Using simple circuits to measure voltages and currents

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Physics 132 - Section LL
Mondays 8:00 AM
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Abstract:

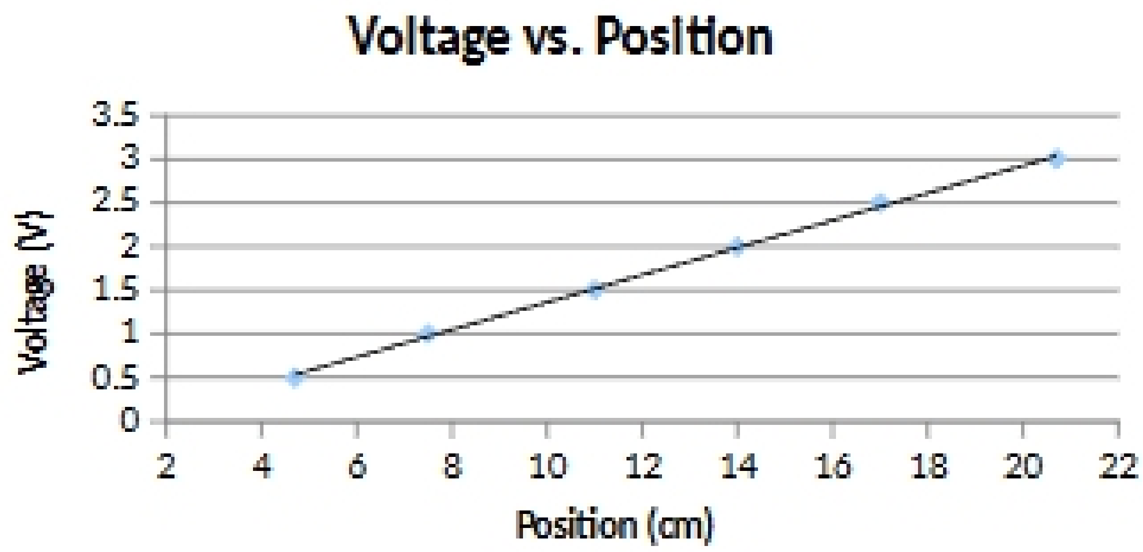
The goal of this lab was to develop an understanding of direct current electric circuits and Ohm's Law. In order to do this, we measured the voltages and currents in some simple parallel and series circuits. We used voltage vs. current relationships to determine the ohmic nature of resistors.

Questions:

1. State the equation for Ohm's law. What do the variables V, I, and R stand for, and what are the units of each? Of the units listed, which one is equivalent to coulomb/second? (1 point)

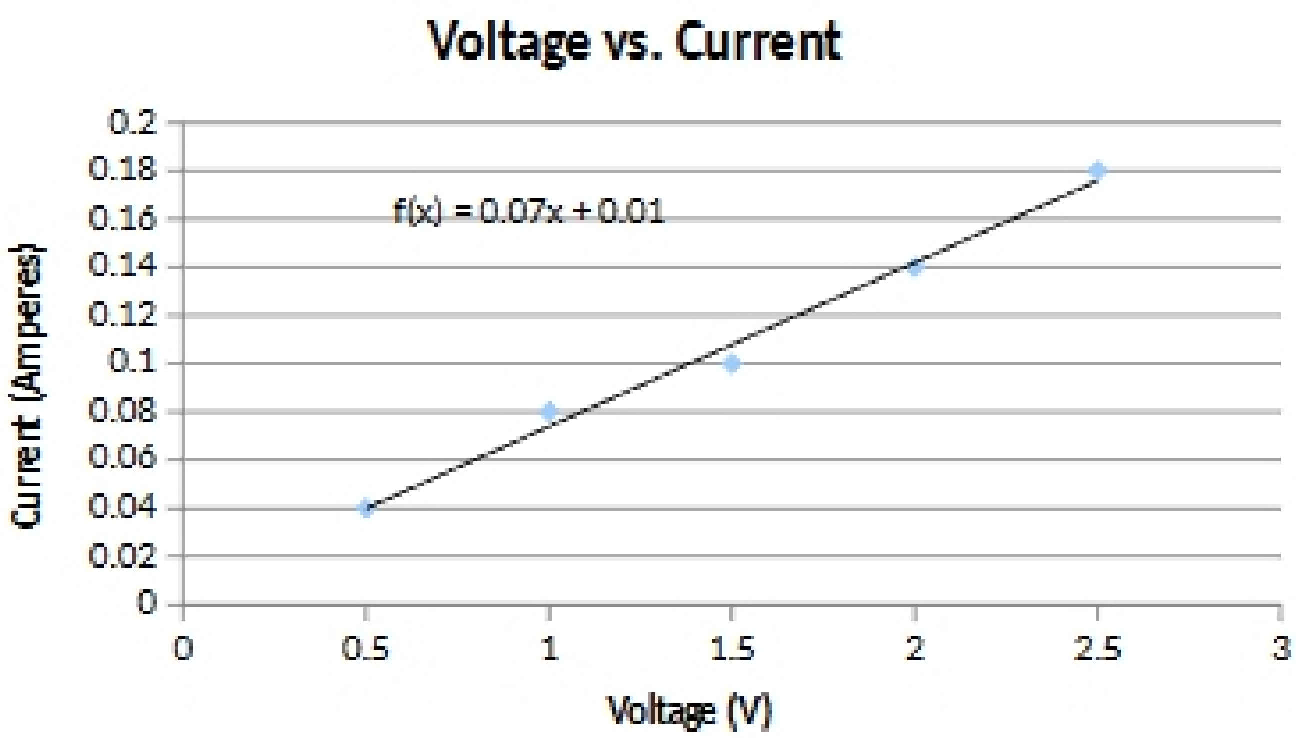
Though there are many versions of Ohm's law, the basic equation is:
change in **voltage (delta V) = current (I) x resistance (R).** *V* stands for the difference in electric potential between any two points on a circuit, or voltage. The unit for voltage is volts which corresponds to coulomb/second. *I* refers to the amount of current produced between two points in a circuit. The unit for current is known as an ampere. *R* refers to the total amount of resistance between two points on a circuit. The unit for resistance is known as an ohm.

2. From Part 3.1.1 (Power Supply): Produce a graph of output voltage Voltage as a function of the sliding contact position x, measured from the bottom end of the slide wire resistor. Verify that the data points fall on a straight line rather than a curve (don't actually compute the slope). Did the current change while you varied the sliding contact position x? (2 points)



The data points do all fall in a straight line. The greater the value of the sliding position, the greater the change in voltage. While our current meter was switched off at this point, the current would vary with the sliding contact position because, as in accordance with Ohm's Law, voltage is directly proportional to current. Because voltage is increasing, current would increase as well as in accordance with the Ohm's Law.

3. From part 3.1.2 (Ohm's law): Produce a graph of voltage V as a function of current I. Compute the slope, which will give the resistance R (in ohms) of the resistor. In the lab, you should also have deduced R from the color-coding on the side of the resistor itself (recall in-lab question 1). Does your value for R fall within the manufacturer's expectations? (1.5 points)



The R value calculated from graph = 0.068^-1 = 14. 7 ohms. The R value from the color coding side is 10 ohms. Our calculated R value is not within the manufacturer's expectations since 14.7 ohms is not within 5% of 10 ohms. The percent error in this case is very high reaching 47%.

4. From part 3.1.5 (resistors in series/parallel): Using the resistor color code in your manual (part 3.2), write the value of each resistor used in this part of the experiment.
From this, compute the total resistance Rtot (i) resistors in series, and (ii) resistors in parallel. (2 points)

R1 = 36
R2 = 10

(i) $R_{series, tot}$ = 36 + 10 = 46 ohms
(ii) $1/R_{parallel, tot} = (1/R_1) + (1/R_2)$ = (1/36) + (1/10) = 0.1277 = $1/R_{parallel,tot}$
$R_{parallel, tot}$ = 0.1277^-1 = 7.83 ohms

5. From part 3.1.5 (resistors in series/parallel): Use the measured voltage V and current I for the two cases: Rtot to calculate (i) resistors in series, and (ii) resistors in parallel. Compare your measured values for the series and parallel cases to those calculated in the previous question. That is, compute the percent difference for each case. (2 points)

(i) V = I *R V/I = R 3/0.06 = 50 ohms (R_{tot})

Previous value = 46 ohms; Percent difference = [(50-46)/46] *100 = 8%

(ii) V/I = R 3/0.28 = 10.7 ohms (R_{tot})

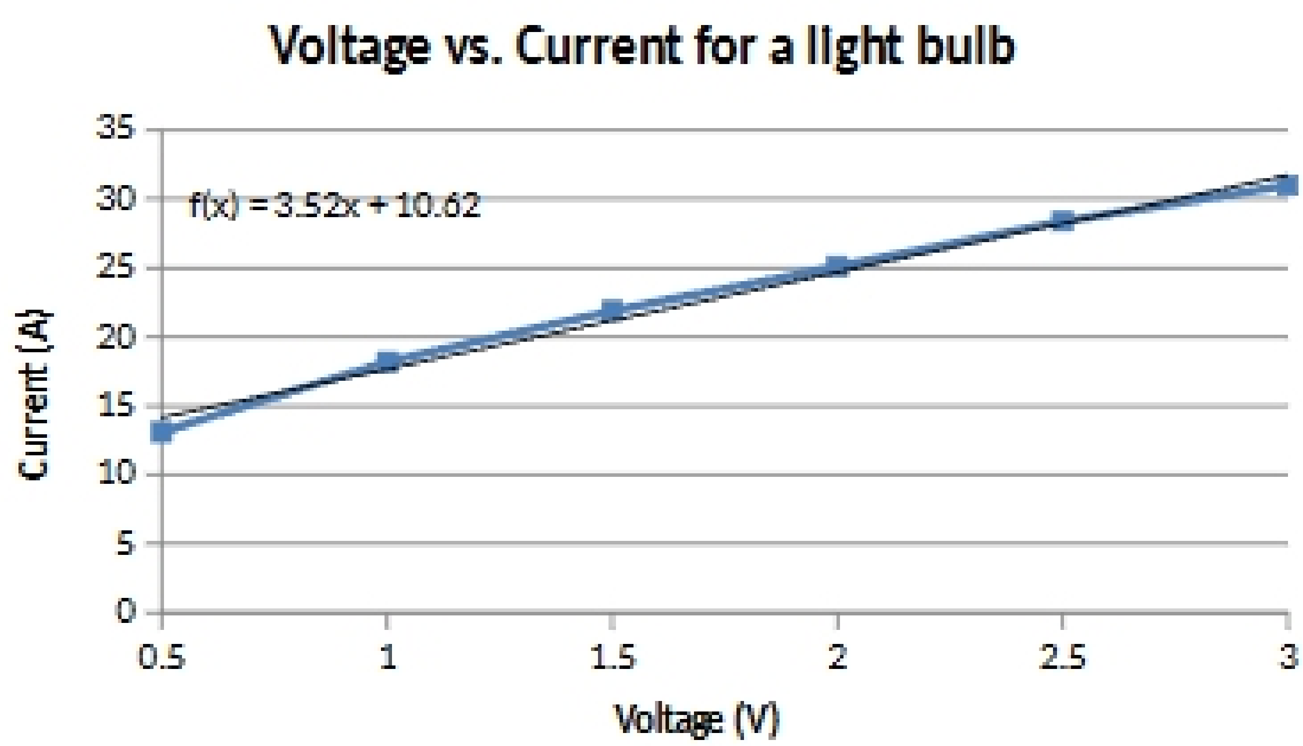
Previous value = 10 ohms; Percent difference = [(10.7-10) / 10] *100 = 7%

The differences in the previous values and measured values are relatively small since the values for both types of circuits are very similar. This is why the percent error is so small.

6. An Ohmic device is one that obeys Ohm's Law. According to your data, are carbon resistors Ohmic devices? Support your answer with references to your graphs and/or equations. (1 point)

Yes, the carbon resistor is an ohmic device. An ohmic device is one that follows Ohm's law (V = IR) and a simple example is a basic resistor In order to determine this, I looked at a plot that measured voltage in relation to current. An ohmic device, such as our carbon resistor, would have a straight line in a graph with current vs. voltage and constant slope. According to the question 3 graph, the device showed a linear relationship between voltage and current and a constant slope. Therefore, it is an ohmic device.

7. From part 3.1.4 (Light Bulb): In reality a light bulb is not an ideal resistor. As the light bulb heats up its resistance increases. Pretend you measured the current through a light bulb at different voltages and arrived at this data. Plot a voltage as a function of current for this data. Please connect the dots instead of adding a best fit line. What can you say about the resistance of the light bulb? (1.5 points)



Resistance = slope^-1 = 3.5229^-1= 0.28 ohms

The bulb is not an ohmic device since the graph is non-linear .The filament of a normal light bulb is made from tungsten. This means that its resistance will increase with temperature. When we apply a voltage, current will flow and this will parallel an increase in temperature which will be simultaneously followed by an increase in resistance. As a consequence, the current will