# Parallel Circuits

**OBJECTIVES**

Students will…

- Discover the characteristics of a circuit when resistors are arranged in parallel.

**MATERIALS**

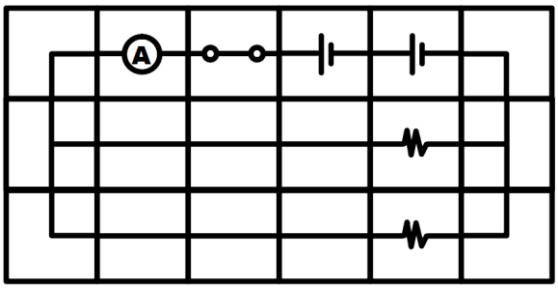
- PASCO modular circuits kit, PASCO wireless voltmeter, PASCO wireless ammeter

**SAFETY**

- Be vigilant not to drop or break the electric circuit kit components.
- Leave your switches in the open position when not taking measurements.

**PROCEDURE**

1. Create a circuit that matches the schematic diagram below. Use the 10 Ω resistor in the middle row (“branch”) and the 33 Ω resistor in the bottom branch. LEAVE THE SWITCH IN THE OPEN POSITION.




2. Open Capstone and create a graph of current versus time. Then use the symbol shown below to add a second graph. Put voltage on the y-axis and time on the x-axis of the second (bottom) graph.

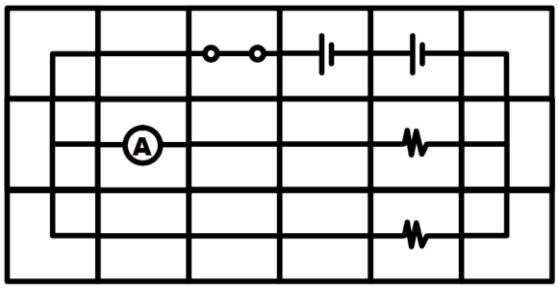
3. Turn on the ammeter. This will allow you to read the current that runs “through” the circuit. Remember to leave the switch in the open position.
4. Turn on the voltmeter and clip the red “positive” lead onto the tab on the side of the positive end of the batteries. Clip the black “negative” lead onto the tab on the negative end of the batteries. This will allow you to measure the voltage “across” the resistor. Remember that the switch should still be in the open position. (Pro

Tip: Be sure your batteries are oriented exactly as shown in the schematic diagram.)

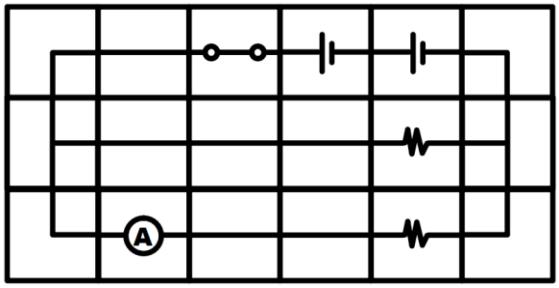
5. Press record on Capstone. Close the switch and allow current to run through the circuit for a second or two. THEN OPEN THE SWITCH and stop recording. Be sure that the switch is open when you are not recording.
6. Highlight the portion of the graph showing the time when the current ran through the circuit. Then press the ∑ symbol at the top of the graph to find the mean current. Record the mean current in a data table like the one below. (You will fill in other values later.)

| | Resistance (Ω) | Current (A) | Voltage (V) |
|---|---|---|---|
| | 10 | Step 9 | Step 9 |
| | 33 | Step 11 | Step 11 |
| Totals | Step 12 | Step 6 | Step 7 |

7. Highlight the portion of the Voltage versus Time graph showing the time when the current ran through the circuit. (This should be the same time period as that measured in step six.) Then press the ∑ symbol at the top of the graph to find the mean voltage across the batteries. Record it in the data table where indicated.
8. Remove the ammeter and the wire below the ammeter and switch their locations to rebuild the circuit as shown below.



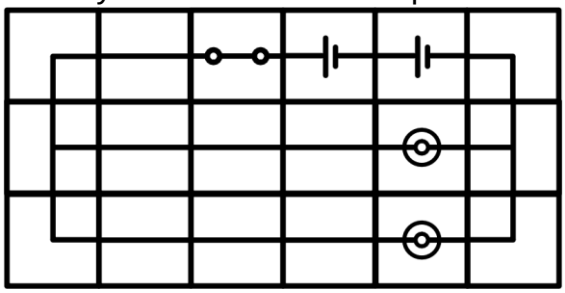

9. Unhook the voltmeter leads and place them across the 10 Ω resistor (the one in that branch) so that the positive lead is next to the end of the resistor that is closest to the positive end of the batteries and the negative lead is next to the end of the resistor that is closest to the negative end of the batteries. (Be sure your battery terminals are oriented as shown in the schematic diagram.) Press record and close the switch for one or two seconds. THEN OPEN THE SWITCH. Record the current in the 10 Ω resistor branch and the voltage across that resistor.
10. Rearrange the ammeter with the wire below the ammeter in the bottom branch so that your circuit looks like the one below.




11. Repeat step 9 so that this time you are measuring the current through the bottom branch and the voltage through the 33 Ω resistor. Record these in the data table.
12. Calculate the total resistance using Ohm's law and the total values for current through and voltage across the batteries. Write this in the data table.
13. Recreate the data table starting with what's shown below. Label this table "If this were a series circuit…" Use the voltage from step 7 as the total voltage.

| | Resistance (Ω) | Current (A) | Voltage (V) |
|---|---|---|---|
| | 10 | | |
| | 33 | | |
| Totals | | | Step 7 |

14. Run calculations to fill out the rest of the table as if this were a SERIES circuit.
15. Analysis:
    a. Compare the total resistance in the parallel circuit to what it would be if this were a series circuit.
    b. Compare the total current in the parallel circuit to what it would be if this were a series circuit.
    c. Compare the voltage across each resistor in the parallel circuit to what it would be if this were a series circuit.
16. Replace the resistors with light bulbs. The brightness of the light bulbs will indicate how much current is running through that part of the circuit. Therefore you can remove the ammeter and replace it with a wire or a jumper cable or you can shrink the width of the circuit by removing excess wire. The bulb in the middle branch will be Bulb A, and the bulb in the bottom branch will be Bulb B. You will no longer need your voltmeter and Capstone.



17. Close the switch. Both bulbs should light up.
18. Let's mess with the branches and see what the impact is on the other branches.

a. Unscrew the bulb in the middle branch. Write (and complete) this sentence: “When Bulb A is disconnected, there (is/is not) current through Bulb A, and the current in Bulb B (stops/continues).”
b. Now reconnect Bulb A and unscrew Bulb B. Write (and complete) this sentence: “When Bulb B is disconnected, there (is/is not) current through Bulb B, and the current in Bulb A (stops/continues).”
c. Speculate about a rule regarding what happens to current through one branch when a change is made to another branch.
d. When you open the switch in the main part of your circuit, current to both branches stops. Speculate about why this is.