PHY 3107, Spring 2017, Homework #6

due Tuesday, March 7

1.) Two spin-zero bosons are in a one-dimensional infinite well. [The wavefunction for a single particle in an infinite well is $\psi(x) = \sqrt{2/L}\ \sin(n\pi x/L)$.] a) Write the wavefunction for the system consisting of these two particles. b) What is the lowest (or ground-state) energy of the system?

2.) Two electrons each with spin-$\frac{1}{2}$ are in a one-dimensional infinite well. [The wavefunction for a single particle in an infinite well is $\psi(x) = \sqrt{2/L}\ \sin(n\pi x/L)$.] a) Write the wavefunction for the system consisting of these two particles. b) What is the lowest (or ground-state) energy of the system? [Hint: Ignore spin and construct an anti-symmetric spatial wavefunction for the first part. But for the second part, remember that the two electrons cannot be in the same spatial wavefunction!]

3.) The outer electron of the potassium atom occupies the $4s^1$ atomic level. You measure a value for the ionization energy of this electron of 4.35 eV. Using this information and example 9.6 in your text, find the value of Z_{eff} for the $4s^1$ electron in potassium.

4.) Let's look at oxygen. A) write out the electronic configuration for the atom oxygen (charge 8). B) Does oxygen have the outermost shell filled? C) For each of the 8 electrons, write the quantum numbers n, l, m_l, m_s, j, m_j. [Note: The final 2 are superfluous.]