A Solubility Product

# Introduction

For slightly soluble salts, an equilibrium is established between the solid salt with its ions in solution. For some general salt AB,

AB(s) ⬄ A+(aq) + B-(aq)

Since the concentration of a pure substance in the solid phase remains constant, the equilibrium expression is simplified to:

Ksp = [A+][B-]

For salts formed by ions of difference charges, such as A2B or AB2, the subscript becomes the power for the ion’s concentration.

The solubility of NaCl may be experimentally determined by fairly simple procedures. We will also investigate how the addition of either of its ions to its saturated solution may result in the formation of a precipitate.

# Materials and Methods

2 150-mL beakers

Evaporating dish

Watch glass

10-mL graduated cylinder

Stirring rod

Tongs

Two medium-sized test tubes

Sodium chloride (NaCl)

Sodium hydroxide pellets (NaOH)

2.0 M sodium hydroxide solution (NaOH)

# Procedure

1. Prepare a saturated solution of sodium chloride by adding 10 g of the salt to 25 mL of water in a beaker. Stir constantly until there is an excess of the solid in the bottom of the beaker. Decant the saturated solution.
2. Determine the mass of the evaporating dish to the nearest 0.01 g and record it on the Report Sheet.
3. Measure approximately 10 mL of the salt solution into a graduated cylinder and record the volume to the nearest 0.1 mL.
4. Pour the solution into the evaporating dish, cover with a watch glass, and place it on a hot plate, evaporating the solution the dryness.
5. Remove the dish with tongs and place it on a wire gauze to cool. After cooling, record the mass of the evaporating dish and solid residue to the nearest 0.01 gram. Use the data to calculate the solubility product of sodium chloride.
6. Pour 5 mL of the saturated sodium chloride solution into a test tube and add two pellets of solid sodium hydroxide. Stir carefully to dissolve as much of the sodium hydroxide as possible. Record your observations.
7. Pour 5 mL of the saturated sodium chloride solution into a test tube and add 5 mL of 2 M NaOH solution. Stir carefully and record your observations.

# Data and Results

1. Calculate the mass of salt by subtracting the mass of the dish from the mass of the product and dish.
2. Calculate the moles of sodium and the moles of chlorine in the sample.
3. Calculate the concentrations of sodium and ion chloride ion in the original solution.
4. Calculate the solubility product for sodijum chloride.
5. What happens to the saturated NaCl solution when solid NaOH is added to it, and why?
6. What happens to the saturated NaCl solution when 2 M NaOH is added to it, and why?