PHYS 272 SECTION 6 – PRELAB FOR TH4430-1.

1. An aluminum calorimeter with a mass of 78 g contains 229 g of water. The calorimeter and water are in thermal equilibrium at 21.7°C. A 154 gram metal sample at 96°C; is placed in the water, and the entire system stabilizes at a final temperature of 25.5°C. Use the specific heats from Table 20.1 in the textbook.

(a) Determine the specific heat of the metal sample

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(b) Suppose the metal is known to be copper. If the error was due only to heat leaking from the container into the environment, how much heat must have leaked out during the measurement process?

(c) What percentage is this of the heat transferred from the sample to the calorimeter?

(d) It is interesting to compare this to the percent error in the measurement of the specific heat. What was the percent error in the measurement, relative to the accepted specific heat of copper?

Can you understand the relation between the answers to (c) and (d) based on the heat transfer equations? Think about this. Note that in a real experiment, heat loss (or gain, depending on the temperatures of the calorimeter and room) may not be the only source of error. It can be minimized by adjusting the starting temperature of the calorimeter so that the average temperature during the process is the same as room temperature. Then the net flow into and out of the calorimeter should cancel.

2. An aluminum calorimeter with a mass of 84 g contains 198 g of water. The calorimeter and water are in thermal equilibrium at 31.1°C. A 33.8 g sample of ice at 0°C; is placed in the water, and the entire system stabilizes at a final temperature of 17.3°C. Use the specific heats in Table 20.1 in your textbook.

(a) What value of the latent heat of fusion of ice was obtained in this experiment?

(b) The latent heat of fusion of ice is known to be 333 J/g. One explanation for the difference is that the ice could have been wet, so that not all of the sample was actually frozen. What percentage of the sample would have had to be water to explain the difference?

(c) How does this compare to the percent error in the measurement? Calculate the percent error in the result of part (a) relative to the accepted latent heat of fusion for ice.

Water on the ice is only one possible source of error, which can be avoided by drying the ice before putting it in the calorimeter. Another source of error would be heat leaking into the calorimeter from the room. This can be mitigated by starting with warm enough water so that the average temperature of the calorimeter is the same as the room temperature, so that the heat exchanged with the room cancels.