Name:_____ Points:___/10

SMITH - INDUSTRIAL SCIENCE B - 1RST PERIOD - OFF-SITE LEARNING PACKET DAY 4

Chapter 9 Electricity
Lesson 4 – **Voltage Sources, Volts in an Electric Circuit**

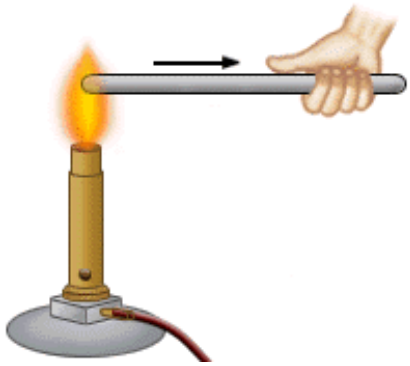
Lesson Objectives

- **define the bellwork vocabulary words** (**battery**, **capacitor**) with 100% accuracy
- **state what causes charges to flow through a conductor** with 100% accuracy
- **describe the voltage usage in a circuit** with 100% accuracy

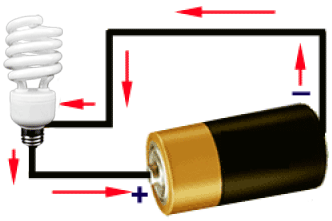
Associated Text:

Chapter 9 Lesson 4

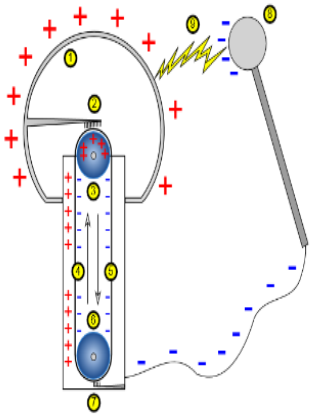
Voltage Sources



When the ends of a conductor of heat are at different temperatures, heat energy flows from the higher-temperature part to the lower-temperature part. The flow ceases when both ends reach the same temperature. Likewise, when the ends of an electrical conductor are at different electric potentials, charges in the conductor flow from the higher-potential end to the lower-potential end. The flow of charge persists until both ends reach the same potential. Without a difference in electric potential, no flow of charge occurs.



Consider a Van de Graff generator. A Van de Graff generator is a device that is used to separate electrical charge. Connect one end of a wire to the charged Van de Graff generator, for example, and the other end to the ground, and a surge of charge flows through the wire. The flow is brief, however, for the sphere quickly reaches the same potential as the ground. Having such a brief flow of charge is relatively useless in powering electrical devices.

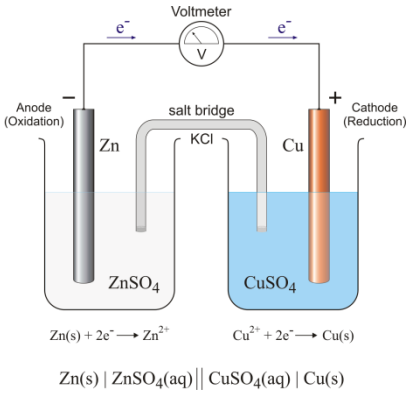


To attain a sustained flow of charge in a conductor, some arrangement must be provided to maintain a difference in potential while charge flows from one end to the other. This situation is analogous to the flow of water from a higher reservoir to a lower one. Water flows in a pipe that connects the reservoirs only as long as a difference in water level exists. The flow of water in the pipe, like the flow of charge in the wire that connects the Van de Graff generator to the ground, will cease when the pressures at the two ends are equal. A continuous flow is possible if the difference in water levels – and hence the difference in water pressures – are maintained with a pump.

A sustained electric current requires a suitable pumping device to provide a difference in electric potential – in other words, to provide a voltage difference. Chemical batteries or generators are "electrical pumps" that maintain a steady flow of charge. These devices do work to pull negative charges away from positive ones. In chemical batteries, this work is done by the chemical disintegration of zinc or lead in acid, and the energy originally stored in chemical bonds is converted to electric potential energy. Generators separate charges by electromagnetic induction, a process described in the next section. The work done by whatever means in separating opposite charges is available at the terminals of the battery or generator. This energy per charge provides the difference in potential (the voltage difference) that provides the "electrical pressure" to move electrons through a circuit joined to these terminals.

A common automobile battery provides an “electrical pressure” of 12 volts to a circuit connected across its terminals. Then 12 joules of energy is supplied to each coulomb of charge that is made to flow in the circuit. When it completes the circuit, the charge is without this energy, which has been “dropped off” in one or more electrical devices. We say there is a 12-volt *voltage drop* in the circuit.

Batteries



An electric battery is a device consisting of two or more electrochemical cells that convert stored chemical energy into electrical energy. Each cell has a positive terminal, or cathode, and a negative terminal, or anode. The terminal marked negative is at a higher electrical potential energy than is the terminal marked positive. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work. Although the term battery technically means a device with multiple cells, single cells are also popularly called batteries.

Guided Reading Questions: ***(10 pts.)***

use the chapter text and guided notes found above

Voltage Sources

1. If the ends of a conductor of heat are at different temperatures, which direction will thermal energy flow?

2. If the ends of a conductor of electricity are at different potentials, which direction will electrical energy flow?

3. What does a Van de Graff generator do?

4. What happens if you connect a charged Van de Graff generator to a wire that is attached to the ground?

5. What are the two common "electrical pumps" cited in the text?

6. How much energy is given to each coulomb of charge passing through a 6-volt battery?

7. Describe how voltage is used up in a circuit.

8. Does voltage produce current or does current produce voltage? Which is the cause and which is the effect?

9. What are the two terminals of a battery called?

10. Batteries convert _____ energy into _____ energy.

11. Which terminal of a battery actually supplies the higher potential (voltage)?

Lesson Notes:
Voltage Sources, Volts in an Electric Circuit

The Flow of Electric Charge

- when the ends of an electrical conductor are at different electric potentials (voltage), charges (electrons) in the conductor flow from the higher-potential end to the lower-potential end
- the flow of charge persists until both ends reach the same potential
- without a difference in electric potential, no flow of charge occurs

Voltage Sources

- to have a sustained flow of charge in a conductor, some arrangement must be provided to maintain a difference in potential while charge flows from one end to the other
- a sustained electric current requires a device to provide a difference in electric potential (voltage difference)
    - chemical batteries or generators are devices that do this

Voltage and Work

- the work done by whatever means in separating opposite charges is available at the terminals of the battery or generator
- this energy per charge provides the difference in potential (the voltage difference) that provides the "electrical pressure" to move electrons through a circuit joined to these terminals

Summary:

- Voltage is the amount of energy per charge (coulomb or electron).
- In other words, each charge has the ability to do a certain amount of work (energy).
- At the end of a circuit, the voltage is always zero.
- Therefore: all the energy given to the charges (by the battery or generator) is used up in any electrical circuit.

Vocabulary

Battery – any source of a continuous supply of electric charge
Capacitor – a device used to store electrical charge