

**Homework: Resistance**

1. Read 11.4
2. **Define** and give an **example** the following two terms: superconductor, non-ohmic conductor
3. Pg. 465 #2, 3, 4
4. Pg. 467 #4-7

Date: \_\_\_\_\_

**Electrical Resistance (11.4)****Electrical Resistance** (11.2, pg. 451)

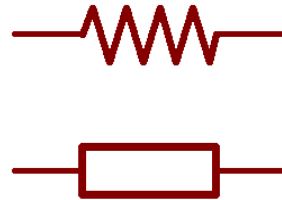
- 1a. **Electrical resistance** - The ability of a substance to \_\_\_\_\_ the flow of electric current, and \_\_\_\_\_ electrical energy into other forms of energy.
  - All electrical loads have this property.
- b. occurs because of \_\_\_\_\_ between the electrons in the current, and the substance's atoms

**Resistors**

2. Resistors are devices used in electric circuits to safely decrease the current by a certain amount.
  - They don't convert electrical energy into anything usable, but they do produce **heat** as a result.



**Figure 1.** Electrical resistors look small tubes or beads on the wire. Different sizes indicate different amounts of resistance.



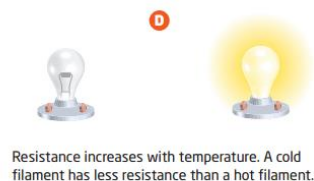
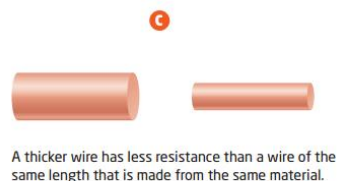
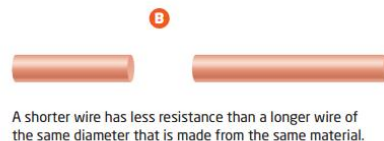
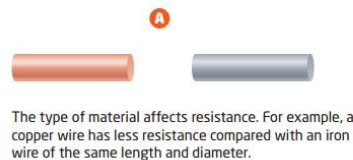
**Figure 2.** Two circuit symbols representing resistor are shown. Even though they look different, they represent the same thing.

Good conductors provide very little resistance to electrical current. The best conductors provide very little resistance - so little that it can be considered *negligible*.

**Factors That Affect Resistance of a Wire**

3. There are four major factors that will affect the resistance of a wire:

Factor	Description (complete by using the words <i>higher</i> or <i>lower</i> )
Type of Material	Materials differ in their atomic structure. Materials that allow electrons to flow freely have _____ internal resistance. They are excellent conductors. Examples: copper, silver
Length	The thicker the wire, the _____ the internal resistance it has.
Diameter (thickness)	The longer the wire, the _____ the internal resistance.
Temperature	The hotter the wire, the _____ the internal resistance.



**Figure 11.25** Several factors affect the resistance of wires.

**Homework: Ohm's Law**

1. Ohm's Law practice problems
2. Pg. 464 #1-6
3. Pg. 467 #1-7

**Relating Current to Resistance and Voltage**

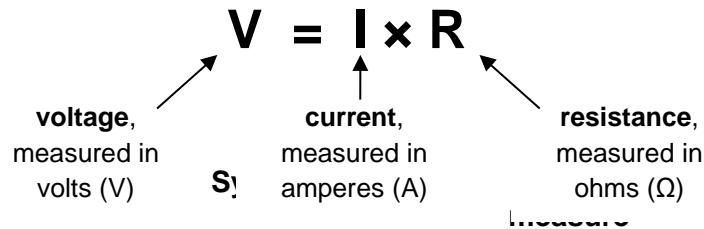
Voltage, current, and resistance in a circuit are all related to each other.

In general,

4. When resistance is increased, current \_\_\_\_\_ (increases/decreases).
5. If voltage is increased, current \_\_\_\_\_ (increases/decreases).

**Ohm's Law**

Ohm's Law describes the relationship between three quantities: resistance, potential difference, and current. It is often expressed using the formula shown below.



Complete the chart:

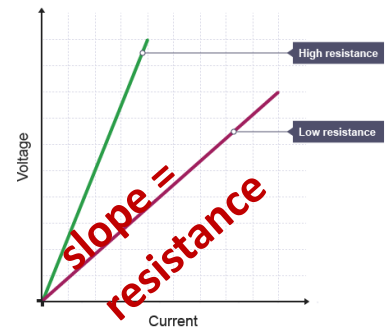
Symbol	Variable	Unit of measure
	voltage current	
	current resistance	
	resistance	

6. The formula for Ohm's Law can be re-arranged to solve for *any* of the three variables, as long as the other two are known. Re-write Ohm's Law in its other two forms:

$$R =$$

$$I =$$

7. a. Rising temperatures can lower a material's resistance. A resistor that obeys Ohm's Law will have a constant resistance, regardless of temperature. Such a resistor is called an \_\_\_\_\_ resistor.
- b. Since  $R = V/I$ , a graph of voltage vs. current will always be a straight line for an ohmic resistor

**Ohm's Law: Sample Problem**

A technician is checking the circuits on a vehicle. The technician measures the current entering a component as 0.75 A. The potential difference across the component is 12 V. What is its **resistance**?

GIVEN:

ANALYSIS & SOLUTION:

STATEMENT:

REQUIRED:

Date: \_\_\_\_\_

## Ohm's Law: Practice Problems

Text	Symbol	Factor	Factor (Sci. Not)
kilo	k	1 000	$10^3$
hecto	h	100	$10^2$
(none)	(none)	1	$10^0$
deci	d	0.1	$10^{-1}$
centi	c	0.01	$10^{-2}$
milli	m	0.001	$10^{-3}$

1. Find the unknown quantity. GRASS format is not required for these problems. If there are many decimals in your answer, report to **two** decimal places.

a) $I = 10 \text{ A}$ $R = 1500 \ \Omega$ $V = ? \text{ V}$	b) $I = ? \text{ A}$ $R = 200 \ \Omega$ $V = 240 \text{ V}$	c) $I = 15 \text{ A}$ $R = ? \ \Omega$ $V = 110 \text{ V}$
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d) $I = ? \text{ A}$ $R = 250 \ \Omega$ $V = 175 \text{ V}$	e) $I = 15 \text{ A}$ $R = ? \ \Omega$ $V = 225 \text{ V}$	f) $I = 25 \text{ A}$ $R = 300 \ \Omega$ $V = ? \text{ V}$
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2. Find the unknown quantity (CONVERT FIRST to the unit with no prefix)

a) $I = ? \text{ A}$ $R = 2000 \ \Omega$ $V = 20 \text{ mV} = \underline{\hspace{2cm}} \text{ V}$	b) $I = 25 \text{ mA} = \underline{\hspace{2cm}} \text{ A}$ $R = ? \ \Omega$ $V = 110 \text{ V}$	c) $I = 1 \text{ kA} = \underline{\hspace{2cm}} \text{ A}$ $R = ? \ \Omega$ $V = 50 \text{ mV} = \underline{\hspace{2cm}} \text{ V}$
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**WORD PROBLEMS** Use GRASS format for each of these word problems.

3. How much **resistance** does a light bulb create if it has a current of 25 mA around it in a 9 V circuit?

GIVEN:

ANALYSIS & SOLUTION:

STATEMENT:

REQUIRED:

4. A heating coil offers a resistance of 2.5 k $\Omega$ . What **voltage** is required so that 1.5 A of current pass through it?

5. An electric toy has a resistance of 120  $\Omega$ , and requires a current of 0.050 A to work properly. **How many 1.5 V cells** does the toy require?

6. The human body offers a very small amount of resistance (let's say 1 m $\Omega$  for argument). If a lightning bolt (said to have 1.21 GV, or 1 210 000 000 V of potential according to a famous movie called *Back to the Future* released in 1984), hits you, how much **current** is flowing through your body? Express your answer in amperes, and in gigamperes (if you can!).

**Answers**

1a) 15 000 V; b) 1.2 A; c) 7.33  $\Omega$ ; d) 0.7 A; e) 15  $\Omega$ ; f) 7500 V  
2 a)  $1.0 \times 10^{-5}$  V; b)  $4.4 \times 10^3$  A; c)  $5 \times 10^{-5}$   $\Omega$  3) 360  $\Omega$   
4) 37 500 V 5) 6V total  $\rightarrow$  4 cells 6) 1 210 000 000 000 A = 121 GA