

CHEMISTRY LAB

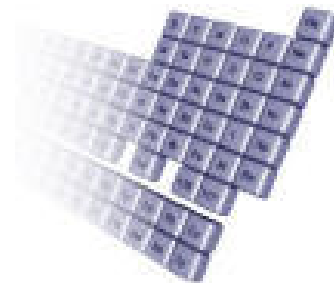
Thermodynamics



Measuring Heats of Solution

MATERIALS

sodium thiosulfate (“photographer’s hypo”), $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$
Calcium chloride, $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$
50-mL graduated cylinder
distilled water
calorimeter
thermometer
weigh boats
electronic balance
SAFETY GOGGLES



PROCEDURE

In this lab, you will use a calorimeter to determine the heats of solution of two salts, one exothermic, and one endothermic. The equation you will need:

$$\text{Heat} = \text{mass} \times C_p \times \Delta T$$

$$\Delta T = T_{\text{final}} - T_{\text{initial}}$$

where Heat is in Joules, mass is in grams, ΔT is in $^{\circ}\text{C}$, and $C_p = 4.18 \text{ J/g} \cdot ^{\circ}\text{C}$ (for water)

NOTE: Do NOT put hypo or any chemical directly on the pan of the balance.

1. Place a weigh boat on the balance and tare (zero) it.
2. Weigh out 10.0 ± 0.2 grams of hypo ($\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$). Record the weight on the data table.
3. Measure out 50. mL of water into a graduated cylinder and pour it into the calorimeter.
4. Place the top on the calorimeter with the thermometer and allow it to stand for 2 minutes. Record the temperature of the calorimeter (initial temperature of water) in the data table.
5. Add the hypo to the calorimeter; immediately place the lid on and stir carefully with the stirring rod.

**READ
ALL
INSTRUCTIONS
BEFORE
PROCEEDING**

SAFETY NOTE

Make sure to clean all materials well before, between, and after use. Chemicals that remain have the possibility of affecting observational data. Please wash hands immediately if contact with the hypo or calcium chloride occurs.

5. Add the hypo to the calorimeter; immediately place the lid on and stir carefully with the stirring rod.
6. Record the highest or lowest temperature reached to the nearest ± 0.2 °C (final temperature of water) in the data table. Be sure all the salt has dissolved when the experiment is over.
7. Carefully dump the contents of the calorimeter into the sink and rinse the cup, thermometer, and stirring rod.
8. Repeat steps 1 thru 8, **substituting 6.50 ± 0.02 g of calcium chloride ($\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$) and 100. mL of water.**
9. Complete the data table by calculating the change in heat in joules, joules per mole, and kilojoules per mole.

■ QUESTIONS

10. Find the heat of solution for $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ from the table provided in class. Determine a percent error for your heat of solution for calcium chloride.
 11. Which heat of solution is endothermic? Which one is exothermic?
 12. Describe in words what happens on a molecular level when an ionic substance dissolves. Include a sketch.
 13. **Endothermic** heats of solution occur because the ions have more attraction for the ions in the crystal lattice than they do for polar water molecules. Why then are some heats of solution **exothermic**?
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