

## Experiment 10: Practical Electricity

Many metal surfaces have a very thin layer of rust that can throw off resistance readings (rust is an *insulator*). The red and black probes have sharp metal tips; these are sharp so that you can dig the pointers slightly into the metal to get a better reading.

1. Review: Form a circuit with a small flashlight bulb and a flashlight battery. Use a multimeter to measure the voltage across the light bulb, and the current through the light bulb. Note units.

Voltage: \_\_\_\_\_

Current: \_\_\_\_\_

2. Using the multimeter as an Ohmmeter (the  $\Omega$  settings), measure the resistance of the both the small flashlight bulb and the large flashlight bulb. Resistance is measured in Ohms (the symbol is  $\Omega$ ).

Small bulb: \_\_\_\_\_

Large bulb: \_\_\_\_\_

3. Based on these resistance measurements, predict the brightness of the large flashlight bulb (in a circuit with 1 battery) compared to the small bulb. Call the small bulb brightness in step 1 a "5".
4. Test your prediction (keep in mind these are ballpark/eyeball "measurements"), and explain why.
5. A household "nightlight" bulb is designed to emit about the same amount of light as these flashlight bulbs, but it runs on 120V instead of 1.5 or 3V.
  - a. Predict the resistance of the nightlight bulb compared to the flashlight bulb (circle prediction):

*The resistance of the "nightlight" bulb would be  
much greater  
greater  
about the same  
less  
much less  
than the resistance of the flashlight bulb.*

- b. Now test your prediction and explain why.

6. Measure the resistance of these circuit elements (in Ohms):
- Large Resistor (blue w/ stripes) \_\_\_\_\_
  - Potentiometer: connect to the middle pole, and *either* other pole. Turn knob to see how resistance varies, then record min and max: \_\_\_\_\_ - \_\_\_\_\_  
(FYI, whenever you turn a knob on an electrical device, such as the volume on a stereo, you are probably turning a potentiometer.)

7. a. Measure the resistance of two identical medium sized (brown with stripes) resistors:

Resistor 1 \_\_\_\_\_

Resistor 2 \_\_\_\_\_

These should be pretty close, and for the next part, you can consider them to both be the average of the two measurements.

- b. Predict the *combined resistance* of these two resistors arranged in series and in parallel:

In series: \_\_\_\_\_

In parallel: \_\_\_\_\_

- c. Test your predictions, and explain.

8. Light bulbs are good for getting a feel for voltage, resistance, current, and power, but they aren't so good for exact measurements because their resistance changes as they get hotter. Resistors, on the other hand, have pretty consistent resistance at different temperatures.

- a. In lab 9.2 you showed that current through, resistance of, and voltage across, a component are related by Ohms Law:

$$\text{Voltage} = \text{Current} * \text{Resistance} \quad (V = i R, \text{ so } i = V/R)$$

- b. Based on Ohms law, predict and then measure the current that would flow through the large blue resistor with different voltages applied to it. *Show calculations for each*, and take any resistance or voltage measurements that you need to do the prediction. Then measure the current.

With 1 battery:

With 2 batteries in series:

With 3 batteries in series:

With 2 batteries in parallel:

c. Now try predicting and measuring the current flow for a small flashlight bulb instead of a resistor.

With 1 battery:

With 2 batteries in series:

With 3 batteries in series:

Discuss the accuracy of your results, and compare this accuracy to the accuracy in part b, using the resistor. Explain. Is the resistance of the light bulb increasing or decreasing as it gets hotter?

9. Think back to lightbulbs arranged in series and parallel. The brightness of the light increases with the total power delivered to the bulbs.

Power to each bulb = (Voltage across each bulb) \* (Current through each bulb).

Or,  $P = i V$

Based on step 7 in Lab 10.1, and  $V = i R$ , would you expect lightbulbs in series or in parallel to deliver more light (brightness)? Explain. Is this due to more voltage applied to each, more current through each, or both? You can either show this mathematically, or setup an experiment, or both.