Aufbau principle:

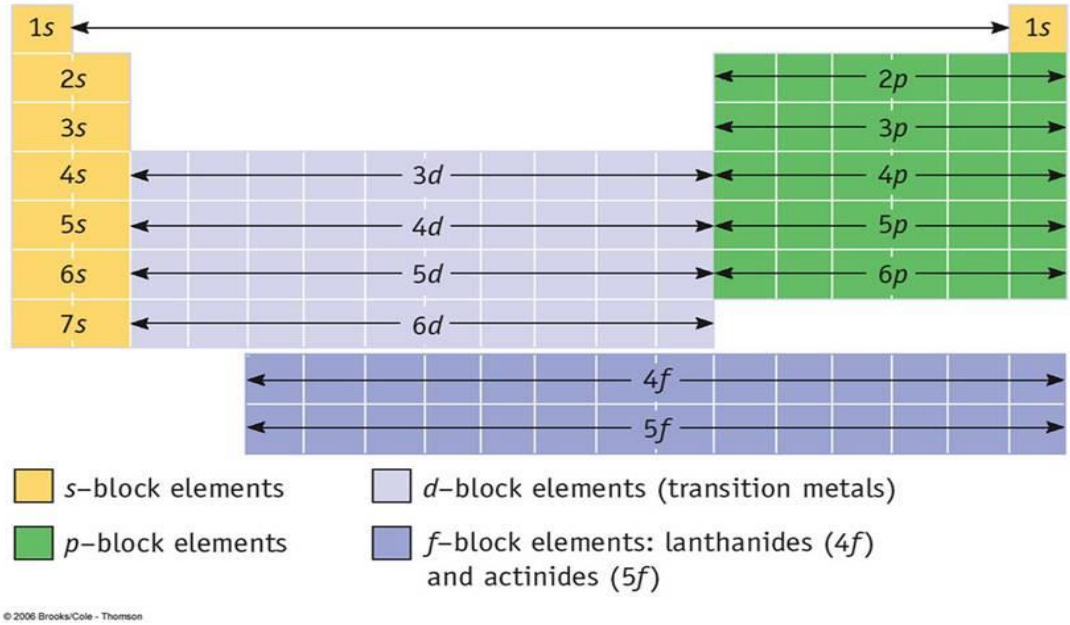
Each shell is composed of one or more subshells, the

- First shell has one subshell: ____
- Second shell has two subshells: ____ and ____
- Third shell has ____, ____, and ____
- Fourth shell has ____, ____, ____ and ____
- Fifth shell has ____, ____, ____, and ____

Subshell label	Max electrons	Shells containing	Historical name
s		Every shell	**S**harp
p		2nd shell and higher	**P**rincipal
d		3rd shell and higher	**D**iffuse
f		4th shell and higher	**F**undamental

Electrons per shell level:

Shell Level (n)	Subshell Name	Subshell Max Electrons	Shell Max Electrons ($2n^2$)
1			
2			
3			
4			



Hund's rule:

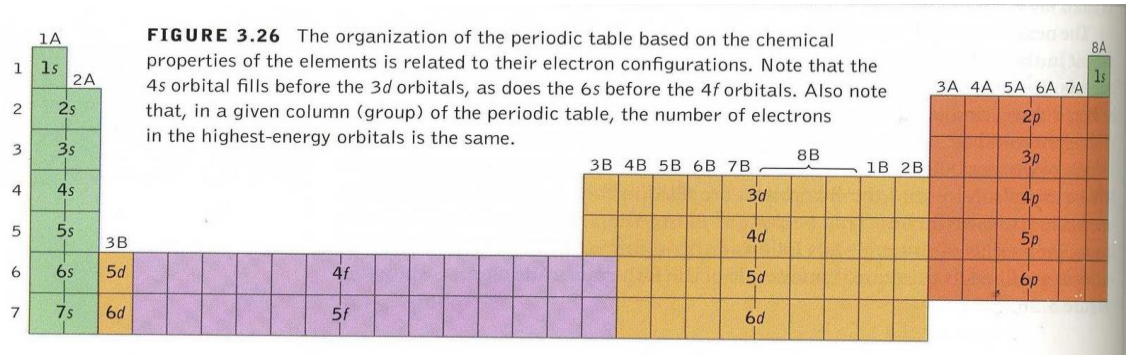
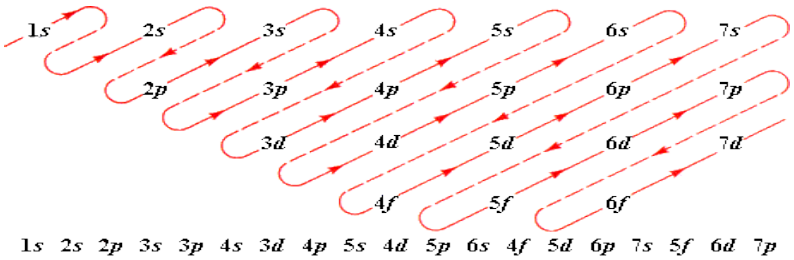


FIGURE 3.26 The organization of the periodic table based on the chemical properties of the elements is related to their electron configurations. Note that the 4*s* orbital fills before the 3*d* orbitals, as does the 6*s* before the 4*f* orbitals. Also note that, in a given column (group) of the periodic table, the number of electrons in the highest-energy orbitals is the same.



Orbital Notation:

- Arrows represent _____
- Since electrons are _____, when they pair up, they tend to _____.
- The first arrow _____ and the paired arrow _____.
- Opposite directions allow 2 electrons to share the same orbital without repelling each other.
- The "s", "p", and "d" sublevel has _____, _____, and _____ (respectively) location for electrons to go.

Arrows represent electrons, and ⇵ shows opposite spins.

_____ _____ _____ _____ _____ _____

1s 2s 2p 3s

Example: Carbon - $6e^-$

_____ _____ _____ _____ _____

1s 2s 2p

Example: Chlorine - $17e^-$

_____ _____ _____ _____ _____ _____ _____ _____ _____

1s 2s 2p 3s 3p

Noble Gas notation:

- Abbreviates major portions of electron configuration
- Find the nearest _____of lesser atomic number
- Write that noble gas in _____
- Write the remaining _____ that follows the noble gas used

Identify examples of the following principles:

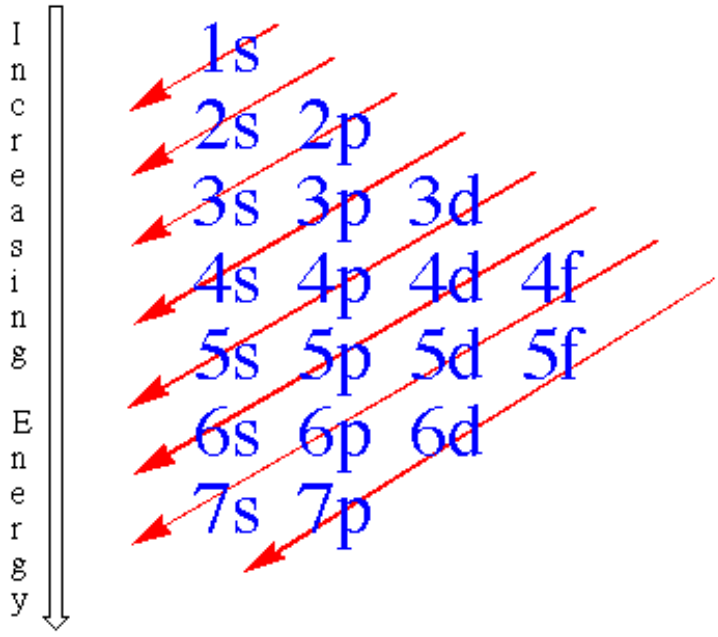
1) Aufbau:

2) Hund's rule:

3) Pauli exclusion:

Orbital Diagrams for the Ground States of Atoms from $Z = 1$ to $Z = 10$

Atom	Z	Configuration	Orbital Diagram 1s	2s	2p
Hydrogen	1	$1s^1$	↑	○	○○○
Helium	2	$1s^2$	↑↓	○	○○○
Lithium	3	$1s^2 2s^1$	↑↓	↑	○○○
Beryllium	4	$1s^2 2s^2$	↑↓	↑↓	○○○
Boron	5	$1s^2 2s^2 2p^1$	↑↓	↑↓	↑○○
Carbon	6	$1s^2 2s^2 2p^2$	↑↓	↑↓	↑↑○
Nitrogen	7	$1s^2 2s^2 2p^3$	↑↓	↑↓	↑↑↑
Oxygen	8	$1s^2 2s^2 2p^4$	↑↓	↑↓	↑↓↑↑
Fluorine	9	$1s^2 2s^2 2p^5$	↑↓	↑↓	↑↓↑↓↑
Neon	10	$1s^2 2s^2 2p^6$	↑↓	↑↓	↑↓↑↓↑↓

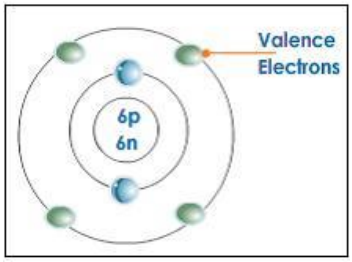


The Importance of Valence (Outer Shell) Electrons

- The outermost shell of an atom is called its _____.
- It is the Valence shell that determines which elements will bond in _____.

Valence Electrons

- Electrons of the _____
- Involved during chemical combinations
- Electrons are either:
  - _____ from the outermost shell
  - _____ into the outermost shell
  - _____ with the electrons in the outermost shell of another element.



Elements having same number of valence electrons in their atoms possess _____chemical properties.

Elements in the same _____ (column) have the same number of _____in their outermost shell.

Thus, their chemical properties are similar.

(_____.)

Electronic configuration of Br

$1s^2\ 2s^2 2p^6\ 3s^2 3p^6 3d^{10}\ 4s^2 4p^5$

$[Ar]\ 3d^{10} 4s^2 4p^5$

[Ar] = "noble gas core"

$[Ar] 3d^{10}$ = "pseudo noble gas core"

(electrons that tend *not* to react)

Atom's reactivity is determined by valence electrons

valence e's in Br: $4s^2 4p^5$

highest *n* electrons

Ion and Anion

Ions are atoms or molecules which have _____ **or** _____ one or more valence electrons giving the ion a net positive or negative charge.

- Cations are ions with a net _____ charge.
- Anions are ions with a net _____ charge.

Because of arsenic's position on the periodic table, it can make four different ions: As+3, As-3, As+5 and As+1. Electron configurations for the first two ions of arsenic may be written using the basic rules we have already learned.

Here is the electron configuration again for neutral arsenic so you can easily compare it with the As+3 and As-3 ions.

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^3$

33 electrons. (An equal number of protons and electrons.)

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}$

30 electrons. (A positive charge means that electrons have been LOST. Notice that the 3 electrons in 4p are missing.)

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6$

36 electrons. (A negative charge means that electrons have been GAINED. Notice that 4p has 3 EXTRA electrons, making a total of 6 and completely filling the 4p sublevel.)

Now, what if lithium were an ion, rather than an atom? (Remember, ions have unequal *numbers of protons and electrons.)*