10.10.2: Lecture Demonstrations

The q/T Paradox: Which "Contains More Heat", a Cup of Coffee at 95 °C or a Liter of Ice water?[1]

A small mass of water at 0°C is added to a measured mass of liquid nitrogen, and the amount that evaporates is compared to the mass that evaporates when a larger mass of water at 95°C is added to liquid nitrogen. This demonstration requires knowledge of both specific heat and heat capacity.

Determination of the Enthalpy of Fusion of Water

Calculate Enthalpy of Fusion of Ice (assuming heat capacity prerequisite)

Dip a computer-interfaced thermistor probe in 100g of water in a styrofoam cup calorimeter. Add 3-5 g of ice to a paper towel on a balance, and record the total mass. Start temperature acquisition 1 sample/second, 3 minutes total, and after a few readings, remove ~2 g of ice from the balance and add it to the calorimeter. Record the final mass on the balance and calculate the mass of ice. Display the T vs. time plot [2]. Record the final temperature.

q (cal) + q (water) = q (water from ice) + q (ice)

14.4 J/°C (20.97-22.70°C) + 100 (4.18)(20.97-22.70°C) = -(q + 1.90 (4.18)(20.97-0°C))

q = 581 J

ΔH = 581J/1.90 g x (1kg/1000 J) x (18 g/mol) = 5.5 kJ/mol (6.07 kJ/mol true value)

References

1. ↑ J. Chem. Educ., 2005, 82 (6), p 856
2. ↑ We use Vernier LoggerPro(R)software

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