PHYS 232C Lab 3. Specific heat capacity

Find the heat capacity of three different metals using a calorimeter, a temperature sensor, a hot plate, and ice water. Use the heat capacities to identify the metals.

Tie a string to the metal cylinder. Cool the metal in the ice water and begin recording its temperature. Heat water on the hot plate to about 55 degrees Celsius and pour it into the calorimeter. **Be careful not to add water to the space between the cups, since this air gap is an insulative barrier.** Begin recording the temperature of the water in the calorimeter. Allow the inner cup of the calorimeter and the water to come to thermal equilibrium. Wait until the water temperature is about 50 degrees Celsius. Take the metal out of the ice bath, blot it quickly with a paper towel, and put the metal in the calorimeter. **Do not touch the metal with your hands.** Continue recording the temperature of the water until it is clear that thermal equilibrium has been achieved. (This typically takes on the order of minutes.) Record an additional 60 seconds of data.

Use the initial and final temperatures to find the specific heat of the metal. For each substance we have $Q_i = M_i c_i \Delta T_i$. Conservation of energy tells us that $\sum_i Q_i = 0$. This equation can be solved for the specific heat of the metal. Note that the water and the inner cup have the same initial temperature. To find the final temperature, fit the temperature vs. time data after thermal equilibrium has been achieved to a linear function. Use this fit to find the equilibrium temperature corresponding to the time that the initial temperature was measured. This will account for thermal losses to the environment. Perform two fits, one with a high estimate and another with a low estimate of the final temperature to get a better estimate of the final temperature and error on the final temperature.

Estimate the error on the specific heat capacities for the metals. What do you think is the most important contributor to the error on these measurements?