Ohm's Law Experiment Kit

P6-8011

INSTRUCTIONAL GUIDE

Contents

Ohm's Law Experiment Kit:

- Wooden base with mounting points
- 50 cm nichrome wire (+ spare wire)
- Light socket attached to alligator clips
- Mini light bulb (+ spare 3.7V bulb)

Required for this lab:

- Ruler (01-0115)
- Power source
- We recommend using a Genecon hand-crank generator (P6-2631) as it is a battery-free and versatile source of electricity for the classroom.

Background

At the time of **Georg Simon Ohm** (1789-1854), the electrochemical cell was a rather new idea. Back then it was often called the "galvanic circuit." Ohm's background was primarily in mathematics, and he gained his reputation as a physicist when teaching at the Jesuit Gymnasium of Cologne. During his time at this school, he published *Die galvanische Kette, mathematisch bearbeitet* (The Galvanic Circuit Investigated Mathematically). In this work, Ohm's Law (which Ohm named after himself) says "The electromotive force [voltage] acting between the extremities of any part of a circuit is the product of the strength of the current, and the resistance of that part of the circuit." He defined resistance as the proportionality constant between voltage and current. His mathematical definition looks like this:

$$C \times R = E$$

Where E is "electromotive force" or potential difference (measured in volts), C is current (in Amperes) and R is resistance (in Ohms). Nowadays, the symbol for potential difference is most often seen as V, and current is most often symbolized as I and the equation is conventionally written like this:

$$V = I \times R$$

Earlier experiments by Andre-Marie Ampere defined current as "intensity" of electricity, thus the symbol for current and a useful visual for the concept.

Introduction

Ohm's law identifies what makes voltage across two points on a circuit proportional to the current across the same two points. Every material has this characteristic to a varying degree, and is called electrical resistance, or the opposition to the flow of electrical current. A material with low resistance is electrically conductive, like copper or gold. Materials with very high resistance are often called insulators. Rubber and plastics are often very good insulators and are used to surround conductors to prevent short-circuiting.

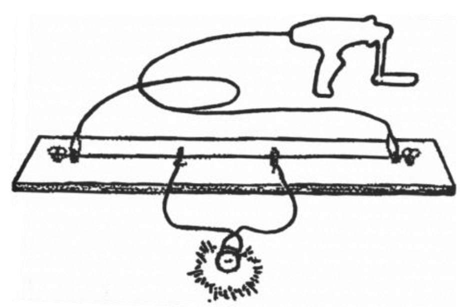
So, what's the difference between conductive and resistive materials?

The main factor is how "delocalized" the electrons are in a material. Generally speaking, materials with neatly-arranged electrons are much more conductive-and less resistive-than materials with loosely-arranged electrons. From our knowledge on states of matter, we know that temperature excites atoms and that with increased temperature, materials become less atomically organized. It follows to reason that increasing the temperature of a material increases its resistance.

Yet another factor that determines resistance of a material is its shape. For example, a long wire with a large diameter will have more resistance that a short wire with a small diameter. Changing these parameters is by far the simplest way to vary resistance. The other factors contributing to resistivity are difficult to control (you can't just tell electrons to become less organized in a material). That's why in this experiment, we will be physically changing the amount of resistance by changing the length of wire in the circuit.

Set-Up

Since this is a qualitative experiment, we will not be taking measurements; although, this experiment could be easily quantified by including a multimeter and battery pack. To set up the apparatus, attach the leads from the energy source to the nichrome wire near the mounting points. Next, fasten each lead from the light socket near the center of the wire. Your apparatus should look similar to that in the diagram to the right.



Data Collection

With a lab partner cranking the generator at a consistent pace, slowly slide one of the alligator clips closer to the point where the light bulb apparatus is attached to the wire. Watch the light bulb as the clips get closer together, effectively shortening the circuit.

Now replace the clips so your apparatus looks like the diagram above. Measure the distance between the power source clips and the light bulb clips. Record this measurement in the table below or create your own table for recording data. Crank the Genecon to light up the bulb. Record your observation; is it easy or hard to light up the bulb? Then move the clips in and record the new measurement. Crank the Genecon and record your observations. Repeat this process until you have at least five data points.

Trial	Distance	Observations
1		
2		
3		
4		
5		

Data Analysis

Do your observations agree with Ohm's Law? If they do, explain what proof you have in terms of voltage, current, and most importantly, resistance. If they don't, troubleshoot your apparatus—see if you can explain the problems you're having in terms of voltage, current, and resistance.

Resources

You can see Georg Ohm's groundbreaking publication (translated from German) right here! Just follow this link to see what Georg has to say for himself:
https://books.google.com/books?id=Qkh8AAAAIAAJ&pg=PA202#v=onepage&q&f=false

Related Products

Electromagnetic Force Demonstrator (P6-2625) Watch how the aluminum pipe travels along the track in the direction the current is applied, reinforcing the interrelated concepts of Current, Magnetic fields and the Lorentz Force.

1 Farad Capacitor (P6-8012) The Arbor Scientific 1 Farad Capacitor Demonstration - Study and understand stored potential, capacitance, and energy conversion using a 1 Farad Capacitor. The Genecon's output can be stored and then tapped using this unique miniature capacitor.