

- Instructor Copy -

Ohm's Law Experiment Worksheet

Objective: Understand and apply Ohm's Law in a practical setting by measuring voltage, current, and resistance in a simple circuit.

Materials Needed:

- Series Circuit Magnetic Trainer
- A multimeter
- Power Supply - Instructors: You can utilize the power supply that comes with the kit, or a bench top power supply.

Safety Precautions:

- Always double-check the circuit connections before powering it on. Ensure that the students do not have any connections that are short to ground.
- Never handle electrical components with wet hands.
- Be mindful of the power supply voltage to avoid damaging the components or the multimeter.
- Ensure that you're following all local regulations in regards to utilize proper personal protective equipment

Setup instructions

Before students set up their circuits, ensure that you have enabled the 33k ohm resistor in the blue wire. The schematic shows the wire being blue in color.

To enable the resistance on any component or node which it is equipped with, remove the bottom cover of the node using the supplied plastic "coins", large flat head screwdriver, or similar tool. Once cover has been removed, remove the jumper bar from the terminals labeled "NOM" or "NORM". Move the jumper bar to the terminals labeled "RES". You can verify that you have properly enabled the resistor in the circuit by checking the leads on the node itself.

Background

Imagine you're trying to push water through a hose. The amount of water that flows through the hose can change depending on two things:

1. how much you push (like turning up the water pressure)
2. how thick or thin the hose is (the hose's resistance to water flow).

In electricity, we have similar ideas:

- The push is called voltage. It's like the pressure that pushes the electric "water" (which we call electrons) through a wire.
- The flow of this electric "water" is what we call current. It's how many electrons are moving through the wire.
- The thickness of the hose (which makes it easier or harder for the water to flow) is similar to resistance in a circuit. Resistance is how much a material resists the flow of electrons.

Ohm's Law helps us understand how these three things are related in a simple formula:

$$A = V/R$$

- A (current) is similar to how much water is flowing through the hose.
 - It's measured in amperes (A), often just called amps.
- V (voltage) is like the pressure pushing the water through.
 - It's measured in volts (V).
- R (resistance) is like the hose's thickness that affects how easily water can flow through.
 - It's measured in ohms (Ω).

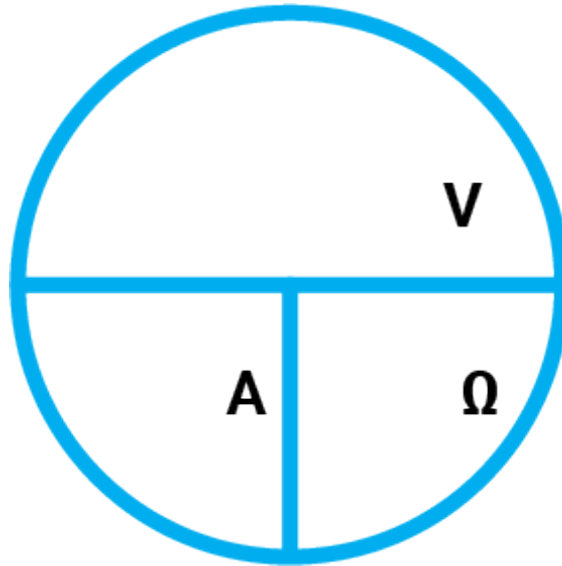


Figure 1: Ohm's Law Circle

Understanding the Ohm's Law Circle

The Ohm's Law Circle is a helpful tool that illustrates the relationship between three key elements in electricity: Voltage (V), Current (I), and Resistance (Ω).

Here's how it's laid out:

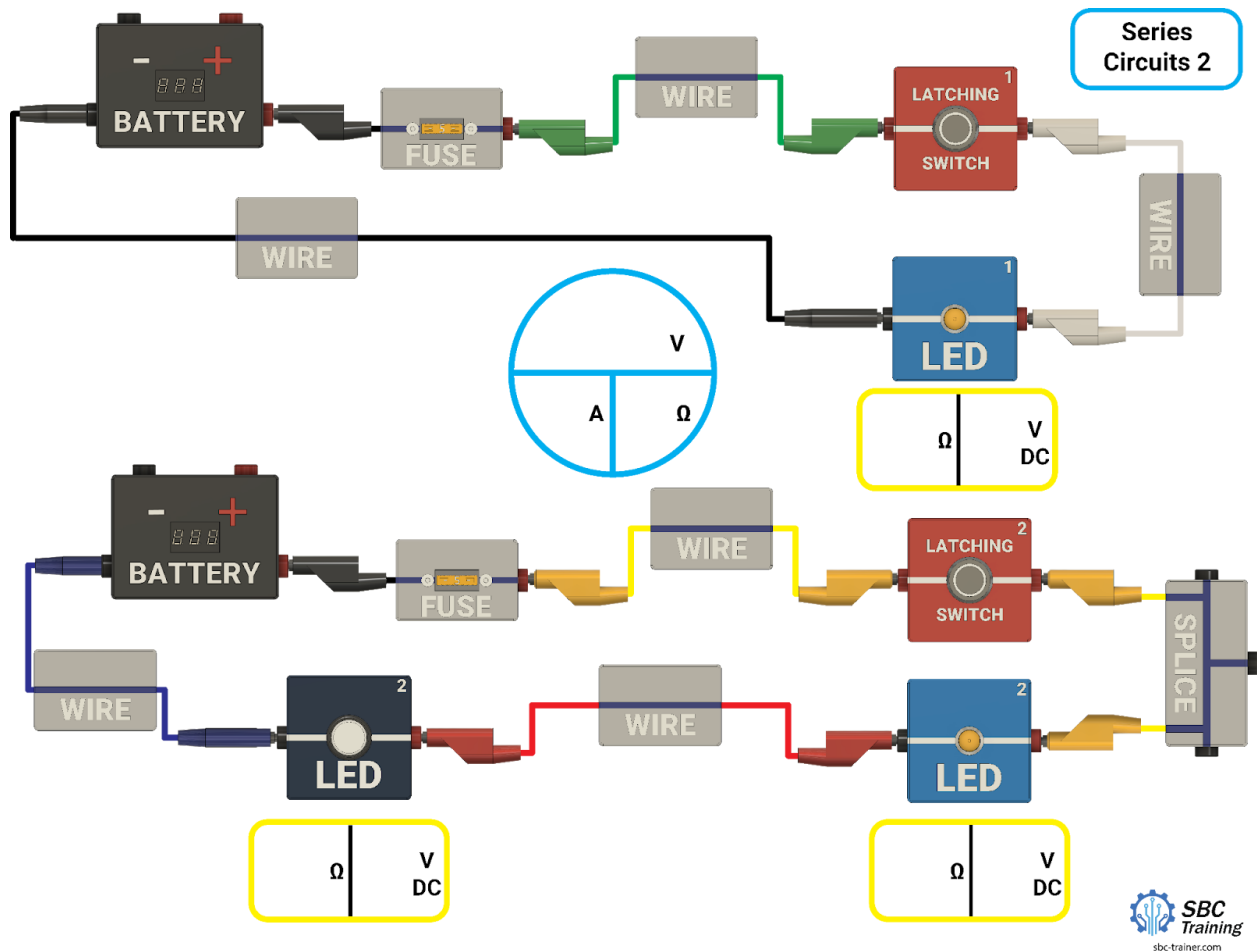
- Voltage (V) is positioned at the top of the circle to signify its role as the primary source of energy.
- Current (A) is on the bottom left of the circle, indicating the amount of electricity flowing.
- Resistance (Ω) is on the bottom right, showing how difficult it is for electricity to pass through. Resistance is measured using the Ω (Omega) symbol

Using the circle is straightforward. If you want to find out one of these values you just need to know the other two. Here's how:

- To calculate the Voltage (V), you multiply Current (I) by Resistance (Ω).
- To determine the Current (I), you divide Voltage (V) by Resistance (Ω).
- To find out the Resistance (Ω), you divide Voltage (V) by Current (I). Think of this as cutting the circle across in the opposite direction.

This circle simplifies electrical calculations by visually representing how Voltage, Current, and Resistance are interrelated, eliminating the need to memorize formulas.

Ohm's Law LAB

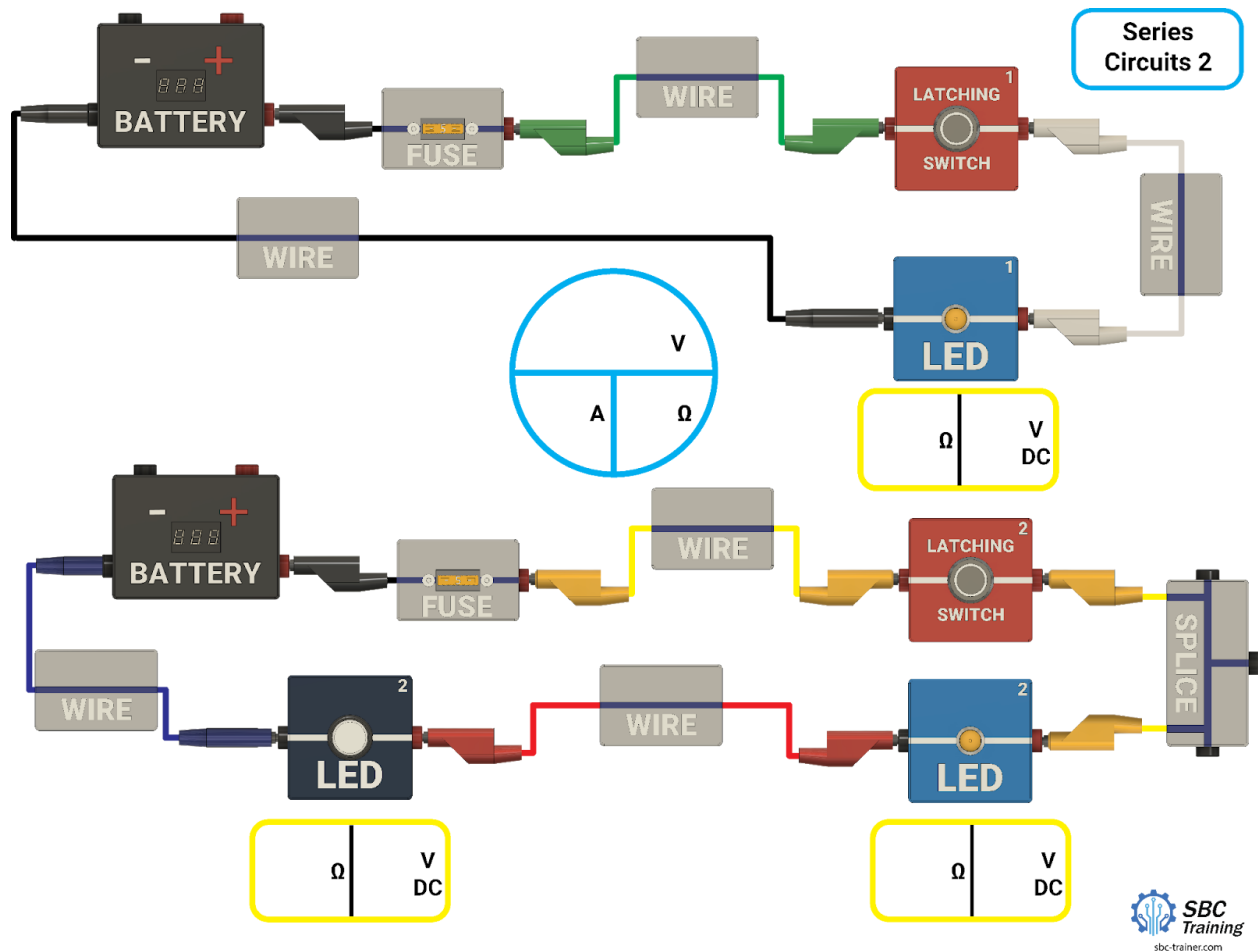


Setup

Complete the following steps to set up for testing:

1. Place all of the electrical nodes on the Series Circuits Sheet
2. Do not connect the POWER SUPPLY to the circuit until instructed to do so.

Testing



Resistance Measurements

1. Set the multimeter to measure Resistance (See Figure 3)
2. When performing any resistance measurements, ensure that the circuit that you are tested is powered down. For this exercise, ensure that your power supply is turned off and there is no current flowing through the circuit.
3. Place the multimeter probes on the terminals (See Figure 4) of the WIRE nodes. Measure the resistance of the green, black and blue wire nodes
4. Record the resistance measured for each node. (See Figure 3 for example reading)

Green WIRE Node Resistance: _____ Ω Answer: 1.2 ohms

Black WIRE Node Resistance: _____ Ω Answer: 1.2 ohms

Blue WIRE Node Resistance: _____ Ω Answer: 33k ohms

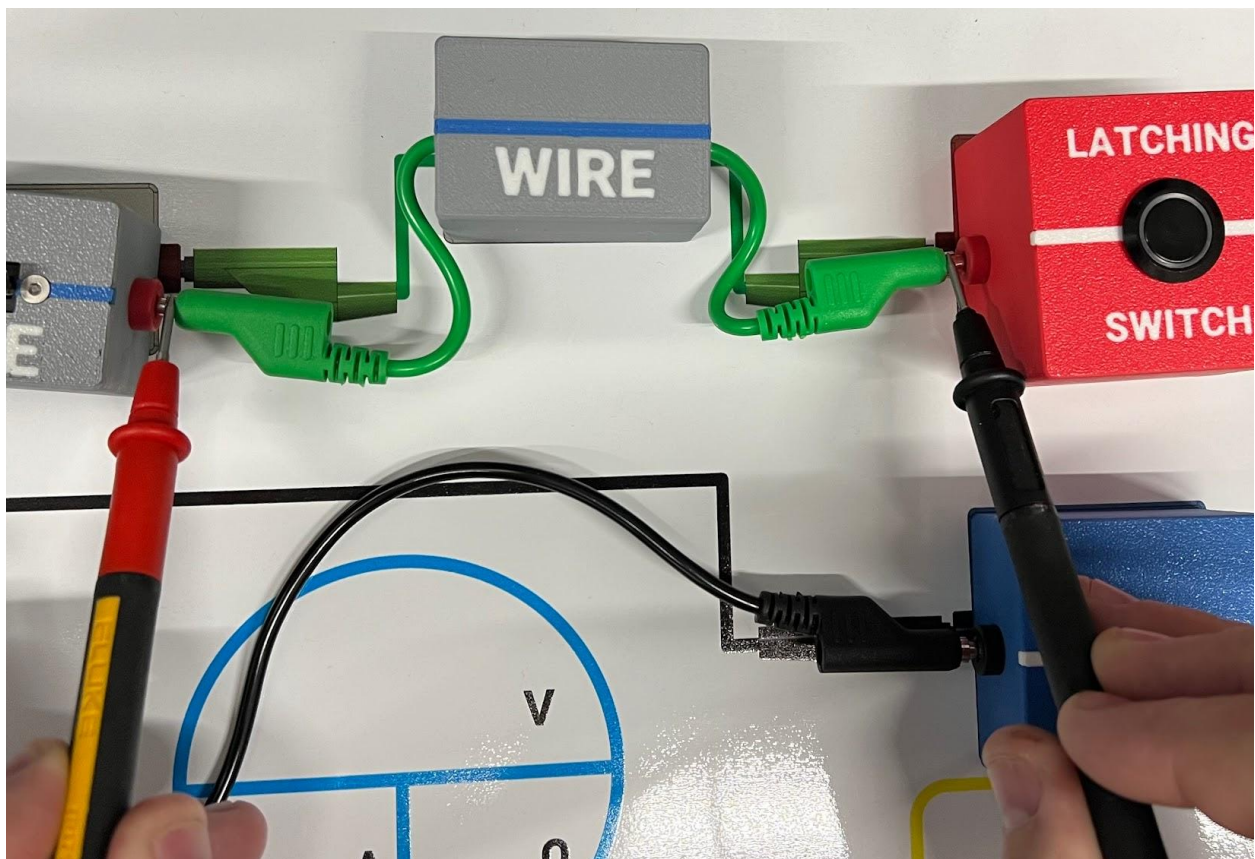


Figure 2: Multimeter probe resistance measurement



Figure 3: Multimeter Resistance Setting

Voltage Measurements

1. Set the multimeter to measure DC Volts
2. Connect the POWER SUPPLY to each battery using the red and black POWER SUPPLY WIRES
 - Connect the POWER SUPPLY WIRES to the jacks of the POWER SUPPLY as shown in Figure 2
 - Attach one set of wires to the positive (red) and negative (black) terminals at the top of BATTERY A, and connect another set to the positive (red) and negative (black) terminals at the top of the BATTERY B. See figure 3
3. Turn on the POWER SUPPLY by pushing up on the switch located at the top left side of the POWER SUPPLY
4. Place the multimeter probes on the terminals of the BATTERY for the top circuit
5. Record the voltage measured for the top circuit.
6. Repeat the voltage measurement for the bottom circuit

Top BATTERY Voltage: _____V This will be dependent on the power supply you are using and the state of charge. About 12 V

Bottom BATTERY Voltage: _____V This will be dependent on the power supply you are using and the state of charge. About 12 V



Figure 2: POWER SUPPLY Connection

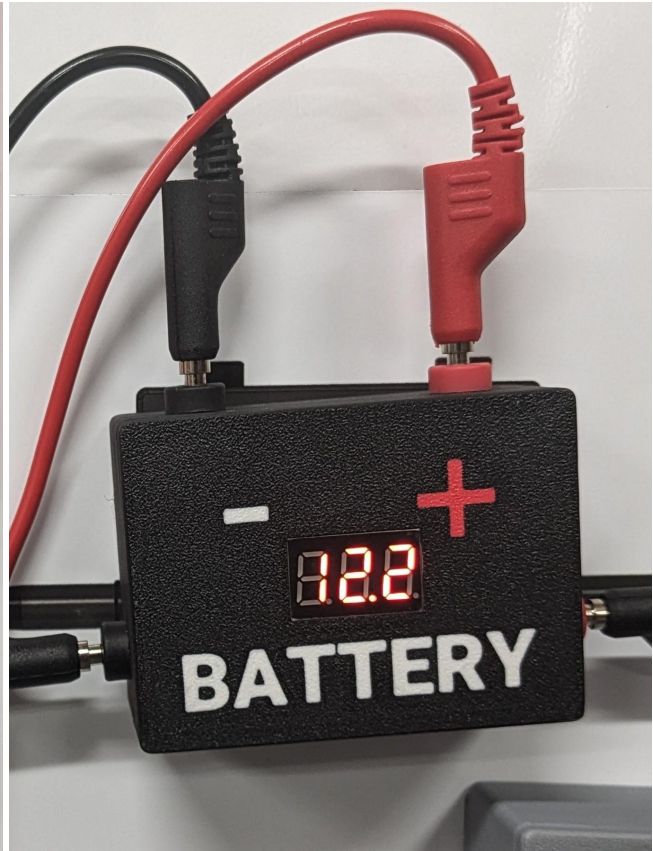
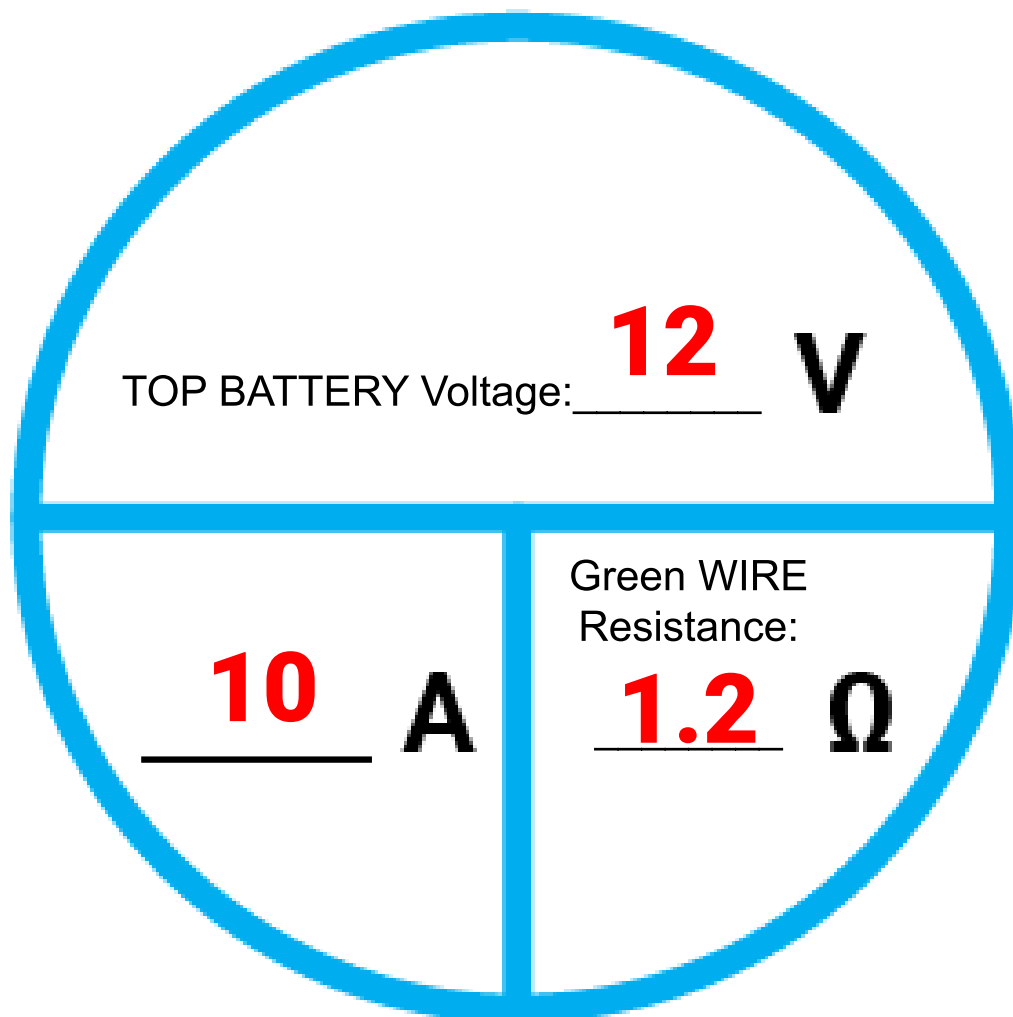


Figure 3: BATTERY Connection

Current Calculation

1. In the following calculations we will **ONLY** use the resistance measurement for the WIRE by itself. For now we will ignore the resistance of the other components in the circuit.
2. Using the Ohm's Law Circle below, calculate the current in the top circuit using the voltage measurement from the top BATTERY and the resistance measurement from the green WIRE node.

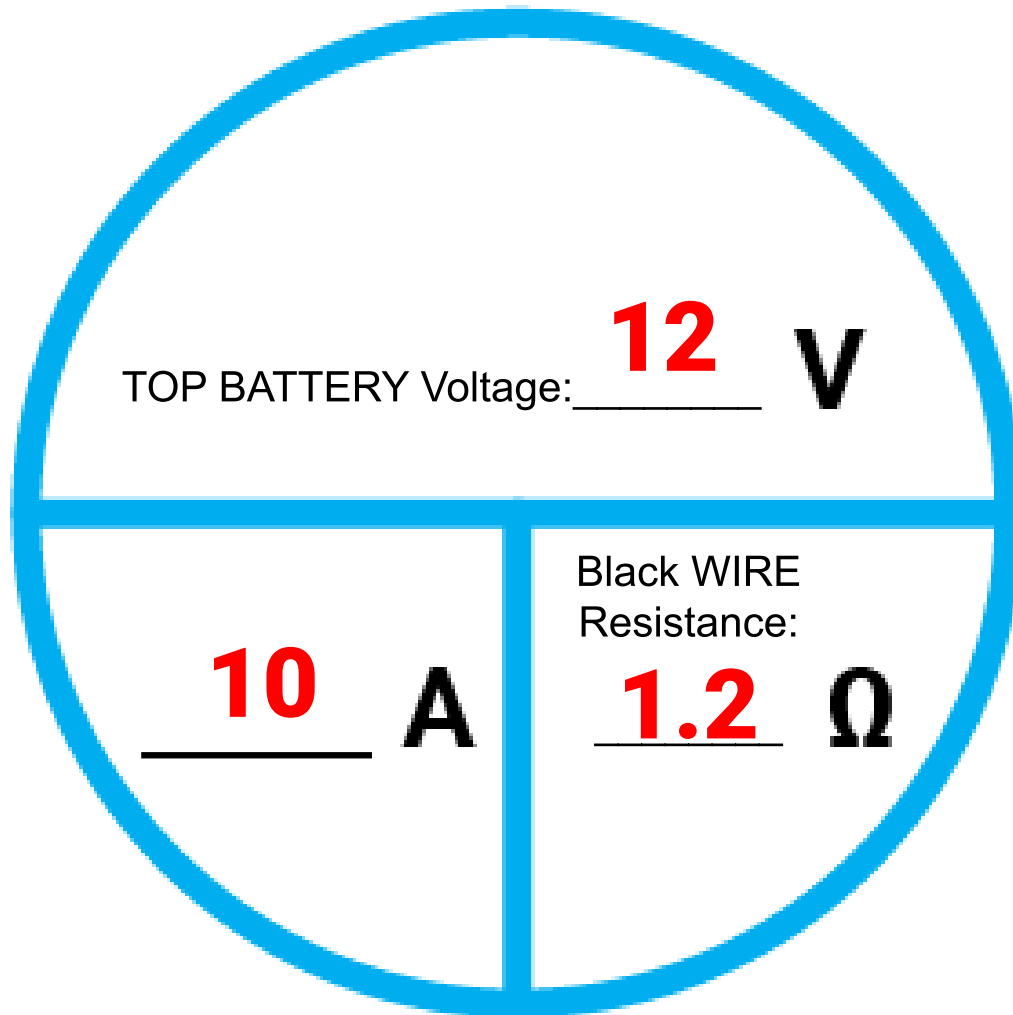
These numbers will vary based on their measurements. They should be dividing voltage by resistance



Current Calculation

3. Calculate the current for the Top Battery and the Black WIRE node

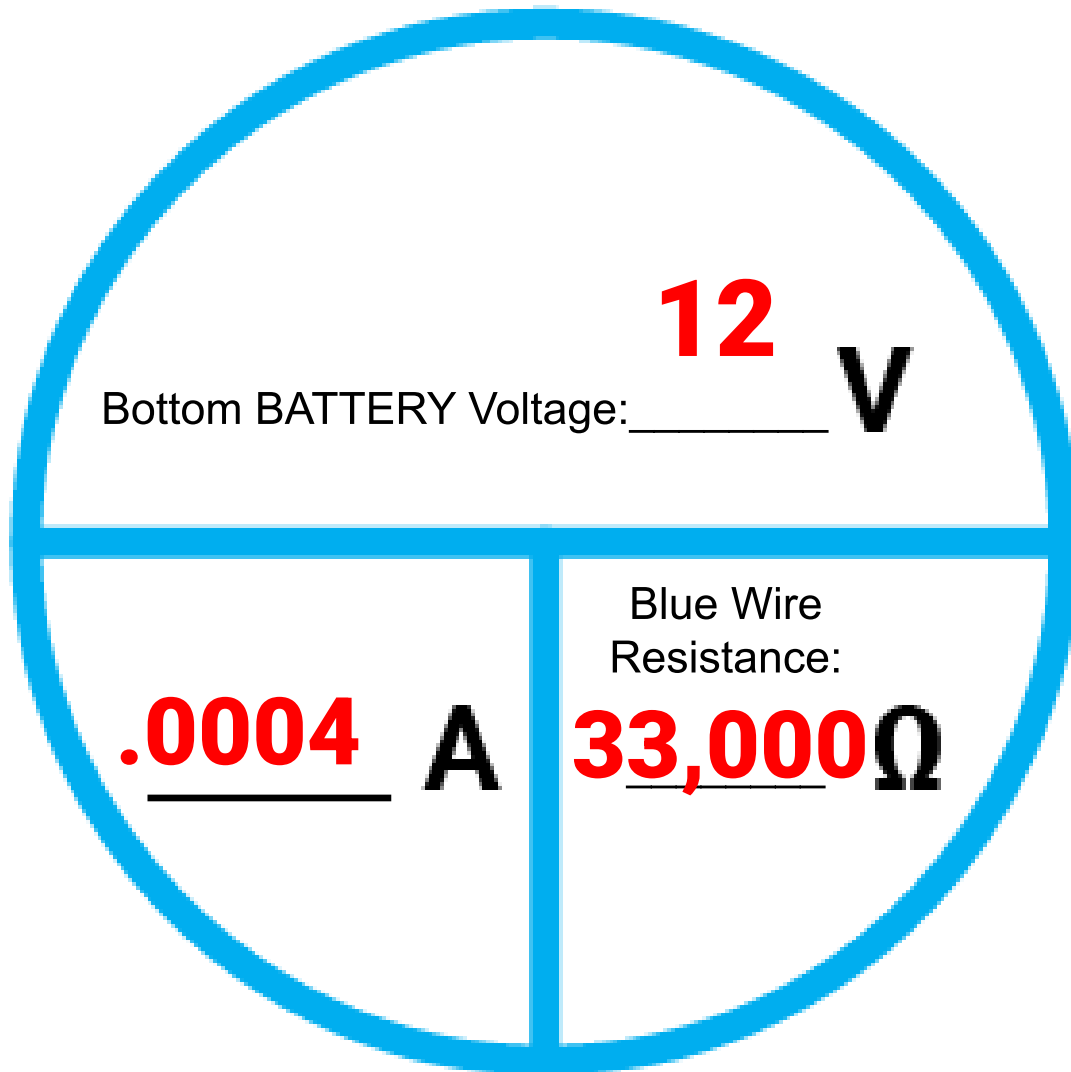
These numbers will vary based on their measurements. They should be dividing voltage by resistance



Current Calculation

4. Calculate the current for Bottom BATTERY and WIRE 3

These numbers will vary based on their measurements. They should be dividing voltage by resistance



Current Calculation

5. Which WIRE calculation has the lowest current?
- a. WIRE 1
 - b. WIRE 2
 - c. WIRE 3 **Answer**
6. If the voltage in the circuit is the same what can be said about the relationship between resistance and current? **(SELECT ALL THAT APPLY)**
- a. As the resistance in the circuit increases the current decreases **Correct**
 - b. As the resistance in the circuit decreases the current decreases **Incorrect**
 - c. As the resistance in the circuit increases the current increases **Incorrect**
 - d. As the resistance in the circuit decreases the current increases **Correct**
 - e. There is no relationship between resistance and current in the circuit **Incorrect**