Module 7 – Build an Electric Circuit

INSTRUCTIONS

Open the simulation[1].

SIMULATION OVERVIEW

On the right side, there are several boxes and images.

In the first, ensure the Show Current, Labels, and Values boxes are checked. Also ensure Electrons radio dial is filled (Conventional is not).

The last, bottom set of images indicates which type of visual representation you will see. You may choose the graphic or the schematic style.

On the left side, the components required to create a circuit are found. They are represented in a manner determined by the bottom left image selection (above).

To utilize these circuit components, simply click on the item and drag it into the blue work area. Once there, each component can be adjusted in length, direction, angle, and location in the field. To make adjustments, click on one end of the component and adjust it as needed. To move or relocate an entire component, click and drag the component to the required position or location. To remove a component, click on it and select the trash can icon at the center bottom of the field. To disconnect a connecting point, click on the circled connection and select the scissors. Once you have built a completed circuit, click on the switch to close the circuit. If everything has been connected correctly, current will flow.

SERIES CIRCUIT

Series Setup

1 Place a battery from Slide 1 in the lower middle portion of the blue work space.

2 Place and connect a switch to the right of the battery.

3 Place and connect an ammeter to the right of the switch (placing it in-line where we want to measure the amperage). The ammeter can be found in the second box on the right side.

4 Moving vertically, place three (3) resistors from Slide 1 in series (going upward) on the right side of the circuit. These will be referred to as R_1, R_2, and R_3, respectively, from bottom to top.

5 On the left side, place a wire connected to the left end of the battery and running vertically upward, stretched to about the same height as the resistors on the right side.

6 Place and stretch a wire running horizontally to connect the left wire and right resistors.

[1] https://phet.colorado.edu/sims/html/circuit-construction-kit-dc-virtual-lab/latest/circuit-construction-kit-dc-virtual-lab_en.html

7 Click on the first resistor (R_1) and adjust the resistance to 3 Ω. Repeat for the other resistors.

8 Click on the battery to ensure it is set to 9.0 V.

Table 1: Series Scenario 1

Scenario 1 Setup

1 Place a voltmeter across the first resistor (R_1, next to the ammeter). The red lead should be at the bottom end of the resistor and the black lead should be touching the top end of the resistor. The voltmeter will indicate the voltage drop across the resistor and the ammeter will indicate the current flow.

2 Click on the switch to close the circuit.

Procedure

1 Record the current flow from the ammeter.

2 Record the voltage drop across the first resistor, R_1, from the voltmeter.

3 Move and place the voltmeter across the second resistor, R_2.

4 Record the current and voltage values.

5 Move and place the voltmeter across the third resistor, R_3.

6 Record the current and voltage values.

7 Calculate the power across each resistor.

Table 2

Calculate the total voltage and total power in Table 2.

Table 3: Series Scenario 2

Scenario 2 Setup

1 Click on the second resistor and adjust the resistance to 6 Ω.

2 Click on the third resistor and adjust the resistance to 9 Ω.

3 Close the circuit.

Procedure

4 Record the current from the ammeter.

5 Move and place the voltmeter across R_1 (3 Ω).

6 Record the voltage across R_1.

7 Move and place the voltmeter across R_2 (6 Ω).

8 Record the voltage across R_2.

9 Move and place the voltmeter across R_3 (9 Ω).

10 Record the voltage across R_3.

11 Calculate the power across each resistor.

Table 4

Calculate the total voltage and total power in Table 4.

Additional: Click on the first resistor, R_1, and adjust the resistance to 100 Ω. Observe what happens to the current as the resistance is increased to this value.

Before starting the next section, click on the reset button in the bottom right corner.

PARALLEL CIRCUIT

Parallel Setup

1 Place a battery from Slide 1 in the lower left portion of the blue work space.

2 Place and connect a switch to the right of the battery.

3 Place three wires on the right side of the battery/switch combination to allow room for the parallel components. Note: Do not stretch a single wire as it will not allow connections along its length. There must be separate wires to accomplish the connections.

4 Starting at the far right, vertically place and connect a wire, then a resistor, and then another wire upward.

5 Move to the left about one third of the distance between the end of the horizontal wire and the switch, and vertically place and connect a wire, then a resistor, and then another wire upward.

6 Move to the left another one third of the distance between the end of the horizontal wire and the switch (but still to the right of the switch), and vertically place and connect a wire, then a resistor, and then another wire upward. (You should now have three vertical columns of wires and resistors to the right of the switch.)

7 On the left side, place a wire connected to the left end of the battery and running vertically upward, stretched to about the same height as the resistors and wires on the right side.

8 Place and stretch a wire running horizontally to connect the left wire to the first vertical wire and resistor column. Add another horizontal wire between the first and second columns, and then a third across the final space. Adjust the vertical column wires as needed.

9 Click on the far-right resistor (R_1) and adjust the resistance to 3 Ω. Repeat for the other resistors. The resistors will be referred to as R_1, R_2, and R_3, respectively, from right to left (outside toward inside).

10 Click on the battery to ensure it is set to 9.0 V.

Table 5: Parallel Scenario 1

Scenario 1 Setup

1 Insert an ammeter between the first resistor (R_1) and the bottom wire, in-line with R_1. The ammeter can be found in the second box on the right side.

2 Place a voltmeter across the first resistor (R_1, next to the ammeter). The red lead should be at the bottom end of the resistor and the black lead should be touching the top end of the resistor. The voltmeter will indicate the voltage drop across the resistor and the ammeter will indicate the current flow.

3 Click on the switch to close the circuit.

Procedure

1 Record the current flow from the ammeter.

2 Record the voltage drop across the first resistor, R_1, from the voltmeter.

3 Move the ammeter from Column 1 and place it between the second resistor (R_2) and the bottom wire, in-line with R_2. Rejoin R_1 to the bottom wire in Column 1.

4 Move and place the voltmeter across the second resistor, R_2.

5 Record the current and voltage values.

6 Move the ammeter from Column 2 and place it between the third resistor (R_3) and the bottom wire, in-line with R_3. Rejoin R_2 to the bottom wire in Column 2.

7 Move and place the voltmeter across the second resistor, R_3.

8 Record the current and voltage values.

9 Calculate the power across each resistor.

Table 6

Calculate the total current and total power in Table 6.

Table 7: Parallel Scenario 2

Scenario 2 Setup

1 Click on the second resistor, R_2, and adjust the resistance to 6 Ω.

2 Click on the third resistor, R_3, and adjust the resistance to 9 Ω.

3 Click on the battery to ensure it is set to 9.0 V.

4 *Insert an ammeter between the first resistor (R_1) and the bottom wire, in-line with R_1. The ammeter can be found in the second box on the right side.

5 Place a voltmeter across the first resistor (R_1, next to the ammeter). The red lead should be at the bottom end of the resistor and the black lead should be touching the top end of the resistor. The voltmeter will indicate the voltage drop across the resistor and the ammeter will indicate the current flow.

6 Click on the switch to close the circuit.

*Note: Although the instructions indicate that you should begin with R_1, you may start with R_3 and move backward since the ammeter and voltmeter are both still attached to the third column from the previous scenario. If you choose to do so, ensure you record the correct values in the appropriate table spaces.

Procedure

1 Record the current flow from the ammeter.

2 Record the voltage drop across the first resistor, R_1 (3 Ω), from the voltmeter.

3 Move the ammeter from Column 1 and place it between the second resistor, R_2 (6 Ω), and the bottom wire, in-line with R_2. Rejoin R_1 to the bottom wire in Column 1.

4 Move and place the voltmeter across the second resistor, R_2 (6 Ω).

5 Record the current and voltage values.

6 Move the ammeter from Column 2 and place it between the third resistor, R_3 (9 Ω), and the bottom wire, in-line with R_3. Rejoin R_2 to the bottom wire in Column 2.

7 Move and place the voltmeter across the second resistor, R_3 (9 Ω).

8 Record the current and voltage values.

9 Calculate the power across each resistor.

Table 8

Calculate the total current and total power in Table 8.

