**ATOC 3500/CHEM 3151**

**Problem 11**

**Motivation:** Pretty soon we are going to start determining whether or not molecules can be broken apart by photons of particular energies (i.e., wavelengths). In Problem 10 we learned how to convert between energy and wavelength. In this problem, we will examine how to take the total energy contained in the bonds of a mole of substance and convert to the energy of a single bond. We’ll use a real example of photolysis of ozone, because it one of the most important processes in the atmosphere – it leads to formation of OH, a radical that initiates most of the breakdown of compounds that are emitted to the atmosphere.

**Problem:** Photolysis of ozone the process in which the ozone molecule (O3) absorbs a photon of light and breaks into two fragments, O and O2. Not only is this the process that shields the surface from harmful UV radiation, it is also responsible for heating the stratosphere and initiative chemical reactions that are important in the atmosphere, such as production of OH, a molecule that is quite reactive and ‘cleanses’ pollutants from the atmosphere.

1. We call the bond strength (Ho)of a molecule as the energy that it takes to break a bond. In the case of O3 🡪 O + O2, Ho = 105 kJ mol-1 (kilojoules per mole, note that a kilojoule is 1000 joules). Determine the amount of energy in Joules that are contained in a single ozone bond.
2. If the energy from (a) were to be provided by a photon on light, what would the wavelength of light be (use the method you learned in Problem 10)?

Note that the answer to (b) represents the minimum energy that a photon needs to have in order to break the O3 bond, and dissociate it into O + O2. In other words, it is amount of energy contained in one mole of photons (6 x 1023 photons) of the particular wavelength of light that can dissociate a mole of ozone.

(c) In what region of the spectrum is the wavelength you determined in part (b)?