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BOCES Science Laboratory Investigation

Ohm’s Law

**Introduction**

Ohm’s Law relates the resistance of a resistor to the voltage put through it and the current flowing through the circuit. It’s very simply given as:

**V = I x R**

Where V is the voltage in volts, I is the current in amperes, and R is the resistance in ohms. It’s easy to see that if the voltage is kept the same (as it is in many electrical systems in a car), then current decreases as resistance increases. The reverse is also true. As resistance decreases, current increases.

Of course, the voltage and the current going through the wires are not the only things that can affect the resistance of a wire. A heavier gauge (remember, lower number = larger wire) wire will have a larger cross-sectional area, and therefore will allow more current to flow through. A lighter gauge wire will have a smaller cross-sectional area, and will allow less current to flow through. For a wire with a constant gauge, a longer wire will have a bigger resistance than a shorter wire. These variables can be figured into resistance quite easily:

**R = ρ L/A**

Where R is the resistance, in ohms, ρ (the Greek letter rho) is the resistivity in ohm·meters, L is the length of the wire in meters, and A is the cross-sectional area in square meters. It’s easy to see here that as length goes up, so does resistance. Because the area (A) is on the bottom of the equation, when area increases, resistance decreases. Resistivity is a property of a material in much the same way that density is; breaking the material up doesn’t change its resistivity, but it can change the resistance.

**Purpose**

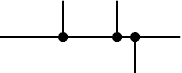
The purpose of this investigation is to allow you to verify Ohm’s law through experimentation, and also to work with circuit diagrams.

**Procedure**

1. Obtain a breadboard, an LED, and a battery.
2. Set up a simple circuit so that the LED lights.
3. Draw a diagram of the circuit that you have made in the space below. Be sure to use the appropriate symbols as necessary.

voltmeter symbolammeter symbolLED symbol

Light-Emitting Diode Ammeter Voltmeter

ohmmeter symbolcell symbol

motor symbol Ohmmeter Battery Wire Junctions

Motor

1. Add a voltmeter to the circuit. Remember, voltmeters are always placed in parallel to the circuit being measured. They measure the voltage drop across two points. Record the voltage across the battery below.
2. Add an ammeter to your circuit. Remember, ammeters are always placed in series in the circuit being measured. The ammeter measures the current that flows through it. Record the amperage of the battery below.
3. Use Ohm’s law to calculate the resistance in the circuit.
4. Now add a resistor to the circuit. Again measure the voltage and amperage across the resistor. Record it below.
5. Use Ohm’s law to calculate the resistance now. Is it the same as the band pattern on the resistance indicates? How far off were you?

**ANALYSIS**

QUESTION 1: In a car, where would you want to use a heavier gauge wire, and where would a lighter gauge wire be more appropriate? Why, in terms of Ohm’s law?

QUESTION 2: As a wire gets longer, what happens to its resistance?

QUESTION 3: As a wire gets a greater cross-sectional area, what happens to its resistance?

QUESTION 4: If there is no load in a circuit, what happens to the electrical energy?