|  |  |  |
| --- | --- | --- |
| Summary of the Concentration Types | | |
| **Concentration Type** | **Mathematical Formula** | **Use** |
| ppm  ppb | http://pages.towson.edu/ladon/image/ppmg.jpg | When physical properties are more important than chemical properties.  **ppm = mg/kg**  Mixtures of solids.  **ppb = mg/Mg or μg/kg**  When the concentrations are very low, use ppm or ppb. |
| % composition | %W/W = [(mass of solute)/(mass of solution)] x 100%  Or 🡪 g solute/100g solution  %V/V = [(volume of solute)/(volume of solution)] x 100%  Or 🡪 mL solute /mL solution  %W/V = [(mass of solute)/(volume of solution)] x 100%  Or 🡪 g solute /100mL solution | For ease of making a solution. |
| Molarity | M=n mol solute/L solution | Most common in laboratory solutions |
| *\*Mole fraction* | X=mol A/mol total | Mixtures of solids or gases  Mixtures in which the roles of solute and solvent are not clear |
| *\*Molality* | m=n mol solute/kg solvent | Situations in which the properties of the **solvent** are studied. |
| *\*Normality* | N=n mole equivalents/L solution | Acids and bases  Oxidizing agents  Reducing agents |
| *\*Formality* | F=n formula weight units/L solution | Ionic compounds |

\* These measurements of concentration are not used in Chem 20 at this time.

**Percent Composition**

**Concept Check:** According to the organization [SeaFriends](http://www.seafriends.org.nz/oceano/seawater.htm), seawater has 904 ppm of sulfur. What is the mass percent of sulfur in seawater?

**Answer:** Assume one million grams of seawater. The number of grams of solute in one million grams is 904. This gives

mass%=(904g/1EE6g)100=0.0904%

**Molarity [Concentration Amount] (moles/Volume 🡪 mol/L)**

**Concept Check:** A solution contains 5.7 grams of potassium nitrate dissolved in enough water to make 233 mL of solution. What is its molarity?

5.7g/(101.103g/mol)=0.056mol
M=0.056mol/0.233L=0.24mol/L

**Answer:** The formula weight of KNO3 is 101.103 g/mol.

### Percent Composition to Molarity:

In order to convert mass percent to molarity or vice versa, you need to know the density of the solution. Assume 100 grams of solution; this gives you a mass of solution and a mass of solute. Use the density to find the volume of the solution. Use dimensional analysis to convert the mass of the solute to moles. Parts per million and billion can be worked the same way except for the decimal point.

**Concept Check:** Concentrated hydrochloric acid is 31% hydrochloric acid and 69% water, by mass. If the density of concentrated hydrochloric acid is 1.16g/mL, what is its molarity?

**Answer:** Assume 100 grams of concentrated hydrochloric acid; this has 31 grams of HCl and 69 grams of water. The formula weight of hydrochloric acid is 36.46 g/mol, so 31 grams is 0.85moles. **Find the volume of the solution**.

D=M/V
V=M/D
V=100g/(1.16g/mL)=86.2mL=0.08262L

**Find the molarity**.

M=0,85mol/0.0826L=12mol/L