# Ohm's Law

Electric circuits are controlled by 3 factors:

- I: the current  in the circuit, which has the unit amps
- V: the voltage in the circuit, which has the unit volts.
- R: resistance, which is measured in ohms.

**Ohm's Law** is the mathematical relationship between these three terms and is given by $R = V \div I$

## Part A

**Purpose:** To understand the relationship between current, voltage, and resistance.

**Procedure:**

- Go to the simulation at this link: https://www.pbslearningmedia.org/asset/hew06_int_ohmslaw/
- Set the value of the resistor to 200Ω by slidiing the button until it reads 200 ohm
- Slide the voltage slider until the current reads 2.
- Record the voltage and the current for your 200Ω resistor in the data table in the obsevations section.
- Repeat the proecudue with increasing values of 2 Amps until you reach 20 Amps

Repeat the procedure with a 400Ω resistor.

**Observations**

**Data Table**

| **Resistor = 200Ω** | | | **Resistor = 400Ω** | |
|---|---|---|---|---|
| **Current, I** | **Voltage, V** | | **Current, I (A)** | **Voltage, V (V)** |
| **0** | | | **0** | |
| **2** | | | **2** | |
| **4** | | | **4** | |
| **6** | | | **6** | |
| **8** | | | **8** | |
| **10** | | | **10** | |
| **12** | | | **12** | |
| **14** | | | **14** | |
| **16** | | | **16** | |
| **18** | | | **18** | |
| **20** | | | **20** | |

**Analysis**

Graph your table of values

- Using graph paper to plot a graph of Voltage, V versus Current, I.
- The Voltage will be on the vertical or y-axis.
- Draw a straight line of best fit through your plotted points.
- Use a coloured pencil to draw this line and create a legend in the lower right of your graph showing that this colour represents your 200Ω resistor.
- On the same graph and using a different colored pencil, plot and graph the data for the 400Ω resistor.

**Inquiry Questions**

1. Which of resistance, voltage, and current was maintained at a constant level?

2. Examine your data. Use two rows of the table to show:

   a) What happens to the current when the voltage is halfed?

   b) What happens to the current when the voltage is doubled?

   c)What happens to the current when the voltage is tripled?

   d) What happens to the voltage when the current is halfed?

   e) What happens to the voltage when the current is doubled?

   f) What happens to the voltage when the current is tripled?

3. Voltage and current is said to have a **direct relationship** because as one value changes, the other also change. Look at the equation for Resistance, and using your answers for Question 1, 2, give a brief description or explanation of how you can determine whether a table of value and a graph shows a direct relationship.

4. Predict what the graph of 600Ω resistor would look like by choosing a third color pencil and draw and appropraite line on the same graph.

   In the space below, explain or justify how you drew this third graph.

**5.** (Optional) Determine the slope of your two lines. What general statement can you make about the slope of V-I graph and the reistance?

## Part B

Another way to express Ohm's Law is V = I × R. In this part you will learn how Current affects Resistance.

**Purpose:** To examine the relationship between Current and Resistance in a circuit.

**Procedure**

- Go to the simulation at this link: https://www.pbslearningmedia.org/asset/hew06_int_ohmslaw/
- Set the value of the voltage to 9.0 volts
- Set the Reistance to 100 Ω. Record the resistance and current in the data table.
- Repeat with resistance set to 140 Ω  and continue with increases of 40 Ω, collecting about 15-20 pieces of data
- Plot the data with the Resistance on the x-axis.

**Observation and Analysis**

| Resistance | Current |
|---|---|
| **100** | |
| **140** | |
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**Inquiry Questions**

1) Describe what happens to your current as you change your resistance.

2) Resistance and Current is known as an i**nverse relationship.** Explain how you can recognize an inverse relationship in a table of value and a graph.

**Part C: Extension**

Science use a lot of math equations to describe physical properties. Two of these are:

- Density which is given by Density = M ÷ V where M is the mass and V is the volume
- Spring Force given by Force = k × x, where k is known as the spring constant and x is how long the spring is stretch when an amount of force, F, is used.

Table B

| x | y |
|---|---|
| 5 | 30 |
| 10 | 15 |
| 15 | 10 |
| 20 | 7.5 |
| 25 | 6 |
| 30 | 5 |
| 35 | 4.2857143 |
| 40 | 3.75 |
| 45 | 3.3333333 |
| 50 | 3 |

Table A

| x | y |
|---|---|
| 4 | 1.4 |
| 8 | 2.8 |
| 12 | 4.2 |
| 20 | 7 |
| 28 | 9.8 |
| 32 | 11.2 |
| 36 | 12.6 |
| 40 | 14 |
| ----- | |

1. Use what you learned from Part A and Part B
   a. Explain which equation shows a direct relationship and which shows an inverse relationship

   b. Which table is for the spring and which is for density. Justify your choice.

2. Sketch what the graph from each table will look like and explain why it has the shape you sketched.

3. There are many examples of direct and inverse relationships in real life. Provide two examples of each. A sample is done for you.

| | **Direct Relationship** | **Inverse Relationship** |
|---|---|---|
| **Sample** | The more you leave your light on, the higher your electricity bill | The older your car, the less valuable it is. |
| **Example 1** | | |
| **Example 2** | | |