1.8: Filling Orbitals with Electrons

As stated above, an s sublevel can accommodate two electrons, the p accommodates six, there can be 10 in the d sublevel and 14 in the f. Although there are two electrons in the s sublevel, these electrons are not identical; they differ in the quantum property known as spin. As a simple device to illustrate this, the electrons within a suborbital are often represented as arrows pointing up or down, graphically representing opposite spin axes (↑ and ↓). Electrons are added to sublevels according to Hund's rules which state that every orbital in a subshell is singly occupied with one electron before any one orbital is doubly occupied, and all electrons in singly occupied orbitals have the same spin. When a subshell is doubly occupied, the electrons have opposite spins.

For example, carbon has a filled 1s sublevel, a filled 2s sublevel and two electrons in the 2p sublevel ($2p^2$).

The electron configuration for fluorine is $1s^2\ 2s^2\ 2p^5$.

This sequence continues nicely until the third period; it turns out the 3d orbitals are slightly higher in energy than the 4s orbital, therefore the 4s fills with two electrons, and then the next 10 electrons are placed in the 3d orbital. This is a general trend in the periodic table, and the order of filling can be easily predicted by the scheme where you simply follow the arrows on the diagonal to determine the next orbital to fill.

One of the shortcuts that is often used when writing electron configuration is to show "core" electrons simply as the inert gas from the preceding period. For example, fluorine is in the second period (n = 2). That means that the orbitals associated with the first period are already filled, just like they are in the inert gas, helium (He). Therefore, instead of writing the configuration for fluorine as we did above, we can replace the $1s^2$ with the "helium core".

Calcium is in the fourth period and in Group 2. That means that the first three quantum levels are filled (n = 1, 2 and 3) just like they are in argon.

? Exercise 1.8.1: Electron Configurations

a. Write the complete electron configurations for the elements beryllium and carbon.
b. Identify the elements corresponding to the following electron configurations:
   - $1s^2\ 2s^1$ and $1s^2\ 2s^2\ 2p^6$.