

Chapter 15 Solutions

15.1 Forming Solutions

Key Terms

solution
aqueous solution
supersaturated

solvents
saturated
concentrated

solutes
unsaturated
dilute

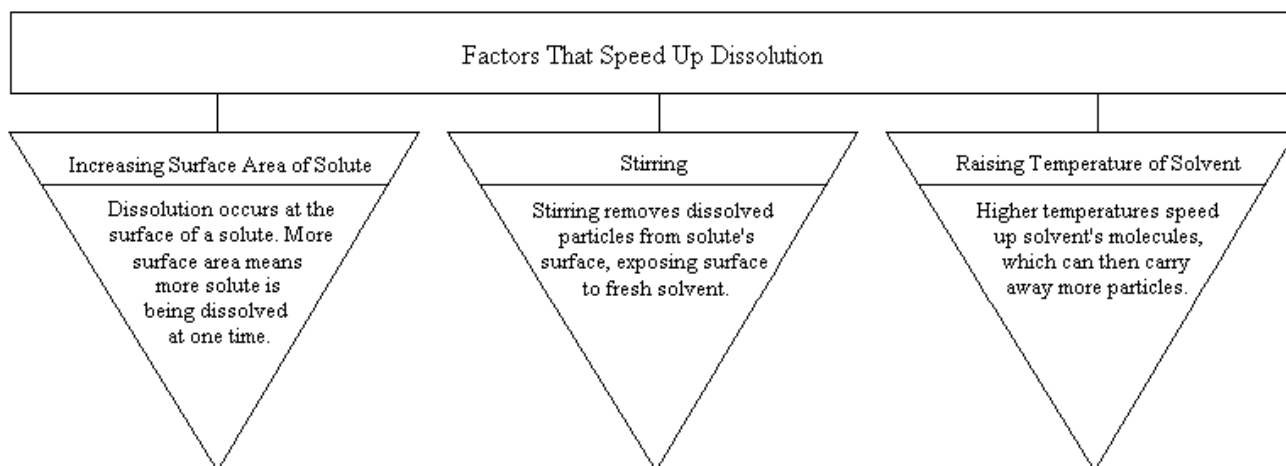
Summary

When ionic substances dissolve in water, they break up into individual anions and cations that are spread evenly throughout the water. The negative end of the water molecule is attracted to the cation, whereas the positive end is attracted to the anion. Polar substances dissolve in water in a similar way. The molecules of substances not soluble in water are not attracted to water molecules.

As a general rule, *solvents* (substances that do the dissolving) usually dissolve *solutes* (substances to be dissolved) with polarities similar to their own.

A *solution* is a mixture in which the individual parts are homogeneously blended. When a solution contains as much solute as it can dissolve at that temperature, it is said to be *saturated*. A solution that has not reached the limit of solute that can be dissolved is *unsaturated*. Sometimes when a saturated solution at a high temperature is cooled quickly, all the solute will remain dissolved. This type of solution is called a *supersaturated* solution and usually is unstable. A *concentrated* solution has a relatively large amount of solute dissolved in it. A *dilute* solution contains a relatively small amount of solute.

The dissolution (dissolving) process may happen quickly or slowly. Three factors affect the speed of the dissolution process.



15.2 Describing Solution Composition

Key Terms

mass percent
dilution

molarity (M)

standard solution

Summary

The *mass percent* of a solution's composition is the mass of solute present divided by the total mass of the solution (both solvent and solute) and multiplied by 100%.

Molarity (M) expresses the concentration of a solution, or the amount of solute in a given volume of solution. Molarity is the number of moles of solute per volume of solution in liters. A solution in which the concentration is known accurately is called a *standard solution*.

The process of adding more solvent to a solution is called *dilution*.

15.3 Properties of Solutions

Key Terms

neutralization reaction
equivalent weight

equivalent of an acid
colligative property

equivalent of a base

Summary

The following five steps are involved in solving stoichiometric problems involving solutions:

1. Write the balanced equation for the reaction. For reactions involving ions, write the net ionic equation.
2. Calculate the moles of reactants.
3. Determine which reactant is limiting.
4. Calculate the moles of other reactants or products as required.
5. Convert to grams or other units if required.

An acid–base reaction is often called a *neutralization reaction*. When just enough strong base is added to react exactly with the strong acid in a solution, we say the acid has been *neutralized*. One product of this reaction is always water.

Normality (N) is a unit of concentration that focuses mainly on the H^+ and OH^- ions available in an acid–base reaction. One *equivalent of an acid* is the amount of that acid that can furnish 1 mol of H^+ ions. One *equivalent of a base* is the amount of that base that can furnish 1 mol of

OH^- ions. The *equivalent weight* of an acid or a base is the mass in grams of 1 equivalent (equiv) of that acid or base.

Normality is defined as the number of equivalents of solute per liter of solution.

The presence of various solutes in solvents affects the boiling points and freezing points of the solvent. Raising of the boiling point of a solvent by a solute is an example of a *colligative property*, which is a property of a solution that depends on the number of solute particles present.

Additional Active Reading Questions

1. Describe the difference between a saturated solution and an unsaturated solution.
2. What are the three factors that speed up dissolution?
3. Calculate the mass percent of a 12,000-g sample of solution containing 846.6 g of solute.
4. What is the molarity of a solution containing 2.7 mol of NaCl in 0.9 L of solution?
5. What is *dilution*?
6. What happens when just enough strong base is added to react exactly with the strong acid in a solution?
7. What is the term for the amount of an acid that can furnish 1 mol of H^+ ions?
8. What is the name for a property of a solution that depends on the number of solute particles present? Give an example.