

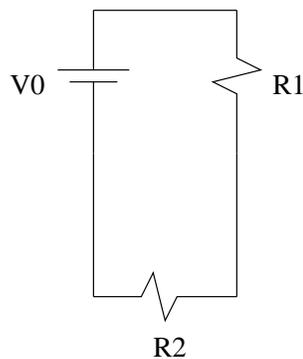
Kirchhoff's Laws

The purpose of this lab is to discover Kirchhoff's Voltage Law and Kirchhoff's Current Law by making voltage and current measurements on circuits. You are not expected to know these laws in advance.

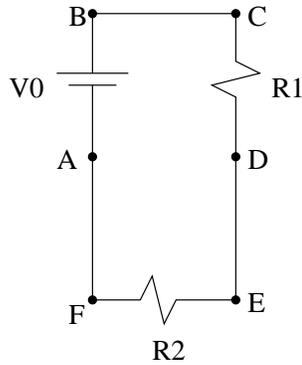
1 Kirchhoff's Voltage Law

The purpose of this section is to discover Kirchhoff's Voltage Law by making voltage measurements and noticing a pattern.

1. Please construct the circuit shown below. You will need the DC voltage supply at the end of the lab bench, two resistors, and three wires. Please choose two resistors that don't have the same resistance. Set the DC supply voltage to 12 V. (You need to measure this with the voltmeter.)



We say that the two resistors are *in series* in this circuit. It will be useful for our later work to label some points on the circuit. We choose to label the points where wires connect to circuit elements.



When you measure voltage with the voltmeter, you need to put the black lead somewhere and you need to put the red lead somewhere. So, voltage is a measurement *between* two points on the circuit. It is helpful to have a notation that reflects this fact. So, we will use the symbol V_{BA} to represent the voltage measured when you put the red lead at point B on the circuit and the black (“common”) lead at point A. Similarly, V_{AB} represents the voltage measured with the red lead at point A and the black lead at point B.

2. Measure the following voltages and record them in the table below.

V_{BA}	
V_{CB}	
V_{DC}	
V_{ED}	
V_{FE}	
V_{AF}	

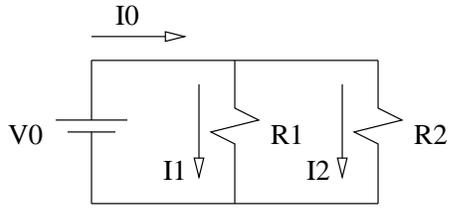
3. What do you notice about the voltages across wires? (The voltages across wires are the voltages you measured with the voltmeter leads on opposite sides of a wire, like V_{CB} , V_{ED} , and V_{AF} .)

V_{CB}	
V_{FC}	
V_{EF}	
V_{BE}	

9. What do you notice about these voltages?

10. Consider the “big” loop of the circuit that goes $A \rightarrow B \rightarrow C \rightarrow F \rightarrow E \rightarrow D \rightarrow A$. Measure the voltages between adjacent points along this loop and record them in the table below. If you have measured some of these voltages already, you don’t need to measure them again.

V_{BA}	
V_{CB}	
V_{FC}	
V_{EF}	
V_{DE}	
V_{AD}	



We say that the two resistors in this circuit are *in parallel*.

2. Measure each of the currents labeled in the diagram.

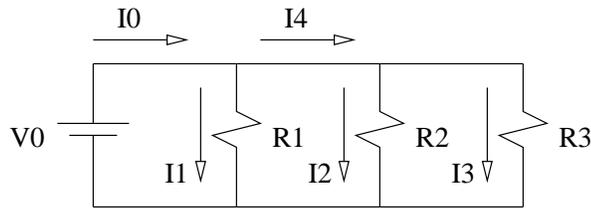
REMEMBER: Measuring current is different from measuring voltage. It is easy to blow the fuse on the current meter. Do not hesitate to check with your instructor before connecting the current meter to the circuit.

Current I_0	
Current I_1	
Current I_2	

3. What relationship do you see among the currents that you measured?

4. Write a sentence that generalizes this last relationship that you noticed into something that sounds like a general rule. You have just written a preliminary version of Kirchhoff's Current Law. (Please check this with your instructor.)

Let's see how Kirchhoff's Current Law works for a more complicated circuit. Please build the circuit below.



5. Measure the currents listed in the table below.

Current I_0	
Current I_1	
Current I_4	

6. What relationship do you see among these currents?

7. Measure the currents listed in the table below.

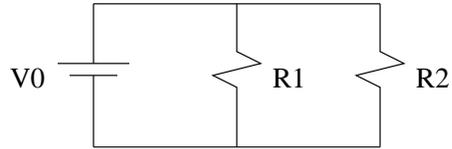
Current I_2	
Current I_3	
Current I_4	

8. What relationship do you see among these currents?

9. Write a sentence that brings together what you have learned about currents into a general rule. (In other words, try to write an improved version of Kirchhoff's Current Law.) Please check this with your instructor.

3 Questions

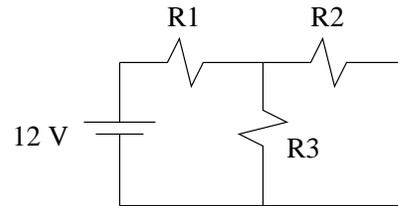
1. Consider the circuit below.



Label points on the circuit with letters. What does Kirchhoff's Voltage Law have to say about this circuit? (Give an answer in words.)

2. Write down equations expressing Kirchhoff's Voltage Law for the circuit above. Your equations should contain voltages between points, like V_{BA} . If you are unsure about what Kirchhoff's Voltage Law says about this circuit, you could construct the circuit and make some voltage measurements.

3. Consider the circuit below.



Label this circuit with arrows for currents, and give the currents names like I_1 . What does Kirchhoff's Current Law have to say about this circuit? (Give an answer in words.)

4. Write an equation expressing Kirchhoff's Current Law for the circuit above. Your equations should contain currents like I_1 . If you are unsure about what Kirchhoff's Current Law says about this circuit, you could construct the circuit and make some current measurements.