Mini-Lab

Molar Enthalpy of Solution

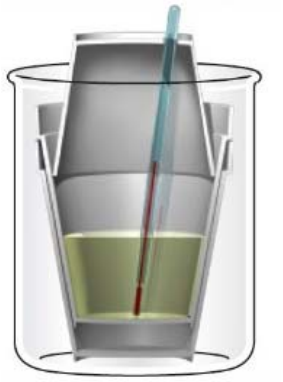
Name: _____

Date: _____

In this investigation, you will…

Use a simple coffee cup calorimeter to determine the molar enthalpy of solution ($\Delta H°_{sol}$) of a soluble ionic compound.

Procedure



1. Read the entire procedure before continuing. Set up a data table to record your temperature observations.
2. Build a coffee cup calorimeter, using the diagram as a guide. You will need to nest one coffee cup inside another. A third cup will be inverted to serve as the lid.
3. Measure out 50.0 mL of room temperature water and pour it into your calorimeter.
4. Place the thermometer in the water, and take temperature readings at 1-minute intervals, for a total of 3 minutes. This temperature is your initial temperature, $\mathbf{T_1}$.
5. Measure out 5 grams of KNO_3. Get a mass as close to this as possible, but make sure to record the exact mass in your data table.
6. Quickly add all of the KNO_3 to the water in the calorimeter. Cover the calorimeter, and record the temperature every 30 seconds, stirring gently and continuously.
7. When the temperature remains constant, stop taking recordings. This temperature will be your final temperature, $\mathbf{T_2}$.

Observations

Class average value for change in temp = -6.97C

Analysis

a. Determine the amount of heat that is transferred out of the water in the calorimeter.

GIVEN	SOLUTION
m = 50.0 g + 5.0 g (water + salt) = 55.0 g c = 4.18 J/gC ΔT = - 6.97 C	q = m c ΔT = (55.0)(4.18)(-6.97) = - 1602 J = - 1.602 kJ

b. Use the quantity in (a) to determine the amount of heat that is absorbed by the KNO_3 as it dissolves. This is the ENTHALPY OF REACTION.

$\Delta H_{KNO3} = - \Delta H_{H2O} =$ + 1.602 kJ

c. Use the enthalpy of reaction from (b) to determine the MOLAR ENTHALPY OF SOLUTION, ΔH_{sol}, for KNO_3, in kJ/mol.

GIVEN	SOLUTION
m of KNO_3 = 5.0 g M_{KNO3} = 101.11 g/mol	Step 1: Find n n = 5.0/101.11 = 0.0495 mol Step 2: Find ΔH_{sol} ΔH_{sol} = 1.602 kJ/0.0495 mol = 32 kJ/mol (rounded to 2 SD)

d. The molar enthalpy of solution ΔH_{sol} of KNO_3 at 25°C is 34.89 kJ/mol. Use the formula to calculate your percentage error.

$$\text{percent error} = \frac{|\text{measured value} - \text{actual value}|}{\text{actual value}} \times 100\%$$

% err = (32-34.89)/34.89 * 100 = 8.28%

e. Identify three potential sources of error in this experiment (i.e., what are three reasons your measured value is different from the actual value?)

Numerous potential sources, including:

Heat transfer to calorimeter
Heat transfer with environment
Incomplete dissolving of salt
Reference value cited for temperature of 25C (expt performed closer to 22)
Improper measurement of volume/temperature