Name:___________________________ Points:___/10

SMITH - INDUSTRIAL SCIENCE B – 3RD PERIOD - OFF-SITE LEARNING PACKET DAY 8

Chapter 9 Electricity
Lesson 8 – **Electric Shock, Electric Power**

Lesson Objectives

- **define the bellwork vocabulary words (electric power, watt)** with 100% accuracy
- **state what causes shock in the human body** with 100% accuracy
- **state the formula for electric power** with 100% accuracy

Associated Text:

Electric Shock

Which causes electric shock in the human body – current or voltage? The damaging effects of shock are the result of current through the body. From Ohm's law we can see that this current depends on the voltage applied and also on the body's electrical resistance. The resistance of the human body ranges from about 100 ohms if the body is soaked with salt water to about 500,000 ohms if the skin is very dry. If we touch the two electrodes of a battery with dry fingers, completing the circuit from one hand to the other, we can expect to offer a resistance of about 100,000 ohms. We usually cannot feel 12 volts if we do this, though 24 volts just barely tingles. If our skin is moist, however, 24 volts can be quite uncomfortable. The following table describes the effects of different amounts of current on the human body.

Current (A)	**Effect**
0.001	Can be felt
0.005	Is painful
0.010	Causes involuntary muscle contractions (spasms)
0.015	Causes loss of muscle control
0.070	Goes through the heart; serious damage, probably fatal if current lasts for more than 1 s

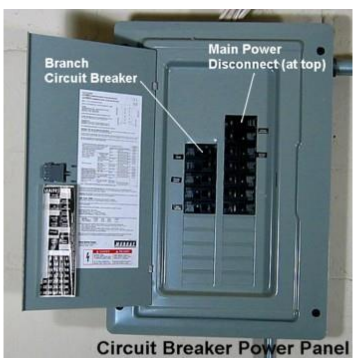
For you to receive a shock, there must be a *difference* in electric potential between one part of our body and another part. Most of the charge making up the current will pass along the path of least electrical resistance connecting these two points. Suppose you fell from a bridge and managed to grab onto a high-voltage power line, halting your fall. So long as you touch nothing else of different potential, you receive no shock. Even if the wire is a few thousand volts above ground potential and even if you hang by it with two hands, no appreciable amount of charge flows from one hand to the other. This is because there is no appreciable difference in electric potential between your hands. If, however, you reach over with one hand and grab onto a wire of different potential…zap! We have all seen birds perched on high-voltage wires. Every part of their bodies is at the same high potential as the wire, and so they feel no ill effects.

Most electric plugs and sockets today are wired with three connections. The two flat prongs on a plug are for the current-carrying double wire inside the socket, one part of which is "live" (energized) and the other neutral, while the round prong connects to a wire in the electrical system that is grounded – connected directly to the ground. The electrical appliance at the other end of the plug is therefore connected to all three wires. If the live wire in the plugged-in appliance accidentally comes in contact with the metal surface of the appliance, and you touch the appliance, you could receive a dangerous shock. This won't occur when the appliance casing is grounded via the ground wire, which assures that the appliance casing is always at zero ground potential.

Parallel Circuits and Overloading

Electricity is usually fed into a home by way of two wires called *lines*. These lines are very low in resistance and are connected to wall outlets in each room – sometimes through two or more separates circuits. About 110-120 volts of electric potential is impressed on these lines by a transformer in the neighborhood that steps down the higher voltage supplied by the power utility. This voltage is than applied across appliances and other devices connected in parallel by plugs to the house circuit. As more devices are connected to a circuit, more pathways for current result in lowering of the combined resistance of the circuit. Therefore a greater amount of current exists in the circuit, and this can be a problem. Circuits that carry more than a safe amount of current are said to be *overloaded.*

To prevent overloading in circuits, fuses are connected in series along the supply line. In this way the entire line current must pass though the fuse. The fuse shown in the following figure is constructed with a wire ribbon that heats up and melts at a given current. If the fuse is rated at 20 amperes, it will pass 20 amperes but no more. A current above 20 amperes melts the fuse, which “blows out” and breaks the circuit. Before a blown fuse is replaced, the cause of the overloading should be determined and remedied. Often, insulation that separates the wires in a circuit wears away and allows the wires to touch each other. This greatly reduces the resistance in the circuit, which causes the current to overload, and is called a short circuit.



In modern buildings, fuses have been largely replaced by circuit breakers, which use magnets or bimetallic strips to open a switch when the current is too great. Utility companies use circuit breakers to protect their lines all the way back to the generators.

Electric Power

The moving charges in an electric current do work. This work, for example, can heat a circuit or turn a motor. The rate at which work is done – that is, the rate at which electric energy is converted into another form, such as mechanical energy, heat, or light – is called **electric power**. Electric power is equal to the product of the current and voltage.

power = current x voltage

If the voltage is expressed in volts and the current in amperes, then the power is expressed in watts. So, in units form,

watts = amperes x volts

If a lamp is rated at 120 watts operates on a 120-volt line, you can see that it draws a current of 1 ampere (120 watts = 1 ampere x 120 volts). A 60-watt lamp draws ½ ampere on a 120-volt line. This relationship becomes a practical matter when you wish to know the cost of electrical energy, which is usually a small fraction of a dollar per kilowatt-hour, depending on locality. A kilowatt is 1000 watts, and a kilowatt-hour represents the amount of energy consumed in 1 hour at the rate of 1000 watts. Therefore, in a locality where electrical energy costs 25 cents per kilowatt-hour, a 100 watt electric light bulb can be run for 10 hours at a cost of 25 cents. A toaster or iron, which draws much more current and therefore much more energy, costs about ten times as much to operate.

So we've learned some electricity – beginning with the knowledge that protons and electrons of atoms are the sources of electric charge. We've learned that charges attract or repel one another – likes repel, opposite attract. We've seen that electrons in the wires of a circuit flow away from the negative terminal of a battery and toward the positive terminal to produce electric current. And what have we done with electric current? Much more that was done with currents of water that powered industry in previous centuries. Understanding and control of electric currents has transformed the world, where almost everything about us now depends on the flow of electrons – from microchips in electrical devices to motors of industry.

http://riaus.org.au/wp-content/uploads/2012/03/FRS_Behind-the-shock-machine.jpg
http://cdn.shopify.com/s/files/1/0866/3386/products/SKU72x_Birds_on_Wire_bdf1e87e-727a-44e7-91b9-e0ba0f409a48.png?v=1441993674
https://www.zoro.com/leviton-plug-5-15p-15a-125v-515pr/i/G2308713/?gclid=CLeL8eL89dACFZm6wAodGf0EiQ&gclsrc=aw.ds
https://openclipart.org/image/2400px/svg_to_png/189935/transformer.png
http://www.bdc.co.uk/image/cache/data/Fuses/glass-fuse-anti-surge-1a-96-800x500.jpg
http://www.norcalrealty.us/Uploads/64/57/6457/Gallery/60-amp-circuit-breaker.jpg
https://www.1000bulbs.com/product/56801/IN-0060A277V.html?gclid=CNm5n6f_9dACFQgOaQod9vAJYw

Guided Reading Questions: ***(10 pts.)***
use the chapter text and guided notes found above

Electric Shock
1. What causes electric shock in the human body?

2. The amount of current running through the human body depends to two things: the voltage applied and ________________________?

3. What is the range of resistance for the human body?

4. Suppose your skin is very dry and it has about 100,000 Ω resistance, how much current flows through your body if you touch the terminals of a 12–V battery?

5. If your skin is very moist – so that your resistance is only 100 Ω – and you touch the terminals of a 12–V battery, how much current do you receive?

6. For a person to receive a shock, there must be a _____________________________ in electric potential between one part of the body and another part.

Parallel Circuits and Overloading
7. Are household circuits normally wired in series or in parallel?

8. How does the amount of current in a home circuit differ from the amount of current in a reading lamp?

9. Why will too many electrical devices operating at one time often blow a fuse?

Electric Power
10. What is the relationship among electric power, current, and voltage?

11. Which draws more current, a 40-W bulb or a 100-W bulb?

Lesson Notes:

Electric Shock

- The damaging effects of shock are the result of current through the body.
- From Ohm's law we can see that this current depends on two things
    1) the voltage applied
    2) the body's electrical resistance
- The resistance of the human body ranges from about 100 ohms if the body is soaked with salt water to about 500,000 ohms if the skin is very dry.
- Typically you have about 100,000 Ω of resistance.

Electric Power

- The moving charges in an electric current do work.
- The rate at which work is done – that is, the rate at which electric energy is converted into another form, such as mechanical energy, heat, or light – is called electric power.
- Electric power is equal to the product of the current and voltage.
    - power = current x voltage
- If the voltage is expressed in volts and the current in amperes, then the power is expressed in watts. So, in units form,
    - watts = amperes x volts

Vocabulary

electric power – the rate at which work is done by current electricity
watt – the unit of electrical power