Ohm's Law
Lesson 5

Remember:
Pretty **P**lease **M**y **D**ear **A**unt **S**ally
(From left to right; **P**arentheses; **P**ower; **M**ultiply; **D**ivide; **A**dd, **S**ubtract)

We have a problem:
Matt installed super driving lights his on Chevy truck that has a 12 Volt electrical system. The 15 Amp fuse he installed to protect the circuit keeps blowing. While diagnosis the problem, he found the circuit has 0.4 Ohms of resistance. Is the fuse properly rated for this circuit and how can we tell?

Well let's find out if the fuse is okay, or if there is another problem with the circuit. But first let's review the terms we're going to be using today:

Identify The Math, Math Terms, Vocabulary, Description Or Definitions

- **Voltage:** Electromotive force (E)

- **Ohms:** Unit of electrical resistance measurement (R)

- **Amperage:** Current or Inductive force (I)

- **Current flow:** One ohm is the resistance that will allow one ampere to flow when pushed by one volt.
- The relationship between these three is utterly and totally critical in the understanding of electricity. It is described in **Ohms Law**, the fundamental physical law governing electricity.

- **Ohm's Law:** Ohm's law states that the electrical current (I) flowing in a circuit is proportional to the voltage (E) and inversely proportional to the resistance (R). The formula can be reorganized so that the relationship can easily be seen for all of the three variables.

- **Ohms Law** tells us simple but crucial facts like:

- If the voltage is doubled on a given circuit, then the current flow (Amps) will double.

- If the current flow became doubled on a given circuit, but the applied voltage stayed the same, then the resistance must have been reduced to one-half of its previous level.

- If a circuit has a high but measurable resistance, and voltage is applied, then some current will flow. (Although the current would be very small)

- If a circuit has infinite resistance, and voltage is applied, then no current will flow. (Air has infinite resistance, as do most insulators).

- If a circuit has a very low resistance (such as a piece of wire or a piece of metal) and voltage is applied, then a very large current will flow.

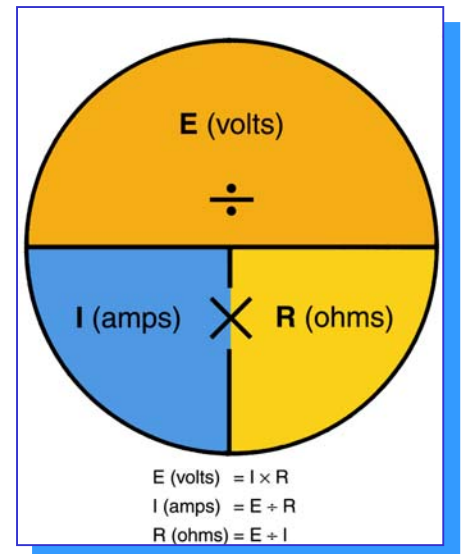- If no voltage is applied, then no current will flow.

Ohm's Law   Watt's Law

E = I x R   W = E x I
E = Voltage   W = Watts
 I = Amps   E = Voltage
R = Ohms   I = Amps

E (volts)

÷

I (amps) X R (ohms)

E (volts) = I × R
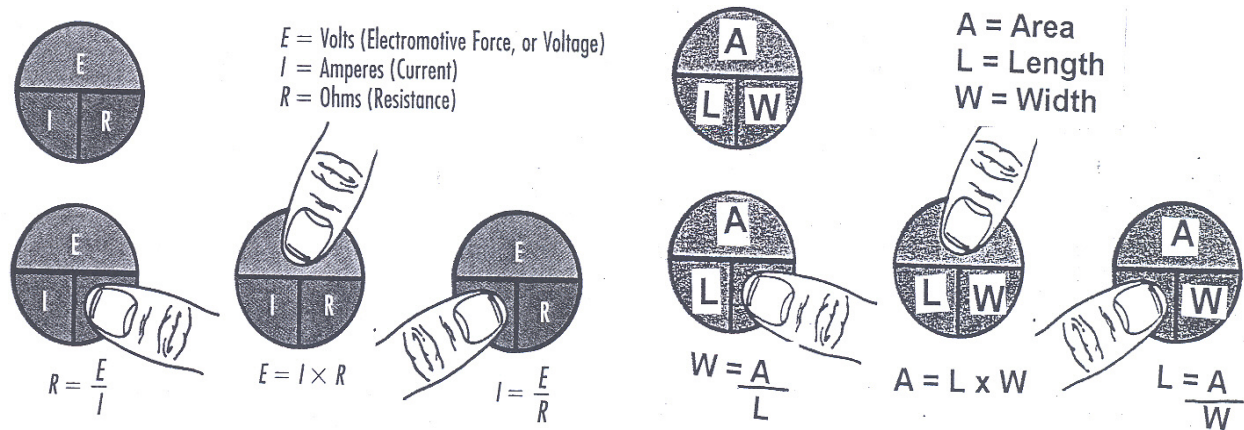I (amps) = E ÷ R
R (ohms) = E ÷ I

Simple Example:
1. 6 volts = 2 amps x 3 Ohms of resistance
2. 2 amps = 6 volts / 3 Ohms of resistance
3. 3 Ohms of resistance = 6 volts / 2 amps

Our original problem:

Matt installed super driving lights on his Chevy truck that has a 12 Volt electrical system. The 15 Amp fuse he installed to protect the circuit keeps blowing. While diagnosis the problem, he found the circuit has 0.4 Ohms of resistance. Is the fuse properly rated for this circuit and how can we tell? Let's do the math, then we can determine if the 15-amp fuse is the proper size, or if we need a different rated fuse to protect the circuit.
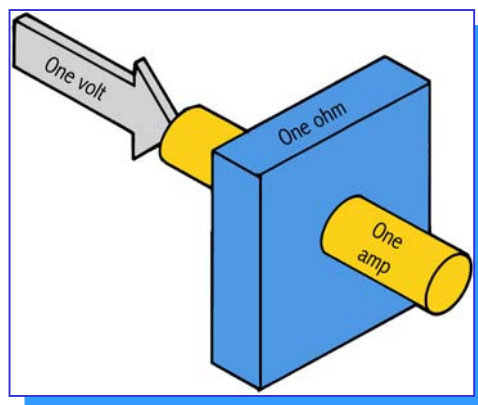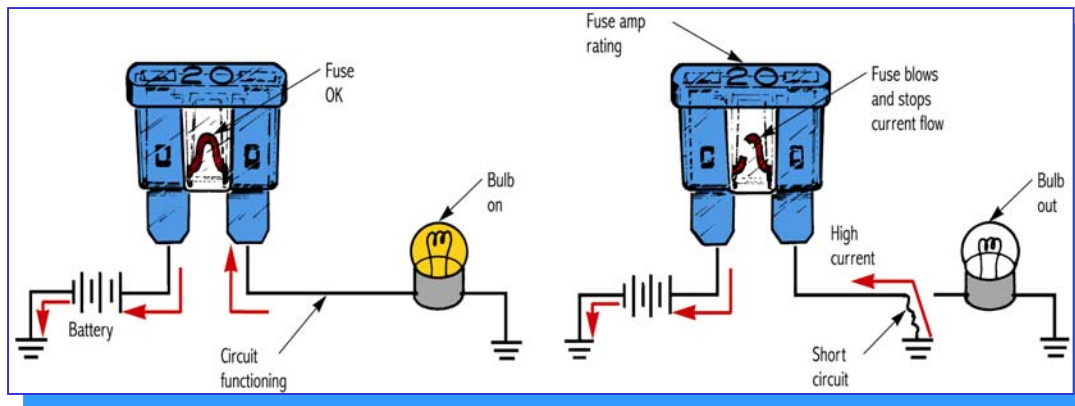
1. Using Ohms Law let's calculate the following: A 1998 Ford F-150 draws 180 amps while starting to crank the engine. What is the resistance if the voltage is 12 volts?

2. If the resistance in the rear taillight is 1.8 ohms and the voltage equals 12 volts, what is the amperage?

3. A 100-amp alternator has 0.12 ohms of resistance. What must the voltage equal?

E = Volts (Electromotive Force, or Voltage)
I = Amperes (Current)
R = Ohms (Resistance)

$R = \dfrac{E}{I}$ $E = I \times R$ $I = \dfrac{E}{R}$

A = Area
L = Length
W = Width

$W = \dfrac{A}{L}$ $A = L \times W$ $L = \dfrac{A}{W}$

4. The formula for area of a rectangle is A = L x W where A is the area, L is the length and W is the width. Find the width of a rectangle that has a length of 8 ft and an area of 120 sq ft.

5. The formula for distance is D = R x T where D is the distance, R is the rate of speed in mph and T is the time in hours. If a car is traveling at an average speed of 55 mph and you travel 385 miles, how long did the trip take?

6. The formula to calculate gross pay is GP = R x T where GP is gross pay (pay before payroll deductions), R is the rate of pay per hour and T is the time in hours. A worker works 43 hours and his gross pay is $344. How much did he make per hour?

7. Solve for x: y= $\dfrac{2(x + 1)}{4}$

8. What the minimum fuse rating is needed to protect a circuit with .8 Ohms of resistance in a 12V circuit?

9. What is voltage drop, and what should the voltage reading between the positive battery terminal and the alternator battery (B+) terminal be? Why?

Lesson 5 Worksheet – Ohm's Law

Name: _____ AM-1: _____   PM _____ Date: _____

1. Find E when I = 15 amps and R = 8 ohms.

2. Find the resistance (R) when the voltage is 120 and the current is 6 amps.

3.Find the current (I) if the voltage is 12 and the resistance is 1.2 ohms.

4. If the area of a room is 107.01 square feet and the width 8.7 feet, what is the length of the room?

5. If you travel for 5 hours at an average speed of 68 mph, how far have you traveled?

6. If your gross pay is $326.25 and you make $8.70 and hour, how many hours have you worked?

North Montco Technical Career Center

Math-In-CTE

Lesson 5 Homework – Ohm's Law

Name: _____ AM-1: _____   PM _____ Date: _____

1. If the current in a circuit is 15 amps and the resistance is 0.4 ohms, what is the voltage?

2. A relay winding draws 2 amps of current when tested at 12 volts. What is the resistance of the winding?

3. A 12-volt light bulb has a resistance of 3 ohms. What is the current through the light bulb?

4. If a yard is 23 feet long and 13 feet wide, what is the area of the yard?

5. If you traveled 416 miles in 6.5 hours, what was your average speed?

6. If you worked for 42.4 hours and you make $9.40 an hour, what is your gross pay?