Physics 390: Homework 2

For full credit, show all your working.

1. **Photons:** Suppose a red LED, of the kind used in the small light on the power switch of your TV, gives out 40 mW of light with wavelength 650 nm. How many photons does it emit per second?

2. **X-ray tube:** A typical x-ray tube used at a dentist's office has an accelerating voltage of 80 kV. What is the minimum wavelength of x-rays it can produce?

3. **Compton effect:** In his experiments on the Compton effect, Compton used photons of wavelength 0.0711 nm. (a) What is the energy of these photons? (b) What is the wavelength of the photons scattered at 180°? (c) What is the energy of the photons scattered at 180°? (d) What is the recoil energy of the electrons when $\theta = 180°$?

4. **Rutherford scattering:** Consider the Rutherford scattering experiment, in which α particles scatter off the positively charged nuclei of atoms in a target. What will be the distance of closest approach R to a gold nucleus for α particles with energies (a) 4.5 MeV, (b) 7.7 MeV, and (c) 10.0 MeV?

5. **Atomic spectra:**

    (a) Either write a computer program or use a spreadsheet to calculate the wavelengths of the first five spectral lines in the Lyman, Balmer, and Paschen spectral series of hydrogen.

    (b) Out of the 15 lines, which ones are visible to the eye?

    For full credit turn in a printout of your program or spreadsheet along with your answers.