Chemical Reactions and Equations

What is a Chemical Equation?

A **Chemical Equation** is a written representation of the process that occurs in a chemical reaction. A chemical equation is written with the **Reactants** on the left side of an arrow and the **Products** of the chemical reaction on the right side of the equation. The head of the arrow typically points toward theright or toward the product side of the equation, although reactions may indicate equilibrium with the reaction proceeding in **both** directions simultaneously. The elements in an equation are denoted using their symbols.**Coefficients** next to the symbols indicate the**stoichiometric** numbers. Subscripts are used to indicate the number of atoms of an element present in a chemical species. An example of a chemical equation may be seen in the combustion of methane:

$$\mathbf{CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O}$$

Balancing Equations Notes

A balanced chemical equation is an equation for a chemical reaction in which the number of atoms for each element in the reaction and the total charge are the same for both the reactants and the products. In other words, the mass and the charge are balanced on both sides of the reaction. No matter has been created. No matter has vanished.

Symbol	**Meaning**
+	used to separate one reactant or product from another
	used to separate the reactants from the products - it is pronounced "yields" or "produces" when the equation is read
	used when the reaction can proceed in both directions - this is called an equilibrium arrow and will be used later in the course
(g)	indicates that the substance is in a gaseous state
	an alternative way of representing a substance in a gaseous state
(s)	indicates that the substance is in a solid state

↓	an alternative way of representing a substance in a solid state
(aq)	indicates that the substance is dissolved in water - the aq comes from aqueous
(ℓ)	Identifies a phase state as pure liquid
	indicates that heat is applied to make the reaction proceed

Law Of Conservation Of Mass

In all chemical equations the **LAW OF CONSERVATION OF MASS** must be met. Matter CANNOT be created nor destroyed in a chemical reaction.

Remember, in a chemical reaction, the atoms/ions are simply **rearranged** to form new substances.

Therefore, chemical equations **MUST be balanced**.

What Is A "Balanced" Chemical Equation?

A balanced chemical equation is one in which **each side** of the equation has the **same number** of atoms/ions of each element.

Example:

$$Al\ (s) + O_2\ (g) \rightarrow Al_2O_3\ (s)$$

Not Balanced

1 Al	2 Al
2O	3O

$$\mathbf{4}Al(s) + \mathbf{3}O_2(g) \rightarrow \mathbf{2}Al_2O_3(s)$$

Balanced

4 Al	4 Al
6O	6O

RULES FOR BALANCING CHEMICAL EQUATIONS

1. Write the **correct** chemical formulas for **all** of the reactants and the products.
2. Write the formulas of the **reactants** on the **LEFT** of the reaction arrow; write the formulas of the **products** on the **RIGHT** of the reaction arrow.
3. COUNT the total number of atoms/ions of each element in the reactants and the total number of atoms/ions of each element in the products.** A **polyatomic ion** that appears ***unchanged*** on both sides of the equation is counted as a single unit.
4. Balance the elements one at a time using **coefficients**.
    a. A coefficient is a small WHOLE number that is written ***in front*** of a chemical formula in a chemical equation.
    b. When **no** coefficient is written, the coefficient is assumed to be **1**.
    c. It is best to begin with elements **OTHER THAN** hydrogen and oxygen. These elements often occur more than twice in equations.
    d. ** You must **NOT** attempt to balance the equation by changing subscripts in chemical formulas!!!!!!
5. Check each atom/ion, or polyatomic ion to be sure that the equation is **correctly balanced**.
6. Finally, make sure that all of the coefficients are in the **LOWEST** possible whole number ratios. (At least one of the coefficients must be a prime number!)

Use coefficients to make sure the number of atoms is the same on both sides of the equation.

1. _**2**_H_2 +___O_2 →_**2**_H_2O
2. _**2**_HCl+___Zn→___ZnCl2 +___H2
3. _**2**_Al+_**3**_CaS→___Al2S3 +_**3**_Ca

Write the skeleton equation for the reaction of **solid Iron and gaseous chlorine react to produce a solid iron (III) chloride**

Write unbalanced equation Fe (s) + Cl_2 (g) → $FeCl_3$ (s)
Write balanced equation 2Fe(s) + 3Cl2 (g) → 2FeCl3(s)

Diatomic "buddy" Elements

Diatomic Elements are always diatomic (written with a subscribe of 2) when they are in their elemental form

1. Hydrogen H_2
2. Nitrogen N_2
3. Oxygen O_2
4. Fluorine F_2
5. Chlorine Cl_2
6. Iodine I_2
7. Bromine Br_2
8. Sulfur S_8