A Cool(ing) Idea

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The instruction manual for PASCO scientific’s radiation cube lists four experiments that can be done with the system: introduction to thermal radiation, inverse-square law, Stefan-Boltzmann law (high temperature), and Stefan-Boltzmann law (low temperature). I tried the latter two with very satisfactory results. While I was doing the experiments, I realized that another procedure could be done using the radiation cube and an ohmmeter—Newton’s law of cooling experiment:

\[ T - T_{\text{room}} = (T_o - T_{\text{room}})e^{-t/\tau} \]  

where \( T_{\text{room}} \) is room temperature, \( T_o \) is the initial temperature of a hot object, and \( T \) is the temperature of the object at time \( t \).

The temperature of the cube (with a 100-W bulb inside) can be obtained by using an ohmmeter to measure a thermistor resistance embedded in the cube. Table I in the manual lists the temperature \( T \) as a function of resistance \( R \). For temperatures above ~35 °C, I obtained the following relationship:

\[ T = -27.85 \ln (R) + 342.8 \]  

where \( T \) is the temperature of the cube in °C and \( R \) is the thermistor resistance in ohms.

The experimental procedure is very simple: (a) Heat the cube to a high temperature. (b) Turn off the power. (c) Measure thermistor resistance \( R \) as a function of time \( t \). (d) Use Eq. (2) to get the corresponding temperature \( T \) of the cube. (e) Plot \( T - T_{\text{room}} \) as a function of time \( t \). Figure 1 shows a sample result. The law is easily and nicely shown. Although the experiment could also be done using a thermometer, water, and a calorimeter, readers may find it worthwhile to try the method described here.

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**Record Magnetic Field**

“...magnet designers have built that Florida-poly-Bitter magnet—a modified version of MIT’s technology—that in February reached a world record 33.1 tesla for continuous field by a resistive magnet.” 1