

## Factors Affecting

## Solution Formation

Text reference:  
Chapter 16

### Introduction

A solution consists of a *solute*, the material that is dissolved, and a *solvent*, the material that the solute is dissolved in. In Experiment 27, you studied the solubility of various types of solutes in water. In this experiment, you will investigate a variety of factors that influence the rate at which a solute dissolves in a solvent. Specifically, you will examine the effects of temperature, degree of mixing, and particle size on rate of dissolution.

### Objectives

1. To test the effects of particle size, degree of mixing, and temperature on the rate of dissolution.



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### Equipment

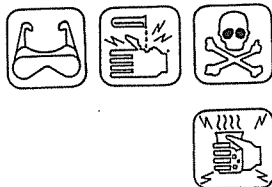
2 safety goggles	1 wire gauze
7 large test tubes	1 gas burner
1 test tube rack	1 mortar and pestle
2 100-mL beakers	1 spatula
1 ring stand	1 glass stirring rod
1 ring support	

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### Materials

sodium chloride, NaCl	paper towels
copper(II) sulfate pentahydrate, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  	weighing paper
ice	distilled water

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### Safety

1. Wear safety goggles.
2. Copper compounds are poisonous and are a water pollution hazard. The copper sulfate used in this experiment should not be poured down the sink. Wash your hands thoroughly after use.

### Procedure

As you perform the experiment, record your observations in Tables 31.1 and 31.2, found at the end of the Procedure section.



## Part A. Effects of Particle Size and Mixing

1. Label four large test tubes with the numbers 1 through 4. Using a spatula and a piece of weighing paper, obtain four pea-sized crystals of copper(II) sulfate pentahydrate,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ . **CAUTION:  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  is toxic and irritating. Avoid contact with this material.** Put one crystal into Tube 1 and another crystal into Tube 2. Crush the third crystal with the mortar and pestle and pour the powder into Tube 3. Crush the fourth crystal and pour the powder into Tube 4.
2. Fill each of the four test tubes about one-third full with water. Place Tubes 1 and 3 in the test tube rack without shaking them. Flick Tubes 2 and 4. Note how long it takes for the contents of each of the four tubes to dissolve. Record your observations in Table 31.1.

## Part B. Effect of Temperature

3. Add 50 mL of distilled water to a 100-mL beaker. Place the beaker on a wire gauze in a ring stand assembly set up in the usual fashion. Heat the water to boiling, using a gas burner. While the water is heating, proceed to the next step.
4. Fill a 100-mL beaker halfway with crushed ice and then add approximately 30 mL of distilled water to the beaker. Proceed to the next step while the water is chilling.
5. Label three large test tubes with the numbers 1 through 3. Add 5 g of sodium chloride to each test tube. Place the tubes in a test tube rack.
6. Fill Tube 1 one-third full with ice-cold water. Fill Tube 2 one-third full with distilled water at room temperature. Fill Tube 3 one-third full with boiling water. Pour the boiling water from the beaker using a paper towel handle as illustrated in Figure 31.1. **CAUTION: Fill the tubes while they are supported in the test tube rack. Do not hold a tube while pouring boiling water into it.** Gently agitate the contents of the tubes by moving the test tube rack back and forth. **CAUTION: Do not pick up or otherwise handle the hot test tube.** Note how long it takes for the contents of each tube to dissolve. Record your observations in Table 31.2.

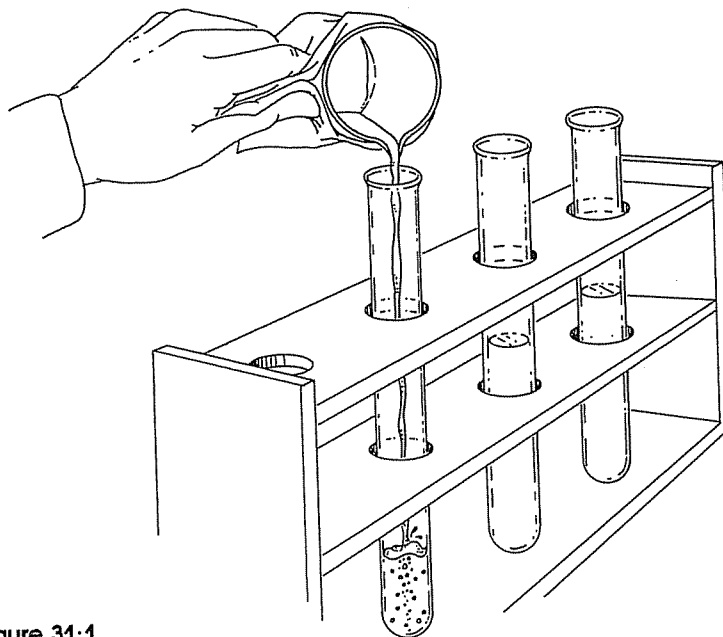


Figure 31.1

Table 31-1 Effects of Particle Size and Mixing on Solution Formation				
Tube	Particle Size	Mixed?	Time to Dissolve	Observations

Table 31-2 Effects of Temperature on Solution Formation			
Tube	Temperature	Time to Dissolve	Observations

### Results and Conclusions

1. What effects does particle size appear to have on the rate at which a solute dissolves?

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2. Why does shaking affect the rate at which a solute dissolves?

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3. Explain the results of the temperature study in terms of the kinetic theory.

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