1. Using the Bohr model of the atom, determine the ionization energy of the last electron of the first 5 elements in the period table. Compare this to the IE's tabulated in your book. Explain any similarities or differences

2. It is known that the lifetime of the $n = 4$ state of hydrogen is approximately 10^{-10} s before it decays to the $n = 2$ state.

   a) What is the uncertainty in the energy that corresponds to this value?

   b) What is the corresponding uncertainty in the frequency and wavelength of the photon?

   c) Comment on how large these uncertainties are compared to the energy difference between the two states predicted by the Bohr model.

   d) In your book (and in problem 4 on HW 6), the emission spectrum of the $n = 4 \rightarrow 2$ transition is shown as a sharp line. What does your answer to part c) indicate about what the emission spectrum actually looks like?

3. The wavefunction for a particle-in-a-box is:

$$\psi(x) = \sqrt{\frac{2}{L}} \sin\left(\frac{n\pi x}{L}\right)$$

What is the probability that the particle will lie between $x = 0$ and $x = L/4$ if the particle is in its $n = 2$ state?

4. In words, describe the physical significance of $\psi^2 = 0$.

5. The motion of an electron in a C=C double bond, with length 1.34 Å, can be estimated as a particle-in-a-1D-box.

   a) Determine the energy of the electron in its three lowest allowed states.

   b) Determine the wavelength of light necessary to excite the electron from its ground to first excited state.

6. It has been suggested that spacecraft could be powered by the pressure exerted by sunlight striking a sail. The force exerted on a surface is the momentum p transferred to the surface per second. Assume that photons of 6000 Å light strike a solar sail perpendicular to the surface. How many must be reflected per second by 1 cm^2 of surface to produce a pressure of 10^{-6} atm?