

15 Electrodynamics

Lab C: OHM'S LAW

Name _____

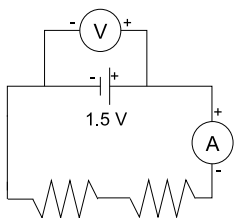
Inquiry Physics

You will recall from our electrostatics unit that voltage is energy change per unit charge. Mr. M will demonstrate how to use a voltmeter, a device which measures the change in electrical energy per unit charge occurring across a circuit element. The instructions are summarized below:

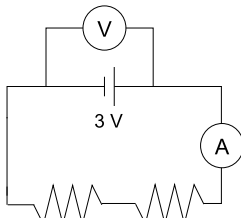
Voltmeter Procedure

To measure the voltage across a circuit element, one wire is connected from the positive (+) terminal of the voltmeter to the positive (+) side of the circuit element. Another wire connects the negative (-) terminal of the voltmeter to the negative (-) side of the circuit element. Voltmeters are always hooked **across** an element, not in series with it. The voltmeter can be thought of as a small parallel circuit added onto the existing circuit. **Never** hook a voltmeter in series.

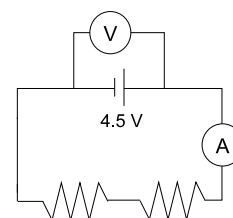
You will experiment to discover the relationship between voltage (V), current (I), and resistance (R). We will begin by examining how voltage affects current when resistance is held constant. Connect circuits 1, 2, and 3. Set the power supply as indicated or hook up batteries to create the required voltages. Measure and record in Table I the voltage and the current for each. (**Measure** the voltage - do not assume it is what you set on the supply or what you see on the battery label.)



Circuit #1: Voltage Set at 1.5V



Circuit #2: Voltage Set at 3V



Circuit #3: Voltage Set at 4.5V

Table I - Voltage and Current Data

READ THE METERS TO THE LIMIT OF THEIR PRECISION

Circuit	Voltage = V (volts)	Current = I (amperes)	Resistance = R (ohms)
1			
2			
3			

Use the computer to construct a graph of the data with current on the x-axis and voltage on the y-axis. Have Mr. M check your results before printing any graphs. Save your data as "H#G#L15C", replacing # with the correct numbers.

- The shape of your graph indicates the relationship between voltage and current. What is that relationship?

- Use the program's regression line capability to fit a line to your graph. Write out the complete linear equation relating voltage (V) and current (I), inserting properly rounded slope and y-intercept numbers.

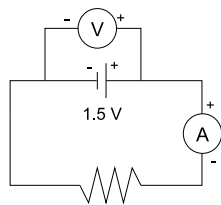
- The slope of the graph is related to what was held constant in the experiment. Identify the proper relationship and use it to re-write your equation in purely symbolic form.

- We will consider your graph's slope to be a "measured" value. The supposed value of the resistors can provide a theoretical value for what the slope should have been. Compute the percentage error between those values.

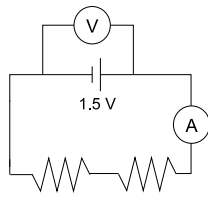
$$\% \text{ error} = \frac{|\text{measured} - \text{theoretical}|}{\text{theoretical}} \times 100$$

SHOW YOUR WORK

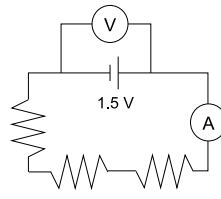
Next we will examine how resistance affects current when voltage is held constant. Connect circuits 4, 5, 6, and 7. **BE SURE TO PROVIDE A VOLTAGE OF 1.5 V.** Record all data in Table II.



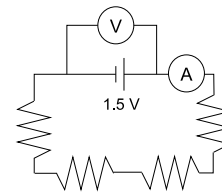
Circuit #4



Circuit #5



Circuit #6



Circuit #7

Table II - Resistance and Current Data
READ THE METERS TO THE LIMIT OF THEIR PRECISION

Circuit	Voltage (V)	Current (A)	Resistance (Ω)
4			
5			
6			
7			

Use the computer to construct a graph of the data. Graph resistance on the x-axis and current on the y-axis. Have Mr. M check your results before printing any graphs. Save your data as "H#G#L15D".

5. The shape of your graph indicates the relationship between resistance and current. What is that relationship?

6. You cannot perform a linear fit to a curve. Select your data points and then use the "Analyze" menu's "Automatic Curve Fit" option to fit the appropriate type of curve to your data. What type of fit did you select?

7. The computer will provide the necessary constant(s) for your curve. Write out the complete equation relating resistance (R) and current (I), inserting the appropriately rounded constant(s).

8. The constant in your equation is related to what was held constant in the experiment. Identify the relationship and re-write your equation in purely symbolic form.

Your answers to questions 3 and 8 should be mathematically equivalent. If they are not, ask Mr. M for assistance.

9. Use the value from your graph as the "measured" value and the average voltage as the "theoretical" value to calculate a percentage error.

SHOW YOUR WORK

10. You have discovered a relationship known as Ohm's Law. It states that the current in a circuit is

_____ to the _____

and _____ to the _____.