PHYSICS 111 LABORATORY #2

RESISTANCE AND ELECTRICAL MEASUREMENTS

1) Objective: In this laboratory you will make some simple electrical measurements and check that carbon resistors obey Ohm's Law.

2) Background: Electrical resistance is defined in the equation V = IR, where V is the change in potential (or voltage drop) across an element and I is the current through the element. A material whose resistance is constant is said to obey Ohm's Law.

To measure the electrical potential difference (synonyms: voltage difference, voltage drop) across an element in a circuit, a voltmeter is put across its terminals, i.e., the voltmeter is connected in parallel with the circuit element. To measure the current flowing through a circuit element an ammeter must be inserted in series with the element - the current must flow through the ammeter in order to measure it! This can be done by "breaking" one of the wires and inserting the ammeter in series with the circuit element. Figure 1 shows examples of correct connections for measuring the voltage drop across and current through a resistor R connected in series with a voltage source.

Your voltage source in this experiment is an electronic "power supply" whose output voltage can be varied from zero to about 30 volts. DO NOT CONNECT AN AMMETER DIRECTLY ACROSS THE TERMINALS OF THE POWER SUPPLY. Since the ammeter has virtually zero resistance it can draw a very large current, which could damage the instrument. The current must be limited by some additional resistance placed in the circuit. You will measure current and voltages with a digital "multimeter", so called because this versatile measurement device can measure several electrical properties, including voltage, current and resistance.

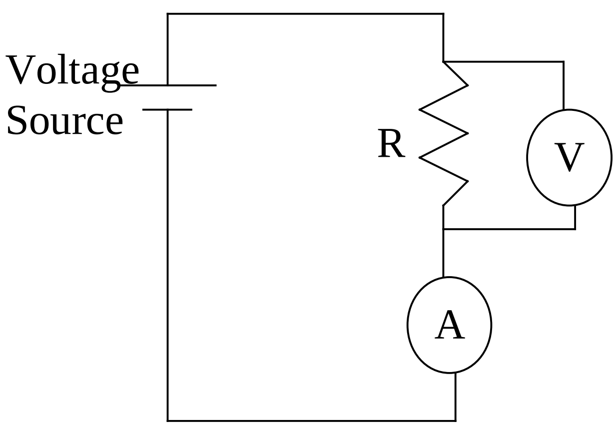

Figure 1

3) Procedure:

IMPORTANT: Before turning on the power supply, for each new circuit, ask your instructor to check your circuit connections!!

a) Ohm's Law - Wire the circuit in Fig. 1. Collect data for a graph of voltage versus current. Find the slope of the resulting straight line and compare this value with the color-coded value given in the resistor. **(See last page.)**

b) Repeat part (a) for your second resistor.

c) The digital multimeter may be used to directly measure resistance by connecting the two leads directly across the isolated resistor. Compare your results here with those in (a) and

(b) and measure the resistance of your third resistor.

d) A Simple Series Circuit - Wire the circuit of Figure 2. Place the voltmeter across the power supply and adjust to 10 volts. Measure the voltage across R_1, R_2, and the power supply. Measure the current through R_1, R_2, and the power supply. Compare the three voltage readings. What can you say about the voltages and currents in series circuit?

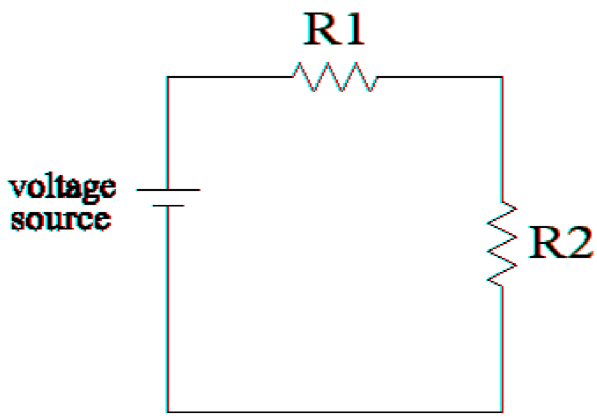

Figure 2

The equivalent resistance of a series circuit is given by $R = R_1 + R_2$. Do your results agree with this?

e) A Simple Parallel Circuit: - Wire the circuit of Figure 3. Adjust the power supply output to 5 volts. Measure the voltages across each resistor and compare them to the voltage across the power supply. Measure the current through each resistor and through the power supply. What can you say about voltages and currents in a parallel circuit? The equivalent resistance of a parallel circuit is given by $1/R = 1/R_1 + 1/R_2$. Do your results agree with this? (Some thinking is required!)

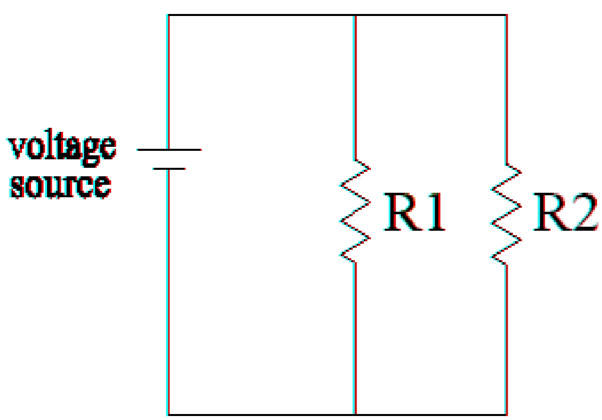

Figure 3

f) Compound Series/Parallel Circuit. Wire the circuit of Figure 4 and adjust the power supply to 5V. Measure the voltages across each resistor. Calculate the current through each resistor knowing its resistance. Measure the current through each resistor and explain your results in detail in light of parts (d) and (e) above.

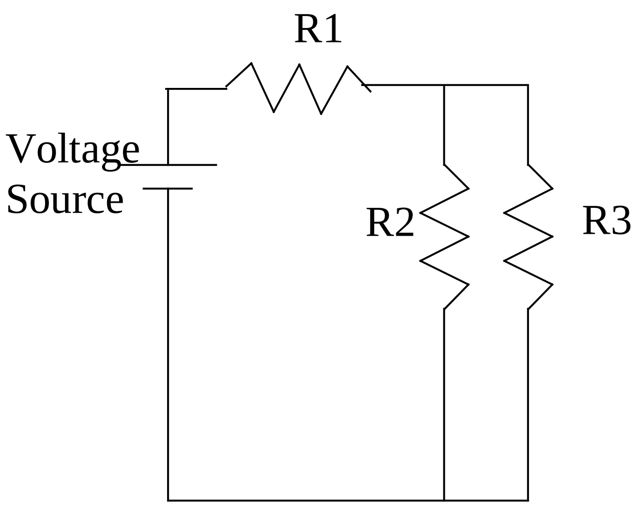

Figure 4

g) Go back to the simple series circuit of Part (d) and replace one of the resistors with a small light bulb (in its socket) and repeat a set of measurements. Does the light bulb obey Ohm's Law?

Addendum: Standard Resistor Color Code Scheme

	0	black	4th stripe
	1	brown	none: ±20%
	2	red	silver: ±10%
	3	orange	gold: ±5%
	4	yellow	
three color stripes	5	green	
	6	blue	
	7	violet	
	8	gray	
	9	white	

EXAMPLE:
Brown - Black - Orange
1 0 1×10^3 = 10×10^3 = 10,000 ohms
= 10 K

Safe power dissipation depends on the physical size of the resistor. In general, the resistors with the larger surface areas can safely dissipate more power.