

Investigation 17C: Resistance and Ohm's law

Essential question: How is resistance measured?

Ohm's law $I = V/R$ is the fundamental relationship between current, voltage, and resistance in a circuit. Devices that measure resistance are based on Ohm's law. These devices apply a known voltage and/or current, and then determine the resistance. In this investigation you will use a similar experimental technique to measure the resistance of a bulb.

Part 1: Current through different resistors

1. Open the experiment file **17C_ResistanceAndOhmsLaw**, and then power-on the current sensor and connect it to your software.
2. Construct the circuit shown using one battery, a switch, a current sensor, a 10- Ω resistor, and any necessary wire modules.
3. Start data collection, close the switch, and record the measured current in the data table.
4. Repeat the experiment for the 33- Ω and 100- Ω resistors. Tabulate your results for R and I .
5. Repeat the experiment for two other resistors using the spring clip module. You will have to read the resistor values using their colored bands. Tabulate your results for R and I .

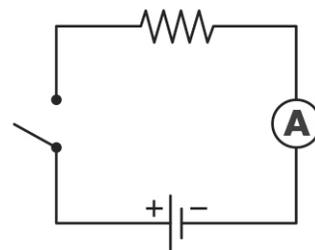


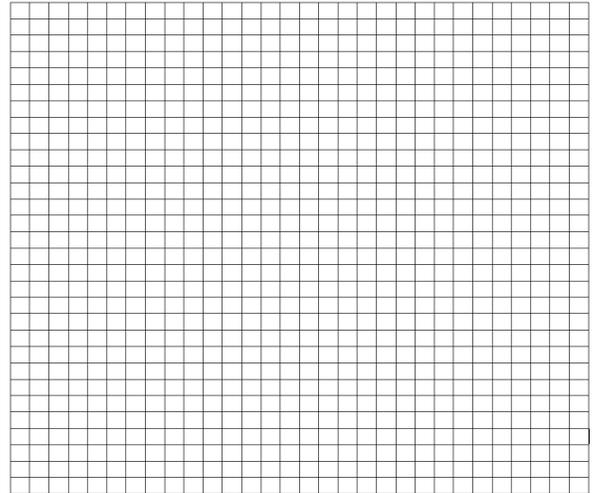
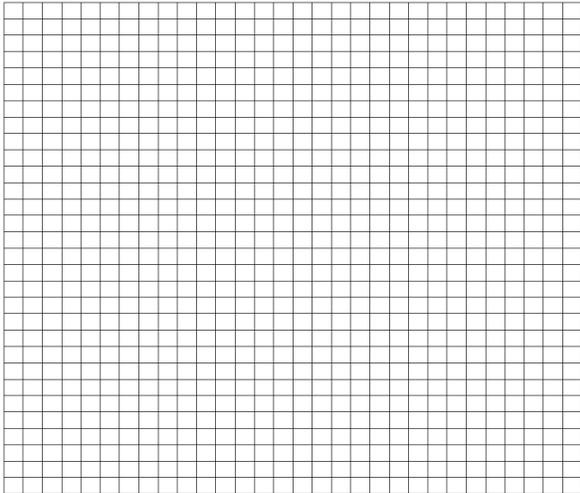
Table 1: Current through known resistors

I (A)	R (Ω)	$1/R$ (Ω^{-1})

Questions

- a. Graph I on the vertical axis and R on the horizontal axis. What type of curve best fits this data?
- b. Calculate $1/R$ for each resistor. Make a second graph with I on the vertical axis and $1/R$ on the horizontal axis to create a linear graph. Fit a line to determine the slope of the data. What is the value of the slope?

- c. What does the slope of this graph represent? Why?

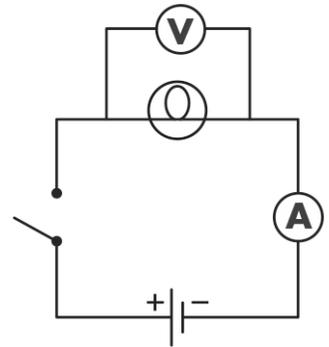


Part 2: Resistance of a light bulb

1. Power on the voltage sensor and connect it to your software.
2. Replace the resistor with the bulb and attach the voltage sensor across the bulb.
3. Measure the current and voltage for the illuminated bulb.
4. Calculate the resistance of the bulb using Ohm's law $R_{meas} = V/I$.

Questions

- a. What is the resistance of the bulb? Show your work, including units.
- b. Imagine you have a complicated circuit containing many resistors. Describe in words how you can use Ohm's law to find the effective resistance of the entire circuit.



Applying new knowledge

1. What is the voltage drop across a $50\text{-}\Omega$ resistor when a current of 0.10 A flows through it?

2. What is the current through a $10\text{-}\Omega$ resistor when a voltage of 5.0 V is applied across it?

3. How much current flows through a $145\text{-}\Omega$ lamp connected across the 120-V house electrical system?

4. A resistor with $R = 101\ \Omega$ is connected across a 1.50-V battery. How much current flows through the resistor?

5. The U.S. electricity grid delivers a voltage of 120 V to households.
 - a. What resistor is needed to set the current in a household's 120-V circuitry to one amp?

 - b. If that is a maximum allowed current, then is that required resistance a maximum or minimum?

6. A simple circuit consists of a voltage source and a single resistor.
 - a. How does the current change if the resistance is doubled?

 - b. How does the current change if the resistance is halved?

 - c. If you want to reduce the current in a circuit, do you increase or decrease the resistance?