Physics Lab #2: Parallel and Series Circuits

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Abstract: In this lab, the resistance of parallel and series circuits were found through calculation and measurement. The lab was unsuccessful because in parts two and three, the percent errors were over 5%, but part four was successful.

Theory: The formula to determine the resistance in a series circuit can be found by applying Kirchoff's Voltage Law and Ohm's Law. The current flowing through a circuit can be assumed to be the same, because there is only one path through the circuit for the current to take. The sum of the voltages across components must equal the total current supplied by the power supply, so the equation we receive is $R_{tot}=\sum R$.

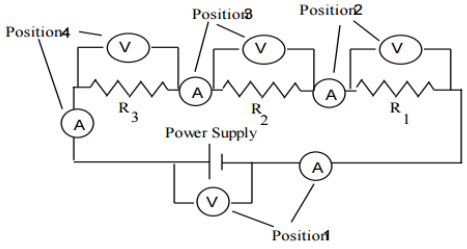
The formula to determine the resistance in a parallel circuit can be found by applying Kirchoff's Current Law and Ohm's Law. The voltage across all resistors is the same in parallel, and the current varies dependent on resistance. With this information, the equation for resistance in parallel circuits is $R_{tot}=\frac{1}{\sum \frac{1}{R}}$

Objective: The objective of the lab was to look at the properties of parallel and series circuits, like resistance, voltage, and current.

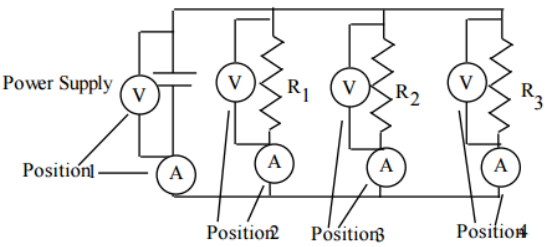
Procedure: First, the resistance of the three resistors were measured. Then, the three resistors were put in series with one another, and the voltage drop across each resistor was measured. The current between each resistor was then measured. The voltage drop across the entire circuit was also measured, and so was the current. Next, the resistors were put in parallel, and all the same things were measured. Next, two resistors were put in parallel, and those two were put in series with the last resistor, and the same values were measured. Finally, the voltage and current across a light bulb were measured as the voltage supplied changed.

Setup:

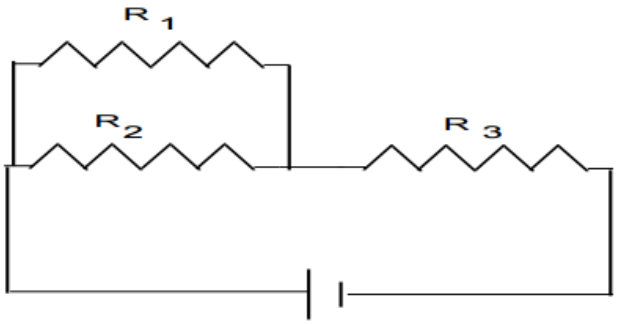
Part two



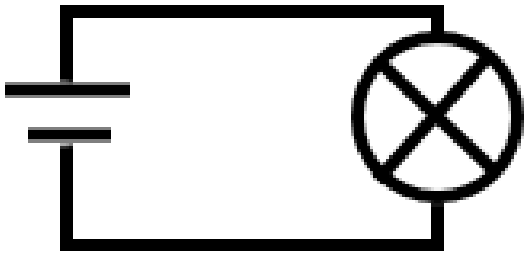
Part three



Part four



Part five



Data:

Part 1

	R_meas (Ω)
R1	5130
R2	1010
R3	9880

Part 2 Series

	V (V)	I (A)
P1	0.634	0.0000603
P2	0.063	0.0000605
P3	0.329	0.0000603
P4	1.029	0.0000603

Part 3 Parallel

	V (V)	I (A)
P1	1.02	0.000102
P2	1.02	0.000196
P3	1.02	0.000936
P4	1.03	0.001181

Part 4 Complex

	V (V)	I (A)
P1	0.0798	0.000015
P2	0.08	0.000078
P3	0.949	0.000095
P4	1.03	0.000095

Part 5 Lightbulb

V (V)	I (A)
0	0
0.5	0.03
1	0.05
1.5	0.06
2	0.07
2.5	0.08
3	0.09
3.5	0.1
4	0.11
4.5	0.12

Calculations:

Part One:

Series Resistance:

$$R = R_1 + R_2 + R_3 = 5130\Omega + 1010\Omega + 9880\Omega = 16020\Omega$$

Parallel Resistance:

$$R = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}} = \frac{1}{\frac{1}{5130\Omega} + \frac{1}{1010\Omega} + \frac{1}{9880\Omega}} = 777.5\Omega$$

Part Two:

Calculated Resistance:

$$R_{calc} = \frac{V}{I} = \frac{0.634\,V}{6.03*10^{-5}\,A} = 10500\,\Omega$$

Part Five:

Calculated Power:

$$P = V*I = 0.5\,V*0.03\,A = 1.5*10^{-2}\,W$$

Qualitative Error Analysis: One error for this lab is that resistors all have their own error range, so that can throw off the results. Another error is that the breadboard was most likely adding resistance to the circuit, making the measured current values smaller and increasing the total calculated resistance.

Quantitative Error Analysis:

Part One: N/A

Part Two:

Percent Error: 6.19%

Part Three:

Percent Error: 6.32%

Part Four:

Percent Error: 0.67%

Part Five: N/A

Results:

Part One:

Series Resistance: 16020 Ω

Parallel Resistance: 777.5 Ω

Part Two:

	Calc R (Ω)
P1	10500
P2	1040
P3	5450
P4	17100

Total Resisance: 17000 Ω

Part Three:

	Calc R (Ω)
P1	10000
P2	5200
P3	1090
P4	872

Total Resistance: 826 Ω

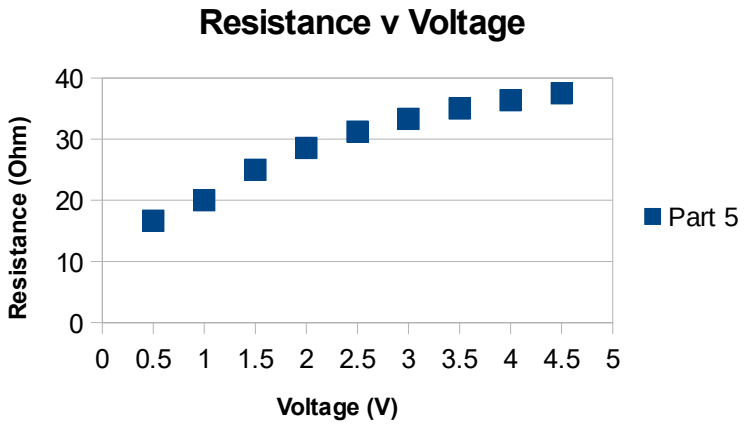
Part Four:

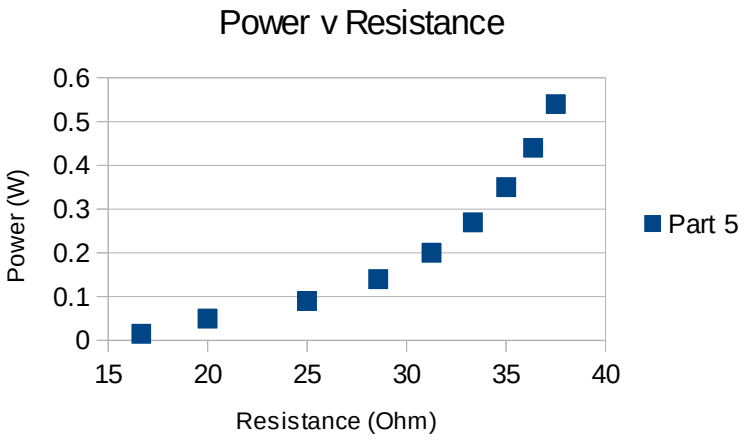
	Calc R (Ω)
P1	5320
P2	1025.64103
P3	9989.47368
P4	10842.1053

Total Resistance: 11000 Ω

Part Five:

V (V)	R (Ω)	P (W)
0.5	16.67	0.015
1	20	0.05
1.5	25	0.09
2	28.57	0.14
2.5	31.25	0.2
3	33.33	0.27
3.5	35	0.35
4	36.36	0.44
4.5	37.5	0.54





Conclusion: This lab was unsuccessful because our percent error was over 5% for part two and three. Part four was successful, however the lab was successful only one of three times. Part one and five had no percent error or ways to determine success.