Solutions

•Concentration is a quantitative way to express how much of "something" is dissolved in another "something". Usually a solid in a liquid, sometimes a gas in a liquid.

Concentration Units

Concentration: a measure of the amount of solute dissolved in a given quantity of solvent

A **dilute** solution contains a small amount of solute

A **concentrated** solution contains a large amount of solute

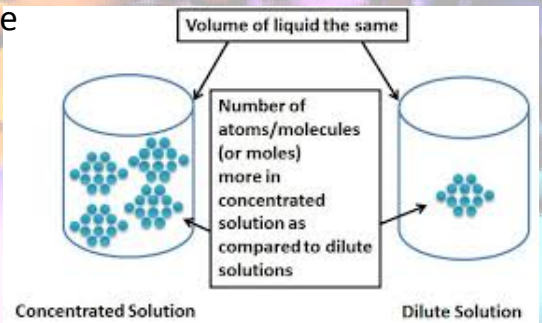
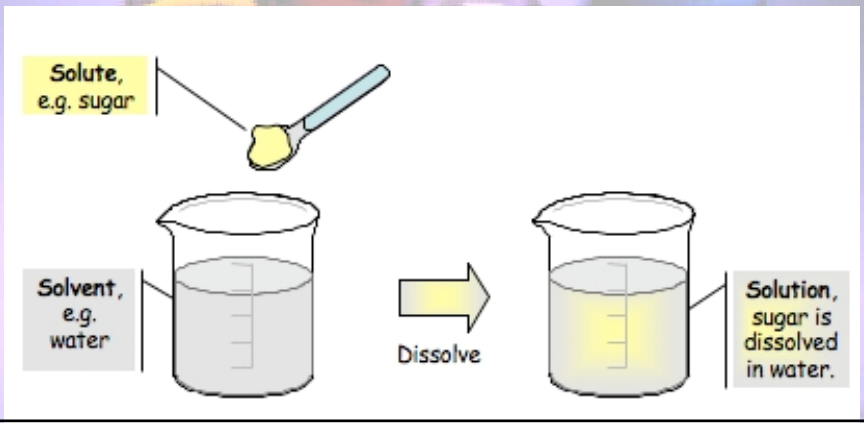


Image from: http://pharmaxchange.info/press/2011/02/a-primer-on-measuring-concentrations-%E2%80%93-molarity-moles-and-other-confusing-stuff/3-2/

Solutions

•Solvent: the dissolving medium in a solution
•Solute: a substance dissolved in a solvent to form a solution
•Solution: solute + solvent (a homogeneous mixture)



Concentration

- Molarity (M): mol solute / L solution
- When using molarity, we say, for example, that a solution is 0.500 molar or 0.500 M (of course it means mol/L)

Molarity Example:

Intraveneous (IV) saline solutions are often administered to patients in the hospital. One saline solution contains 0.90 g NaCl in exactly 0.100 L of solution. What is the molarity of the solution?

Known: Mass = 0.90 g NaCl

Volume = 0.100 L solution

Unknown: Molarity

Remember: $\text{Molarity(M)} = \frac{\text{moles of solute}}{\text{liters of solution}}$

Answer: 0.15 M

Concentration

- Parts per million (ppm):
  g solute / 1,000,000 g solution

$$\text{ppm} = \frac{\text{mass solute}}{\text{mass solution}} x 10^6$$

- Parts per billion (ppb):
  g solute / 1,000,000,000 g solution

$$\text{ppb} = \frac{\text{mass solute}}{\text{mass solution}} x 10^9$$

- Mass % (pph): g solute / 100 g solution

$$\%\ \text{conc.} = \frac{\text{mass solute}}{\text{mass solution}} x 100$$

ppm (parts per million)

Example:

A 155.3 g sample of pond water is found to have 1.7×10^{-4} g of $Ca_3(PO_4)_2$. What is the concentration of $Ca_3(PO_4)_2$ in ppm?

$$\text{ppm} = \frac{\text{mass solute}}{\text{mass solution}} x\,10^6$$

ppb (parts per billion)

Example:

An article says that researchers found 0.003 g of mercury in a 1000 L (1000 kg) sample of water. What is the concentration of mercury in ppb?

$$\text{ppb} = \frac{\text{mass solute}}{\text{mass solution}} x\,10^9$$

g/100 g H_2O

Solubility curves use concentrations in:

g solute/100 g H_2O

To calculate:

$$\frac{\text{mass solute (in grams)}}{\text{mass } H_2O \text{ (in grams)}} \times 100\text{g } H_2O$$

Concentration

- Dilution: If you are preparing a new solution from a solution that you already know the concentration of, you can calculate its new molarity with the following equation (where M is molarity and V is volume):

$$M_1V_1 = M_2V_2$$

Example: How many L of 8M HCl would be required to make 2L of 1M HCl?

Factors Affecting Rates of Dissolution (Dissolving)

1. Size of the Particles: The smaller the particles = quicker dissolution.

Why?

Dissolution (dissolving) occurs at the surface of the solute and the solvent. When a crystal (like sugar, $CuSO_4$, or salt) is broken up more solute molecules are in contact with the solvent (water) and are able to be dissolved. A.k.a. More surface area to the solvent = quicker dissolution.

2. Agitation of solution: the more agitation (shaking) = quicker dissolution

Why?

Shaking causes more solvent to come into contact with the solute causing quicker dissolution.

3. Temperature: the warmer the solution = the quicker dissolution

Why?

The warmer something is (i.e water) more its molecules are moving around. The more they are moving around the more solute molecules with which they will come into contact causing a quicker dissolution rate.

Solutions – Key Terms

Solution = Solution: a ***homogenous*** mixture of solute + solvent

Solute: the substance dissolved in a solution.

Solvent: the dissolving medium in a solution.

Solubility = The amount of a substance required to form a saturated solution with a **specific amount of solvent** at a **specified temperature**.

Molality

Molality (m): the number of moles of solute per kilogram of solvent

Units: m *ex: 4.0 m is "4 molal"*

$$\text{Molality} = \frac{\text{moles of solute}}{\text{kg of solvent}}$$

Molality Example:

How many grams of potassium iodide must be dissolved in 500.0 g of water to produce a 0.060 molal KI solution?

Known: mass of water = 500.0g

Solution concentration = .060*m*

Unknown: Mass of solute = ? g KI

Remember: Molality = $\frac{\text{moles of solute}}{\text{kg of solvent}}$

Answer : 5.0 g KI

Concentration

- Homework
- 4.60, 4.62, 4.64, 4.74, 4.80, 4.116