

Series & Parallel Resistors Activity

Purpose

Students will explore how voltages across resistors and currents going through resistors behave under various combinations of resistors in series and parallel. The students will also build circuits and verify the voltages, currents, and resistances using a multimeter.

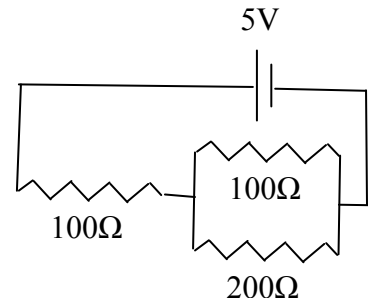
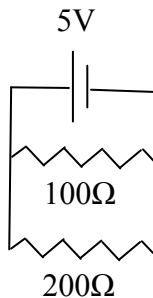
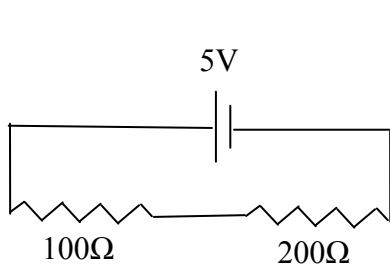
Part I: Series & Parallel Combinations with Two and Three Resistors (40 pts total)

Calculate the total resistance of each circuit, the voltage across each resistor and the current going through each resistor for the circuits drawn below. After you have theoretically determined the resistances, voltages and currents, assemble each circuit using the two 100Ω resistors and the 200Ω resistor your group has been provided, and verify the voltages and currents using a multimeter.

You have only been provided one multimeter, so you will need to convert back and forth from a voltmeter to an ammeter. The currents flowing through the resistors will be in the milliamp range (10^{-3} Ampere). Therefore, you will need to use the (mA) and (COM) ports of the multimeter and the 200mA setting on the multimeter dial when you are using the multimeter as an ammeter.

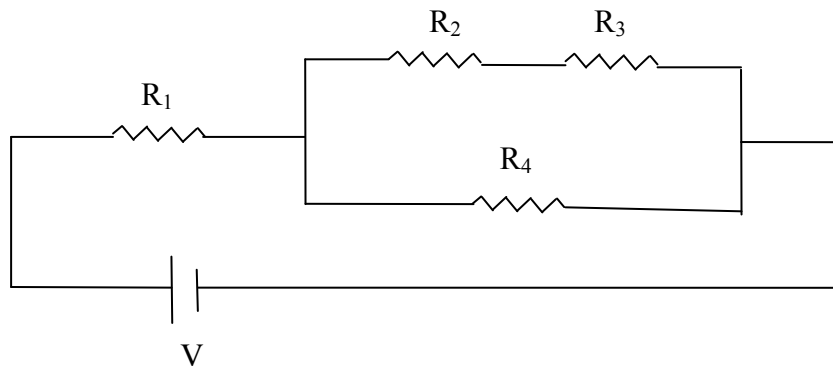
Make sure each member of the group understands how to use a multimeter to measure voltage and current. A group member will be chosen at random to take measurements in Part II, and the group's score will depend on the ability of the group member to measure the voltage and/or the current using a multimeter. Also be aware that your group will be allowed to blow one fuse in the multimeter. After you have blown your first fuse, each additional fuse will result in a grade deduction. Specifically if an ammeter is connected in parallel with a resistor, the current reading will be ambiguous, and the multimeter fuse may be blown.

Note the tolerance of each resistor is 1% so your measurements may not match your calculated values exactly, but they should be very close.



Part II: Series and Parallel Combinations using Four Resistors (60 pts total)

Your group will use the schematic below (also located on the Data Sheet) to design a circuit that will meet the three (3) criteria your group has been assigned. Your TA will assign your group one of the 12 sets of conditions from the table below. Your group must use **two 100Ω** resistors, **one 200Ω** resistor, and a **50Ω** resistor, and only these values, to build your circuit by assigning them to the correct positions in the circuit below. When you are confident that your group has designed your circuit properly and your group has calculated the current that will pass through the 50Ω resistor, your TA will come to your station and provide your group with a 50Ω resistor and test your group's knowledge of the circuit.



Individuals from your group will be randomly selected to use the multimeter to determine the voltage across the 200Ω resistor and the current through the 50Ω resistor. The individuals selected will be responsible for properly setting and connecting the multimeter to the circuit, and the group will be given a score based on the individual's attempt. If the individual fails to properly set and connect the multimeter, another individual within the group will be given a chance, but the point value will incrementally be reduced. This process will continue until the point value is down to zero.

	Power Supply Voltage (V)	Total Resistance (Ω)	Position of 50Ω Resistor in the Schematic	Voltage Across 200 Ω Resistor (V)
1	11	150.00	R ₁	7.33
2	11	125.00	R ₁	4.40
3	11	185.71	R ₂	5.08
4	11	171.43	R ₂	3.67
5	11	142.86	R ₄	2.20
6	11	260.00	R ₂	8.46
7	8	150.00	R ₁	5.33
8	8	125.00	R ₁	3.20
9	8	185.71	R ₂	3.69
10	8	171.43	R ₂	2.67
11	8	142.86	R ₄	1.60
12	8	260.00	R ₂	6.15

Name: _____

Name: _____

Name: _____

Name: _____

Data Sheet

Series and Parallel Resistors

Hints:

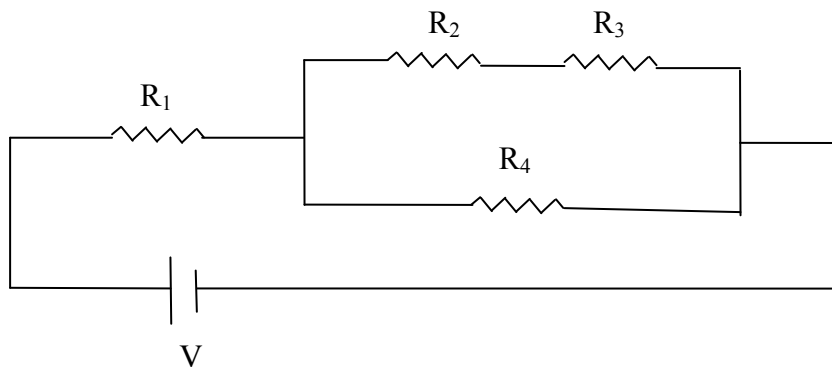
1. Voltmeters and Ammeters must be used in such a way as not to alter the circuit. When a meter is inserted in a circuit, the meter should not allow a significant amount of current to be diverted from the component(s) to which the meter was connected. Remember that current is lazy, and current will take the path of least resistance.
2. A voltmeter will typically have a resistance on the order of a $M\Omega$. Consider a $100\ \Omega$ resistor in parallel with a $1,000,000\ \Omega$ resistor. What percentage of the current will go through the $1,000,000\ \Omega$ resistor?
3. To read the voltage across a resistor with a voltmeter, connect the voltmeter in parallel with the resistor. This is true as long as the resistance of the resistor is much less than the resistance of the voltmeter.
4. An ammeter will typically have a resistance near zero ohms. What happens if you put a jumper wire across a resistor while it is in a circuit? Does the current want to flow through the resistor or the jumper wire?
5. To read the current through a resistor with an ammeter, connect the ammeter in series with the resistor.
6. Connecting an ammeter in parallel with a resistor will result in an ambiguous current reading, and the multimeter fuse may blow.
7. For Part II, solve for the total resistance in variable form.
 - a. You may create an Excel spreadsheet to easily vary the values of the resistors.

Part I (40 points total)

Blown Fuse #	1	2	3	4	5
Point Deduction	0 pts	5 pts	10 pts	10 pts	15 pts

Score (0-40 pts): _____

Part II (60 points total)



Assigned conditions from table (circle one): 1 2 3 4 5 6 7 8 9 10 11 12

Conditions from Table			
Power Supply Voltage	Total Resistance	50Ω Resistor Position	Voltage across 200Ω Resistor

Groups predicted value of current through the 50Ω resistor: _____

Testing of the Circuit while witnessed by your TA:

Total Resistance of the circuit as read by TA prior to connecting to Power Supply (5 or 0 pts): _____

Verification of Power Supply Voltage using multimeter as read by a Group Member (5 or 0 pts): _____

Student use of Multimeter to read voltage across 200Ω resistor (10, 5, or 0 pts): _____

Turn the power supply off while connecting the multimeter.

Verification of voltage across 200Ω resistor as read by a Group Member (5 or 0 pts): _____

Student use of Multimeter to read current through 50Ω resistor (20, 15, 10, 5, or 0 pts): _____

Turn the power supply off while connecting the multimeter.

Verification of the groups predicted value of current through the 50Ω resistor (15 points): _____