Specific Heat of Water

We are going to use an electric pot to calculate the specific heat of water. We will calculate the electrical power it is consuming, time how long it is on to get the energy delivered, measure the mass of the water, and its temperature rise and voila!

Here's what to do:

1. Carefully measure 1.5 liters of water into the pot. **Write down the mass and the uncertainty of the mass.** The uncertainty of the mass will be twice half the smallest division on the graduated cylinder. Don't turn it on yet, but place it on the base, and put the thermometer in and let it come to equilibrium. **Measure the initial temperature, and estimate the uncertainty of the temperature.**
2. Put the multimeter on 200 VAC, and CAREFULLY plug the leads into the same strip as the pot. Don't read the voltage yet, wait until the pot is on.
3. Get the stopwatch ready, and turn on the pot for 4 minutes, (**Write down the time you use and its uncertainty**) and then turn it off. While it is on write down the voltage. **The voltage will vary, so come up with what you think is an average, and an uncertainty.**
4. Watch the thermometer, and read the highest value it reaches. **Write the temperature down and its uncertainty**.
5. Take out the thermometer, pour out the water, take the pot off its base, turn it over, and with the multimeter on 200 ohms, **measure the resistance of the leads and its uncertainty**, (Touch the leads together firmly), and the **resistance of the heating element and its uncertainty.** (Turn switch to "on", and find the resistance between the outer two plugs on the bottom. Don't forget to turn the switch off when you are done.)
6. Make a nice **data table with units and uncertainties.**

How to calculate:

1. Find the change in temperature and the uncertainty of the change by subtracting initial from final temperature. Remember, the uncertainty of a difference is the sum of the uncertainties.
2. Find the resistance of the heating element and its uncertainty by subtracting the resistance of the leads from the resistance you measured between the two prongs on the pot.
3. Calculate the power delivered to the element from the voltage and the resistance.
4. Calculate the energy delivered to the water by multiplying time by power.
5. Use $Q = mc\Delta T$ to find C
6. Use $\frac{\Delta C}{C} = 2\frac{\Delta V}{V} + \frac{\Delta R}{R} + \frac{\Delta m}{m} + \frac{\Delta T}{T} + \frac{\Delta t}{t}$ to find the uncertainty of the specific heat.
7. Express the specific heat as a best guess +/- an uncertainty.

How to conclude:

1. Citing data from your experiment, and what the accepted value is for the specific heat of water, (Look it up. it actually depends on the temperature....) **make a logical argument as to whether the accepted value does or does not fall within your uncertainty.**
2. Heat almost certainly was lost to the surroundings. Would that make your value for C too high or too low. **Explain why**
3. List at least three main sources of error in the experiment. (I can think of about ten...)
4. For your three sources, explain how we might mitigate them.