Problem Set #7

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1. For an electron in hydrogen what angles do the allowed orbital angular momentum vectors make with respect to a z-axis if the orbital angular momentum quantum number $l = 2$? Ignore the electron’s spin.

2. The total angular momentum of an electron in hydrogen is the sum of its orbital and spin angular momenta: $\vec{J} = \vec{L} + \vec{S}$. Suppose $l = 2$. Enumerate all of the possible $J_z = L_z + S_z$ values. If this number is $2j + 1$ (in analogy with the quantum numbers $l$ and $s$) what is $j$ and what is the magnitude of $J$?

3. An electron in hydrogen is initially in a 4d state with $m_l = 2$. Enumerate all of the possible states $(n, l, m_l)$ that it can make a transition to by emitting a photon via an electric dipole process.

4. What is the ground state electronic configuration for P ($Z = 15$)? What is the electronic configuration of the first excited state?

5. Repeat Problem 3 for Rb ($Z = 37$).

6. The ground state of Ag ($Z = 47$) is $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 4d^{10} 5s^1$. The ionization energy of Ag is 7.58 eV. What is the effective nuclear charge “seen” by the 5s electron?