**Balancing Chemical Equations**

For AP Chemistry and those who know the polyatomic ions

An equation is balanced when there are an equal number of atoms/ ions on each side of the equation.

*Why? CONSERVATION* OF MASS

Matter is neither created nor destroyed!

Example: 2H2 + O2 → 2H2O

There are two types of numbers in this equation

1. Subscripts: example - O2

The subscripts can NEVER be changed.

2. Coefficients: example 2H

This is the number in front of the atom or compound that can be changed to balance the equation.

If there is no coefficient assume the number 1. There is one unit of O2 in the above equation.

In order to calculate the numbers of atoms/ ions multiply the subscript by the coefficient.

For polyatomic ions, multiply the subscript outside of the brackets by the coefficient. No brackets means the subscript for the whole polyatomic ion is 1.

Examples: 2Na2SO4or2Na2(SO4)There are 4 Na and 2 SO4

2Ca(NO3)2 There are 2 Ca and 4 NO3

Steps to Balance Equations

(that usually work!)

1. If the equation is not written for you, write the reactants on the left followed by the products on the right.

2. Look for matching polyatomic ions on both sides. If they are there, bracket them off and treat them as a unit.

Note: A Polyatomic ion must exist on both sides of the equation to be considered a unit!!!!

3. If there is and OH ion on one side and not on the other, but there is an H2O on the other side only (not on both sides), write water as H(OH) and treat the OH as an ion in brackets.

Example for step 2 and 3

**NaOH + H2SO4 → Na2SO4 + H2O**

Step 2 - Polyatomic ions are on both sides. Bracket ions so there is no confusion.

**Na(OH) + H2(SO4) → Na2(SO4) + H2O**

Step 3 – There is and OH on one side and a water on the other so rewrite.

**Na(OH) + H2(SO4) → Na2(SO4) + H(OH)**

4. Use a chart to help balance and write each atom/ ion on each side with the number of atom next to it. One side is for the reactants; the other side is for the products.

**Na(OH) + H2(SO4) → Na2(SO4) + H(OH)**

|  |  |
| --- | --- |
| Na 1  OH 1  H 2  SO4 **1** | Na 2  OH 1  H 1  SO4 **1** |

5. Balance one atom/ ion at a time. Start with metals, then non-metals. If you can, leave oxygen and hydrogen (not in ions) for last. Change your numbers in the chart at each step always checking both sides. You may have to go back and rebalance some atoms/ions as you go along.

**2 Na(OH) + H2(SO4) → Na2(SO4) + H(OH)**

|  |  |
| --- | --- |
| Na 1 2  OH 1 2  SO41  H 2 | Na 2  OH 1  SO41  H 1 |

6. Balance Non-metals one at a time. Now we have 2 (OH) on one side and not on the other. Fix that. Then change the numbers in your chart. Always check both sides.

**2 Na(OH) + H2(SO4) → Na2(SO4) + 2 H(OH)**

|  |  |
| --- | --- |
| Na 1 2  OH 1 2  SO41  H 2 | Na 2  OH 1 2  SO41  H 1 2 |

7. Now we are balanced. We have equal number of atoms/ions on the reactant side and product side of the equation. Rewrite the equation as it should be. Single polyatomic ions are never in brackets and water is written as **H2O**

**2NaOH + H2SO4 → Na2SO4 + 2H2O**

8. Finally make sure the coefficients are in the lowest whole number ratio.

The above coefficients are 2, 1, 1, 2 this is the lowest whole number ratio for each coefficient.