Experiment 2:
The Temperature Dependence of the Resistance of a 100 W Light Bulb

Purpose:

To investigate the relationship between the temperature of the filament of a light bulb and its resistance.

Materials Needed:

1. Ohmmeter - digital autoranging preferred, such as the VWR P/N 26983-175
2. 100 W light bulb

Procedure:

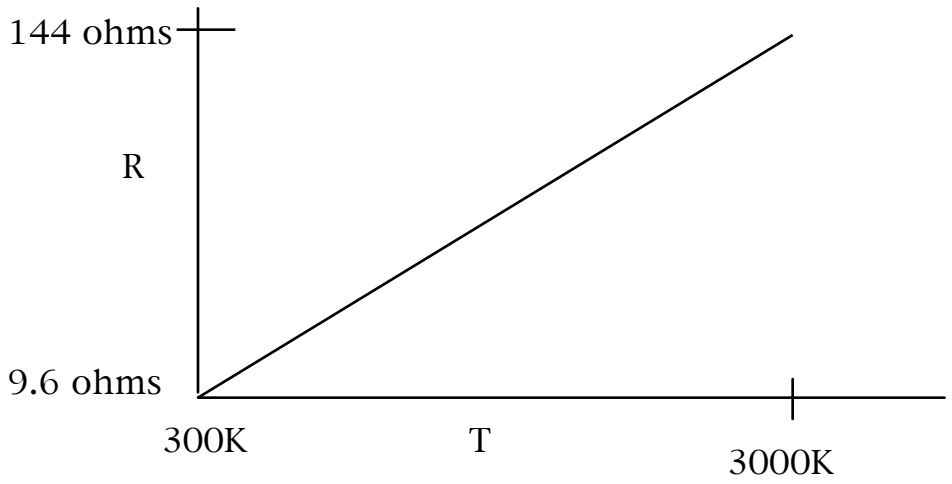
1. Insert the 100 W light bulb in a lamp socket, turn on the lamp and keep it on for about 5 minutes or more.
2. Unplug the lamp and using the two flat prongs on the cord plug and the ohmmeter, measure the resistance of the 100 W light bulb filament as it cools. Record the resistance every 5 seconds for 1 minute and then every 10 seconds for the next minute or more. (Note that the lamp will remain hotter for longer if the bulb is placed in a vertical position with the bulb housing over the bulb. In this position, the heat is trapped more than in other positions. To keep the lamp even hotter for longer **after unplugging the lamp**, place a fireproof pad (such as an oven glove) over the lamp housing to trap the heat so that the bulb will cool down at a slower rate.
3. Use the results of experiment 1 to convert the measured values of resistance to temperature. Assume that the resistance varies linearly with temperature and that the temperature of the filament when it is on is 3000 K or about 2700 C.
4. Plot the filament temperature as a function of time as it was cooling.

Teacher's Guide for Experiment 2

1. Keep the bulb on until it gets hot to the touch.

2. Since the filament has the greatest resistance in the circuit, the filament resistance can be measured by measuring the circuit resistance at the prongs.

3. In experiment 1, the filament resistance at room temperature was determined to be about 9.6 ohms and about 144 ohms at 3000 K (the temperature of the filament when the lamp is on.) So the filament resistance R and the filament temperature T are related as shown in the graph below (assuming a linear dependence which is a good approximation). Using this graph or the linear relationship between R and T, the measured values of the resistance of the filament can be converted to temperature.



4. From 2, values of R vs time were measured. From 3, values of R vs T were determined. Using these two data sets, values of T vs time (the filament cooling curve) can be determined.

Note that there are two other ways to demonstrate that the filament resistance increases with increasing temperature

- Measure the resistance of the bulb as you warm it by holding it in your hands.
- Attach a copper wire to each of the lamp socket screws. Place the bulb and lamp socket in an oven at about 350 F or 200 C and snake the copper leads out of the oven and attach them to an ohmmeter.