Name:_____ Points:___/10

SMITH - INDUSTRIAL SCIENCE B – 3RD PERIOD - OFF-SITE LEARNING PACKET DAY 5

Chapter 9 Electricity
Lesson 5 – Electric Current

Lesson Objectives

- **define the bellwork vocabulary words (valence electron, ampere, drift speed)** with 100% accuracy
- **state the difference between how voltage and current are manifested within a circuit** with 100% accuracy
- **differentiate between alternating and direct current** with 100% accuracy

Associated Text:

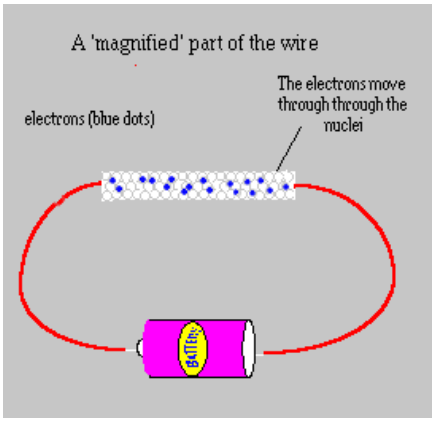
Chapter 9 Lesson 4

André-Marie Ampère, whom the unit of electric current is named for.

Electric Current

Just as water current is the flow of H_2O molecules, **electric current** is the flow of charged particles. In circuits of metal wires, electrons are the flowing charged particles. This is because one or more electrons from each metal atom are free to move throughout the atomic lattice. These charge carriers are called conduction electrons. These conduction electrons move through the wire because a sustained electric field is induced in the wire by a voltage source. The protons in the wire also feel the force of the electric field, but they do not move because they are bound inside the nuclei of atoms that are in fixed positions (definition of a solid). In fluids, however, positive ions, negative ions, and electrons may compose the flow of electric charge.

In a nerve cell the "current" is produced by charged ions, both positive and negative. In a solid metal wire, the current is carried by the electrons only.



The rate of electrical flow is measured in amperes (abbreviation A). An **ampere** is the rate of flow of 1 coulomb of charge per second. (Recall that 1 coulomb, the standard unit of charge, is the electric charge of 6.25 billion billion electrons.) In a wire that carries 5 amperes, for example, 5 coulombs of charge passes any cross section in the wire each second. In a wire that carries 10 amperes, twice as many coulombs pass any cross section each second.

It is interesting to note that a current-carrying wire is not electrically charged. Under ordinary conditions, negative conduction electrons swarm through the atomic lattice made up of positively charged atomic nuclei. So there are as many electrons as protons in the wire. Whether a wire carries a current or not, the net charge of the wire is normally zero at every moment.

There is often some confusion about charge flowing *through* a circuit and voltage placed, or impressed, *across* a circuit. We can distinguish between these ideas by considering a long pipe filled with water. Water flows through the pipe if there is a difference in pressure across, or between, its ends. Water flows from the high-pressure end to the low-pressure end. Only the water flows, not the pressure. Similarly, electric charge flows because of a difference in electrical pressure (voltage difference). You say that charges flow *through* a circuit because of an applied voltage *across* the circuit. You don't say that voltage

flows through a circuit. Voltage doesn't go anywhere, for it is the charges that move. Voltage produces current (if there is a complete circuit).

Direct Current and Alternating Current

Electric current may be dc or ac. By dc, we mean **direct current**, which refers to the flowing of charges in *one direction*. A battery produces direct current in a circuit because the terminals of the battery always have opposite signs. Electrons move from repelling negative terminal toward the attracting positive terminal, always moving through the circuit in the same direction.

Alternating current (ac) acts as the name implies. Electrons in the circuit are moved first in one direction and then in the opposite direction, alternating to and fro about relatively fixed positions. This can be accomplished by periodically switching the sign of the terminals. Nearly all commercial ac circuits involve currents that alternate back and forth at a frequency of 60 cycles per second. This is a 60-hertz current (a cycle per second is called a *hertz* Hz) In some countries, 25-, 30-, or 50-hertz current is used. Throughout the world, most residential and commercial circuits are ac because electric energy in the form of ac can easily be stepped up to a high voltage to be transmitted great distances with small heat losses, then stepped down to convenient voltages where the energy is used. Why this is so is quite interesting and is considered in the next section.

Image URLs

https://en.wikipedia.org/wiki/Andr%C3%A9-Marie_Amp%C3%A8re#/media/File:Ampere_Andre_1825.jpg
https://www.diodeled.com/media/catalog/product/cache/2/image/2500x/472321edac810f9b2465a359d8cdc0b5/i/n/in-wall-rated-wire-detail.jpg
https://awaypoint.files.wordpress.com/2017/04/nerve-cell-model.jpg
http://members.shaw.ca/len92/electrons_moving_wire.gif
https://upload.wikimedia.org/wikipedia/commons/8/8d/Duracell_9_Volt_0849.jpg

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

use the chapter text and guided notes found above

Electric Current

1. What is electric current?

2. In circuits with metal wires, what subatomic particle makes up the current?

3. What are the charge carrying particles called?

4. Do the protons in a metal wire feel the electric field that causes current to flow?

5. Why don't the protons in a metal wire move?

6. The rate of electrical flow is measured in _____.

7. When 1 coulomb of charge is flowing through a wire per second, we say that the current is _____.

8. You say that charges flow _____ a circuit because of an applied voltage _____ the circuit.

9. Distinguish between dc and ac.

10. Does a battery produce dc or ac? Does the generator at a power station produce dc or ac? How about the alternator in your car?

Lesson Notes:

Electric Current

- electric current is the flow of charged particles
- in solid conductors:
  - it is the electrons that are flowing
  - the protons are locked in the nucleus and unable to move
- each atom has 1 or more electrons that are very loosely bound, and are free to move from one atom to another in the atomic lattice
- in fluids, positive charges can flow (i.e. the human body**)**

Electric Current Measurement

- the rate of electrical flow is measured in amperes (abbreviation A)
- an **ampere** is the rate of flow of 1 coulomb of charge per second
- it is important to distinguish what flows in a conductor: charges (electrons) flow, voltage does not
- a difference in voltage causes the charges to flow
- voltage (potential) gets used up, the charges do not

Direct Current

- electric current may be dc or ac.
- dc
  - direct current
  - charges flow in one direction
  - batteries, alternators
  - drift speed (rate at which electron actually flow through wire)
    - low, typically 2 ft./hr. in 12 volt system

Alternating Current

- ac
  - alternating current
  - electrons move in one direction, then the other
  - typically 60 times per sec 60 Hz
  - electrons never move through the wire
  - changing voltage easy

Vocabulary

valence electron – the outermost electron or electrons in a neutral atom
ampere – the unit of electrical current, one coulomb per second
drift speed – the rate in which electrons flow through a circuit, applies only to direct current.