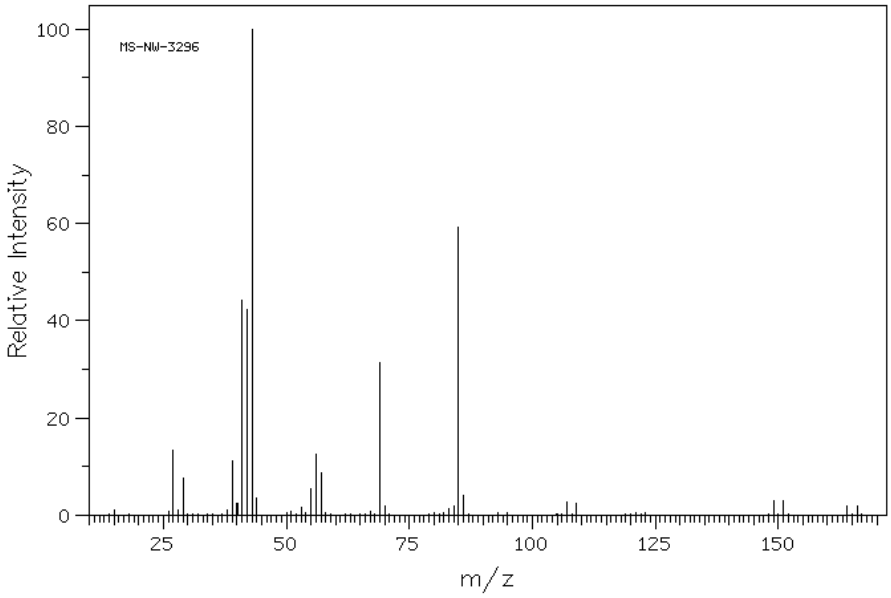




b. In addition to more accurately measuring the *m/z* ratios, describe how you could confirm the identity of the fragment.

2. A mass spectrogram for a molecule with a molar mass of 165.07 g/mol appears below. There are three sets of peaks that arise from ions that contain bromine.

a. (6 pts. ea.) Circle those peaks.



b. (6 pts.) Explain how you know that there are bromine atoms in those ions.

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

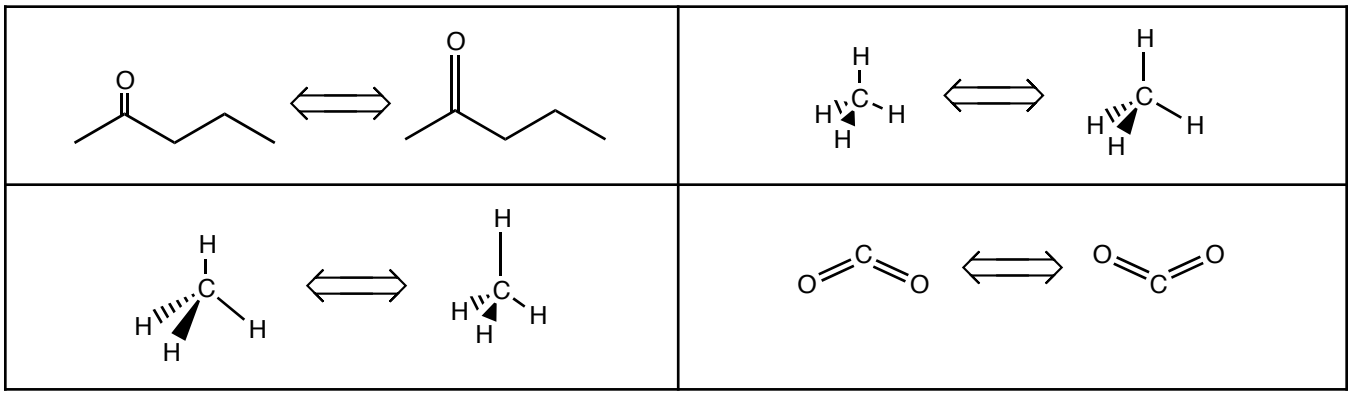
3. When the molecular ions formed from alkyl halides fragment, they can do so by homolytic cleavage and by heterolytic cleavage.

a. (8 pts.) Draw the products for the heterolytic cleavage of the halogen to α-C bond in 1-chlorobutane.

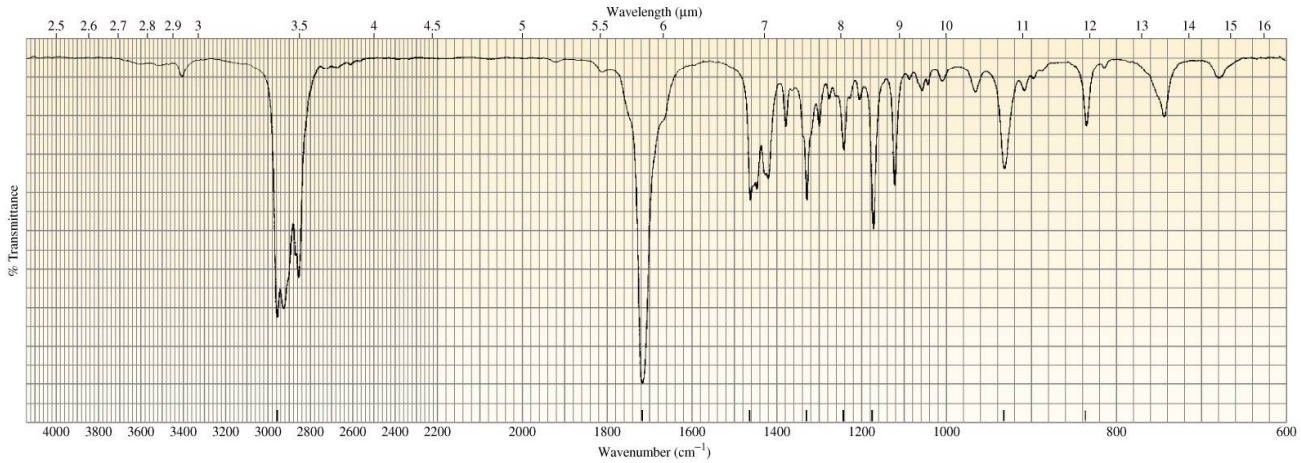
b. (4 pts.) Circle the fragment that you expect to see in the mass spectrum and calculate its m/z ratio.

4. (10 pts.) The IR spectra of alcohols have peaks that correspond to both C–H and O–H stretches. The C–H stretches are generally sharp intense peaks, whereas the O–H peaks are usually intense but broad peaks. Explain why one set of peaks is sharp (narrow) while the other is broad.

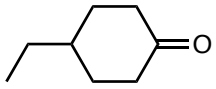
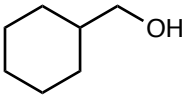
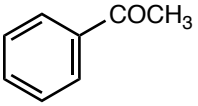
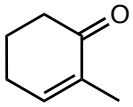
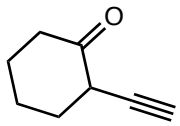
5. (12 pts.) Representations of vibrating molecules are drawn below. Each graphic shows the bond or bonds that are vibrating in different position. Determine which vibrations would absorb infrared light.



6. a. (6 pts.) Assign two peaks in the following IR spectrum. Be as specific as possible.



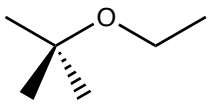
b. (10 pts.) Determine which one of the below molecules could have produced the IR spectrum. For each molecule explain why it was ruled out or in.

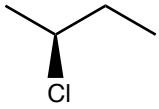






7. (6 pts.) What property of the proton enables us to use NMR spectroscopy to determine the structure of a molecule.

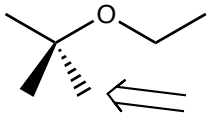
8. a. (8 pts.) For each of the following molecules, determine the number of peaks that would appear in the NMR spectrum (label the H's with a letter, a different letter for each chemically distinct set of H's).

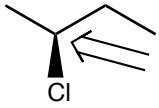
b. (8 pts.) Indicate which proton(s) would give rise to the peak that would appear at the highest frequency in the NMR spectrum.

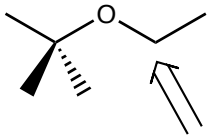


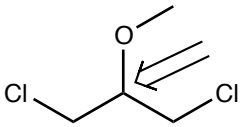


9. (12 pts.) Determine the multiplicity of the peaks for the H atoms on the indicated C atoms.

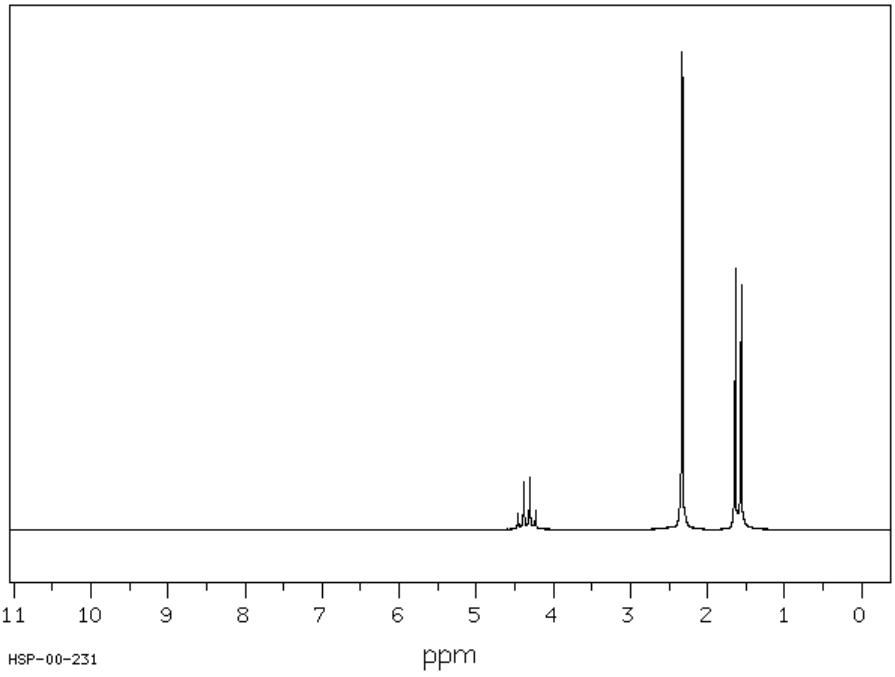


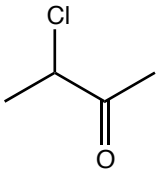






10. (6 pts.) Assign the peaks in the following NMR spectrum; that is, indicate which protons give rise to which peaks in the NMR spectrum.





11. (6 pts.) Assign the peaks in the following NMR spectrum; that is, indicate which protons give rise to which peaks in the NMR spectrum.