CHAPTER 2 – THE PERIODIC TABLE

A. Periods:

 - horizontal rows

 Period 1:

 - H, He

- valence electrons are in the first principal energy level

Period 2:

- valence electrons are in the second principal energy level

Period 3:

- valence electrons are in the third principal energy level

B. Groups:

 - vertical columns

- elements in the same groups have similar properties (react similarily)

- this is because the outermost principal energy level of each element in a group has the same number of valence electrons

Ex:

Group 1 elements have 1 valence electron.

Group 2 elements have 2 valence electrons.

Group 17 elements have 7 valence electrons.

Group 1 is called the Alkali Metals

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Group 2 is called the Alkaline Earth Metals

Group 17 is called the Halogens

Group 18 is called the Noble Gases

Periodic Law:

- properties of elements are periodic functions of their ATOMIC NUMBER!

- when elements are arranged by atomic number, those with similar properties (groups) will be at regular intervals.

Metals, Nonmetals, Metalloids, and Noble Gases:

- all elements to left of zig-zag line are metals

- all elements touching zig-zag line are metalloids

- all elements to right of zig-zag line (except Group 18) are nonmetals

- Group 18 is called the Noble Gases

Note:

Most Active Metal is francium (Fr) in bottom, left-hand corner

Most Active Nonmetal is fluorine (F) in upper, right-hand corner

Metals:

- have low ionization energy (in other words, it doesn’t take much energy to remove the outermost electron from a metal)

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- have low electronegativity (in other words, metals have little attraction for electrons

- tend to lose electrons to form positive ions

 Ex: Na --> Na+1

- have metallic luster (shine)

- are malleable (can be made into sheets)

- ductile (can be made into wire)

- good conductors of heat and electricity

* most are solid at room temperature [exception: Mercury (Hg)]

Nonmetals:

* high ionization energy
* high electronegativity
* tend to gain electrons to form negative ions
* Ex:

Cl 🡪 Cl-

* lack metallic luster and are brittle in the solid phase
* poor conductors of heat and electricity
* usually gases or solids at room temperature [exception: Bromine (Br)]

Metalloids:

- have some properties of both metals and nonmetals

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Noble Gases (Group 18):

- have eight valence electrons (exception He)

- do not react with other elements easily (xenon and radon will react with fluorine and oxygen)

- monoatomic gases

- complete outer principal energy level

- stable

Transition Elements:

- elements in Groups 3 – 11.

- ions of transition elements are usually colored both as solid and in solution

Ions of Metals and Nonmetals:

- atoms gain or lose electrons to attain a complete outer shell

- a postive ion has fewer electrons than the original atom

- a negative ion has more electrons than the original atom

NOTE: The number of protons REMAINS THE SAME!!!!

Ex:

Lithium Atom: Lithium Ion:

3 protons 3 protons

3 electrons 2 electrons

 (+1 ion)

Fluorine Atom: Fluorine Ion:

9 protons 9 protons

9 electrons 10 electrons

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 (-1 ion)

Note:

- metals lose electrons and have positive ions

- nonmetals gain electrons and have negative ions

Allotropes:

- different forms of the same element

- have different molecular formulas or crystalline structures

- have different properties

Types of Allotropes:

 a. Oxygen:

 - has two allotropes (O2 and O3)

- O2 is the oxygen we breathe; O3 makes up the ozone layer

b. Carbon:

- many allotropes that differ in crystalline structure

1. diamond: every carbon atom is bonded to four other carbon atoms; very hard

2. graphite: carbon atoms are arranged in sheets or layers; used in pencils

3. coal: no definite pattern

4. buckminsterfullerene: made up of rings of 5 and 6 carbon atoms connected into a ball (looks like a soccer ball); each “bucky ball” has 60 to 70 carbon atoms

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Chemical Properties of Elements:

- a chemical property of an element describes how an element reacts in a chemical reaction (ex: burning)

- Reaction of Metals:

- Metallic character decreases across a period

- Metallic character increases down a group

- Group 1 elements react faster than Group 2 elements because it is easier to lose one valence electron than two

Ionization Energy:

- amount of energy needed to remove an electron

- the smaller the ionization energy, the easier it is to lose an electron

- DECREASES down a group

- INCREASES across a period

Electronegativity:

- attraction for electrons

- the larger the electronegativity, the more the atom attracts electrons

- DECREASES down a group

- INCREASES across a period

Atomic Radius:

- half the distance between adjacent nuclei

- DECREASES across a period

- increase in positive charge of nucleus pulls electrons closer and causes smaller atomic radius

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- INCREASES down a group

 - adding principal energy levels

Ionic Radius of Metals and Nonmetals:

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- ionic radius is the radius of an ion

- metals lose electrons, so ionic radius is smaller than atomic radius

- nonmetals gain electrons, so ionic radius is larger than atomic radius

* INCREASES down a group
* DECREASES across a period (due to the stronger attraction of nucleus for electrons)