

## Chemistry Chapter 2 – Stoichiometry

**Warning:** Read the questions CAREFULLY. Pay special attention to the units of values. Is it giving you moles or grams? Liters or milliliters? Pounds or Kilograms? Degrees Celsius or Degrees Kelvin? Mixing up units is the easiest way to fail a test, so don't let it happen

**Another Warning:** Be careful of units when doing proportions. Make sure you're using the correct units for the problem

**Even Another Warning:** When dealing with diatomic molecules, don't forget to double to atomic weight

- Stoichiometry** – the study of the quantitative relationships in chemical formulas and equations
- Molecular Mass** – sum of all the atomic masses of atoms (**units are u or amu for single atoms, grams for molecules**)
- Mole** – the Chemist's dozen, each mole contains  **$6.02 \times 10^{23}$**  atoms/molecules
  - 1 mole of any gas has a volume of **22.4 Liters** at Standard Temperature and Pressure (STP)
- Molarity** – Moles of Solute/1 Liter of solution
- Standard Temperature and Pressure** – 1atm of pressure (or 760 mm Hg) and a temperature of 273 Kelvins (K)
  - .5 molarity (Abbreviated .5M) means .5 moles of solute for 1 liter of solution
- Changes of Concentration Problems**
- Given 3 out of these 4 pieces of data: Initial volume, Initial molarity, final volume, final molarity. Find missing info
  - The equation: Initial Volume x Initial molarity = Final Volume x Final Molarity**
  - Example:** Given a 10L solution of 2M HCl, how many liters would you have if you diluted the solution to 1M?

Initial Volume – 10L  
Initial molarity – 2M  
Final Volume - ? – lets call this value x  
Final Molarity – 1M  
 $10L * 2M = 1M * x$   
 $x = 20L$ , so the final volume will be 20L of 1M HCl
- Percentage Composition Calculations** – Given the % comp, assume 100g of the substance
  - All %'s become grams (30% Carbon, 70% Oxygen becomes 30g C and 70g O<sub>2</sub> if total weight is 100g)
  - Change all weights to MOLES (Divide weight by atomic weight. Ex. for 30g carbon,  $30g/12g = 2.5$  Moles)
  - Set up the chemical formula, divide by the lowest number of moles, then multiply to get whole numbers
  - Example:** A compound contains 30% Carbon and 70% Oxygen. What's the chemical formula?

Assume there are 100 grams of the compound  
30% of 100g is 30g, so there must be 30g of Carbon  
70% of 100g is 70g, so there must be 70g of Carbon  
 $30g\ C = 2.5$  moles C ( $30/12$ )  
 $70g\ O = 4.375$  moles O ( $70/16$ )  
The preliminary chemical formula would be C<sub>2.5</sub>O<sub>4.375</sub>  
Divide both numbers by the smaller of the two, or in this case, 2.5, and you get C<sub>1</sub>O<sub>1.75</sub>  
Multiply in any way you can to get whole numbers, reduce, and you get a final answer of C<sub>4</sub>O<sub>7</sub>  
You can multiply by any whole number as long as the answers are whole numbers  
C<sub>8</sub>O<sub>14</sub> reduces to C<sub>4</sub>O<sub>7</sub>, much like reducing a fraction
- Calculating the Molar Mass of a Gas** – Given a gas is 3.165g/Liter at STP, what is the molar mass?
  - At STP, the space that 1 mole of ANY gas takes up is ALWAYS 22.4 Liters
  - If the gas is 3.165g/L, and you want the molar mass, you simply multiply by 22.4L
  - However, using a proportion makes it more clear, and also helps calculate other values
  - Example:** Given a gas is 3.165g/Liter at STP, what is the molar mass?

Let x = the molar mass of the gas  
 $3.165g/1L = x\ grams/22.4L$   
 $x = 70.9g$ , hence the molar mass of this gas is 70.9 grams
- Common Names/Chemical Formulas (Memorize These)** – H<sub>2</sub>O (Water), NH<sub>3</sub> (Ammonia), CH<sub>4</sub> (Methane)
- Diatomic Molecules** – Molecules that exist in pairs when on their own. These 7 molecules are diatomic
  - Hydrogen (H<sub>2</sub>), Oxygen (O<sub>2</sub>), Nitrogen (N<sub>2</sub>), Bromine (Br<sub>2</sub>), Chlorine (Cl<sub>2</sub>), Iodine (I<sub>2</sub>), and Fluorine (F<sub>2</sub>)
  - This means you will NEVER see that you have a jar with 10 moles of O in it, always 10 moles of O<sub>2</sub>
  - However, these molecules can be single if they're paired with others, such as Carbon Monoxide (CO)
- Heart of the Problem Format** – number of moles DESIRED/number of moles GIVEN. Know it, but it's not too useful
- Acids are a special type of solution with a high concentration of the H<sup>+</sup> (hydrogen)
- Bases are a special type of solution with a high concentration of the OH<sup>-</sup> (hydroxide) ion
- In a complete neutralization reaction between an acid and a base, final solution has the same number of H<sup>+</sup> and OH<sup>-</sup> ions