Northeast Community College
Diversified Manufacturing Technology

Parallel Circuits

Name: _____ Date: _____

PURPOSE:

The following experiment is designed to illustrate the major characteristics of a parallel circuit. It will provide experience in measuring and calculating electrical quantities in parallel circuits.

DISCUSSION:

Circuits consisting of just one battery and one load resistance are very simple to analyze, but they are not often found in practical applications. Usually, we find circuits where more than two components are connected together.

There are two basic ways in which to connect more than two circuit components: *series* and *parallel.* Every circuit combination, regardless of its complexity, has resistance. Because most circuits are complex it is not practical to measure each component. Therefore, knowing a few simple rules can help you to better understand the type of circuit in which you are dealing.

In a parallel resistive circuit, the total resistance is always less than the resistance value of the smallest resistor of that circuit. As more branches are added to a parallel circuit there are more paths for current, thus total circuit current increases. In other words, as current increases, the resistance decreases if there is no change in the amount of voltage applied.

Like resistance for series circuits, a simple mathematical equation can be used to calculate the total resistance of a parallel circuit.

$$\text{Total Resistance} = \frac{1}{\frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} \ldots}$$

> The total resistance of two or more resistors connected in parallel is equal to the reciprocal of the sum of the reciprocals.

One can also use the sum of individual currents across each resistor to determine total resistance of a parallel circuit. Total Current (I_T) = Current of Resistor 1 (I_{R1}) plus the current of resistor 2 (I_{R2}) plus the current of resistor 3 (I_{R3}) and so on.

$$I_T = I_{R1} + I_{R2} + I_{R3} \ldots$$

PROCEDURE:

1. Using the PHET Circuit Construction Kit, construct the circuit identified as Figure 7-1.

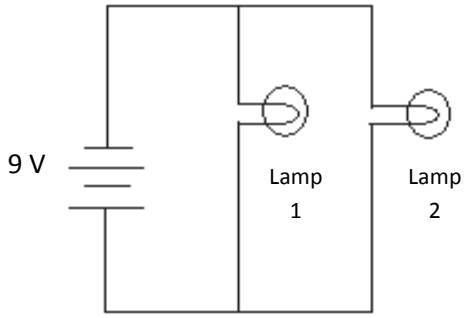


Figure 6-1

a. Measure the voltage and current across the terminals of the battery and across the terminals of each lamp.

   Battery _____V Lamp 1_____ V Lamp 2_____V

   Battery _____A Lamp 1_____ A Lamp 2_____A

   Are all of the voltages the same? _____

b. Remove lamp 1 from the circuit. (Do not connect the wires where the lamp was removed). Did the voltage and/or current across lamp 2 change? Why or why not?

c. Did the brightness of lamp 2 change when lamp one was removed? _____

d. Replace lamp 1 and remove lamp 2 from the circuit. (Do not connect the wires where the lamp was removed). Did the voltage and/or current across lamp 1 change? Why or why not?

e. Did the brightness of lamp 1 change when lamp 2 was removed? _____

f. Reinstall lamp 2 into the circuit. Add a 100Ω resistor in parallel, as shown in Figure 7-2. Did the addition of the resistor change the brilliancy (brightness) of Lamp 1 or Lamp 2?

   Yes or No

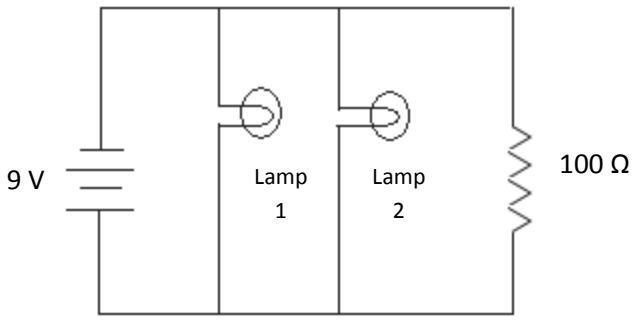


Figure 7-2

g. Does your data indicate that each branch of a parallel circuit is independent of the other branches? Yes or No

h. Construct the circuit as shown in Figure 7-3. Inserting the ammeter (or you can use the non-contact ammeter) at the locations identified as A, B, C…. Record the current.

A = _____A D = _____A G = _____A

B = _____ A E = _____A H = _____A

C= _____ A F = _____A I = _____A

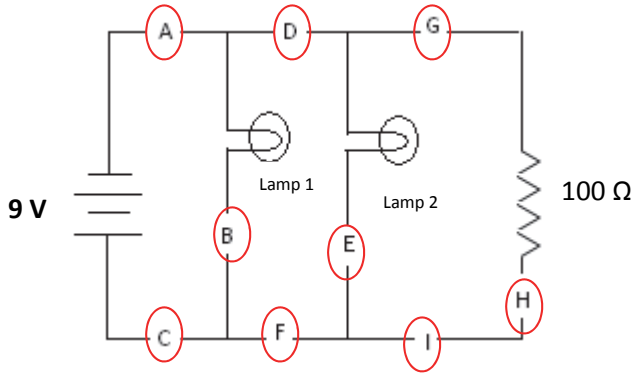


Figure 7-3

i. The sum of the branch currents should equal the total current. What is the total current of the circuit?

_____Ω

j. When you measured points A, D, and G the values were significantly different. Discuss why they are different and what they are measuring in terms of branches.

k. Does it matter where you obtain your measurements when measuring parallel circuits? Why or Why Not?

2. Using the PHET Circuit Construction Kit, construct Figure 7-4. In a live system you would need to remember to measure the resistance before power is applied to a circuit.

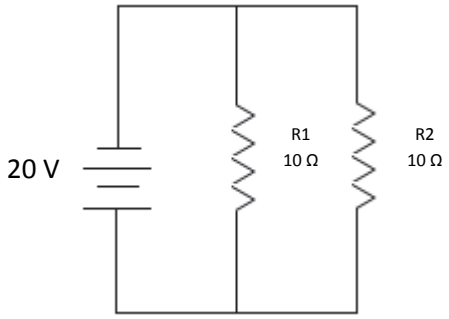


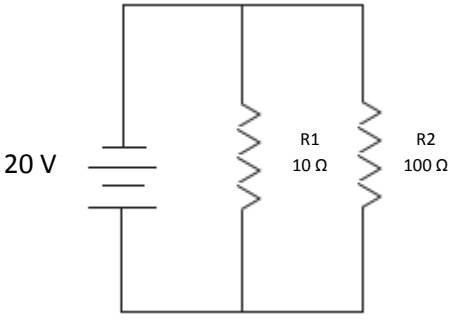
Figure 7-4

a. Does changing the resistance value of R2 from 10Ω to 100Ω affect the current in R1?

b. Does the sum of the branch currents equal the total current?

c. Which resistor, R1 measuring 10Ω or R2 measuring 100Ω, uses more power?

3. Construct the circuit shown in Figure 7-6.



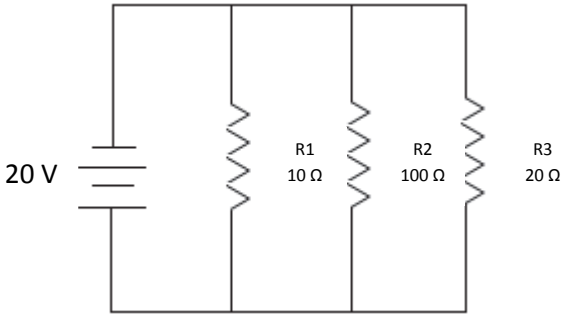


Figure 7-5 Figure 7-6

a. Measure and record the current of the total resistance and that of each resistor.

Total Circuit _____A R1_____A R2_____A R3_____A

b. Would the measured current values of R1 and R2 be the same as there were for the circuit of Figure 7-5?

c. Is R3 equal to the difference between the total current (Figure 7-6) and the total current (Figure 7-5).

d. How much current flows in the conductors that connect R1 to R2 (Figure 7-6).

e. Which of the resistors (R1, R2, or R3) in Figure 7-6 has the least resistance? _____

f. Which of the resistors (R1, R2, or R3) in Figure 7-6 draws the most current? _____

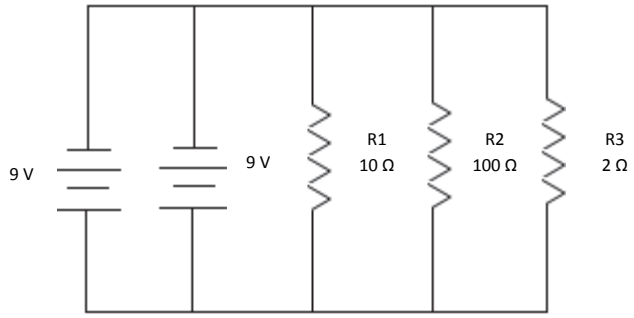
g. Which of the resistors (R1, R2, or R3) in Figure 7-6 consumes the most power? _____.

h. Will the total resistance in Figure 7-6 be more than or less than 10Ω? _____

i. Which of the resistors (R1, R2, or R3) in Figure 7-6 dissipates the most power? _____

j. Which of the resistors (R1, R2, or R3) in Figure 7-6 draw the least current? _____

4. Using the PHET Circuit Construction Kit, construct Figure 7-7.



a. Using the voltmeter, measure and record the circuit voltage? _____V

b. Did connecting the batteries in parallel affect the overall circuit voltage?

c. Measure and record the current across each battery.

Battery 1 _____ A Battery 2 _____A

d. What is the relationship between power source in parallel and current? (Use your circuit to investigate).

e. What do you think would happen if you replaced the 9 volt battery (furthest to the left) with a 10 volt battery?

f. Using the Circuit Construction Kit test your theory to 4(e). Explain the results.

g. Reset your circuit to that shown in Figure 7-7. Replace battery number 2 with a 10 volt battery. Discuss what happens and why.

Resources:

1. Learnabout-electronics.org (n.d.). Sine Wave Peak Voltage. Retrieved from http://www.bing.com/images/search?q=Peak+to+Peak+Value&view=detailv2&&id=8DA4EB89D0F569463C4758FDFFB0DEF3035D8367&selectedIndex=5&ccid=JxCjvh18&simid=608008383454317307&thid=OIP.M2710a3be1d7c170a601bae82b299afcao0&ajaxhist=0

2. University of Colorado Boulder (n.d.). PhET - Circuit Construction Kit.

   Founded in 2002 by Nobel Laureate Carl Wieman, the PhET Interactive Simulations project at the University of Colorado Boulder creates free interactive math and science simulations. PhET sims are based on extensive education research and engage students through an intuitive, game-like environment where students learn through exploration and discovery.

3. Grant Statement

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