Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Creativity in Physics PHYS13796GD – Simulation #3: Electricity and Electric Circuits**

This simulation will examine Ohm’s Law and electric circuits using an online [DC circuit builder interactive](https://www.physicsclassroom.com/Physics-Interactives/Electric-Circuits/Circuit-Builder/Circuit-Builder-Interactive) simulation. Before you begin, answer the following questions to provide a framework of what we will be examining:

1. What are the definitions of Voltage (V), Current (I), and Resistance (R)?
2. What is Ohm’s Law?
3. What is the difference between a series circuit and a parallel circuit?

**Part A: Examining Ohm’s Law**

1. Open the ‘DC Circuit Builder’ interactive using the link provided on Slate. Using the ‘Draw’ button that looks like a pencil, create a simple circuit consisting of a battery, one lightbulb, and wires connecting everything together. Once everything is connected, you should see the current moving around the circuit.
2. Select the ‘Modify’ button right below the Draw pencil button. It will bring up a magnifying glass over either the battery or the bulb. Click the battery, which will now allow you to modify the voltage of the battery. Change the voltage of the battery to 9.0 Volts. Now click the lightbulb to allow you to modify resistance. Change the resistance to 5 ohms.
3. Using Ohm’s Law, what would the current be for this circuit (remember the units for each of your answers where appropriate)?

Current = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. We can now add an ammeter to our circuit to confirm this calculation. Using the ‘Draw’ button again, add the ammeter (the structure on the far right of the draw window) anywhere to your circuit. What number is shown in the ammeter once it is added?

Current = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. To test Ohm’s Law further, complete the table on the following page, either by using the Ohm’s Law formula or by using the simulation (using the ‘Modify’ button to make the corresponding changes to both the battery and the lightbulb to find the current for each of the different variations).

|  |  |  |  |
| --- | --- | --- | --- |
| **Voltage** | **Current at resistance of 5 ohms** | **Current at resistance of 10 ohms** | **Current at resistance of 20 ohms** |
| 7.0 V |  |  |  |
| 9.0 V |  |  |  |
| 12.0 V |  |  |  |
| 18.0 V |  |  |  |
| 27.0 V |  |  |  |

1. Describe the change in current as voltage is doubled and then tripled in magnitude:
2. Describe the change in current as resistance is doubled and then tripled in magnitude:

**Part B: Series and Parallel Circuits**

1. Using the DC Circuit builder interactive, use the ‘Draw’ pencil button to create a series circuit with three lightbulbs in series and with an ammeter right before each lightbulb. Your circuit should now consist of a battery, three lightbulbs, three ammeters, and wires connecting everything together. Once everything is connected, you should the current moving around the circuit.
2. Using the ‘Modify’ button, change the voltage of the battery to 9.0 Volts and the resistance of each light bulb to 5.0 ohms.
3. Current in a series circuit: what is the current shown by the ammeter in front of your three lightbulbs (again, remember units)?

Bulb #1 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #2 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #3 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Based on your values, what can you say about how current flows around a series circuit?
2. Voltage in a series circuit: the numbers in the white circles shown around the circuit are voltages, starting with 9 volts leaving the battery. What are the voltage values in front of and behind each of your three lightbulbs (remember units)?

Bulb #1 = \_\_\_\_\_\_\_\_\_\_\_\_ Bulb #2 = \_\_\_\_\_\_\_\_\_\_\_\_\_ Bulb #3 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

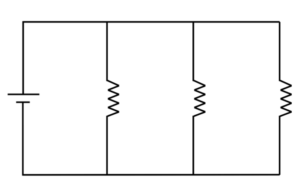
1. Based on your values, what would be the voltage drop across each lightbulb?

Voltage drop = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Resistance in a series circuit: using Ohm’s Law along with your battery voltage and the current displayed by one of your ammeters in your circuit, calculate the total resistance for your circuit.

Total Resistance = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Based on this value, what is the relationship between the total resistance of the circuit and the individual resistances of each lightbulb?
2. Now change your circuit into a parallel circuit, with three lightbulbs each having their own path as shown below and place an ammeter at the four locations indicated by an arrow on the figure.



1 Using the ‘Modify’ button, change the voltage of the battery to 9.0 Volts and the resistance of each light bulb to 5.0 ohms.

1. Current in a series circuit: what is the current shown by the ammeter in front of your three lightbulbs?

Bulb #1 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #2 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #3 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Based on your values, what can you say about how current flows around a series circuit?
2. Voltage in a series circuit: the numbers in the white circles shown around the circuit are voltages, starting with 9 volts leaving the battery. What are the three voltage values in front of your three lightbulbs?

Bulb #1 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #2 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #3 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Based on your values, what would be the voltage drop across each lightbulb?

Voltage drop = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Resistance in a series circuit: using Ohm’s Law along with your battery voltage and the current displayed by one of your ammeters in your circuit, calculate the total resistance for your circuit.

Total Resistance = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Based on this value, what is the relationship between the total resistance of the circuit and the individual resistances of each lightbulb?

31 Using the ‘Modify’ button, change the voltage of the battery to 9.0 Volts and the resistance of each light bulb to 5.0 ohms.

1. Current in a series circuit: what is the current shown by the ammeter in front of your three lightbulbs?

Bulb #1 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #2 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #3 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Based on your values, what can you say about how current flows around a series circuit?
2. Voltage in a series circuit: the numbers in the white circles shown around the circuit are voltages, starting with 9 volts leaving the battery. What are the three voltage values in front of your three lightbulbs?

Bulb #1 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #2 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #3 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Based on your values, what would be the voltage drop across each lightbulb?

Voltage drop = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Resistance in a series circuit: using Ohm’s Law along with your battery voltage and the current displayed by one of your ammeters in your circuit, calculate the total resistance for your circuit.

Total Resistance = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Based on this value, what is the relationship between the total resistance of the circuit and the individual resistances of each lightbulb?

41 Using the ‘Modify’ button, change the voltage of the battery to 9.0 Volts and the resistance of each light bulb to 5.0 ohms.

1. Current in a series circuit: what is the current shown by the ammeter in front of your three lightbulbs?

Bulb #1 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #2 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #3 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Based on your values, what can you say about how current flows around a series circuit?
2. Voltage in a series circuit: the numbers in the white circles shown around the circuit are voltages, starting with 9 volts leaving the battery. What are the three voltage values in front of your three lightbulbs?

Bulb #1 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #2 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #3 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Based on your values, what would be the voltage drop across each lightbulb?

Voltage drop = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Resistance in a series circuit: using Ohm’s Law along with your battery voltage and the current displayed by one of your ammeters in your circuit, calculate the total resistance for your circuit.

Total Resistance = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Based on this value, what is the relationship between the total resistance of the circuit and the individual resistances of each lightbulb?

21 Using the ‘Modify’ button, change the voltage of the battery to 9.0 Volts and the resistance of each light bulb to 5.0 ohms.

1. Current in a series circuit: what is the current shown by the ammeter in front of your three lightbulbs?

Bulb #1 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #2 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #3 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Based on your values, what can you say about how current flows around a series circuit?
2. Voltage in a series circuit: the numbers in the white circles shown around the circuit are voltages, starting with 9 volts leaving the battery. What are the three voltage values in front of your three lightbulbs?

Bulb #1 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #2 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #3 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Based on your values, what would be the voltage drop across each lightbulb?

Voltage drop = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Resistance in a series circuit: using Ohm’s Law along with your battery voltage and the current displayed by one of your ammeters in your circuit, calculate the total resistance for your circuit.

Total Resistance = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Based on this value, what is the relationship between the total resistance of the circuit and the individual resistances of each lightbulb?
2. Using the ‘Modify’ button, change the voltage of the battery to 9.0 Volts and the resistance of each light bulb to 5.0 ohms.
3. Current in a parallel circuit: what is the current shown by the ammeter in directly front of your three lightbulbs (numbered 2 to 4 in figure above)?

Bulb #1 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #2 = \_\_\_\_\_\_\_\_\_\_\_ Bulb #3 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Based on the current from your ammeter in position 1 in the figure above, and your values for each lightbulb, what can you say about how current flows around a parallel circuit?
2. Voltage in a parallel circuit: the numbers in the white circles shown around the circuit are voltages, starting with 9 volts leaving the battery. What are the voltage values in front of and behind each of your three lightbulbs?

Bulb #1 = \_\_\_\_\_\_\_\_\_\_\_\_ Bulb #2 = \_\_\_\_\_\_\_\_\_\_\_\_ Bulb #3 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Based on your values, what would be the voltage drop across each lightbulb?

Voltage drop = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Resistance in a parallel circuit: using Ohm’s Law along with your battery voltage and the current displayed by the ammeter at position 1 in your circuit, calculate the total resistance for your circuit.

Total Resistance = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Based on this value, what is the relationship between the total resistance of the circuit and the individual resistances of each lightbulb (hint: this relationship is based on the reciprocal of the different components)?