February 20, 2007
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Student Handout.

Demonstrate a Knowledge of Electromotive Force (e.m.f) Production.

After reading this section you will be able to do the following:

* Define **e.m.f.** and explain how it is measured.
* Explain why **e.m.f.** is important to the flow of electrical current.
* List several examples of sources of **e.m.f.**.

The force generated by all electric power sources is call the Electromotive Force and abbreviated to **e.m.f.** Often denoted as **E** or $\mathcal{E}$. It is represented by the difference in electric potential, or voltage, between the terminals of a source of electricity, e.g., a battery from which no current is being drawn. When current is drawn, the potential difference drops below the **e.m.f.** value. Electromotive Force is usually measured in volts.

We also need to know something about the force that causes the electrons to move in an electrical circuit. This force is called electromotive force, or EMF. Sometimes it is convenient to think of **e.m.f.** as electrical pressure. In other words, it is the force that makes electrons move in a certain direction within a conductor.

But how do we create this "electrical pressure" to generate electron flow? There are many sources of **e.m.f.** Some of the more common ones are: batteries, generators, and photovoltaic cells, just to name a few.

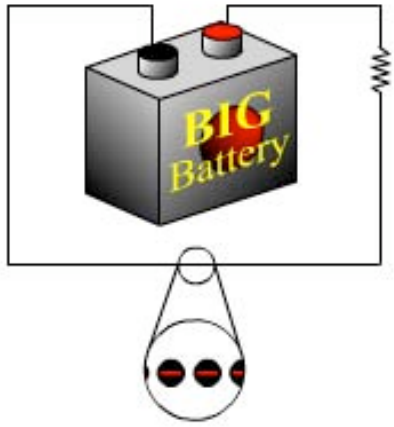


Batteries are constructed so there are too many electrons in one material and not enough in another material. The electrons want to balance the electrostatic charge by moving from the material with the excess electrons to the material with the shortage of electrons. However, they cannot because there is no conductive path for them to travel. However, if these two unbalanced materials within the battery are connected together with a conductor, electrical current will flow as the electron moves from the negatively charged area to the positively charged area. When you use a battery, you are allowing electrons to flow from one end of the battery through a conductor and something like a light bulb to the other end of the battery. The battery will work until there is a balance of electrons at both ends of the battery. **Caution:** you should never connect a conductor to the two ends of a

battery without making the electrons pass through something like a light bulb which slows the flow of currents. If the electrons are allowed to flow too fast the conductor will become very hot, and it and the battery may be damaged.

We will discuss how electrical generators use magnetism to create EMF in a coming section. Photovoltaic cells turn light energy from sources like the sun into energy. To understand the photovoltaic process you need to know about semiconductors so we will not cover them in this material.

Take this link to learn more about the volt: What is a volt? Also how do the ampere and the volt work together in electricity?



To understand how voltage and amperage are related, it is sometimes useful to make an analogy with water. Look at the picture here of water flowing in a garden hose. Think of electricity flowing in a wire in the same way as the water flowing in the hose. The voltage causing the electrical current to flow in the wire can be considered the water pressure at the faucet, which causes the water to flow. If we were to increase the pressure at the hydrant, more water would flow in the hose. Similarly, if we increase electrical pressure or voltage, more electrons would flow in the wire.

Does it also make sense that if we were to remove the pressure from the hydrant by turning it off, the water would stop flowing? The same is true with an electrical circuit. If we remove the voltage source, or **e.m.f.** no current will flow in the wires.

Another way of saying this is: without **i.e.**, there will be no current. Also, we could say that the free electrons of the atoms move in random directions unless they are pushed or pulled in one direction by an outside force, which we call electromotive force, or **e.m.f.**

Review

1. **e.m.f.** is electromotive force. **e.m.f.** Causes the electrons to move in a particular direction.
2. **e.m.f.** is measured in units called volts.

Student Assessment Questionnaire.

Note: This part of the assessment is open book and 100% is the required result.

Name a source of **e.m.f.** Production in the following ranges and explain briefly the process involved.
(Note: Internet research is allowed)

Chemical: _____

_____
_____
_____
_____

Magnetic: _____

_____
_____
_____
_____

Friction: _____

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_____
_____

Piezo-Electric: _____

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Photo Electric: _____

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Thermo coupling: _____

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Name: _____

Course: _____

Date: _____

NSN #: _____

Tutors Signature: _____