

STUDY GUIDE: SOLUTIONS

When you put sugar into water, the sugar seems to disappear. If you sip the water, you will notice a sweet taste. Obviously the sugar is in the water and has not been changed chemically. Instead, the molecules of the sugar have spread out evenly among the water molecules. The sugar has dissolved in the water. A mixture of sugar and water has formed. A mixture in which one substance dissolves in another is called a **solution**. In a solution, the molecules of one substance dissolve and are evenly spaced among the molecules of another substance.

A liquid solution is a mixture in which one substance is dissolved in another substance. The substance that dissolves is called the **solute**. The substance in which the solute dissolves is called the **solvent**. When salt dissolves in water, salt is the solute and water is the solvent.

Not all mixtures are solutions. For instance, if you mix clay with water, particles of clay can be seen throughout the water. This type of mixture is called a **suspension**. A suspension is a mixture containing particles that do not dissolve but are spaced throughout a substance.

Many of the solutions with which you are familiar involve water. Water is capable of dissolving so many substances that it is often referred to a universal solvent. Water is the most common solvent. However, not all substances will dissolve in water. If a substance will not dissolve in a particular solvent, it is said to be **insoluble** in that solvent. Calcium carbonate or chalk, is insoluble in water. You have probably dissolved salt in water, made Kool-Aid®, and tasted soft drinks. These are all solutions that contain water.

Some substances that do not dissolve in water will dissolve in another substance, such as alcohol or gasoline. For example, iodine dissolves in alcohol. However iodine will not dissolve in water. Iodine is insoluble in water.

Solutions are not necessarily liquids. Some solutions consist of gases. Air is a mixture of gases and is considered to be a solution. The main substances in air are nitrogen, oxygen, carbon dioxide, and water vapor.

Alloys are an example of a solid solution. Usually two or more different metals are mixed together in molten form and when cooled to a solid, will have properties different from either metal alone. Probably the most useful alloy is **steel**, a hard, strong, gray or bluish-gray alloy of iron and carbon and usually other elements. **Brass** is a yellow alloy of copper and zinc. **Bronze** is a yellowish-brown alloy of copper and tin.

A solution can consist of two liquids mixed together. An example of this type of solution is alcohol mixed with water. In many cases, mixing two liquids together will not result in a solution. Instead, the two liquids will separate into two layers. For instance, vegetable oil and water will not form a solution. A layer of vegetable oil will form on top of the water.

When you put sugar into coffee, two teaspoonfuls will make the coffee sweeter than one will. That is because more sugar is in the solution. Coffee with more than two teaspoonfuls of sugar will be even sweeter. By increasing the amount of solute in a volume of solvent, a more concentrated solution is made. A solution with a large amount of solute is said to be a **concentrated** solution. A solution with a small amount of solute is said to be a **dilute** solution.

Some solutes will dissolve more easily than others in a particular solvent. For example, at certain temperatures, much more sodium nitrate (NaNO_3) will dissolve in water than will table salt, sodium chloride (NaCl). Only a certain amount of solute will dissolve in a particular solvent at a particular temperature. The amount of a solute that will dissolve in a particular solvent at a given temperature is called the **solubility** of the solute. Solubility is often measured in grams of solute that will dissolve in 100 cm^3 of solvent at a certain temperature.

When a solution contains the most solute it can hold at a given temperature, that solution is said to be a **saturated** solution. If more solute is added to a saturated solution at a certain temperature, the extra solute will fall to the bottom of the test tube and not dissolve. This happens because the spaces between the molecules of the solvent are already filled with particles of solute. There is no room for more solute in the spaces.

If you heat a saturated solution, the solution will be able to dissolve more solute. This type of solution is called **unsaturated**. If more solute is then added to this solution, some of the solute will dissolve. This happens because heating the solvent increases the size of the spaces between the molecules of solvent. The added space makes more room for more particles of solute. More solute can be added to an unsaturated solution until the solution is one again saturated. If the solution is then slowly cooled, the extra solute will remain in solution. The solution will contain more solute than a saturated solution of the same volume. This type of solution is said to be a **supersaturated** solution. If a crystal of solute is added to a supersaturated solution, more crystals form in the solution. Rock candy is produced by putting crystals of sugar into a supersaturated sugar solution, resulting in the formation of more and larger sugar crystals.

QUESTIONS

1. A mixture in which the molecules of one substance dissolve and are evenly spaced among the molecules of another substance is called a _____
2. The type of mixture that sugar and water form is called _____
3. In a solution, the substance that dissolves is called the _____
4. The liquid in which a substance dissolves is called the _____
5. The most common solvent is _____
6. A solution with a large amount of solute compared to the amount of solvent is said to be _____
7. A solution with a small amount of solute compared to the amount of solvent is said to be _____
8. How much of a solute that will dissolve in a particular solvent at a given temperature is called the _____
9. A solution that contains the most solute it can hold at a given temperature is said to be _____
10. In a solution of sugar and water, the solute is _____ and the solvent is _____
11. If you heat a saturated solution, the solution becomes _____
12. A solution that contains more solute than a saturated solution of the same volume is said to be a _____ solution.

MATCHING DIRECTIONS: Put the letter of the meaning by the word it matches.

_____ 1. solute	a. the substance in which another substance dissolves
_____ 2. solvent	b. a solution that contains the most solute it can hold at a given temperature
_____ 3. solubility	c. a mixture in which the molecules of one substance dissolve and are evenly spaced among the molecules of another substance
_____ 4. insoluble	d. a mixture containing particles that do not dissolve but are spaced throughout a substance
_____ 5. saturated solution	e. not being able to dissolve in a particular solvent
_____ 6. suspension	f. how much of a solute will dissolve in a particular solvent at a particular temperature
_____ 7. solution	g. in a solution, the substance that dissolves
_____ 8. concentrated	h. a solution with a large amount of solute

DIRECTIONS: Answer the following questions.

1. Explain the difference between a dilute and concentrated solution.

2. Explain how a supersaturated solution is made.

3. Explain the difference between a solute and a solvent
