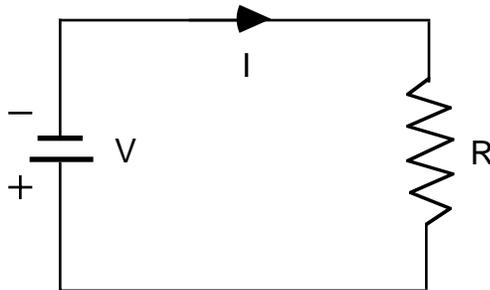


Resistance : Notes/W.S.-30

In a typical simple circuit, a cell (or a battery or a generator) supplies energy to electrons and the electrons lose energy in a **resistor**. The resistor may be the tungsten filament in a light bulb or a nichrome (nickel-chromium alloy) wire which is found in heaters and toasters, or it may be a stove element.

A simple circuit may be represented by the diagram below.



The cell or battery in the circuit is represented by the two parallel lines. One is short (negative terminal), the other is long (positive terminal). Current flows from the negative terminal and goes around the circuit, losing energy in the resistor R, which is represented by the sawtooth line.

For the circuit above, if the voltage is doubled, the current is doubled. If the voltage is tripled, the current is tripled. In general, the voltage is proportional to the current. The proportionality constant is called the resistance R. The voltage is equal to the current multiplied by the resistance.

$$\text{VOLTAGE} = \text{CURRENT} \bullet \text{RESISTANCE}$$

The symbol for voltage is V (units are volts V). The symbol for current is I (units are amperes A). The symbol for resistance is R (units are ohms Ω , this is the Greek letter Omega).

We therefore have the equation below. This is **Ohm's Law**.

$$V = I \bullet R$$

The resistance of various materials

Some common materials are given below. Materials with a higher resistance are higher up on the list.

Plastic	High Resistance
Porcelain	
Glass	
Wool	
Wood	
Stone	
Water	
Human body	
Silicon (in computer chips)	
Carbon (graphite)	
Iron	
Tungsten (in filaments)	
Copper (house wiring)	
Silver	Low Resistance

The high resistance materials are good insulators. The low resistance materials are good conductors.

Problems:

- 1)a) Which metal is the best conductor?
- b) Which material is the best insulator?
- c) What metal is the filament of a light bulb made out of?
- d) Where would you find nichrome wire?
- 2) Give the unit for resistance?
- 3) If the resistance of a light bulb is 90Ω and the current through it is 0.30A , find the voltage across the bulb.
- 4)a) The voltage across a room heater is 120 V . The current is 14A . Find the resistance of the heater.

b) If the voltage across the heater is doubled, what happens to the current? What happens to the resistance?

5) A stove is connected to a voltage of 240 V. The resistance is 8.0Ω . Find the current.

6) A transistor radio requires a 9.0V battery. The current is 0.025A. Find the resistance.

Answers: 1) silver, plastic, tungsten, heater elements, 2) ohm, 3) 27V, 4)a) 8.6Ω , b) current doubles, resistance is unchanged, 5) 30A, 6) 360Ω .