Problem Set #7

due Friday, October 13

PHYSICS 851, FALL 2000

1. (a) Find the ground state energy of a particle of mass \( m \) in a spherical well of radius \( R \), where the potential is \( +\infty \) for \( r > R \) and zero for \( r < R \).

(b) Describe how one would find the energy of the first excited state of the same well.

(c) If the particle is an electron and the radius of the well is 0.15 nm, give a numerical value for the energy of the first excited state in eV.

2. Find the ground state binding energies of the following atoms in eV.

   a. \( e, Pb \)
   b. \( \mu^-, p \)
   c. \( e^+ e^- \)
   d. \( \bar{p}, Pb \)

   The mass of a muon is 205 times larger than that of an electron.

3. For the same cases as in number 2, find the associated Bohr radii.

4. For the Hydrogen atom, calculate the expectation of the operator \( X \) between the ground state and each of the four \( n = 2 \) states.