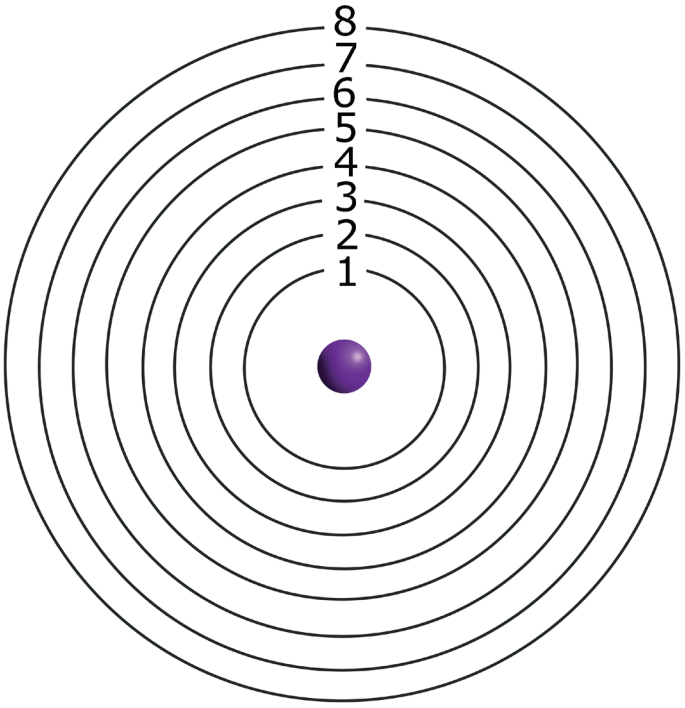

Figure 3.5.1

Electron Shells and Energy

For all known elements, there are a total of 8 electron shells, numbered as shown for a generic atom. Each shell can hold a defined number of electrons. The higher the number of the electron shell, the more electrons it can hold before it gets full. That is to say that shell 2 holds more electrons than shell 1, and shell 3 holds more than shell 2, etc. The actual equation to determine how many electrons a shell can hold is given by $2n^2$, where n is the number of the shell. For example, for the 1st shell, n = 1, so the number of electrons it can maximally hold is $2 \times 1^2 = 2$. So, the first energy shell can "only" hold 2 electrons, and then it is full. If you look back over the atom diagrams we have used in this chapter, you will see that all of them have only 2 electrons in that first shell. For the 2nd energy shell, n = 2 and can hold a total of 8 electrons and we get that by using the $2n^2$ equation, where "n" is the number of the 2nd shell, "2"—$2 \times 2^2 = 2 \times 4 = 8$. For the 3rd energy shell, n = 3, so it can hold 18 electrons—$2 \times 3^2 = 2 \times 9 = 18$. Let's do two more, the 5th energy shell and the 8th energy shell. For the 5th shell, n = 5, so it can hold 50 electrons—$2 \times 5^2 = 2 \times 25 = 50$. 8th energy shell, n = 8, so it can hold 128 electrons—$2 \times 8^2 = 2 \times 64 = 128$. When assigning electrons to the shells, you must know how many electrons each shell can hold so you know where they will go. Of course, you also need to know how many electrons the atom has, and we will be covering how to know that (it is very easy) in the next chapter on the Periodic Table of the Elements. For now, just get comfortable with the idea that the electrons fill in the energy shells from 1st–8th and that the number each shell can hold is given by $2n^2$.

Figure 3.5.2

Electron Shells and the Maximum Number of Electrons

Remember that the maximum number of electrons each shell can hold is given by the equation $2n^2$, where "n" is the number of the shell. Here it is in more detail.

Energy Shell	First (n=1)	Second (n=2)	Third (n=3)	Fourth (n=4)	Fifth (n-5)	Sixth (n=6)	Seventh (n=7)	Eighth (n=8)
Electron capacity	2	8	18	32	50	72	98	128

An idea I want to reinforce is that atoms are 3-dimensional. They are obviously very, very tiny, but that doesn't mean they are flat, 2-dimensional structures like we see on the paper. Just like a drawing of a ball or an apple on a piece of paper is a 2-dimensional representation of a 3-dimensional structure, so are the diagrams of atoms. They are 3-dimensional, which means atoms have depth as well as height and width. This becomes important when we consider electrons and their movements within their orbitals. Electrons move, a lot, and they move fast, revolving around the nucleus within their orbitals, but they don't just go around the nucleus in a single plane; they are free to move anywhere within that 3-dimensional orbital space around the nucleus. They just can't get any closer or farther than the specific orbital allows.