

Calorimetry and Hess's Law

OBJECTIVES

- *Demonstrate proficiency in the use of calorimeters and related equipment.*
- *Relate temperature changes to enthalpy changes.*
- *Determine enthalpies of reaction for several reactions.*
- *Demonstrate that enthalpies of reactions can be additive.*

MATERIALS

- 4 g NaOH pellets
- 50 mL 1.0 M HCl acid solution
- 50 mL 1.0 M NaOH solution
- 100 mL 0.50 M HCl solution
- 100 mL graduated cylinder
- balance
- distilled water
- forceps
- glass stirring rod
- gloves
- plastic-foam cups (or calorimeter)
- spatula
- thermometer
- watch glass

BACKGROUND

Hess's law states that the overall enthalpy change in a reaction is equal to the sum of the enthalpy changes in the individual steps in the process. In this experiment, you will use a calorimeter to measure the energy released in three chemical reactions. From your experimental data, you will verify Hess's law.

SAFETY



For review of safety, please see **Safety in the Chemistry Laboratory** in the front of your book.

PREPARATION

1. Prepare a data table in which to record the total volumes of liquid, initial temperature, and final temperature of the three reactions you will carry out, as well as the mass of the empty watch glass and the watch glass plus NaOH pellets.
2. Gently insert the thermometer into the plastic foam cup held upside down. **Thermometers break easily, so be careful with them, and do not use them to stir a solution.**

PROCEDURE

Reaction 1: Dissolving NaOH

1. Pour 100 mL of distilled water into your calorimeter. Record the water temperature to the nearest 0.1°C.
2. Weigh a clean and dry watch glass to the nearest 0.01 g. Wearing gloves and using forceps, place about 2 g of NaOH pellets on the watch glass. Measure and record the mass of the watch glass and the pellets to the nearest 0.01 g. **It is important that this step be done quickly: NaOH absorbs moisture from the air.**