

OL-36 Series and Parallel Circuit Using PhET Simulation Tool

Objective

1. Learn to build up series circuit and a parallel circuit with three resistors.
2. Use PhET interactive simulation tool ([Circuit Construction Kit AC Prototype](#)) to build the circuits and Verify Ohm's Law

Theory

The relations for two resistors in series and parallel circuits are the following:

Series Circuit

$$R_{total} = R_1 + R_2 \quad (1)$$

$$I_{total} = I_1 = I_2 \quad (2)$$

$$\Delta V = \Delta V_1 + \Delta V_2 \quad (3)$$

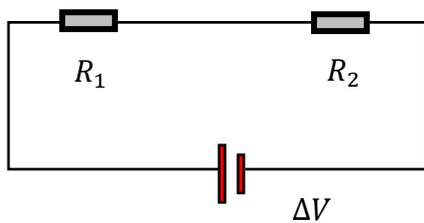


Figure 1 Two resistor in series

Parallel Circuit

$$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2} \quad (4)$$

$$I_{total} = I_1 + I_2 \quad (5)$$

$$\Delta V = \Delta V_1 = \Delta V_2 \quad (6)$$

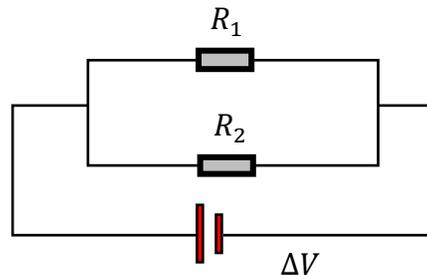


Figure 2 Two resistor in parallel

The relation between the current I passing through a resistor with resistance R and the voltage (electric potential difference) V across the resistor is called Ohm's Law

$$I = \frac{V}{R} \quad (7)$$

Equipment

PhET interactive simulation tool ([Circuit Construction Kit: DC - Virtual Lab](#))

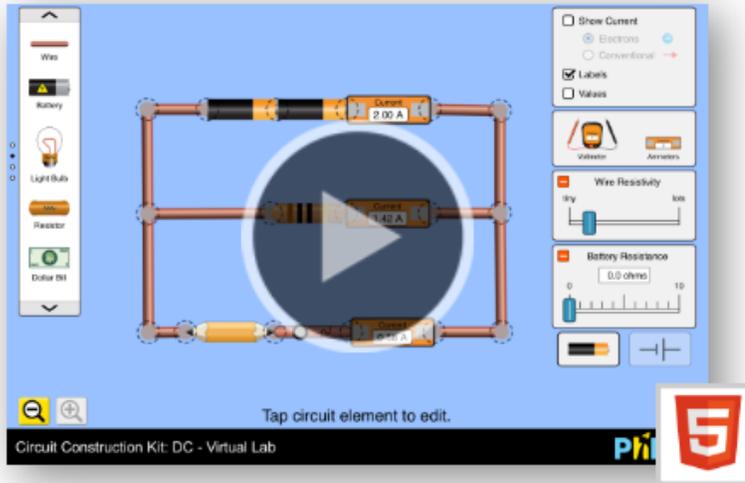
<https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc-virtual-lab>

Procedures

Build the circuit as shown in Figure 1 by using PhET Simulation Tool

1. Click the above http link, you will see

Circuit Construction Kit: DC - Virtual Lab



- Series Circuit
- Parallel Circuit
- Ohm's Law

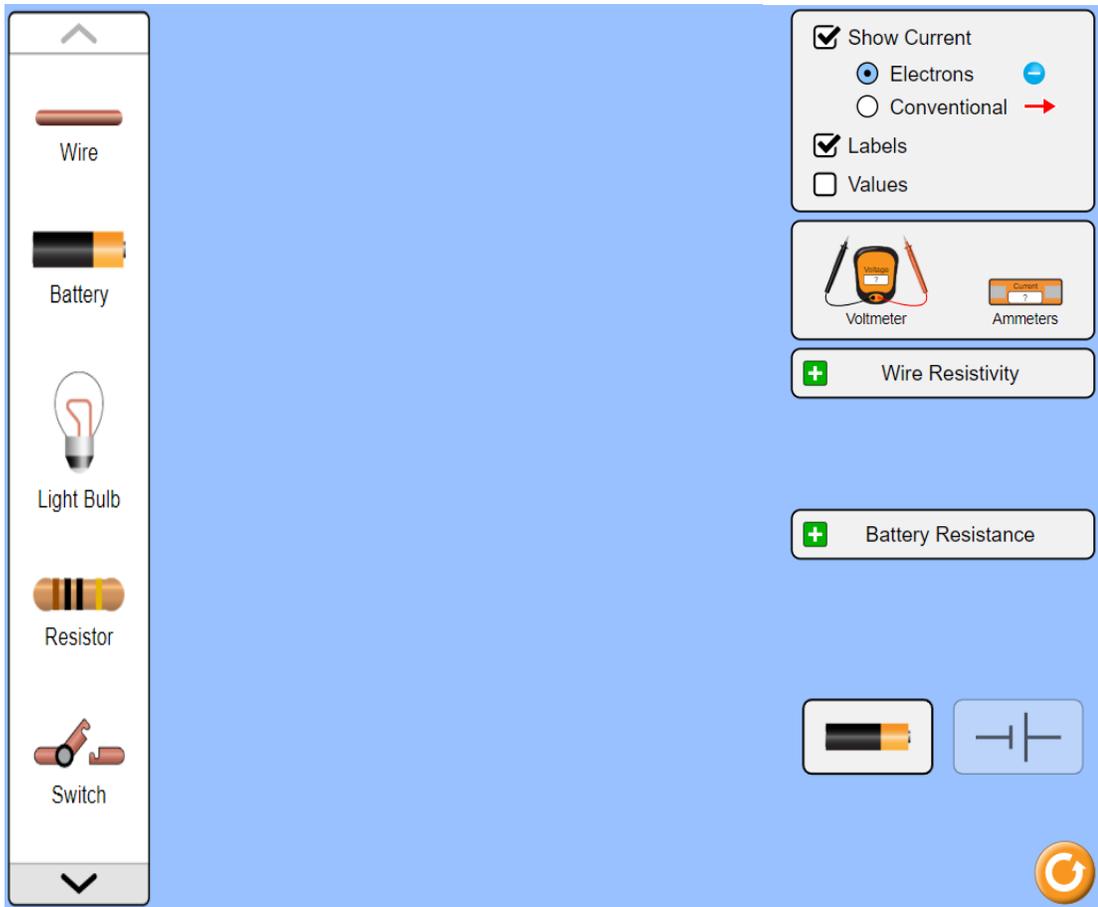
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PhET is supported by

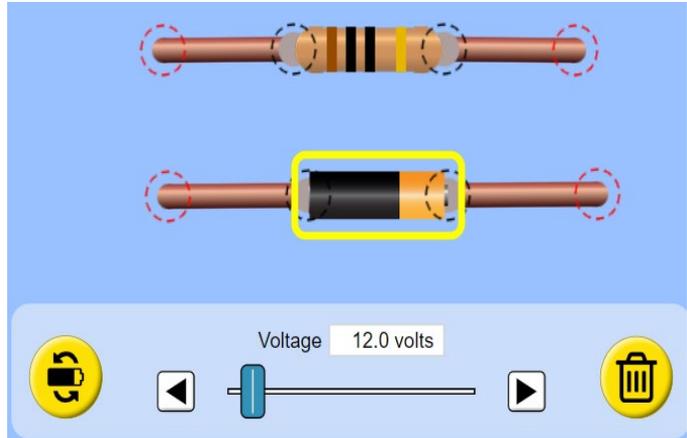
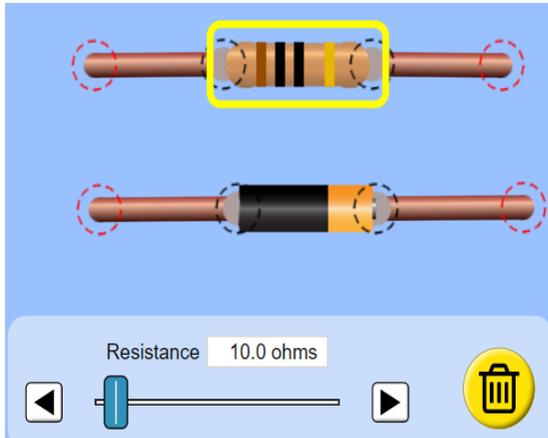


and educators like you.

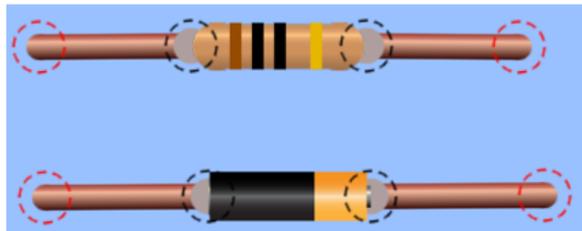
2. Click ►, you will see



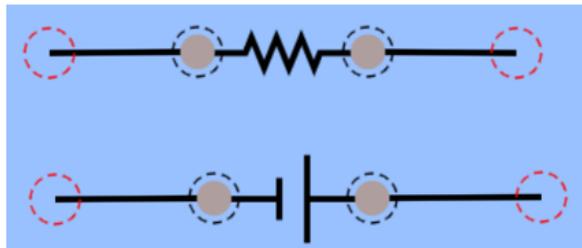
3. Now you build your circuit by using “wire”, “Battery” and “Resistor”



4. You can tap the circuit elements to change it value by adjust



Click Battery, the circuit show as above



Click Battery symbol, the circuit show as below

5. You can also toggle between the battery and the battery symbol as shown above.

6. Use the circuit board, build the series circuit by using three resistors as shown in the following figure 3: set up $R_1 = 20.0 \Omega$, $R_2 = 50.0 \Omega$, $R_3 = 80.0 \Omega$, $\Delta V = 5.0 V$

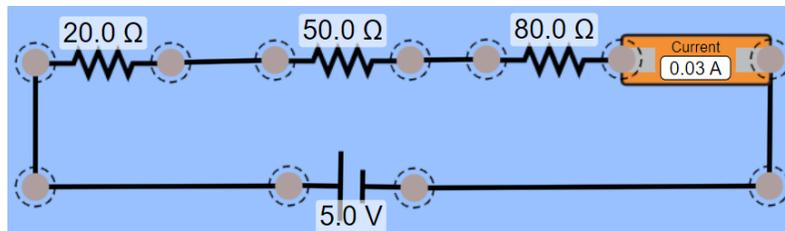


Figure 3

7. Measure the voltage across each resistor, the voltage across over the two R_1 and R_2 (resister R_{12}) and the voltage across over all the resistors (R_{total}). Record the values on the table 1.

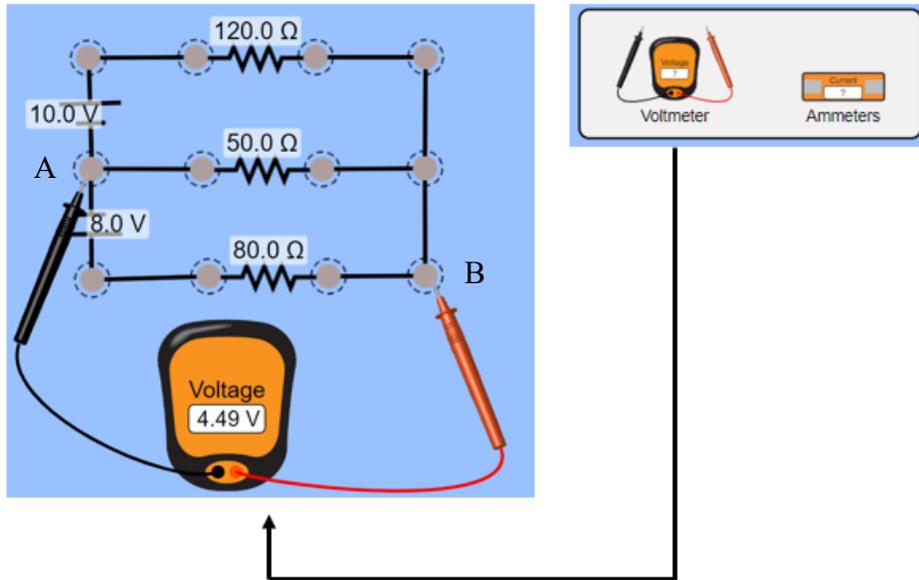


Figure 4

8. How to measure voltage using the voltmeter in the circuit board tool.
 - Simply drag the voltmeter to the necessary location as shown in the figure 4. You can use multiple voltmeters as needed.
 - Voltage measurements look at the potential difference between two points. Figure 4 shows the voltage between A and B.
 - When making the measurement, if the displayed voltage of the voltmeter is positive, it tells that the red color lead is connected to higher electric potential point.
 - If the displayed voltage of the voltmeter is negative, it tells that the red color lead is connected to lower electric potential point.
 - The circuit in figure 4 is an example show you how to measure voltage. It is not the same circuit that you will build.
9. Using Ohm's law calculate the currents for each resistor and put the values on table 1.
10. Using circuit board tool Ammeters measure the current passing through each resistor and record the values on the table 1.
11. How to measure current using ammeters in the circuit board tool.
 - Simply drag the ammeter to the necessary location as shown in the figure 5. You can use multiple ammeters as needed.
 - Measuring the current of a resistor requires the ammeter to be connected in series with the resistor (the figure below shows you how to do this).
 - Checking and unchecking the "show current" and "conventional" checkboxes on the upper-right corner of the circuit board tool will show or hide the current direction.
 - The circuit in figure 5 is an example show you how to measure voltage. It is not the same circuit that you will build.

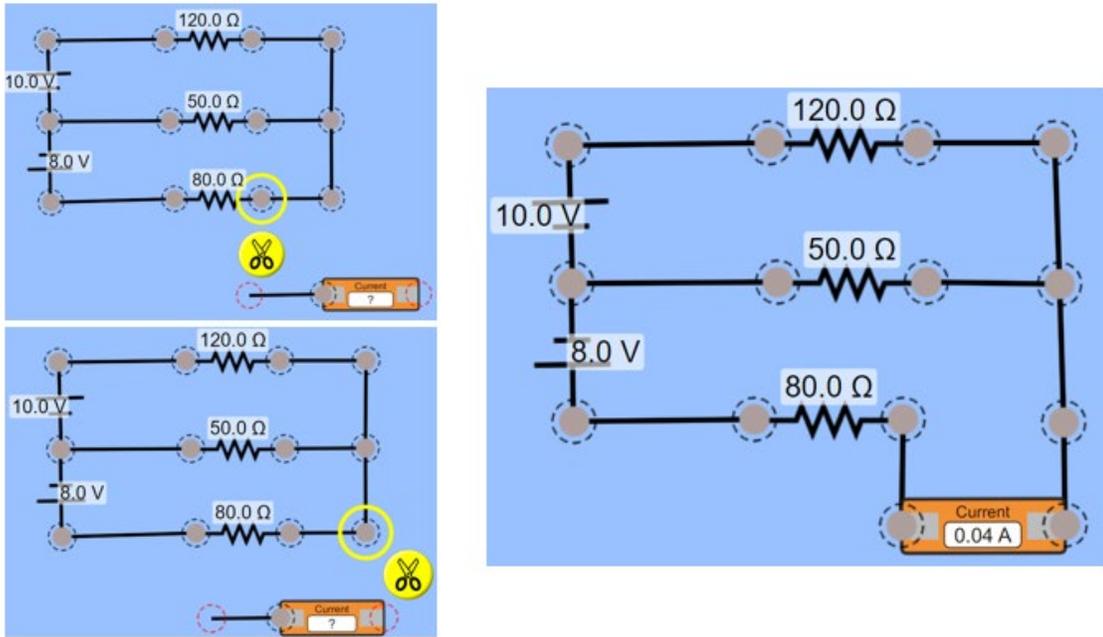


Figure 5

12. Compare the current in table 1, and find the percentage difference.
13. Use the circuit board, build the parallel circuit by using three resistors as shown in the following figure 6.

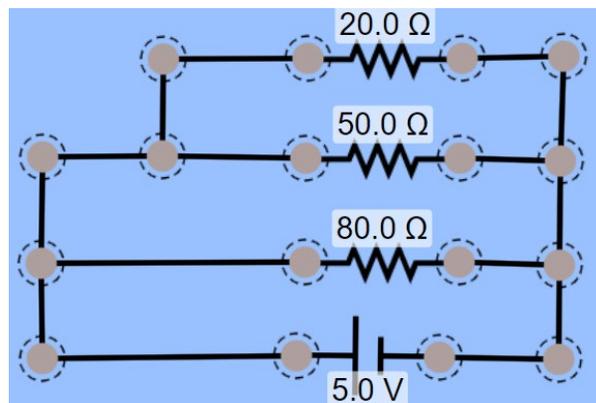


Figure 6

14. Repeat procedures from 7 to 12, record the data in table 1, and find the percentage difference.

Data Table 1

Resistance: R_1 : _____ R_2 : _____ R_3 : _____

	Series				Parallel			
	Measured Voltage	$I_{calculated}$ (Ohm law)	Measured Current	% difference	Measured Voltage	$I_{calculated}$ (Ohm law)	Measured Current	% difference
R_1								
R_2								
R_3								
R_{12}								
R_{total}								

Your Lab Report Should Include the Following

1. Lab theory
2. Your build circuit photo
3. Procedures
4. Your circuit setup photo which shows voltage V_{12} [across the two R_1 and R_2 (resistor R_{12})] measurement; and circuit setup photo which shows current I_{12} [pass through the two resistor R_1 and R_2 (resistor R_{12})] measurement.
5. Data Table 1
6. Conclusion