Chapter 5: Electrons in Atoms
Section Two: Quantum Theory and the Atom

Ground state: the lowest allowable energy state of an atom

Quantum numbers: the properties of atomic orbitals and the properties of electrons in orbitals

- The first three quantum numbers indicate the main energy level, the shape, and the orientation of an orbital
- The fourth, the spin quantum number, describes a fundamental state of the electron that occupies the orbital

Louis de Broglie

- Pointed that the behavior of Bohr's quantized electron orbits was similar to the known behavior of waves
- Suggested that electrons be considered waves confined to the space around an atomic nucleus
- **de Broglie equation:** predicts that all moving particles have wave characteristics
    - $\lambda = h/mv$

Heisenberg uncertainty principle: states that it is fundamentally impossible to know precisely both the velocity and position of an electron or any other particle at the same time

Erwin Schrodinger: developed an equation that treated electrons in atoms as waves

- He called it the **quantum mechanical model of the atom**

Atomic orbital: a three-dimensional region around the nucleus that indicates the probable location of an electron

Principal Quantum number:

- Symbolized by *n*
- Indicated the main energy level occupied by the electron…called the **principal energy level**
- Positive integers (1, 2, 3, and so on)
- As *n* increases, the electron's energy and its average distance from the nucleus increase
- Energy sublevels: orbitals of different shapes, except for the first main energy level
    - Shapes of orbitals: s, p, d, and f
        - s-orbital is spherical
        - p-orbital is dumbbell-shaped
        - d- and f-orbitals are not all the same shape

Angular momentum quantum number

- Symbolized by *l*
- Indicates the shape of the orbital
- The values of *l* allowed are zero and all positive integers less than or equal to $n - 1$

Magnetic quantum number

- Symbolized by *m*
- Indicates the orientation of an orbital around the nucleus
- *s* orbital is spherical; its *m* = 0
- *p* orbital is dumbbell shape; its *m* = -1, 0, and +1

Spin quantum number: has only two possible values (+1/2, -1/2) that indicate the two fundamental spin states of an electron in an orbital

- A single orbital can hold a maximum of two electrons, which must have opposite spins