SNC1 Name: _____

Resistance is Not Futile

1) a) What causes current to flow in a circuit?
What happens when no battery is present?

2) What determines how much current a battery can produce in a circuit?
Think about part C in the simple circuit lab. Did the same battery produce the same current when we added a light bulb?

3) **Resistance**

Resistance is a property of a circuit. It counteracts the ability of the source to produce current.

Conductors have ***low*** resistance.
Insulators have ***high*** resistance.

It is resistance that allows a load to transform electrical energy into other forms!

All circuit components have some resistance:
loads have high resistance
wires and switches have low resistance (as close to zero as possible)
even batteries have some internal resistance

Factors that affect the resistance of a load.

Factor	How it affects resistance
chemical composition	different substances have different resistance
length of the path	the ***longer*** the path, the ***greater*** the resistance
width of the path	the ***wider*** the path, the ***less*** is the resistance
temperature	the ***hotter*** the load, the ***greater*** the resistance

4) What else might affect the current in a circuit?
What if we added more batteries?

5) Ohms Law: current goes up if voltage goes up
current goes down if resistance goes up

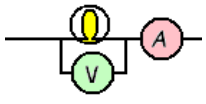
current = voltage / resistance $I = V / R$ (this tells us what current we get for a given voltage)
voltage = resistance x current $V = RI$ (this tells us what voltage we need to produce a current)
Resistance = voltage / current $R = V / I$ (this provides us with a definition for resistance)

Definition of Resistance

Resistance (R) is the voltage needed to generate a certain current in a circuit: $R = V / I$
The unit of resistance is the ohm (Ω).

1 ohm = a resistance where 1 volt is needed to make a current of 1 amp
$1\ \Omega = 1V / 1A$

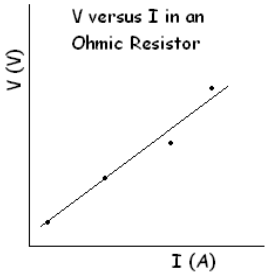
To calculate resistance, we must measure current and voltage:



Ohm's Law

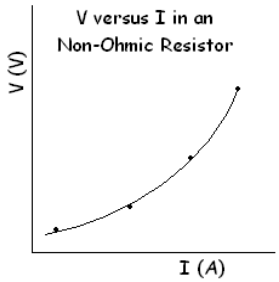
The equation R=V/I is referred to as Ohm's Law.
Ohm found that for simple wire resistors the resistance of the wire was constant for different voltages. Not all substances obey this law, however.

Circuit components that obey Ohm's Law have a constant resistance no matter what the voltage and current. These loads are referred to as ohmic. If you measure the current at different voltages and plot voltage versus current, you obtain a straight line. The slope of this line is equal to the resistance.



In other components, the resistance increase as the current increases. In other words, ratio of the voltage needed to create a certain current increases as the current increases. These types of loads are called non-ohmic.

The slope of the line, which equals the resistance just as for ohmic resistors, increases as current increases.



Causes of Resistance

Resistance can be thought of as being caused by collisions between moving electrons and the electrons of the atoms making up the conductor. How much resistance is present even in a Copper wire (one of the metals with the least resistance) can be appreciated by the slow, 3 cm/min speed that the electrons attain.

Is Resistance All Bad?

A) As stated already, resistance is involved in the transformation of electrical potential energy into other forms of energy in a load. If there is no resistance, there is no transformation of energy. The circuit would accomplish nothing.

Would a circuit with no resistance be nothing worse than useless?
With a very low resistance, the current would be very large. With lots of charges moving through the circuit each second, any part of the circuit with any resistance at all will end up transforming a lot of energy in a short amount of time: this would include the wires and the source, both of which have some resistance. This means that these components will get very hot as all that electrical potential energy is converted into heat. They can get hot enough to melt, release dangerous chemicals (in the case of a battery), explode, cause fires, result in severe burns!

B) Therefore, resistance also allows the current in a circuit to be controlled. Resistors often are used to limit current through sensitive circuit components in devices like computers and radios.

Short Circuits

6) A short circuit occurs when the positive and negative ends of a source, like a battery, are connected with ***no load*** in between. When this happens, a very small voltage can produce a very large current. This can cause the circuit to over heat.