

**Lab #6: Molar Heat of Solution and Molar Heat of Fusion****Objectives:**

1. Using the First Law of Thermodynamics, Conservation of Energy, determine the Heat of Solution of NaOH and the Molar Heat of Fusion of Water.
2. Evaluate the design of a simple calorimeter.

**Hypothesis:**

Comment on the level of accuracy of the Styrofoam Calorimeter.

**Materials:**

Graduated Cylinder	Ice	Electronic Balance	Hot Plate
2 Styrofoam Cups and 2 Plastic Lids	Distilled Water	2 Thermometers	
Scoopula	NaOH <sub>(s)</sub>	Medium Beaker	

**Procedure:****A. Molar Heat of Solution of NaOH:**

1. Put a Styrofoam cup on the electronic balance and calibrate.
2. Measure about 50 mL of distilled water and determine its temperature and mass.
3. Leave the Styrofoam cup with the water on the balance and recalibrate.
4. Add about 6 g of NaOH<sub>(s)</sub> and measure the mass.
5. Cover the cup with the plastic lid and use a thermometer to observe the temperature of the solution continuously. Be sure the NaOH<sub>(s)</sub> is completely dissolved. Stir using a thermometer if necessary.
6. Record the final temperature once the lowest or highest temperature is reached.

**B. Molar Heat of Fusion of Water:**

1. Put a Styrofoam cup on the electronic balance and calibrate.
2. Measure about 50 mL of distilled water and determine its temperature and mass.
3. Leave the Styrofoam cup with the water on the balance and recalibrate.
4. Add about 10 g of ice and place it in the water and measure the mass.
5. Measure the temperature continuously until the lowest final temperature is reached.

**Observations:****Part A: Molar Heat of Solvation of NaOH**

Initial Water Temperature	
Mass of Water used	
Mass of NaOH <sub>(s)</sub> added	
Final NaOH <sub>(aq)</sub> Temperature	

**Part B: Molar Heat of Fusion of Water**

Initial Water Temperature	
Mass of Water used	
Mass of Ice added	
Final Water Temperature	

**Analysis:****Part A: Molar Heat of Solution of NaOH**

1. Using the Law of Conservation of Energy, determine the molar enthalpy of solution of NaOH. Show all the steps involved and list all values used.
2. Draw a detail potential energy diagram for the dissociation of NaOH<sub>(s)</sub> in water. Label all pertinent information and discuss the solution of NaOH in terms of an endothermic or exothermic process.

**Part B: Molar Heat of Fusion of Water**

1. Using the Law of Conservation of Energy and presume that the temperature of ice is  $0^{\circ}\text{C}$ , determine the water's molar enthalpy of fusion. Show all the steps involved and list all values used. (Hint: the ice underwent a potential change and a kinetic change.)

**Evaluation:**

1. What is the % error of the experiment if the theoretical value of the molar enthalpy of solution of NaOH is  $-44.51\text{ kJ/mol}$ ?
2. Given the theoretical molar enthalpy of fusion for water is  $6.01\text{ kJ/mol}$ , calculate the % error of this experiment.
3. Evaluate the effectiveness of the Styrofoam Calorimeter, and suggest some explanations why it might not be effective.

**Conclusion:**

1. Revisit your hypothesis and comment on your prediction.
2. Summarize what you have learned from this lab.