

## 10.10.2: Lecture Demonstrations

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

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 <sup>[2]</sup>. Record the final temperature.

$$q(\text{cal}) + q(\text{water}) = q(\text{water from ice}) + q(\text{ice})$$

$$14.4 \text{ J/}^\circ\text{C} (20.97\text{-}22.70^\circ\text{C}) + 100 (4.18)(20.97\text{-}22.70^\circ\text{C}) = -(q + 1.90 (4.18)(20.97\text{-}0^\circ\text{C}))$$

$$q = 581 \text{ J}$$

$$\Delta H = 581\text{J}/1.90 \text{ g} \times (1\text{kg}/1000 \text{ J}) \times (18 \text{ g/mol}) = 5.5 \text{ kJ/mol} (6.07 \text{ kJ/mol true value})$$

### References

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

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