DEFINATION

1)  The Law of Chemical Equilibrium is a relation stating that in a [reaction](http://chemistry.about.com/od/chemistryglossary/a/reactiondef.htm) [mixture](http://chemistry.about.com/od/dictionariesglossaries/g/defmixture.htm) at equilibrium, there is a condition (given by the equilibrium constant, Kc) relating the[concentrations](http://chemistry.about.com/od/chemistryglossary/g/concentration.htm) of the [reactants](http://chemistry.about.com/od/chemistryglossary/a/reactantdef.htm) and [products](http://chemistry.about.com/od/chemistryglossary/a/productdef.htm). For the reaction   
  
aA(g) + bB(g) ↔ cC(g) + dD(g),   
Kc = [ C ]c·[ D ]d / [ A ]a·[ B ]b

2) 'Titrant' is the compound in the titration buret, mostly its concentration is exactly known.   
'Titrand' is the substance which is being analysed in the titration.   
 **Added**:   
A typical titration begins with a beaker or Erlenmeyer flask containing a precise volume of the*titrand* (or *analyte*) and a small amount of indicator placed underneath a calibrated burette or chemistry pipetting syringe containing the (or *reactant*).   
When the endpoint of the reaction is reached, the volume of *titrant* (or *reactant*) consumed is measured and used to calculate the concentration of analyte, using: 

**Ca = Cr . Vr . M / Va**

where **M** is the mole ratio of the **a**nalyte and **r**eactant from the balanced chemical equation.

4) A complete description of a solution states what the solute is and how much solute is dissolved in a given amount of solvent or solution. The quantitative relationship between solute and solvent is the concentration of the solution. This concentration may be expressed using several different methods, as discussed next.

**A. Concentration by Mass**   
The concentration of a solution may be given as the mass of solute in a given amount of solution, as in the following statements: The northern part of the Pacific Ocean contains 35.9 g salt in each 1000 g seawater. The North Atlantic Ocean has a higher salt concentration, 37.9 g salt/1000 g seawater.

**B. Concentration by Percent**   
The concentration of a solution is often expressed as percent concentration by mass or percent by volume of solute in solution. Percent by mass is calculated from the mass of solute in a given mass of solution. A 5%-by-mass aqueous solution of sodium chloride contains 5 g sodium chloride and 95 g water in each 100 g solution.

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| --- | --- | --- | --- | --- |
| Percent by mass | = | mass of solute  mass of solution | X | 100% |

If both solute and solvent are liquids, the concentration may be expressed as percent by volume. Both ethyl alcohol and water are liquids; the concentration of alcohol-water solutions is often given as percent by volume. For example, a 95% solution of ethyl alcohol contains 95 mL ethyl alcohol in each 100 mL solution.

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| --- | --- | --- | --- | --- |
| Percent by volume | = | volume of solute  volume of solution | X | 100% |

Because the density of liquids changes slightly as the temperature changes, a concentration given in percent by mass is accurate over a wider range of temperatures than is a concentration given in percent by volume. Sometimes a combination of mass and volume is used to express the concentration--the mass of solute dissolved in each 100 mL solution. Using this method, a 5% (wt/vol) solution of sodium chloride contains 5 g sodium chloride in each 100 mL solution.

**C. Concentration in Parts per Million (ppm) and parts per Billion (ppb)** The terms (ppm) and parts per billion (ppb) are encountered more and more frequently as we become aware of the effects of substances present in trace amounts in water and air, and as we develop instruments sensitive enough to detect substances present in such low concentrations. In discussing mass, parts per million means concentration in grams per 106 grams, or micrograms per gram. In discussing volume, parts per million may mean milliliters per cubic meter, or the mixed designation of milligrams per cubic meter. For parts per billion, the general trend is toward the use of micrograms per liter when discussing water contaminants, micrograms per cubic meter for air, and micrograms per kilogram for soil concentrations.

**D. Concentration in Terms of Moles**   
The concentration of a solution may be stated as molarity (M), which is the number of moles of solute per liter of solution or the number of millimoles (mmol) (1 millimole = 10-3 mole) per milliliter of solution.

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| --- | --- | --- | --- | --- |
| Molarity (M) | = | moles solute  volume (liter) solution | = | millimoles solute  milliliter solution |

A 6 M (say "six molar") solution of hydrochloric acid contains 6 mol hydrochloric acid in 1 L solution.

The molarity of a solution gives a ratio between moles of solute and volume of solution. It can be used as a conversion factor between these two units in calculations involving solutions. As a conversion factor, it can be used two ways:

1. Moles/volume (L) states the number of moles in one liter of solution. This conversion factor is used in calculating the number of moles of solute in a given volume of solution.
2. Volume (L)/moles states that one liter contains some number of moles of solution. This conversion factor is used to calculate the volume of a solution that contains a given quantity of solute.

Or

The concentration of a solution

* is a macroscopic property,
* represents the amount of solute dissolved in a unit amount of solvent or of solution, and
* can be expressed in a variety of ways (qualitatively and quantitatively).

**Qualitative Expressions of Concentration**

A solution can be qualitatively described as

* **dilute**: a solution that contains a small proportion of solute relative to solvent, or
* **concentrated**: a solution that contains a large proportion of solute relative to solvent.

**Semi-Quantitative Expressions of Concentration**

A solution can be semi-quantitatively described as

* **unsaturated**: a solution in which more solute will dissolve, or
* **saturated**: a solution in which no more solute will dissolve.

The ***solubility*** of a solute is the amount of solute that will dissolve in a given amount of solvent to produce a saturated solution. For example, at 0oC, we can dissolve a maximum of 35.7 g of solid NaCl in 100 mL of water (a saturated solution). Any additional solid NaCl that we add to the saturated solution simply falls to the bottom of the container and does not dissolve.

**Quantitative Expressions of Concentration**

There are a number of ways to express the relative amounts of solute and solvent in a solution. Which one we choose to use often depends on convenience. For example, it is sometimes easier to measure the volume of a solution rather than the mass of the solution.

Note that some expressions for concentration are temperature-dependent (i.e., the concentration of the solution changes as the temperature changes), whereas others are not. This is an important consideration for experiments in which the temperature does not remain constant.

**Percent Composition (by mass)**

We can consider percent by mass (or weight percent, as it is sometimes called) in two ways:

* The parts of solute per 100 parts of solution.
* The fraction of a solute in a solution multiplied by 100.

We need two pieces of information to calculate the percent by mass of a solute in a solution:

* The mass of the solute in the solution.
* The mass of the solution.

Use the following equation to calculate percent by mass:

Equation for percent by mass

**Molarity**

Molarity tells us the number of moles of solute in exactly one liter of a solution. (Note that molarity is spelled with an "r" and is represented by a capital M.)

We need two pieces of information to calculate the molarity of a solute in a solution:

* The moles of solute present in the solution.
* The volume of solution (in liters) containing the solute.

To calculate molarity we use the equation:

Equation for calculating molarity

**Molality**

Molality, m, tells us the number of moles of solute dissolved in exactly one kilogram of solvent. (Note that molality is spelled with two "l"'s and represented by a lower case m.)

We need two pieces of information to calculate the molality of a solute in a solution:

* The moles of solute present in the solution.
* The mass of solvent (in kilograms) in the solution.

To calculate molality we use the equation:

Equation for calculating molality

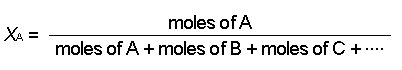
**Mole Fraction**

The mole fraction, *X*, of a component in a solution is the ratio of the number of moles of that component to the total number of moles of all components in the solution.

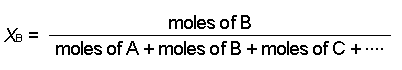
To calculate mole fraction, we need to know:

* The number of moles of each component present in the solution.

The mole fraction of A, *X*A, in a solution consisting of A, B, C, ... is calculated using the equation:



To calculate the mole fraction of B, *X*B, use:



3) **Volumetric Analysis:**  
Volumetric Analysis is to determine the volume of a solution of know concentration require to react quantitatively with a solution of substance to be analyzed.  
Volumetric analysis is also called as titrimetiric analysis.   
  
**Titrate**: Substance to be analyzed or to be determined  
  
**Titrant**: Reagent of know concentration   
  
**Titration**: The process of determining the volume  
  
**Equivalence point:** The point at which complete chemical reaction takes place and equivalent quantity of reagent is used   
  
**End Point:** The point at which the indicator changes its color    
    
**Indicator:** Auxiliary agents used to determine the end point of titration  
  
**Concentration:** A defined quantity of substance in a defined volume of solution  
  
**Normality:** The number of gram equivalents of solute present in one liter of solution and represented by “N”  
  
**Molarity:** The number of moles of solute presents in one liter of solution and represented by “M”  
  
**Molarity:** The number of moles of solute per 1000gm of solvent and represented by “m”  
  
**Importance of Volumetric analysis:**

1. High precision is obtained
2. Simple apparatus is required
3. Easy process and fast result
4. Different methods for different types of substance