Specific Heat Capacity Lab

Vincent Edwards, Ali Mortada

Mt. San Antonio College, Physics 4B, CRN 42240
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1. Purpose

The goal of the experiment was to determine the specific heat capacities of various substances based on measurements of mass, temperature, power, and/or time. For parts 1 and 2 the material was known, so the calculated specific heat capacities could be compared to the accepted values. For part 3 the material was unknown, so its identity was guessed based on the calculated specific heat capacity.

2. Results

All three parts of the experiment involved a calculation of the mass of a sample of DI water (m_w). In the experiment, we measured the combined mass of the water and the foam calorimeter it was in (m_{c+w}), as well as the mass of the dry calorimeter (m_c). Thus, m_w could be calculated using equation 1.

$$m_w = m_{c+w} - m_c \tag{1}$$

The uncertainty of m_w is given by equation 2.

$$\begin{aligned} \Delta m_w &= \sqrt{\left(\frac{\partial m_w}{\partial m_c}\Delta m_c\right)^2 + \left(\frac{\partial m_w}{\partial m_{c+w}}\Delta m_{c+w}\right)^2} \\ &= \sqrt{(\Delta m_c)^2 + (\Delta m_{c+w})^2} \end{aligned} \tag{2}$$

In part 1 of the experiment, a sample of DI water stored in a foam calorimeter was heated using an immersion heater for about 2 minutes, and the resulting change in temperature was measured. Table 1 contains the measured values. m_c is the mass of the dry calorimeter measured with an electronic balance. m_{c+w} is the combined mass of the water and calorimeter measured with an electronic balance. T_i is the initial temperature of the water measured with a temperature probe. H is the heat current delivered by the immersion heater measured with a Watt meter. t is the time the immersion heater was on measured using a stopwatch. T_f is the final temperature of the water measured using a temperature probe.

Note: explain how uncertainty was approximated.

Table 1. Part 1 Measurements

Quantity	Value
m_c	33.02 ± 0.01 g
m_{c+w}	439.19 ± 0.01 g
T_i	20.2 ± 0.4 ℃
H	293 ± 1 W
t	120.2 ± 0.2 s
T_f	38.5 ± 0.4 ℃

Table 2. Uncertainty Trials

Run	T ℃
1	99.0
2	99.1
3	98.8
4	98.7
5	98.6
6	99.0
7	99.1
8	99.1
9	99.0
10	98.9
11	98.8
12	98.8
13	99.1
14	99.2
15	99.1
16	99.2
17	99.1
18	99.1
19	99.2
20	99.1
21	99.0
22	99.1
23	99.3
24	99.0
25	98.8