

Name:

Estimate of time spent on assignment:

Problem Set 1:

1. Convert the following wavelengths or frequencies to wavenumber ( $\text{cm}^{-1}$ ) and energy (eV):  
532nm, 3.33 $\mu\text{m}$ , 589.50nm, 800THz, 10nm
2. You have a sample of diamond. You intend to use it as a calibration source for your Raman spectrometer. You know that the peak you need to calibrate to is the 1332 $\text{cm}^{-1}$  line. The newer researcher in the lab asked what color the light that is Raman scattered will be. Calculate what the wavelength of the light is and what color it will be.
3. Ti:Sapphire lasers can be set to tuned to lase over bandwidth of 700-900nm. Calculate that bandwidth in frequency.
4. Going back to the Ti:Sapphire laser, lets say you could generate an ultrashort pulse that has uses the entire bandwidth above, how short would the pulse be.
5. Can you realistically generate a pulse that short using a Ti:sapphire laser?
6. Find the two deepest absorption features of sulfur hexafluoride. Calculate the line width the peak in nm and  $\text{cm}^{-1}$
7. You need to find a way to remotely monitor CO<sub>2</sub> and methane output of factories by looking at their emissions. How do you do it? What equipment do you use? What technique do you use?
8. You just bought a rare and expensive painting, or at least you think you did. How do you verify its authenticity? What equipment do you use? What technique do you use?