

# Chemistry (Math Notes)

## Module #10

### TERMS

A solute is the substance that is \_\_\_\_\_.

A solvent is the substance that the solute is \_\_\_\_\_.

A solution is the \_\_\_\_\_ + the \_\_\_\_\_.

Solubility refers to the \_\_\_\_\_ amount of solute that can be \_\_\_\_\_ in a \_\_\_\_\_ amount of solvent.

A saturated solution is a solution in which the \_\_\_\_\_ amount of solute has been dissolved.

Precipitation is the process by which a \_\_\_\_\_ solute leaves a solution and turns back into its \_\_\_\_\_.

Exothermic is a process that \_\_\_\_\_ heat.

Endothermic is a process that \_\_\_\_\_ heat.

\_\_\_\_\_ is a common solvent because more substances can be dissolved in it than in solids, even \_\_\_\_\_ can be dissolved in \_\_\_\_\_.

#### Example:

Why? Because all ionic compounds dissolve by splitting into \_\_\_\_\_. Covalent compounds don't break up into \_\_\_\_\_, but the \_\_\_\_\_ molecules \_\_\_\_\_ these compounds.

#### Example:

## RULES OF SOLUBILITY

1. The solubility of an solute depends both on the \_\_\_\_\_ of the solute *and* the \_\_\_\_\_ of the solvent. **(Be sure to understand and remember the facts in Table 11.1 - p.358)**
2. For \_\_\_\_\_ solutes, solubility \_\_\_\_\_ with \_\_\_\_\_ temperature. (*Direct relationship*)
3. For \_\_\_\_\_ solutes, solubility is \_\_\_\_\_ affected by temperature. (*No relationship*)
4. For \_\_\_\_\_ solutes, solubility \_\_\_\_\_ with \_\_\_\_\_ temperature. (*Inverse relationship*)
5. \_\_\_\_\_ pressure \_\_\_\_\_ the solubility of gases. (*Direct relationship*)
6. Pressure does \_\_\_\_\_ affect the solubility of \_\_\_\_\_ and \_\_\_\_\_. (*No relationship*)

## FORMULAS:

Molarity (M) =

Molality (m) =

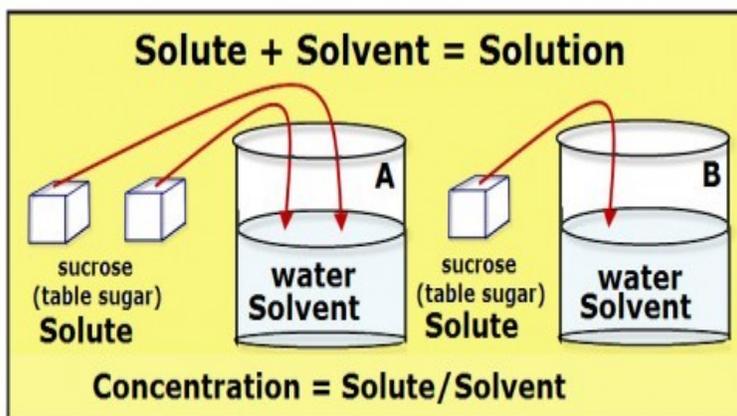
When a solute is dissolved in a solvent, the resulting change in the freezing temperature is determined by the following formula:

Define Freezing Point Depression: \_\_\_\_\_  
\_\_\_\_\_

Define Boiling Point Elevation: \_\_\_\_\_  
\_\_\_\_\_

When a solute is dissolved in a solvent, the resulting change in the boiling point temperature is determined by the following formula:

## What is a Solution? How do You Saturate A Solution?



Each solution is a mixture of sugar (sucrose) and water. Sugar is the solute and water the solvent. Solution A has twice as much sugar added to the same amount of water as does solution B. Thus, Solution A is more concentrated than is Solution B. You can also say that of the two solutions, A and B, Solution B is more dilute.

A **solution** is a **homogeneous mixture**, meaning it is the same throughout. A solution can be made of more than two substances, with one of the substances being the **solvent** and the substances that dissolve in the solvent are called **solutes**.

You make and use chemical solutions every day. Add sugar to your cereal or tea and you have made a solution. Put on any cologne or perfume and you are using a solution. While the examples on this page use water as the solvent, there are many different kinds of solvents—ethyl alcohol is the solvent in colognes and perfumes.

### How Does A Solution Form?

A solution forms when a **solute** dissolves in a **solvent**, which means the solute breaks apart and disperses equally throughout the solvent. Adding sugar to water is an example of making a solution because the sugar (solute) will dissolve in the water (solvent).

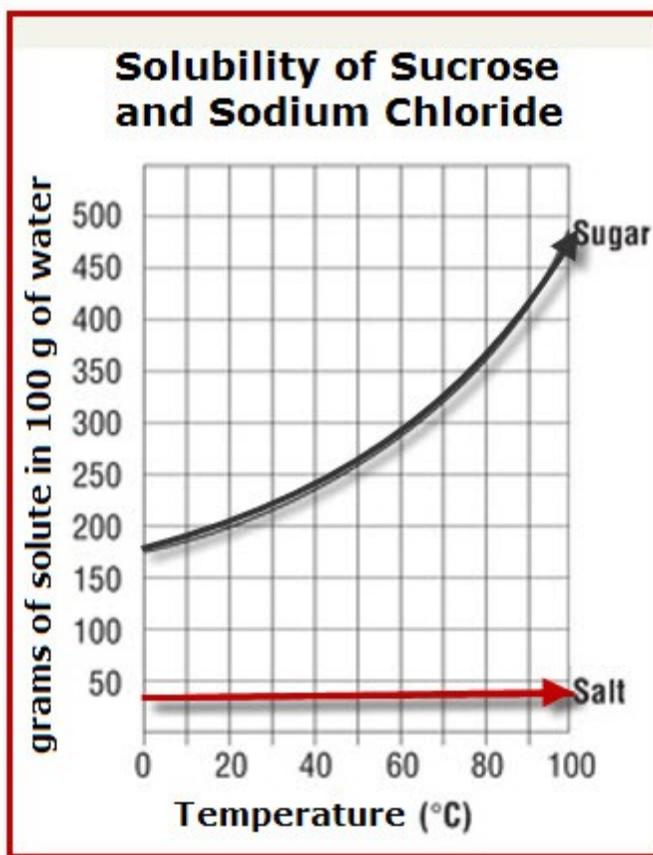
The **concentration** of a solution depends on the ratio of the amount of solute to the amount of solvent. If the amount of solvent remains constant, then the concentration of the solution is a function of the solute. This means that any change in the amount of solute affects the solutions concentration. This could be expressed as:

**C(solute) = amount of solute/ amount of solvent**

Read as: A Solution's concentration as a function of solute is the ratio of amount of solute to amount of solvent.

**Dilute** refers to a low concentration. Dilute is not a quantitative term, instead it is more qualitative, meaning descriptive. Dilute refers to having a small amount of solute in a large amount of solvent. Small and large are also descriptive terms. How small? How large? My point is that saying a solution is dilute doesn't give enough information unless you are comparing it to something else. For example, if you prepare two solutions as shown in the diagram, you could say that solution-A is more dilute than is solution-B.

Other qualitative descriptions for solution concentration include saturated solution and super saturated.



The graph shows that more sucrose (table sugar) dissolves in water as the temperature of the water increases. The graph also shows that while more sodium chloride (table salt) dissolves in water as the temperature of the water increases, the increase is very small.

A **saturated solution** is made by dissolving as much solute as possible in a solvent. For example, add table sugar (solute) to a glass of water (solvent) until no more sugar will dissolve even with vigorous stirring. The undissolved sugar settles to the bottom of the glass. The amount of sugar that dissolves depends basically on the amount of water and its temperature.

Look at the Solubility Graph for Sucrose and Sodium Chloride. The dark line representing the solubility of sucrose – sugar at different temperatures curves upward. The red line representing the solubility of salt-sodium chloride only slightly rises. Thus, while an increase in temperature greatly affects the amount of sugar that will dissolve in water, there is very little effect on the solubility of salt.

A **supersaturated solution** of sugar could be formed by heating the solution to the boiling point of water, which is  $100^{\circ}\text{C}$ . The solubility graph shows that at this temperature, about 475 g of sugar will dissolve in 100 g of water. When all the sugar has dissolved, the solution is allowed to cool. At any temperature lower than  $100^{\circ}\text{C}$ , the solution is considered supersaturated. This is because the solution has more solute dissolved in the solvent than normally dissolves at the lower temperature.

**Supersaturated solutions** are unstable and stirring or jostling the solution can cause the excess dissolved sugar molecules to begin to stick together forming crystals when are said to **precipitate**. Precipitate means to “fall out of solution.”