Lab E3: Resistance and Ohm's Rule **NAME_____**
PH305 2/10/03 **PARTNER_____**

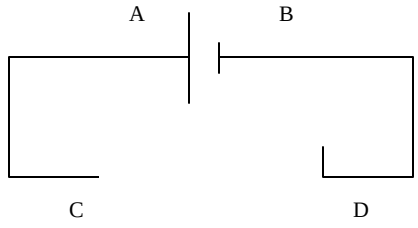
Your goals in this lab are:

1) to learn to use a galvanometer to measure current and voltage difference (see the handout Using a Galvanometer for instructions on this)
2) to determine the resistance of a light bulb and of a resistor, and
3) to determine if the light bulb and resistor obey Ohm's Rule.

The definition of the resistance of a material is: $R = -\Delta V/I$ where ΔV is the voltage difference between two ends of the material and I is the current that the voltage difference causes to flow through the material. The – sign is important to include, because R is positive by definition, and ΔV will be a negative number if the current I is the (positive) conventional current. (We can see that ΔV is negative, because the conventional current I will always flow from a higher voltage at one end of the material to a lower voltage at the other end). A material is said to obey Ohm's Rule if its resistance is a constant, independent of the voltage difference applied across the material.

A. Getting Started – Measuring Voltage Differences

1) Construct the simple circuit shown below with one 1.5-volt battery and a light bulb. The symbol ||| in the circuit diagram represents a battery; the longer line represents the positive terminal, the smaller line the negative terminal. The symbol represents a light bulb.



2) Perform and record the following measurements. BEFORE connecting the leads to make the first measurement, though, call instructor over to make sure you will make the connections correctly.

a) $V_A - V_B$; why is this voltage difference positive ?

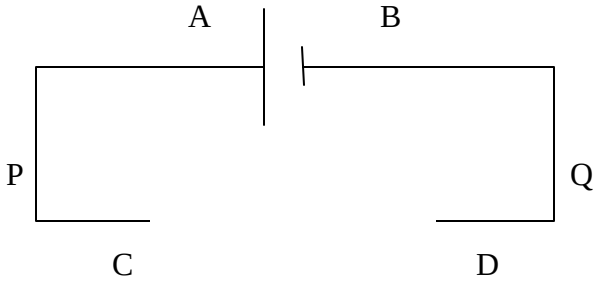
b) $V_C - V_A$; why is this voltage difference zero?

c) $V_B - V_A$; why is this voltage difference negative?

d) $V_D - V_C$; why is this voltage difference negative?

B. Getting Started – Measuring Current

1) For the same circuit you constructed above, measure the current at point P (shown below). BEFORE you actually connect the galvanometer leads to the circuit, call instructor over to make sure you will make the connections correctly.



2) Record the measured current: I_P =

3) Is the current the same everywhere in a simple circuit like this? To find out, measure the current at point Q. Is it the same as the current at point P?

Later we will learn that current can only change when there is a branch in the circuit. Since this circuit has no branches, the current is the same everywhere in the circuit.

C. Determining Resistance

1) You will next determine the resistance of a light bulb for several different values of applied voltage difference. Record your measured values for voltage difference and current for four different applied voltages in the table below (you may use the values you already measured for the first row). Then use the definition of resistance to calculate the filament's resistance for each case. Finally, calculate the electrical power that the light bulb converts into thermal power (use the definition of electric power, $P = I \Delta V$).

Voltage Diff. (Volts)	Current (Amps)	Resistance (Ohms)	Power (Watts)

2)Based on the results of this activity, does the light bulb obey Ohm's Rule ? Why or why not ?

3) Can you explain why your four values for the resistance might be different ? Hint: think about what causes resistance to electrical current flowing through a material.

4)Repeat steps C1-C3 for a resistor that the instructor gives you. When using the galvanometer with the resistor, you will need to remove the shunt resistor from the meter in order to get accurate measurements. With the shunt resistor removed, the scales on the galvanometer change – read the label on the front of the galvanometer to learn how to read the scales properly in this case.

Voltage Diff. (Volts)	Current (Amps)	Resistance (Ohms)	Power (Watts)

5) Does the resistor obey Ohm's Rule ? Why or why not ?