Resistance

Resistance can be thought of as the ability of a material to resist the flow of charge when it is connected to a voltage source. An **insulator** allows only a small amount of current to pass for a particular voltage, and thus has a large resistance. A **conductor** allows a large amount of current to pass for the same voltage, and thus has a small resistance.

The **resistance** (R) of any material is defined as the ratio of the voltage to which it is connected, divided by the current that flows through it.

$$resistance = \frac{voltage}{current} \qquad \text{or} \qquad R = \frac{V}{I}$$

The metric unit of resistance is the **ohm** (Ω). A material with a resistance of 1 ohm will allow 1 ampere of current to flow when connected to a 1 volt source.

In many types of materials, the value of the resistance is **not** constant. That is, the ratio of the applied voltage to the resulting current changes as the applied voltage changes.

In some special cases, the value of the resistance is constant. That is, the ratio of the applied voltage to the resulting current remains constant as the applied voltage changes. This relationship is known as **Ohm's Law**.

Electric components manufactured especially for their resistance are called **resistors**. Resistors that have a constant resistance, regardless of applied voltage, are called **ohmic resistors**.

How a Light Bulb Works

The filament of a light bulb glows because it has a high resistance. When electrons try to move through the filament, they bump into the atoms of the filament. These collisions generate heat. Since the resistance of the filament is high, there are a large number of collisions, generating a large amount of heat. Once enough heat is generated, the filament will begin to glow.

Copper wires don't glow because they have a very low resistance (nearly zero).

Example 1
A flashlight uses two $1.5\ V$ batteries (effectively a single $3.0\ V$ battery) to provide a current of $0.40\ A$ in the filament. Determine the resistance of the glowing filament.

Example 2
A toaster has a resistance of $12\ \Omega$. If it is connected to a $120\ V$ circuit, how much current will flow through the toaster?