

Week 2 Circuits**Day 1 – Current & Day 2 – Voltage**

Lecture Notes: Introduction to Conventional Current → <https://tinyurl.com/upnna3c>

Edpuzzle Video: Introduction to Conventional Current → <https://tinyurl.com/t2ylfh9>

Lecture Notes: Electric Potential Difference and Circuit Basics → <https://tinyurl.com/snnmujd>

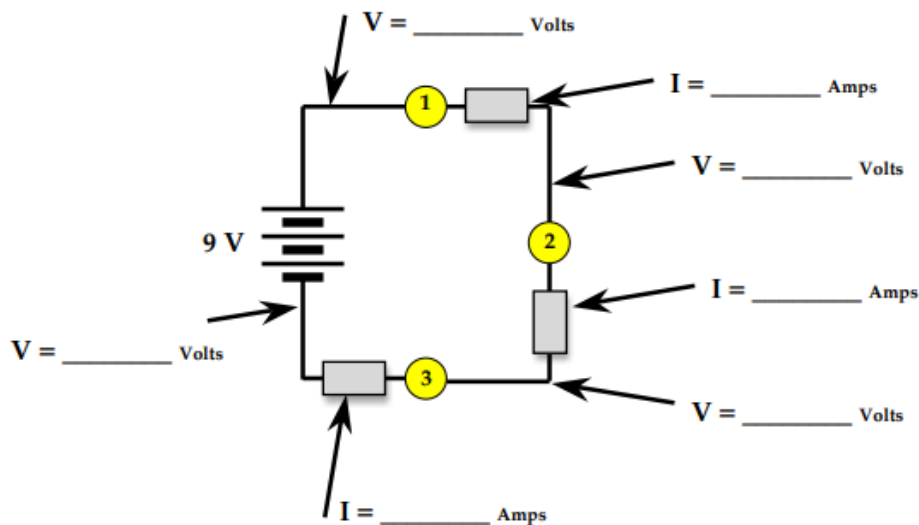
Edpuzzle Video: Electric Potential Difference and Circuit Basics → <https://tinyurl.com/tbqga0a>

- 1.) Watch Edpuzzle Video Introduction to conventional Current
- 2.) Watch Edpuzzle Video Potential Difference and Circuit Basics
- 3.) Using your Computer, tablet or phone navigate to: <https://tinyurl.com/ybregjby> and answer the following questions:

Use the provided link to open the Circuit Builder simulator. Once opened, select the pencil icon and use the tools (at the bottom of the screen) to build a circuit. Simply select a bulb, resistor, wire or ammeter (the rectangular box) and tap or click in the workspace where you wish it to be located. You'll get the hang of it quite quickly. Electric potential values are listed in the workspace at the corner of every square on the grid. Current values are listed on the ammeters.

Change the voltage of the battery to 9 Volts.

Change the resistance of each light bulb to 1, 2, 3 ohms.

Build, Measure, Analyze:

- 1.) Calculate the difference in electric potential (Change of Voltage) across each light bulb.

Bulb 1: $\Delta V = \underline{\hspace{2cm}}$ Joule/Coulomb (volts)

Bulb 2: $\Delta V = \underline{\hspace{2cm}}$ Joule/Coulomb (volts)

Bulb 3: $\Delta V = \underline{\hspace{2cm}}$ Joule/Coulomb (volts)

Please remember ΔV is the amount of **energy each coulomb of charge loses** as it goes through a light bulb.

- 2.) How do the ΔV across each individual bulb compare to each other?
- 3.) How do the ΔV values across each individual bulb compare to the voltage of the battery?
Write an equation for this.

- 4.) What is the current across each light bulb?

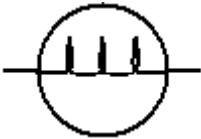

Bulb 1: $I = \underline{\hspace{1cm}}$ Amps Bulb 2: $I = \underline{\hspace{1cm}}$ Amps Bulb 3: $I = \underline{\hspace{1cm}}$ Amps

Does the current change throughout the circuit?

What Changes through the circuit?

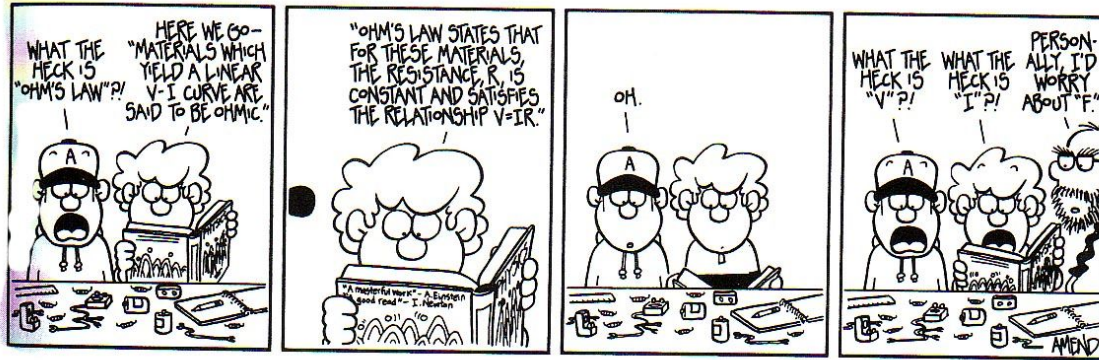
- 5.) What is the function of a battery? What does it do to the charge flowing through the wire?
- 6.) How much Energy does each coulomb of charge have after the first lightbulb?

Reference Sheet

Symbol	What It Is	What It Does
		
		
		
		
		
		
		

Take Quizziz Mastery Quiz at the end of Day 2.

Day 3 – Defining Resistance, Ohmic vs. Non-Ohmic and Electric Power



- 1.) Edpuzzle video → <https://tinyurl.com/wnvibaw>
Lecture Notes → <https://tinyurl.com/qwuey9e>

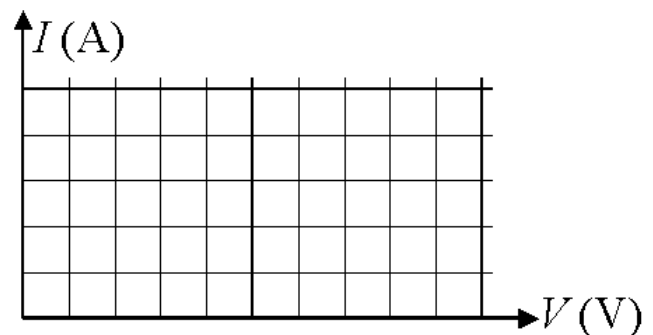
What is the algebraic symbol for resistance? What are the units of resistance?

Explain what an “ohmic” resistor is and what a “non-ohmic” resistor is.

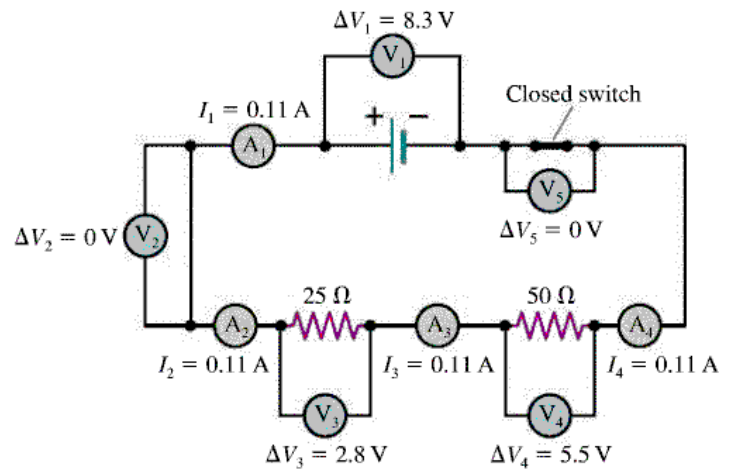
State Ohm’s Law as an equation.

Explain the Ohm’s Law equation.

On the axes of current vs. voltage below, draw three graphs and label them: “low resistance”, “high resistance”, and “non-ohmic resistance”.



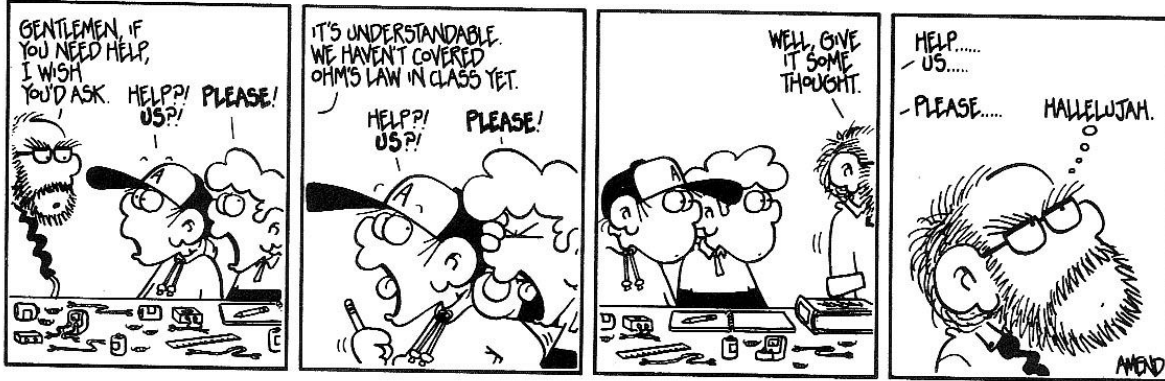
Explain what you notice about the currents in the diagram. What do you notice about the potential differences on the battery and resistors?



Write down 3 equations that describe electric Power.

What is Power?

Day 4 Applications of Ohm's Law (circuits in series)



In your laptop, phone, or tablet navigate to circuit builder: <https://tinyurl.com/ybreqjbv>

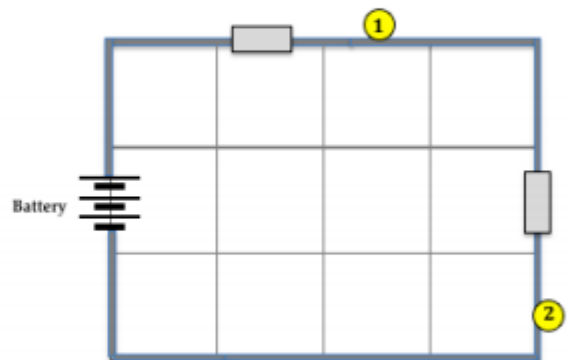
Build, Measure, Analyze:

Use the tools (at the bottom of the screen) to build the circuit below. You need a battery, two bulbs, and two ammeters. Position them as shown.

To build a circuit, click on a bulb, resistor, wire or ammeter (the rectangular box) and click in the workspace where you wish it to be located. When the circuit has been completed, charges should flow and the bulbs should light.

Circuit 1

1. Use red, blue, and yellow markers to color the three wires in the diagram according to their electric pressure. We will refer to locations around the circuit using their designated colors.
2. Set the **voltage of the battery** to 12 Volts. (Tap the Modify icon. Then tap on the battery and use the arrows to increase/decrease the voltage to 12 V.)
3. Set the **resistance** of Bulb 1 to **3 Ω** and the resistance of Bulb 2 to **3 Ω** . (Tap the Modify icon. Then tap on a bulb and use the arrows to increase/decrease the resistance values.)
4. Electric pressure (i.e., voltage) values for each wire are listed inside circles on the wire. Record the electric pressure values for the red, blue, and yellow wires.



$V_{\text{red}} = \underline{\hspace{2cm}}$ Volts

$V_{\text{yellow}} = \underline{\hspace{2cm}}$ Volts

$V_{\text{blue}} = \underline{\hspace{2cm}}$ Volts

5. Observe that there is a difference in color (i.e., electric pressure) on opposite sides of **Bulb 1**. The same is true for **Bulb 2**. We refer to this as a **voltage drop** since the values of voltage undergo a downward change (drop) as charge passes through the bulbs. Use the values in Q#4 to calculate the voltage drops (ΔV) for the two bulbs.

$$\Delta V_{\text{Bulb 1}} = \underline{\hspace{2cm}} \text{ Volts}$$

$$\Delta V_{\text{Bulb 2}} = \underline{\hspace{2cm}} \text{ Volts}$$

6. The current values are listed inside the ammeter boxes for each wire. Observe that the **current is the same in each wire**. The current is $\underline{\hspace{2cm}}$ A.
7. Use the current (Q#6) and the resistance (Q#3) values to calculate the $I \cdot R$ product for the two bulbs.

$$I \cdot R_{\text{Bulb 1}} = \underline{\hspace{2cm}} \text{ A} \cdot \Omega$$

$$I \cdot R_{\text{Bulb 2}} = \underline{\hspace{2cm}} \text{ A} \cdot \Omega$$

8. How does the $\Delta V_{\text{Bulb 1}}$ of Q#5 compare to the $I \cdot R_{\text{Bulb 1}}$ value of Q#7?

How does the $\Delta V_{\text{Bulb 2}}$ of Q#5 compare to the $I \cdot R_{\text{Bulb 2}}$ value of Q#7?

Circuit 2

Create a similar circuit with a 12 Volt battery, two ammeters, and two light bulbs with resistance values of 4Ω for **Bulb 1** and 2Ω for **Bulb 2**. Color code the drawing with **red**, **green**, and **blue** markers.

Determine the following values. The first two rows are read from the **Circuit Builder** program. The last two rows are calculated.

$$I = \underline{\hspace{2cm}} \text{ A}$$

$$V_{\text{red}} = \underline{\hspace{2cm}} \text{ Volts}$$

$$V_{\text{green}} = \underline{\hspace{2cm}} \text{ Volts}$$

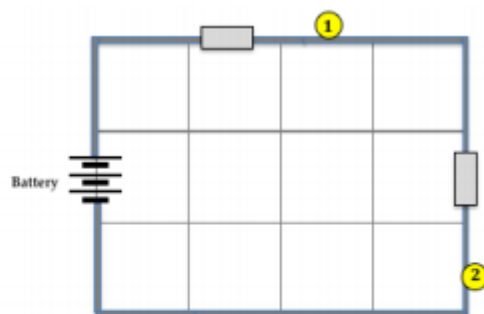
$$V_{\text{blue}} = \underline{\hspace{2cm}} \text{ Volts}$$

$$\Delta V_{\text{Bulb 1}} = \underline{\hspace{2cm}} \text{ Volts}$$

$$\Delta V_{\text{Bulb 2}} = \underline{\hspace{2cm}} \text{ Volts}$$

$$I \cdot R_{\text{Bulb 1}} = \underline{\hspace{2cm}} \text{ A} \cdot \Omega$$

$$I \cdot R_{\text{Bulb 2}} = \underline{\hspace{2cm}} \text{ A} \cdot \Omega$$



Summary and Application:

Conduct voltage drop analysis without using the program. Base answers on the patterns learned from analyzing **Circuits 1 – 7**.

1. Consider the 3-bulb circuit at the right. Color code the diagram with **red**, **yellow**, **green**, and **blue** markers. Suppose you know that ...

Battery voltage = 12 V, Current = 2 A, and

$$R_1 = 3 \Omega \quad R_2 = 2 \Omega \quad R_3 = 1 \Omega$$

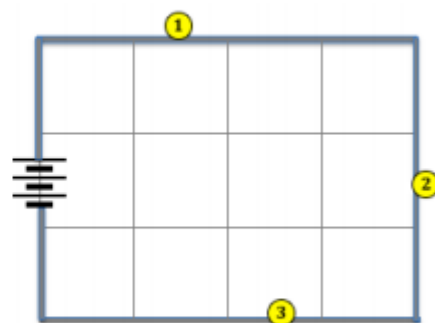
Use $I \cdot R$ values to determine the values of electric pressure for the four different wires:

$$V_{\text{red}} = \underline{\hspace{2cm}} \text{ V}$$

$$V_{\text{yellow}} = \underline{\hspace{2cm}} \text{ V}$$

$$V_{\text{green}} = \underline{\hspace{2cm}} \text{ V}$$

$$V_{\text{blue}} = \underline{\hspace{2cm}} \text{ V}$$



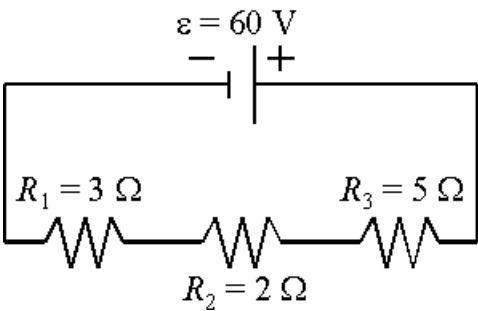
Test your understanding (Take a picture or scan and submit this through google classroom)

A battery ε is connected to three series resistors R_1 , R_2 , and R_3 .

Rank the three resistors based on which one has the greatest current through it. Put “=” signs between those that have the same current, and “>” signs between those with unequal currents.

_____ Greatest Current _____ Least Current _____

Explain why.



Rank the three resistors based on which one has the greatest voltage drop across it. Put “=” signs between those that have the same voltage, and “>” signs between those with unequal voltage.

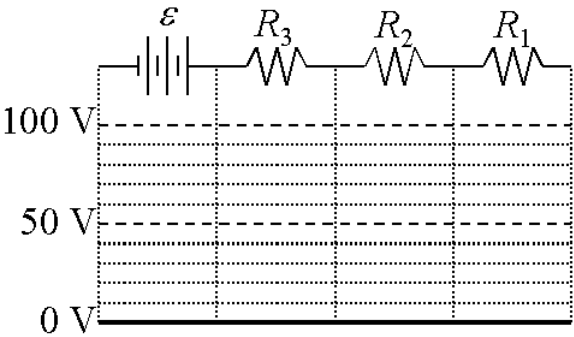
_____ Greatest Voltage _____ Least Voltage _____

Explain why.

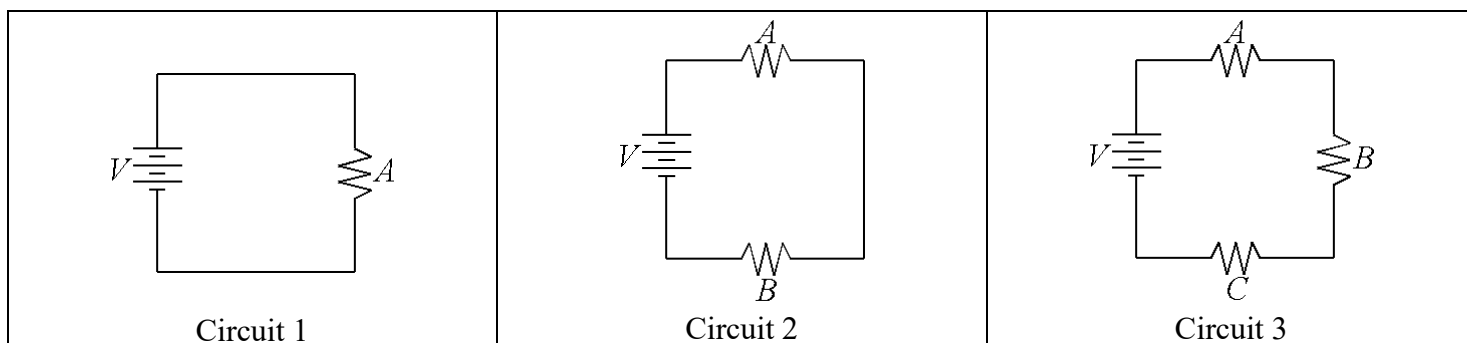
Determine the voltage drop and current through each resistor. Explain your steps below.

	Voltage Drop [V]	Current [A]	Power [W]
R_1			
R_2			
R_3			

Create an electric potential graph for a charge moving around the loop through ε , R_3 , R_2 , and R_1 .



Day 5: Circuits Exploratory Activity - A Series Circuit: Build circuit 1, then circuit 2, then circuit 3.

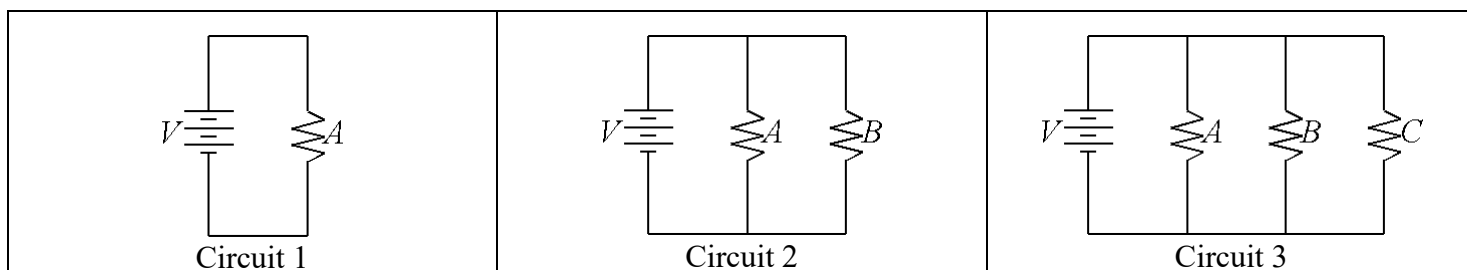


As more light bulbs are placed in the circuit, what happens to the brightness of the bulbs?

Install a switch in the circuit so that when the switch is closed, the lights are all on, and when the switch is open, the lights are all off. Draw the circuit diagram below.

Where must a switch be placed in a series circuit so that it controls all of the light bulbs?

A Parallel Circuit: Build circuit 1, then circuit 2, then circuit 3.



As more light bulbs are placed in the circuit, what happens to the brightness of the bulbs?

Install a switch in the circuit so that when the switch is closed, the lights are all on, and when the switch is open, the lights are all off. Draw the circuit diagram below.

Change the position of the switch so that when the switch is closed, all the lights are on, but when the switch is open, bulb B is off. Draw the circuit diagram below.

Where must a switch be placed in a parallel circuit so that it controls all of the light bulbs?

Where must a switch be placed in a parallel circuit so that it controls only one bulb?

Which way (series or parallel) is your home wired?

Mixed Circuit 1: Create a circuit that has the following features. Draw the circuit diagram.

- With the switch closed:
 - Bulb A is brighter than B and C .
 - Bulbs B and C are equally bright.
- With the switch open:
 - Bulb A is off.
 - B and C stay (about) the same brightness as the switch open.

Mixed Circuit 2: Create a circuit that has the following features. Draw the circuit diagram.

- With the switch closed:
 - Bulb A is brighter than B and C .
 - Bulbs B and C are equally bright.
- With the switch open:
 - C goes out
 - A gets dimmer and B brighter so that now A and B are equally bright.

Mixed Circuit 3: Create a circuit that has the following features. Draw the circuit diagram.

- With the switch closed:
 - B is out.
 - C has the same brightness as A .
- With the switch open:
 - Bulb A is brighter than B and C .
 - Bulbs B and C are equally bright.