

Salt Lake Community College, Chemistry Department

Chemistry Workshop 2

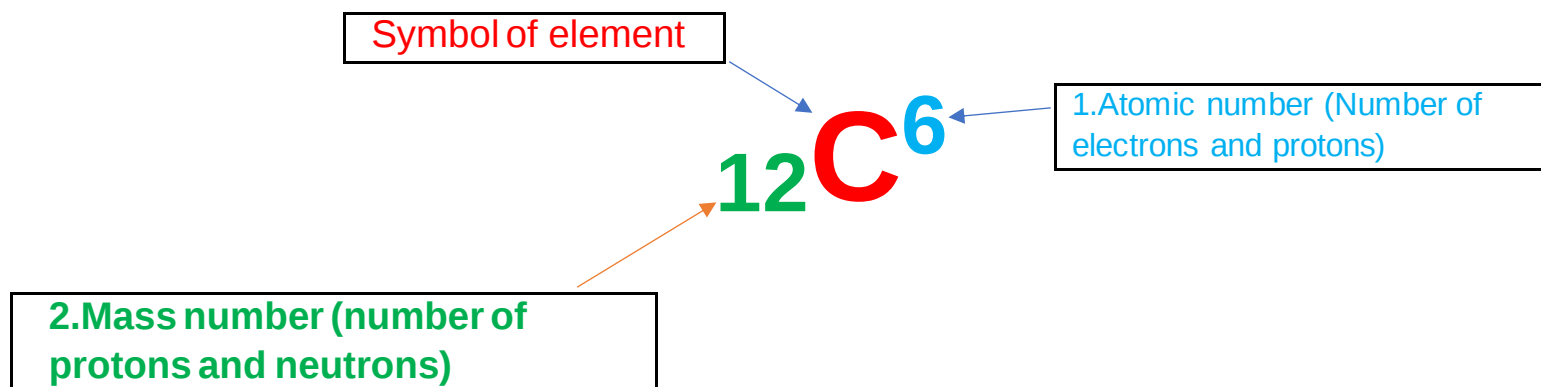
Topic: Atoms and the periodic table

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:

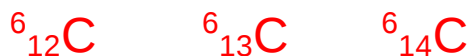
What does atomic number tell us? Gives us the number of protons in an atom!



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



2. 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

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

C. The discrete distances at which electrons can be found from the nucleus can be broken down into shells, subshells, and orbitals

1. **Shell**

- a. Describes distance from nucleus
- b. As n increases, distance increases
- c. The spacing between shells is not linear

2. **Subshell**

- a. Each shell contains as many subshells as its number

3. Any **orbital** can only hold a maximum of two electrons

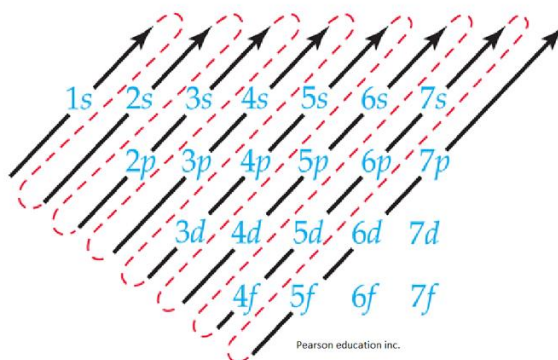
shell (n)	subshell (l)	# orbitals	#electrons /orbital	total electrons
1	s	1	2	2
2	s, p	$1 + 3 = 4$	2	8
3	s, p, d	$1 + 3 + 5 = 9$	2	18
4	s, p, d, f	$1 + 3 + 5 + 7 = 16$	2	32

D. 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.

(a) Which particle in an atom has the smallest mass?

(b) Which particle in an atom is not present in the nucleus?

(c) Which particle in an atom has a positive charge?

2. Which atomic particle determines the chemical behavior of an atom?

3. Give the number of **protons** (p^+), the number of **neutrons** (n^0), and the number of **electrons** (e^-) in one atom of:

Element	p^+	n^0	e^-
$^{23}\text{Na}_{11}$			
$^{19}\text{F}_9$			
$^{39}\text{K}_{19}$			

3. A certain isotope X^{3+} contains 41 electrons and 23 neutrons. What is the mass number of this element?

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

5. How many protons, neutrons and electrons are in one ion of $_{79}^{34}\text{Se}^{2-}$?

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

Element/Ions	Ground state Electron Configuration
Se	
Al	
S ²⁻	
Cr ⁺	

7. The element with the electron configuration

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$ is

- (a) Rb.
- (b) Ar.
- (c) Ca.
- (d) K.
- (e) Mg.

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

Element	Noble gas configuration
C	
N	
Ca	
Na	