**Setup**

1. Dust off your old grade 9 notes to define the following terms:
   * Series Circuit
   * Parallel Circuit
   * Potential Difference (Volts V)
   * Current (Amps A)
   * Resistance (Ohms Ω)
2. Open the following web application to complete the rest of this investigation.

<http://phet.colorado.edu/en/simulation/circuit-construction-kit-dc>

**Series Circuits**

1. Create the circuit described by the diagram to the right
2. Explain why this is called a series circuit.
3. Use the voltmeter tool to measure the following:
   * Potential Difference across the battery: \_\_\_\_\_\_ V
   * Potential Difference across light bulb #1: \_\_\_\_\_\_ V
   * Potential Difference across light bulb #2: \_\_\_\_\_\_ V
4. Batteries are a source of electrical energy and light bulbs are a load. If voltage is related to the electrical potential energy, explain how the measurements in #3 above demonstrate the Law of Conservation of Energy.
5. Use an ammeter to measure the current as follows:
   * Between the battery and the 1st light bulb: \_\_\_\_\_\_ A
   * Between the 1st light bulb and the 2nd light bulb: \_\_\_\_\_\_ A
   * Between the 2nd light bulb and the battery: \_\_\_\_\_\_ A
6. Batteries are a source of electrical charge (electrons), conductors (wires) and loads (light bulbs) carry charge to complete a circuit. Explain how the measurements in #5 above demonstrate the Law of Conservation of Charge.
7. Disconnect a wire to create a break in the circuit. Explain why the current is now zero.

**Parallel Circuits**

1. Create the circuit described by the diagram to the right
2. Explain why this is called a parallel circuit.
3. Use the voltmeter tool to measure the following:
   * Potential Difference across the battery: \_\_\_\_\_\_ V
   * Potential Difference across light bulb #1: \_\_\_\_\_\_ V
   * Potential Difference across light bulb #2: \_\_\_\_\_\_ V
4. Explain how the measurements in #3 above demonstrate the Law of Conservation of Energy.
5. Use an ammeter to measure the current as follows:
   * Between the battery and the 1st light bulb: \_\_\_\_\_\_ A
   * Between the 1st light bulb and the 2nd light bulb: \_\_\_\_\_\_ A
   * Between the 2nd light bulb and the battery: \_\_\_\_\_\_ A
6. Explain how the measurements in #5 above demonstrate the Law of Conservation of Charge.
7. Disconnect a wire to one of the light bulbs create a break in the circuit. Explain why the other light bulb remains lit and the current is stays the same.

**Resistance & Ohm's Law**

1. Create a series circuit with one battery and one resistor. Add an ammeter to measure the current in the circuit. Add a voltmeter to measure the potential difference across the resistor.
2. Change the value of the resistor to 20 ohms and keep it constant.
3. Change the battery voltage and record your observations in the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Battery Voltage** | **Resistor (Ω)** | **Measured Voltage (V)** | **Measured Current (A)** |
| 10 V | 20 Ω |  |  |
| 20 V | 20 Ω |  |  |
| 30 V | 20 Ω |  |  |
| 40 V | 20 Ω |  |  |

1. Change the value of the resistor to 40 ohms and keep it constant.
2. Change the battery voltage and record your observations in the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Battery Voltage** | **Resistor (Ω)** | **Measured Voltage (V)** | **Measured Current (A)** |
| 10 V | 40 Ω |  |  |
| 20 V | 40 Ω |  |  |
| 30 V | 40 Ω |  |  |
| 40 V | 40 Ω |  |  |

1. Plot data from #3 and #5 on a graph of measured voltage vs. measured current. Plot two lines of best fit and calculate their slopes.
2. Ohm's Law states that voltage equals resistance times current. Explain how the graphs verify this law. In Ohm's equation "R = V/I" what do the symbols R, V, and I represent?