

Introduction To Electricity

Electricity

- Electricity gets its name from the electron, a tiny particle which forms part of all atoms, which make up everything in the world. Atoms contain other types of particles - protons and neutrons - but it is the electron which will be interesting us here.
- Electrons and protons have the electrical property of charge. Protons have positive charge and electrons have negative charge and they normally balance each other out. We don't really need to know what charge is. It's just a property like weight or color, but it is this property which makes the whole of electronics happen. But keep in mind the fact that opposite charges attract and similar charges repel.
- When electrons move together in a unified way we say there is a current flowing. Electrons are actually moving all the time in materials like metals but moving in a random disordered way. A current is when they all move together in one particular direction.
- When you get shocked while touching a doorknob after walking over a carpet, that is simply the electrons in you flowing out.

Conductors and Insulators

- Electrons can't flow through every material. Materials that allow a current to flow easily are called conductors. Materials that don't allow a current to flow are called non-conductors or insulators. Metals are the most common conductors, plastics are typical insulators.
 - Good Conductors
 - Gold
 - Copper
 - Carbon
 - Good Insulators
 - Wood
 - Plastic
 - Air

Voltage and Current

- Imagine water flowing through a pipe filling up a pond. The water represents the electrons and the pipe represents the wire. A pump provides the pressure to force the water through the pipe. The pump is the battery. How much water flows out the end of the pipe each second is the current. How hard the water is being pumped is the voltage.
- A narrow pipe will take a long time to fill the pond, whereas a broad pipe will do it much faster using the same pump. Clearly the rate of flow depends on the thickness of the pipe. So we have the situation where the same voltage (pump pressure) can give rise to different currents (flow rate) depending on the pipe. The size of the pipe represents the resistance in the circuit.

Electric Circuits

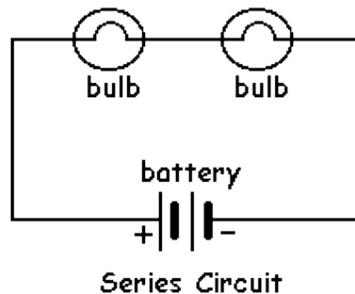
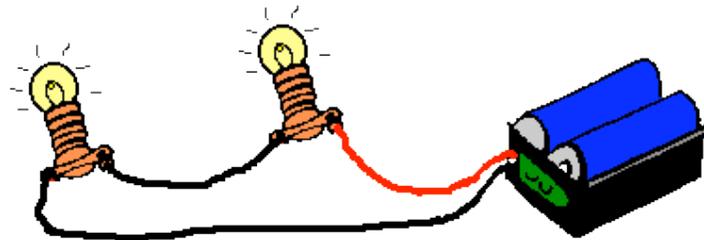
- There are two different kinds of electricity that we use in our daily lives.
 - AC, or Alternating Current, is the kind of electricity that comes from a wall outlet. This kind of current gets its name from the fact that the electron flow is constantly switching direction. Alternating current usually has a very high voltage associated with - the standard voltage of a wall outlet in America is 120 Volts
 - DC, or Direct Current, is the kind of current that is generated from a battery. In this configuration, electrons flow continuously from the positive battery terminal, through the resistors, and back into the negative battery terminal. This type of current usually runs at lower voltages (1.5 to 12 Volts), and is the type of current dealt with in this lesson.

Ohm's Law

- The correlation between voltage, current, and resistance in a simple DC circuit is dictated by Ohm's Law
 - Voltage (V, volts) = Current (I, amps) * Resistance(R, ohms)
 - $V = IR$
- By knowing two of the three variables, it is easy to calculate the third, unknown variable.
- The voltage supplied to a circuit is the easiest one to figure out, seeing as it is usually labeled on the side of the battery being used. The total resistance of the circuit, while constant, can be more difficult to find, because the total resistance seen by the battery depends on how the resistors are connectors.

Electrical Symbols

- Electrical Diagrams are used to describe the layout of a circuit, using symbols to represent electrical components.
 - Here are some basic symbols used to describe common DC Circuits.
- Below is a diagram of a simple circuit using a battery and two light bulbs.



Series Circuits

- Resistors that are connected to each other in a row are said to be in *series* with each other.
- Resistors in series have a total resistance equal to the sum of their individual resistances.

Parallel Circuits

- Resistors that are each individually connected to a voltage source are said to be in *parallel* with each other. In this configuration, although the sum of the individual resistances might be high, the total resistance for the circuit is actually reduced. This is because the current has more paths through which to flow.
- Take, for example, a large pipe filled with flowing water. Even though the pipe is large, there is enough water in the pipe to make the water pressure very high. In order to relieve some of the pressure in the pipe, a second, smaller pipe is connected alongside the original pipe. Because this pipe is smaller than the original pipe, it can hold less water - however, the two of them together hold more water than either could on its own.
 - A Parallel circuit acts in much the same way. When two resistors are connected in parallel, the total resistance is always less than any of the individual resistances, no matter how large or small those resistance might be.
- Using a parallel circuit to connect components to a voltage source allows for a more efficient transfer of power than that of a series circuit. Because the total resistance of the parallel circuit is smaller, it allows for more current.

