**A note about the calculations on Lab 1:**

The heat of fusion of ice, it is true, can be measured through the cooling of water in contact with ice in a calorimeter.

Thus $\Delta H_{fusion} = q_{melting\ ice}$ which works if you assume the ice started off at 0°C, which it did in our case – note that by the time you used the ice, it had been in contact with the room environment for an hour, so any negative ice temperature was brought up to 0° by the room temperature.

So, in theory, the ice melts and the hot water in contact with it cools. Thus, $q_{melting\ ice} = - q_{cooling\ \ water} = - m_{hot\ water}\ c_{water}\ \Delta T_{hot\ water}$

where $\Delta T_{hot\ water} = T_{hot\ water,\ final} - T_{hot\ water,\ initial} = T_{final} - T_{hot\ water}$

Note that in class, I forgot the minus sign – your values should all have been positive (because $\Delta T_{hot\ water}$ is negative).

Recall that $m_{hot\ water} = (density_{hot\ water\ at\ that\ temperature})\ (volume_{not\ water})$, and you looked up the proper density in the CRC.

Note that there is a problem with this analysis – I forgot that the ice melts, and that melted water heats up to $T_{final}$! Thus

$\Delta H_{melting\ ice\ and\ warming\ water} = \Delta H_{fusion} + q_{warming\ melt\ water} = - q_{cooling\ \ water}$

So, taking only the right-hand equality:

$\Delta H_{fusion} + q_{warming\ melt\ water} = - q_{cooling\ \ water}$

or, $\Delta H_{fusion} = - q_{warming\ melt\ water} \ - q_{cooling\ \ water}$

Replacing the q's with their definitions:

$\Delta H_{fusion} = - m_{melted\ water}\ c_{water}\ \Delta T_{melted\ water} - m_{hot\ water}\ c_{water}\ \Delta T_{hot\ water}$

where $m_{melted\ water} = m_{ice}$

and $\Delta T_{melted\ water} = T_{melted\ water,\ final} - T_{melted\ water,\ initial} = T_{final} - 0°C$

How do you calculate $m_{ice}$? Use the density definition again:

$m_{ice} = (\text{density}_{\text{water at the final temperature}})\ (\text{volume}_{final} - \text{volume}_{\text{hot water}})$
Notice that $(\text{volume}_{final} - \text{volume}_{\text{hot water}}) = \text{volume}_{\text{melt water}}$

So, putting it all together then,

$$\Delta H_{fusion}\ (J/g) = \frac{-\ m_{melted\ \ water}\ \ c_{water}\ \ \Delta T_{melted\ \ water} - \ m_{hot\ \ water}\ \ c_{water}\ \ \Delta T_{hot\ \ water}}{m_{ice}}$$

How did I notice this? It seemed that the class's values, on the whole, where higher than expected (in the 350 to 400+ J/g range, regardless of type of setup). This is a classic example of a systematic error. Since the error did not seem to be affected by the type of setup, the error source must lie in the calculations, which is when I thought of that extra melted water term.