

Kirchhoff's Voltage Law

Procedures

Kirchhoff's Voltage Law, or KVL, states that the total voltage around any closed loop is equal to zero. The lesson below provides a hands-on demonstration of KVL.

Students will be able to:

- Describe and use Kirchhoff's Voltage Law to solve problems
- Use a multimeter to measure voltage
- Understand the basic circuitry of batteries

Materials needed:

- Vex long angle rail
- 3 AA Batteries
- 1 9 volt battery
- 1 Digital multimeter

Set Up

1. If you are not familiar with the multimeter, go through the slide show resources/ Multimeter. It will explain how to use the multimeter.
2. Prepare the multimeter to measure direct current voltage. Plug the red lead into the voltage/resistance port, and the black lead into the com port. Switch the multimeter selector to direct current voltage (on most multimeters, it is marked by a V with a straight line and a dotted line over it.)



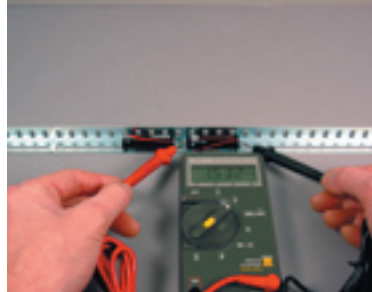
3. Place a battery on the long angle rail. Measure the anode (+) to cathode (-) voltage with the multimeter by placing the red lead on the anode, and the black lead on the cathode. Record the value on your worksheet beside " V_{AB} ".



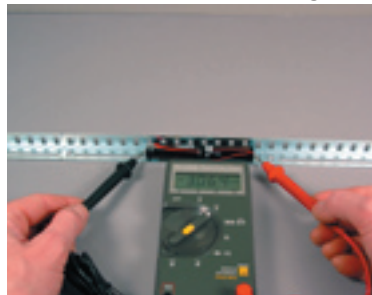
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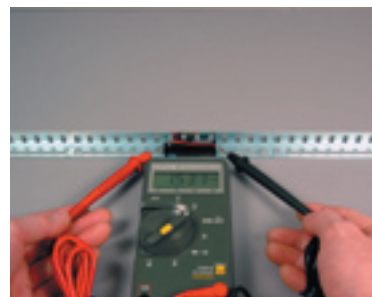
4. Place a second battery on the long angle rail. Measure the anode (+) to cathode (-) voltage of the second battery with the multimeter. Record the value on your worksheet beside " V_{BC} ".



5. Place the two batteries in series on the long angle rail. The cathode of battery 1 should touch the anode of battery 2. Place the red lead on the cathode of battery 2, and the black lead on the anode of battery 1. Record the value on your worksheet beside " V_{CA} ".



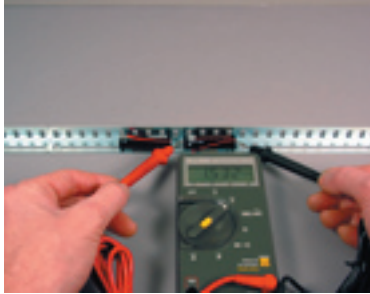
6. On your worksheet, insert the values you found in their proper places in the Kirchhoff's Law equation $V_{AB} + V_{BC} + V_{CA} = 0$. Has this experiment demonstrated Kirchhoff's law?
7. Place 3 batteries on the long angle rail. Measure the anode (+) to cathode (-) voltage of the first battery with the multimeter. Record the value on your worksheet beside " V_{AB} ".



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8. Measure the anode (+) to cathode (-) voltage of the second battery with the multimeter. Record the value on your worksheet beside " V_{BC} ".



9. Measure the anode (+) to cathode (-) voltage of the third battery with the multimeter. Record the value on your worksheet beside " V_{CD} ".



10. Keep the cathode of battery 1 touching the anode of battery 2, and the cathode of battery 2 touching the anode of battery 3. Place the red lead on the cathode of battery 3, and the black lead on the anode of battery 1. Record the value on your worksheet beside " V_{DA} ".



11. On your worksheet, insert the values you found in their proper places in the Kirchhoff's Law equation $V_{AB} + V_{BC} + V_{CD} + V_{DA} = 0$. Has this experiment demonstrated Kirchhoff's law?
12. On your worksheet, answer the following question: If you want to create a voltage source as close as possible to 12 volts that includes a 9 volt battery, how many AA batteries would you include?
13. On your worksheet, answer the following question: If you want to create a voltage source as close as possible to 18 volts that includes a 9 volt battery, how many AA batteries would you include?