Week 8: Introduction to Calorimetry

Dr. Turner

Determining the $\Delta H_{dissolution}$ of $CaCl_2$

$$q_{CaCl_2} + q_{water} = 0$$

$$q_{CaCl_2} = -q_{water}$$

$$q_{CaCl_2} = -m_{water} c_{water} \Delta T_{water}$$

$$\Delta H = \frac{q_{CaCl_2}}{mol_{CaCl_2}}$$

Overview

- Part 1: How is ΔH related to temperature change
  - Section A: Changing $CaCl_2$ mass with constant water volume
  - Section B: Changing water volume with constant $CaCl_2$ mass
  - Section C: Predicting how to get a constant ΔT
- Part 2: How does the identity of the solute affect enthalpy change
  - Section A: Changing NH_4NO_3 mass with constant water volume
  - Section B: Changing water volume with constant NH_4NO_3 mass

Part 1: How is ΔH related to temperature change

Section A: Changing $CaCl_2$ mass with constant water volume

- Add enough $CaCl_2$ to 10 mL (record exact volume) of water in the calorimeter to cause the temperature to change by at least 3 °C.
- Repeat this using the same volume of water with two different masses of $CaCl_2$.
- Calculate q_{rxn} for all three, and use the mass of $CaCl_2$ to calculate the ΔH of water

Section B: Changing water volume with constant $CaCl_2$ mass

- Add enough $CaCl_2$ to 15 mL of water in the calorimeter to cause the temperature to change by at least 3 °C.
- Repeat this using the same mass of $CaCl_2$ but with 10 mL of water and 5 mL of water.
- Calculate q_{rxn} for all three, and use the mass of $CaCl_2$ to calculate the ΔH of water

Section C: Predicting how to get a constant ΔT

- Predict the composition of two solutions with different masses of $CaCl_2$ and water that would give the same temperature change.

$$\Delta H = \frac{-m_{water}\, c_{water}\, \Delta T}{mol_{CaCl_2}}$$

$$\frac{-\Delta H\, mol_{CaCl_2}}{m_{water}\, c_{water}} = \Delta T$$

Part 2: How does the identity of the solute affect enthalpy change

- Add enough NH_4NO_3 to 10 mL (record exact volume) of water in the calorimeter to cause the temperature to change by at least 3 °C.
- Repeat this using the same volume of water with two different masses of NH_4NO_3.
- Calculate q_{rxn} for all three, and use the mass of NH_4NO_3 to calculate the ΔH of water

AND

- Add enough NH_4NO_3 to 15 mL of water in the calorimeter to cause the temperature to change by at least 3 °C.
- Repeat this using the same mass of NH_4NO_3 but with 10 mL of water and 5 mL of water.
- Calculate q_{rxn} for all three, and use the mass of NH_4NO_3 to calculate the ΔH of water