

Physics 223

Experiment 4: Specific Heat of Metals

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In SI units, the specific heat c of a material is defined as the amount of heat required to raise the temperature of 1 kg of the material by 1 degree Kelvin. For example, the specific heat of glass is 840 J/kg·K, which means that it takes 840 J of energy to raise the temperature of 1 kg of glass by 1 K. Other units of the specific heat that are commonly used are cal/g·K (where 1 cal = 4.19 J) and J/mol·K (where 1 mol is 1 mole of the material).

When an object absorbs heat energy, Q , its temperature changes from T_i to T_f such that

$$Q = mc(T_f - T_i) = mc\Delta T$$

where m is the mass of the object. Note that we have taken the object as the “system” so that a positive Q means that the object in question is absorbing heat, while a negative Q means that the object is losing heat.

In this experiment, you are to determine the specific heat of substances using the same “warm water calorimeter” as used in Experiment 2. You will have several different materials available and there will be objects of different masses for each material. There will be an ice bath which will permit you to cool the materials to 0°C and a microwave oven available with which to heat the water to be used in the calorimeter. There will also be resealable freezer bags available for use.

Develop a procedure to measure the specific heats of one of the two materials available in the laboratory (copper and brass). Show the procedure you propose to use and the data you plan to acquire to your Teaching Assistant. In your procedure include details of how you will analyze your data to extract the specific heat of this substance.

Obtaining an accurate measurement of the specific heat will require a careful experimental procedure. It will be important to take into account the masses and thermal properties of calorimeter itself and to devise a consistent procedure to determine initial and final temperatures. It will also be necessary to make sure that any change in temperature is large enough to be accurately measured. Since you spent some time calibrating the performance of the calorimeter in Experiment 2, it is important that you use the same calorimeter for this experiment in order to save some effort.