**Salt Lake Community College, Chemistry Department**

**Chemistry Workshop 2**

**Topic: Atoms and the periodic table**

***Objective***

* Atomic Number, Isotopes and Atomic Weight
* Some Characteristics of Different Groups
* Ions
* The Periodic Table
* Electronic Structure of Atoms and Electron Configurations

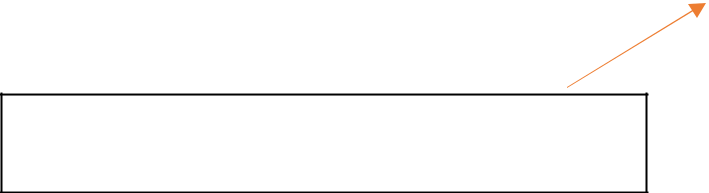
**Atomic Number:**

What does atomic number tell us? Gives us the number of protons in an atom!

Symbol of element



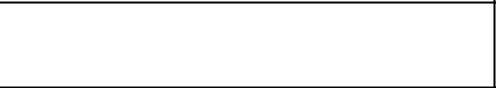
**12C6**

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**2.Mass number (number of**

**protons and neutrons)**

1.Atomic number (Number of electrons and protons)



* 1. Atomic number - the top number for each element in the Periodic Table, Abbreviated "Z"
  2. Mass number abbreviated “A”
* In their elemental state elements are electrically neutral, in each atom the #e- = #p+

**Isotopes and Atomic weight:**

1. Isotopes: substances with the same number of protons but different numbers of neutrons

1. The bottom number in the Periodic Table for each element is the *atomic weight*, the weighted average of the atomic masses of all the isotopes

**Ions:**

1. **Ions** - atoms with an electrical charge
2. In general: metal atoms tend to lose electrons to form cations, nonmetal atoms tend to gain electrons to form anions.

**The periodic table:**

* **Alkali Metals** (Group 1A): Li, Na, K, Rb, Cs, Fr

1. Shiny, soft metals with low melting point

2. React with water to form products (reactivity → unstable)

3. Because of their high reactivity, alkali metals are never found in nature in a pure form.

* **Alkaline Earth Metals (Group 2A):** Be, Mg, Ca, Sr, Ba, Ra

1. Shiny, silver metals
2. Less reactive than their neighbors in group 1A
3. Never found in nature in a pure state

* **Metalloids:** B, Si, Ge, Sb, Te, Po, At

1. Mixed properties (semi- conductors)

2. Solid at room temperature. They can lose or gain electrons.

* **Halogens (Group 7A):** F, Cl, Br, I, At

1. Colorful and corrosive nonmetals
2. Found in nature only in combination with other elements such as NaCl

* **Noble gases (Group 8A):** He, Ne, Ar, Kr, Xe, Rn

1. Colorless gases

2. Label noble gases because their lack of reactivity (stable\*\*8 valence electrons→ nonreactivity)

3. Do not combine with other elements.

**Electronic Structure of Atoms and Electron Configurations**

1. Electrons cannot exist just anywhere with respect to the nucleus; they can only be found at certain specific distances from the nucleus.
2. Areas of high probability are called *orbitals*

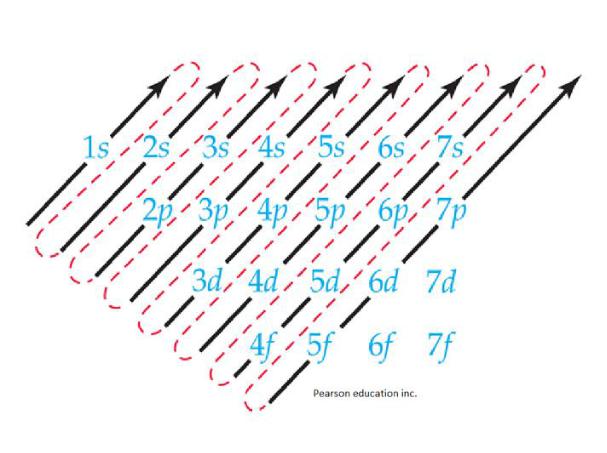
1. The discrete distances at which electrons can be found from the nucleus can be broken down into shells, subshells, and orbitals
   1. Shell
      1. Describes distance from nucleus
      2. As n increases, distance increases
      3. The spacing between shells is not linear
   2. Subshell
      1. Each shell contains as many subshells as its number
   3. Any orbital can only hold a maximum of two electrons

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
| **shell (n)** |  | **subshell (l)** | **# orbitals** | **#electrons** | **total electrons** |
|  | **/orbital** |
|  |  |  |  |  |
|  |  |  |  |  |  |
| 1 |  | s | 1 | 2 | 2 |
|  |  |  |  |  |  |
| 2 |  | s, p | 1+3=4 | 2 | 8 |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| 3 |  | s, p, d | 1+3+5=9 | 2 | 18 |
|  |  |  |  |  |  |
| 4 |  | s, p, d, f | 1+3+5+7=16 | 2 | 32 |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

1. Ground state and excited electrons
   1. Electrons in their lowest energy state are said to be in the *ground state*

**Electron Configuration:**

Below is a simple scheme to help remember the order in which the orbitals are filled.



**Practice Problems**

1. Three kinds of particles are present in atoms.
   1. Which particle in an atom has the smallest mass? **Electron**
   2. Which particle in an atom is not present in the nucleus? **Electron**
   3. Which particle in an atom has a positive charge? **Proton**
2. Which atomic particle determines the chemical behavior of an atom? **Electron**
3. Give the number of protons (p+), the number of neutrons (n0), and the number of electrons (e-) in one atom of:

|  |  |  |  |
| --- | --- | --- | --- |
| Element | p+ | n0 | e- |
|  |  |  |  |
| 23Na11 | 11 | 12 | 11 |
|  |  |  |  |
| 19 F9 | 9 | 10 | 9 |
| 39K19 | 19 | 20 | 19 |
|  |  |  |  |

1. A certain isotope X3+ contains 41 electrons and 23 neutrons. What is the mass number of this element?

**Charge = p+ - e-**

**3+ = p+ - 41 🡪 Solve for p+**

**p+ = 44**

**Mass number (A) = p+ + n0 = 44+ 23 = 67 amu**

1. Give the chemical symbol and the mass number for the ion with 22 protons, 26 neutrons and 19 electrons?

**A= 48 amu, 22Ti3+**

1. How many protons, neutrons and electrons are in one ion of 7934 Se 2− ?

**p+ = 34**

**e- = 36**

**n0 = 45**

|  |  |
| --- | --- |
| Element/Ions | Ground state Electron Configuration |
| Se | 1s22s22p63s23p64s23d104p4 |
| Al | 1s22s22p63s23p1 |
| S2- | 1s22s22p63s23p6 |
| Cr+ | 1s22s22p63s23p63d5 |

Give the complete ground-state electron configuration of: (do not use the inert-gas abbreviation

7. The element with the electron configuration

1s2 2s2 2p6 3s2 3p6 4s1 is

* 1. Rb.
  2. Ar.
  3. Ca.
  4. **K.**
  5. Mg.

1. Write the noble gas configuration for C, N, and Ca?

|  |  |
| --- | --- |
| Element | Noble gas configuration |
| C | [He]2s22p2 |
| N | [He]2s22p3 |
| Ca | [Ar]4s2 |
| Na | [Ne]4s1 |