Take Home Exam 06: Light absorption in Water

Assigned: 10/07/2022

Due (as pdf by email) 10/11/2022 (Tuesday)

•you will receive a simple letter grade for your report

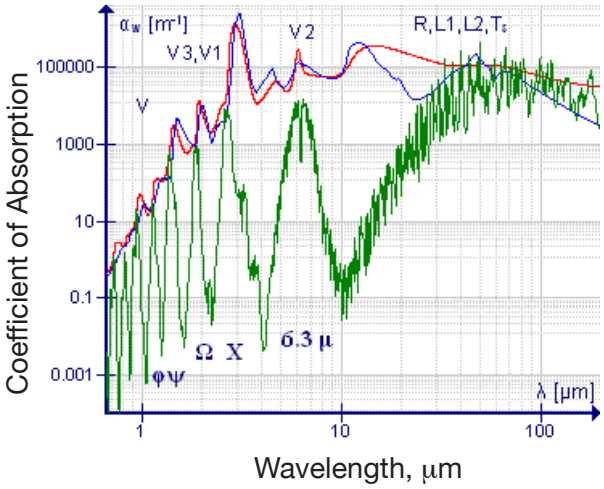
•You may submit your answers in one of two ways:

1) For typed answers: as a .docx file (as is) or converted into a pdf file. (DO NOT SEND GOOGLE DOC)

For handwritten answers: Please scan as images, and group together into one pdf file. Or you may hand them manually to my office (ECME-212)

HW 06

https://en.wikipedia.org/wiki/Electromagnetic_absorption_by_water



The absorption spectrum of water vapor as function of the aborbed wavelength is shown above. The plot in green shows the data of interest to us. It is the absorption spectrum for H_2O molecules in the vapor phase (the data in red are for liquid water).

Questions

(i) Why are the peaks for the vapor more distinct and stronger than in water, especially at the short wavelengths?

(ii) The peaks from vapor molecules arise from differnent vibrational modes of the water molecule. Imagine the vibrations, as if, the oxygen and hyrogen atoms are attached to each other with springs, which can flex, stretch, rotate etc. Pick three modes, for example stretching, flexing and rotational. Place then relative to one another on the spectrum of the peaks in teh green color.

(iii) Calculate the "energy" of vibration at the shortest wavelength shown in the specturm which, let us say, is about 700 nm. Calculate the energy corresponding to this wavelength.

(iv) This question is optional: The energy of formation of H_2O for the following reaction: $H_2(g)+\frac{1}{2}O_2(g)\rightarrow H_2O(g)$ is 241.8 kJ/mol. Calculate the energy for one molecule in units of eV and compare with the number you have calculated in (iii). Please note that (g) stands for "gas phase".