4-3 Electron Configurations

Section 4-3

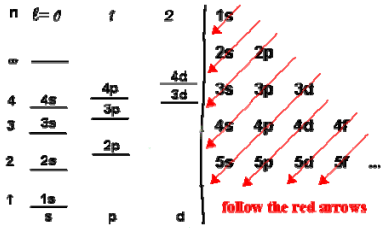
Electron Configuration – the arrangement of electrons in an atom

The lowest energy arrangement of electrons is called the "ground-state electron configuration"

There are three basic rules that determine how electrons are added to orbitals

- –Aufbau Principle
- –Pauli Exclusion Principle
- –Hund's Rule

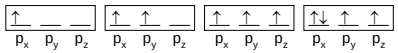
Aufbau Principle – an electron occupies the lowest energy orbital that can receive it (See figure 4-16 in your book)



Section 4-3 (Cont'd)

Pauli Exclusion Principle – no two electrons in the same atom can have the same set of all four quantum numbers. The two values for the spin quantum number will only allow two electrons of opposite spins to occupy the same orbital.

Hund's Rule – orbitals of equal energy are each occupied by one electron before any orbital is occupied by a second electron. All electrons in orbitals occupied by a single electron will have the same spin.



Orbital Notation – an orbital is displayed with a line or a box and each electron occupying the orbital is displayed as an arrow. One electron is ↑ while two electrons is ↑↓. Each line or box is labeled with the principal quantum number and the sublevel letter.

H ↑ (1s) He ↑↓ (1s)

Electron Configuration Notation – electrons are listed by quantum number and sublevel with a superscript to display how many electrons exist in the specific sublevel.

H $1s^1$ He $1s^2$

The superscripts are not exponents!! The addition of all superscripts will total the number of electrons of the atom.

Section 4-3 (Cont'd)

Highest Occupied Level – the electron-containing main energy level with the highest principal quantum number

Inner-shell Electron – electrons that are not in the highest occupied energy level

Li $1s^2 2s^1$

Inner-shell Electrons — Highest Occupied Level

Atoms that have the s and p sublevels at the highest occupied level filled with 8 electrons have an octet.

When an outer octet is filled, the next electron enters the s sublevel on the next main energy level.

Noble-gas Notation – the electron configuration of an element can be shortened by writing the noble gas in brackets from the period before and writing the highest occupied level.

Na $1s^2 2s^2 2p^6 3s^1$

Ne $1s^2 2s^2 2p^6$

⟶ Na [Ne]$3s^1$

Noble-gas Configuration – an outer main energy level fully occupied (usually by eight electrons)

Section 4-3 (Cont'd)

Orbitals can hold two electrons at most.

Helium is treated as an s block element.

For each energy level you can have:

- •One s orbital
- •Three p orbitals
- •Five d orbitals
- •Seven f orbitals

The periodic table is set up in the order orbitals are filled from left to right. A few elements in the d and f blocks break the rules.

Each s and p orbital has the quantum number matching the period number.

Each d orbital has a quantum number that is one less than the period number.

Each f orbital has a quantum number that is two less than the period number.

Section 4-3 (Cont'd)

The energy level of an orbital is affected by size and shape.

As the principle quantum number (n) increases, the electrons are farther away from the nucleus. More energy is needed when they are farther away. This can be thought of as the size of the orbital.

As the angular momentum quantum number (ℓ) increases, the shapes become more complex. More energy is needed for more complex shapes. The increasing order is:

s → p → d → f