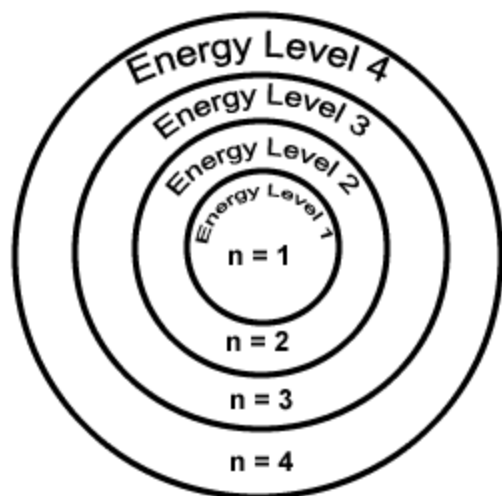


## Electron Orbitals

**Quantum Numbers** specify the properties of atomic orbitals and the properties of the electrons in orbitals

**Orbitals** are regions inside an energy level where the probability of finding an electron is very high.



Principal Quantum Number ( $n$ )	Sublevels in main energy level ( $n$ sublevels)	Number of orbitals ( $n^2$ )	Number of electrons per sublevel	Number of electrons per main energy level ( $2n^2$ )
1	s	1	2	2
2	s p	1 3	2 6	8
3	s p d	1 3 5	2 6 10	18
4	s p d f	1 3 5 7	2 6 10 14	32

- A. Principal Quantum Number ( $n$ )
  1. Indicates the main energy levels occupied by the electron
  2. Values of  $n$  are positive integers
    - a.  $n=1$  is closest to the nucleus, and lowest in energy
  3. The number of orbitals possible per energy level (or "shell") is equal to  $n^2$
- B. Angular Momentum Quantum Number
  1. Indicates the shape of the orbital
  2. Number of orbital shapes =  $n$ 
    - a. Shapes are designated  $s, p, d, f$
- C. Spin Quantum Number
  1. Indicates the fundamental spin states of an electron in an orbital
  2. Two possible values for spin,  $+1/2, -1/2$
  3. A single orbital can contain only two electrons, which must have opposite spin

## Electron Configurations

1. Aufbau Principle
  - a. An electron occupies the lowest-energy orbital that can receive it
2. Hund's Rule
  - a. Orbitals of equal energy are each occupied by one electron before any orbital is occupied by a second electron, and all electrons in singly occupied orbitals must have the same spin
3. Octet
  - a. Highest energy level *s* and *p* electrons are filled (8 electrons)
  - b. Characteristic of noble gases, Group 18
4. Noble gas configuration
  - a. Outer main energy level fully occupied, usually (except for He) by eight electrons
  - b. This configuration has extra stability

Element	Configuration notation	Orbital notation	Noble gas notation
Lithium	$1s^2 2s^1$	$\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ 1s      2s                      2p	[He] $2s^1$
Beryllium	$1s^2 2s^2$	$\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ 1s      2s                      2p	[He] $2s^2$
Boron	$1s^2 2s^2 p^1$	$\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ 1s      2s                      2p	[He] $2s^2 p^1$
Carbon	$1s^2 2s^2 p^2$	$\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ 1s      2s                      2p	[He] $2s^2 p^2$
Nitrogen	$1s^2 2s^2 p^3$	$\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ 1s      2s                      2p	[He] $2s^2 p^3$
Oxygen	$1s^2 2s^2 p^4$	$\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ 1s      2s                      2p	[He] $2s^2 p^4$
Fluorine	$1s^2 2s^2 p^5$	$\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ 1s      2s                      2p	[He] $2s^2 p^5$
Neon	$1s^2 2s^2 p^6$	$\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ $\underline{\hspace{1cm}}$ 1s      2s                      2p	[He] $2s^2 p^6$