Chapter 1-1

Electricity.

The phenomenon of the electric charge was discovered many years ago. Initially this was in the form of static electricity generated by lightning or from the friction of two materials. Today, electricity is better understood and an essential commodity.

Electricity can be described as, **the ordered flow of electrons from a negative point to a positive point.** Materials that resist the flow of electrons are called *insulators* and the materials that allow the flow of electrons are called *conductors*.

Firstly, we need a source of electrons. A *Cell* is a device in which a chemical reaction between materials can produce electrons. The voltage of a cell is approximately 1.2V. See the symbol for a cell in Figure 1.

Many cells connected are called a *battery.* See the symbol for a battery in Figure 1.

A battery is rated in ampere-hours.

Example: A battery rated at 10 amp-hours could supply 10 amps for 1 hour, 1 amp for 10 hours or 5 amps for 2 hours.

A disposable battery is termed a *primary battery* and one that can be recharged is termed a *secondary battery*.

The constant flow of electrons from a battery or cell is termed "*Direct Current" (DC).* Current flow that changes direction on a regular basis is termed "*Alternating current" (AC).* This lesson is based on DC and AC will be addressed later.

When electricity was first discovered, the belief was that the energy flowed from positive (+) to negative (-). This was termed *conventional current flow*. When electricity was better understood, scientists realized that the flow of electrons was electricity and the electrons flowed from negative (-) to positive (+). This is termed *electron flow*.

The application of DC current in the wrong polarity can damage the equipment.

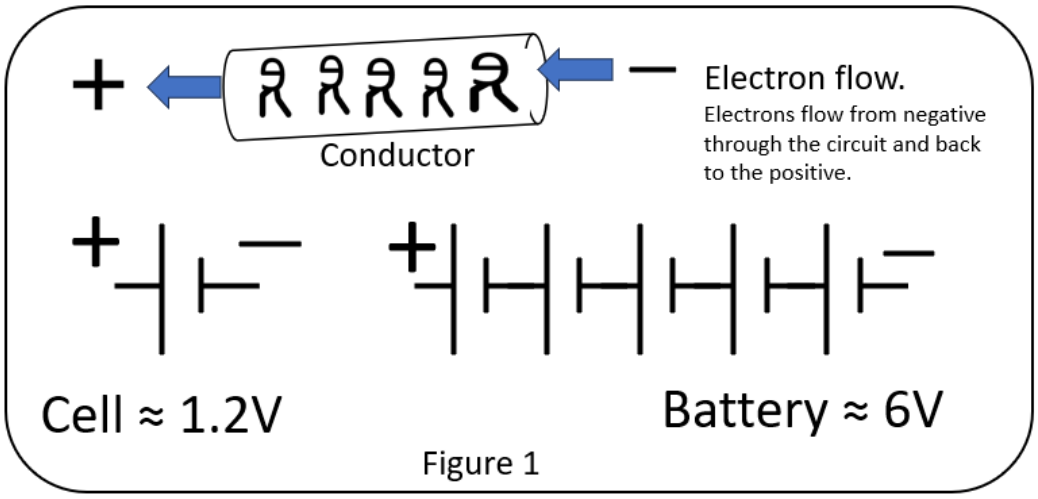


Figure 1

Introducing Ernie, the electron.

The force, or potential, to push the electrons through the conductor is called the ***E**lectromotive Force (EMF)* and is measured in volts (V or E).

The **I**ntensity of electrons, electric current or quantity of electrons flowing through the conductor is measured in *amperes or amps (I).*

Any **R**esistance or opposition to the to the flow of electrons is measured in Ohms represented by the Greek letter Omega (Ω).

In 1781 Georg Ohm documented the relationship between voltage, current and resistance. His findings were not published till 1879 and these are now known as Ohm's Law. The best way to use this law is through the Ohm's triangle shown in Figure 2.

To use the triangle, cover the unit you wish to calculate and the positions of the remaining two units dictate the formulae.

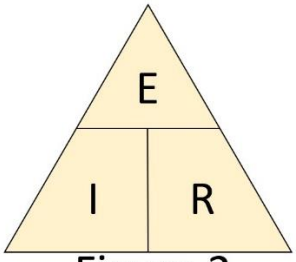


Figure 2

E = I x R I = E ÷ R R = E ÷ I

Examples

1 If 0.5 A is flowing through a 100 Ω resistor, what is the electromotive force on the electrons?

E = I * R = 0.5 * 100 = 50 V

2 If 0.5 A is flowing being pushed by 20 V, what is the resistance in the circuit?

R = E / I = 20 / 0.5 = 10 Ω

3 What is the current in the circuit if 90 V is pushing electrons through a 100 Ω resistor?

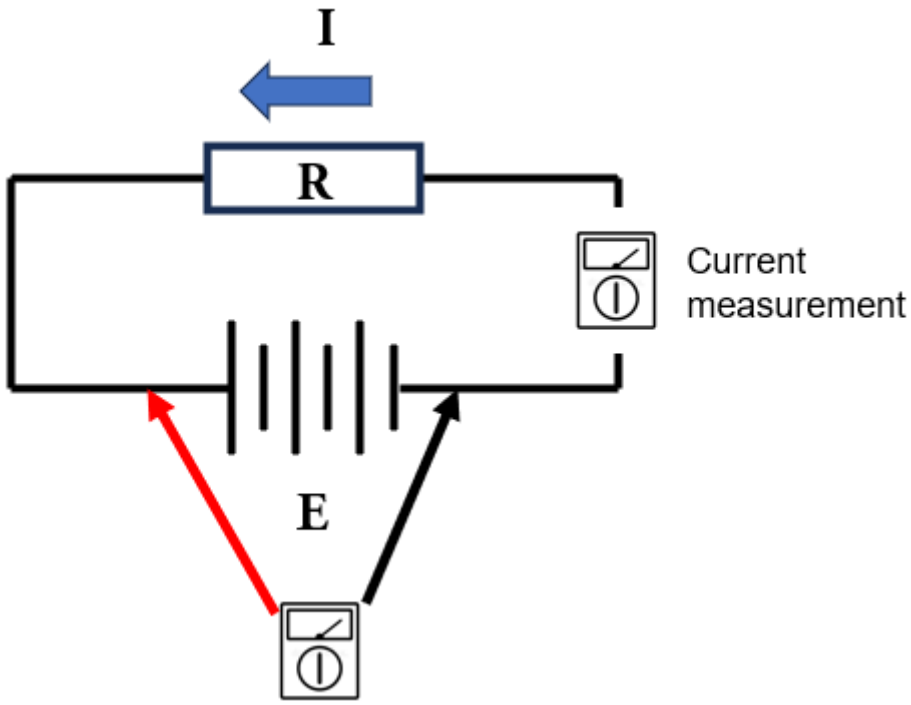
I = E / R = 90 / 100 = 0.9 A

Measuring

Voltage – As voltage is a force pushing electrons along the must be a potential difference between either end of the circuit. So, voltage is measured across the positive and negative points.

Current – Current is looking at the amount of electrons flowing through the circuit so, this measurement must be in the circuit.

Resistance – Resistance relates to individual components. These must be measured out of the circuit to get a true value.



Prefixes

In describing large or small values, a prefix, also called the "SI prefix", is used. The SI unit system changes every three digits. Commonly used prefixes are kilo (k), which means 1000 times, and mega (M), which means 1 million times. Smaller common prefixes are milli (m), which means 1/1000 and micro (μ) means 1/1000000.

Symbol	Word	Multiplier	Magnification
G	giga	10^{9}	1 billion
M	mega	10^{6}	1 million
k	kilo	10^{3}	1 thousand
m	milli	10^{-3}	1 / 1 thousand
μ	micro	10^{-6}	1 / 1 million
n	nano	10^{-9}	1 / 1 billion
p	pico	10^{-12}	1 / 1 trillion

Examples:

- 2,000,000 Ω - 2 MΩ = 2 mega Ohms = 2 million Ohms
- 6, 000 V - 6 kV = 6 kilo volts = 6 thousand volts
- 0.005 V - 5mV = 5 milli volts
- 0.000007 amps - 7 µA = 7 micro amps

Using the prefixes is far simpler than writing all the zeros.

Go to the Chapter 1-1 Questions.

Have fun and stay safe.