3. Electrical Equivalent Heat

1. Purpose：

The purpose of this experiment is to determine the amount of electrical energy that is equivalent to a certain amount of thermal energy. This is accomplished by measuring the amount of electrical energy used in the heating resistor to heat water and the resulting thermal energy added to the water. Also, the number of Joules in one calorie is determined.

2. Theory：

When heat is added to a solid or a liquid, that energy goes into increasing the materials internal energy, and thus increasing its temperature. In this experiment, heat is added to the calorimeter by the use of a heating resistor. The generated electrical energy is converted into heat in the resistor, increasing the temperature of the water. Historically, this has been referred to as the Electrical Equivalent of Heat. The energy to heat the resistor can be calculated by

$$E = P \cdot t \tag{1}$$

Where t is time and p is determined by the Voltage and the resistance.

$$P = \frac{V^2}{R} \tag{2}$$

The relationship between the heat and the resulting change in temperature is given by

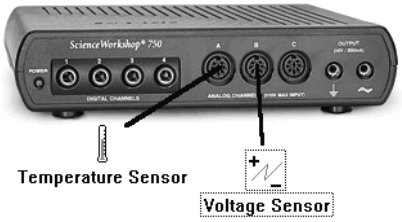
$$Q = m \cdot c \cdot \Delta T \tag{3}$$

Q = heat　　m = mass

c = specific heat　　ΔT= change in temperature

3. Apparatus：

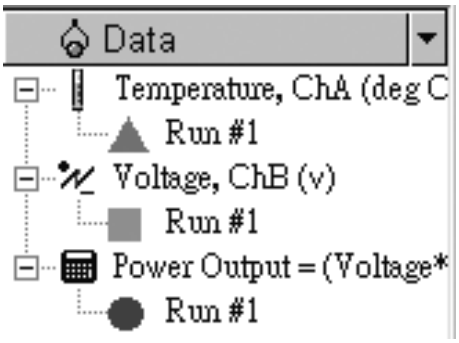
SW750 interface、DC power supply、temperature

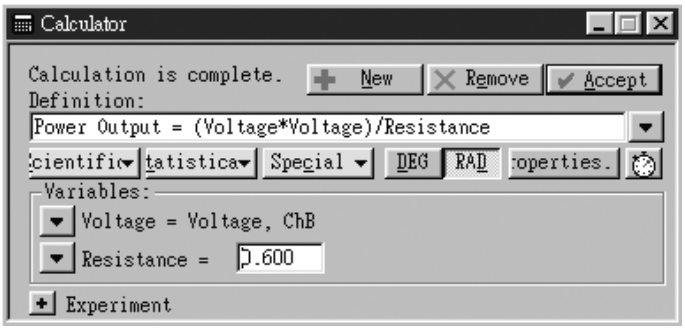


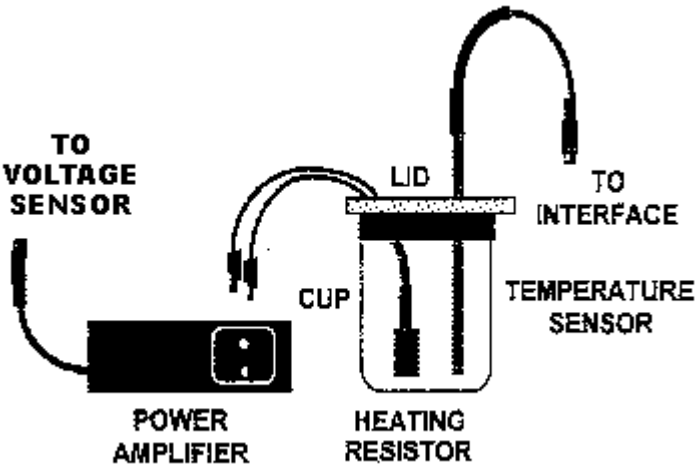
sensor、resistor、calorimeter、multimeter、scale pan。

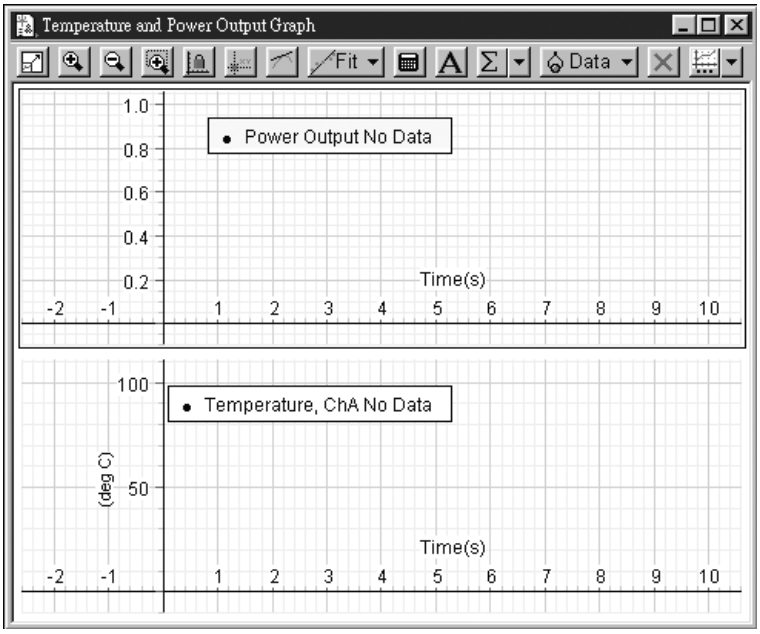
4. Procedure：

1. Add some water to the cup until it reaches the mark.
2. Measure the resistance and key in the value into the software。
3. Measure the mass of the cup and the cup plus water, and calculate the mass of the water. Record the mass in the report sheet。
4. Execute the file “P47 EEH” to open the software. Then press "start" and heat the water at the same time.
5. Gently stir the water and wait for 10 minutes to press "stop".
6. Select max, min and area on the Statistics menu to find the change in temperature ΔT and the energy delivered to the water.
7. Set the heat (in calories) equal to the energy delivered (in Joules). Calculate how many Joules are equivalent to one calorie. Look up the accepted value and calculate the percent error between it and your answer.









5. Questions :

1. Is there anything else that heats up besides the water? If so, what? Does this affect your results?
2. What is a Watt-second?
3. In this experiment, was energy lost or gained? Explain your results using the concept of conservation of energy.