Chemistry 524--2nd Hour Quiz--Keiderling

Nov. 1, 2002 -- 1-2 pm -- 238 SES

Please answer all questions **in the answer book** provided. Calculators, rulers, pens and pencils permitted along with one 8 1/2 x 11" paper with anything you like written on it. If you need a specific fundamental constant, conversion factor or definition ask for it; but everything needed should be in the exam, unless I made an error! There is some possibly helpful information at the end of the quiz. GOOD LUCK!

(30) 1. Consider a conventional Michelson interferometer based Fourier transform spectrometer.

a. Sketch the optical layout for such a spectrometer, labeling the essential components. Give an expression (formula) for the output signal of the detector for the interferometer you draw. Be careful to define all the variables and relate them to the design elements illustrated in your sketch.

b. Briefly describe (use a sketch!) the interferogram (be as quantitative as you can, label axes and indicate frequency/period of major oscillations) that will result in a Michelson interferometer for a light source of:

i. monochromatic, 10 μ wavelength
ii. a continuous bandpass of wavelengths between 9 and 10 μ .
iii. two emission wavelengths, one at 10 μ and one at 9 μ .
iv. Evaluate how much mirror travel is required to just resolve the two wavelengths in part c?
v. Briefly describe the differences in step scan and rapid scan interferometers and give one relative advantage of each.

c. Sometimes the interferogram measured is not symmetrical about x = 0. What kind of distortions of the spectral band shape would result from a Fourier Transform of such an asymmetrical interferogram. Briefly give some reasons for this lack of symmetry and propose a solution to the problem.

d. Fourier Transform Infrared Spectroscopy is often characterized as having **"advantages"** over dispersive spectroscopy. List these three advantages (I do not care if you know the names) and note the conditions under which they are realizable in actual practice.

(5) 2. **Choose one** of the modulators we discussed and briefly explain how it works, what modulation frequencies it can be used to generate and note any characteristics with regard to power, wavelength, angular aperture and complexity of operation.

(10) 3. Describe mode of operation (how it works) and use (sensitivity) of
a. one thermal detector and
b. one photon detector we discussed in class.

(5) 4. Describe how **one** of the polarizers we discussed works, major limitations, where it is useful and typical polarization rations achievable.