Physics 407

Thermal Radiation

1 Goal

The goal of the experiment is to measure the exponent, n, of temperature, T, in the expression:

$$RadiatedPower \propto T^n$$

2 Method

To do this, a 12-volt bulb is put in a circuit containing an ammeter to measure the current, and a voltmeter to measure the voltage across the bulb. The meters used here are the HP multimeters which are interfaced to a computer via the GPIB bus.

For a given voltage across the bulb, V, the radiated power is

$$P = IV$$

On the other hand, the resistance of the filament is

$$R = V/I$$

So the measurement of I and V determine both P and R. The value of R may be used to determine the temperature, from data on the resistivity of tungsten vs. temperature. The data has been written into a file "RESTUNG.DAT". It is recommended that you fit the data to some functional form to do the analysis. There are several least-squares fitting programs available.

Take data with increasing V, measuring both V, and I. Remember that the GPIB system does not read out the two meters simultaneously. The GPIB system produces an ASCII file, which may be imported into a spread-sheet program for subsequent analysis. Convert the I, V data to P, T data. Plot $\log P$ vs. $\log T$ to obtain the exponent. At the lower end of the temperature range, there are physics reasons for not expecting a simple power law behavior. So it is legitimate to discard the data below some temperature. (It is not legitimate, however, to base the cut on the result for n you get with it; this is making an "informed choice".)

3 Be sure to include in your report:

1. Consideration of the other forms of heat loss: conduction and convection.

2. A graph of $I vs. V$.

3. A discussion of how you fitted the data on tungsten resistivity vs. temperature.
4. A discussion of how you found the value of n.
5. A graph of $P vs. T$ together with the best-fit power law.
6. An estimate of the uncertainty in n.