CH301H – Principles of Chemistry I: Honors
Fall 2012, Unique 51390
Homework, Week 9

1. For each of the following, determine whether the indicated order of filling atomic orbitals will arrive at the ground state electron configuration. Justify your answers.

a) 4s < 4p < 3d
b) 4d < 5p < 6s
c) 3s < 3p < 3d
d) 5d < 5p < 5f

2. Explain the periodic trend in electron affinity based on the quantum mechanical ground state electron configuration of atoms.

3. Determine the ground state electron configurations of the following:

a) C
b) Se
c) Fe
d) P
e) Tc
f) Ho

4. Identify the atom or ion corresponding to each of the following descriptions:

a) The atom with a ground state electron configuration $[Kr]4d^{10}5s^{2}5p^{1}$
b) The doubly charged ion with ground state electron configuration $[Ne]3s^{2}3p^{6}$

5. Experimental studies have determined that the first three orbitals for the fluorine atom have energies:

1s:	-689 eV
2s:	-34 eV
2p:	-12 eV

Draw a realistic to-scale energy diagram of the first three orbitals for the fluorine atom. In words, describe the significance of the relative differences in energies moving from 1s to 2s to 2p.

6. For each of the following ions, predict which one will have the larger atomic radius. Justify your answer.

a) O^{-} vs S^{2-}
b) Co^{2+} vs Ti^{2+}
c) Mn^{2+} vs Mn^{4+}

d) Ca^{2+} vs Sr^{2+}

7. The nitrogen atom has one electron in each of its 3 2p orbitals.

a) Write the electron configuration of nitrogen.

b) Using the radial and angular wavefunctions shown in Table 5.2, demonstrate that this electron configuration is spherically symmetric. Hint: the total radial and angular components to the wavefunction are the sum of each individual 2p component; i.e. $Y^2(\theta,\phi) = Y^2(2p_x) + Y^2(2p_y) + Y^2(2p_z)$.

8. In the hydrogen atom, the transition from the 2p state to the 1s state is accompanied by the emission of a photon with an energy of 16.2×10^{-19} J. In the iron atom, the same transition is accompanied by the emission of X-rays of 0.193 nm wavelength. What is the energy difference between these two states in the iron atom? Justify the reason for the variation (if any) in the energy between these two states in these two atoms.