11.4.4: Ohm's Law

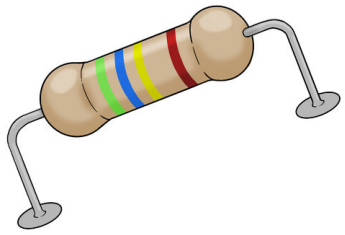

Figure 16.5.1

The bands of color on a resistor are a code that indicates the magnitude of the resistance of the resistor. There are four color bands identified by letter: A, B, C, and D, with a gap between the C and D bands so that you know which end is A. This particular resistor has a red A band, blue B band, green C band, and gold D band, but the bands can be different colors on different resistors. Based on the colors of the bands, it is possible to identify the type of resistor. the A and B bands represent significant digits; red is 2 and blue is 6. The C band indicates the multiplier, and green indicates 10^5. These three together indicate that this particular resistor is a 26,000 Ohm resistor. Finally, the D band indicates the tolerance, in this case 5%, as shown by the gold band. These terms will be explained over the course of this lesson.

Resistance and Ohm's Law

When a potential difference is placed across a metal wire, a large current will flow through the wire. If the same potential difference is placed across a glass rod, almost no current will flow. The property that determines how much current will flow is called the **resistance.** Resistance is measured by finding the ratio of potential difference, V, to current flow, I.

$$R=V/I$$

When given in the form V=IR, this formula is known as **Ohm's Law,** after the man that discovered the relationship. The units of resistance can be determined using the units of the other terms in the equation, namely that the potential difference is in volts (J/C) and current in amperes (C/s):

$$R=\text{volts/amperes}=(\text{joules/coulomb})/(\text{coulombs/second})=\text{joules}\cdot\text{seconds/coulombs}^2=\text{ohms}$$

The units for resistance have been given the name **ohms** and the abbreviation is the Greek letter omega, Ω. 1.00 Ω is the resistance that will allow 1.00 ampere of current to flow through the resistor when the potential difference is 1.00 volt. Most conductors have a constant resistance regardless of the potential difference; these are said to obey Ohm's Law.

There are two ways to control the current in a circuit. Since the current is directly proportional to the potential difference and inversely proportional to the resistance, you can increase the current in a circuit by increasing the potential or by decreasing the resistance.

Example 16.5.1

A 50.0 V battery maintains current through a 20.0 Ω resistor. What is the current through the resistor?

Solution

$$I=V/R=50.0\text{ V}/20.0\ \Omega=2.50\text{ amps}$$

Launch the PLIX Interactive below to explore how Ohm's Law affects the current in a circuit:

Summary

- Resistance is the property that determines the amount of current flow through a particular material.
- V=IR is known as Ohm's Law.
- The unit for resistance is the ohm, and it has the abbreviation Ω.

Review

1. If the potential stays the same and the resistance decreases, what happens to the current?
    1. increase

2. decrease
3. stay the same

2. If the resistance stays the same and the potential increases, what happens to the current?
    1. increase
    2. decrease
    3. stay the same
3. How much current can be pushed through a 30.0 Ω resistor by a 12.0 V battery?
4. What voltage is required to push 4.00 A of current through a 32.0 Ω resistor?
5. If a 6.00 volt battery will produce 0.300 A of current in a circuit, what is the resistance in the circuit?

Explore More

Use this resource to answer the questions that follow.

1. What happens to current flow when voltage is increased?
2. What happens to current flow when resistance is increased?

Additional Resources

Study Guide: Electrical Systems Study Guide

Video: Basic Ohm's Law Problems - Overview

Real World Application: Guess The Efficiency, Batteries

Interactives: Dollhouse, Flashlight, Electric Analogies
