Name:___________________________ Points:___/10

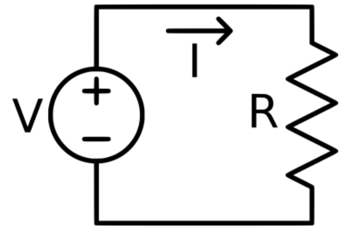
SMITH - INDUSTRIAL SCIENCE B – 3RD PERIOD - OFF-SITE LEARNING PACKET DAY 6

Chapter 9 Electricity
Lesson 6 – **Resistance and Ohm's Law**

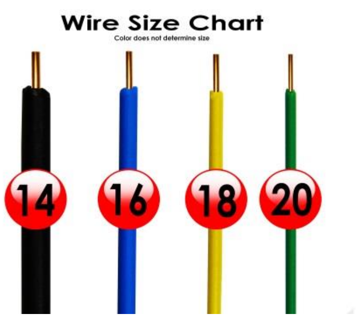
Lesson Objectives

- **define the bellwork vocabulary words (Ohm's Law, ohm, amp, volt)** with 100% accuracy
- **state the physical cause of electrical resistance in wires** with 100% accuracy
- **list the four things that affect electrical resistance in a wire** with 100% accuracy

Text Selection:
Electrical Resistance



A battery or generator of some kind is the prime mover of charge and source of voltage in an electric circuit. How much current there is in the circuit depends not only on the voltage but also on the **electrical resistance** the conductor offers to the flow of charge. This is similar to the rate of water flow in a pipe, which depends not only on the pressure behind the water but also on the resistance offered by the pipe. This resistance of a wire depends on the conductivity of the material and also on its thickness and length. Electrical resistance is less in thick wires. The longer the wire, of course, the greater the resistance. In addition, electrical resistance depends on temperature. The greater the jostling about of atoms within the conductor (in other words, the higher the temperature), the greater resistance most conductors offer to the flow of charge. The resistant of some materials reaches zero at very low temperatures . These are superconductors.



Electrical resistance is measured in units called *ohms*. The Greek letter omega, Ω, is commonly used as the symbol for the ohm, This unit is named after Georg Simon Ohm, a German physicist who in 1826 discovered a simple and very important relationship among voltage, current, and resistance.

Ohm's Law

The relationship among voltage, current, and resistance is summarized by a statement called Ohm's law. Ohm discovered that the amount of current in a circuit is directly proportional to the voltage established across the circuit and inversely proportional to the resistance of the circuit.

$$\text{current} = \frac{\text{voltage}}{\text{resistance}}$$

Or, in units form,

$$\text{amperes} = \frac{\text{volts}}{\text{ohms}}$$

So for a given circuit of constant resistance, current and voltage are proportional to each other. This means we get twice the current for twice the voltage. The greater the voltage, the greater the current. But if the resistance is doubled for a circuit, the current is cut in half. The greater the resistance, the smaller the current. Ohm's law makes good sense.

Ohm's law tells us that a difference in potential of 1 volt established across a circuit that has a resistance of 1 ohm produces a current of 1 ampere. If 12 volts is impressed across the same circuit, the current is 12 amperes. The resistance of a typical lamp cord is much less than 1 ohm, and a typical light bulb has a resistance of more than 100 ohms. An iron or electric toaster has a resistance of 15 to 20 ohms. The current inside these and all other electrical devices is regulated by the circuit elements called resistors, whose resistance may be a few ohms or millions of ohms.

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 100,00 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.

https://upload.wikimedia.org/wikipedia/commons/thumb/a/a0/Ohms_law_voltage_source.svg/2000px-Ohms_law_voltage_source.svg.png

https://b9f5k6r4.map2.ssl.hwcdn.net/wysiwyg/Wire_Size_Chart.jpg

https://upload.wikimedia.org/wikipedia/commons/a/ae/NEMA-AC-Power-Plugs.jpg

***<u>Guided Reading Questions:</u>* (10 pts.)**

use the chapter text and guided notes found above

1. What is the prime mover of charge and the source of voltage in an electric circuit?

2. How much current there is in a circuit depends on two things. What are these two things?

3. What are the four things that determine how much resistance there is in a wire?

4. Electrical resistance is measured in _____________.

5. What is the common symbol used to express electrical resistance?

6. Who is the unit of electrical resistance named after?

7. State Ohm's Law mathematically:

8. If in a circuit you would double the voltage, but the resistance stayed the same, what would happen to the current?

9. If in a circuit you would double the resistance, but the voltage stayed the same, what would happen to the current?

10. What causes shock in the human body, voltage or current?

11. The resistance of the human body ranges from about ______ohms to about _____________ ohms.

12. Which has the greater electrical resistance, wet skin or dry skin?

13. How can birds sit on high voltage wires and not be electrocuted?

Lesson Notes:

Electrical Resistance

- voltage causes current
- electrical resistance inhibits current
- electrical resistance in a wire depends on four things:
    1. the conductivity of the material
    2. its thickness
    3. its length
    4. its temperature
- the unit of electrical resistance is the ohm Ω

Ohm's Law

- the current through a conductor is numerically equal to the voltage impressed divided by the resistance

$$\text{current} = \frac{\text{voltage}}{\text{resistance}} \quad \text{or} \quad I = \frac{v}{r}$$

Vocabulary

Ohm's Law – a relationship that describes current, voltage and resistance in an electric circuit
ohm – the unit of electrical resistance
amp – the unit of electrical current
volt – the unit of electric potential