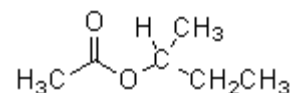


Organic II lecture
Review for exam 1
Spectroscopy

1. What is the relationship between energy, wavelength, frequency and wavenumbers in terms of proportional or inversely proportional? Write equations that interconvert these values.
2. Be familiar with the electromagnetic spectrum from radio waves to ultra violet region - Which region is more energetic than another, and what molecular influence is brought by that region? For example: IR = molecular vibration and bending.
3. What factors influence the frequency at which a bond vibrates?
4. What type of species can be observed by mass spectrometry?
5. Predict the base peak for 2-methylpentane.
6. For 1-butanol, what is the mass corresponding the peak with the highest m/z value?
7. Using a 90 MHz NMR, a doublet was obtained at 5.5 ppm with a coupling constant of $J=10$ Hz.
 - a) What is the probable functionality indicated by this proton?
 - b) What is the geometric orientation between this proton and the proton inducing the splitting?
 - c) Calculate the chemical shift and the gap between the doublet in Hz if the sample is run in a 360 MHz NMR.

8. Consider *sec*-butyl acetate:



- a) Label all chemical environments and predict their spin-spin splitting and chemical shift within 1 ppm.
- b) Which proton(s) appear farthest upfield, and which are farthest downfield?
- c) What is meant by “shielded”?
9. What causes spin-spin splitting? Explain why the methyl group in propane is split into a triplet.
10. In off resonance ¹³C NMR, how would the peak representing the methyl group of propane appear?
11. What is the relationship between the energy difference of α and β nuclear spins and H_0 ?
12. What elements can be specifically identified by mass spectrometry, and tell how?