HW Set #5 Due 10/12/10 (at the beginning of class)

Problems from Chapter 5

2, 4, 6, 10, 14, 16, 18, 20, 24 32, 34, 54, 56

(note soon problems require working some previous odd numbered problems)

Other problems.

1. There is another quantum mechanical problem similar to the particle in a box, that is the particle on a ring (fixed radius in 2-d). This problem is one dimensional as the only variable is the angle around the ring.

$$\hat{H} = -\frac{\hbar^2}{2m}\nabla^2$$

where m is the mass. The 2nd derivative depends on the value of the radius and the angle such that the Hamiltonian is

$$\hat{H} = -\frac{\hbar^2}{2mr^2}\frac{\partial^2}{\partial\phi^2}$$

Given that the solutions to this problem are

$$\psi_n(\phi) = \frac{1}{\sqrt{2\pi}}\exp(in\phi) \text{ where n= } 0,\pm1,\pm2,\ldots.$$

What are the energies. And yes the wavefunctions are complex where i = sqrt(-1)

2. What is the most probable radius for the 1s H-atom wavefunction? 1s in $He^+$? Give your answers in Bohr radii

3. At what distance is the radial node of the 3p H-atom wavefunction? (again give your answer in Bohr radii)

4. Write out an integral that you would need to solve to find the radius within which you would have 90% probability of locating the electron in a 2pz H-atom wavefunction.

5. The first ionization energy of Ne is 2080.7 kJ $mol^{-1}$. Use this to estimate the $Z_{eff}$ for the outer most electron in Ne.

About how many protons has the shielding “cancelled out"

The second ionization energy of Na is 4562 kJ $mol^{-1}$. Use this to estimate $Z_{eff}$ for the outer most electron in $Na^{+}$.

About how many protons has the shielding “cancelled out"

What do these two numbers say about shielding?