Physics 1000 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.

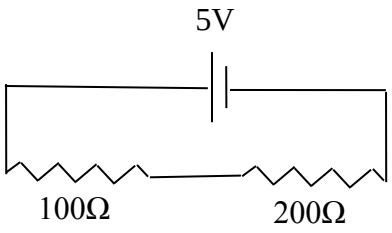
Part I: Series & Parallel Combinations with Two and Three Resistors (40 pts total)

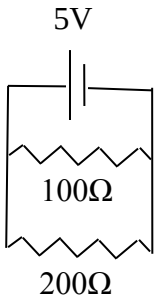
Calculate the total resistance of each circuit, the voltage across each resistor and the current going through each resistor for the circuits drawn below. After you have theoretically determined the resistances, voltages and currents, assemble each circuit using the two 100Ω resistors and the 200Ω resistor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

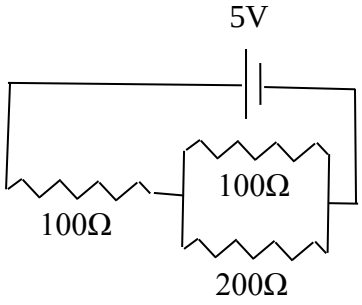
You have been provided two multimeters. The multimeter with the red and black wires will be used as a voltmeter, and the dial should be turned to the 20V setting. The multimeter with the blue (or purple) and black wires will be used as an ammeter. The currents flowing through the resistors will be in 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. When the multimeter is configured using these ports and dial settings, the ammeter is a "fused" ammeter. If you connect the ammeter to the circuit improperly, you may blow the fuse located in the multimeter. Specifically if an ammeter is connected in parallel with a resistor, the current reading will be ambiguous, and the multimeter fuse may be blown. If you blow a fuse, you will be responsible for replacing the fuse. If you blow too many fuses, your TA will begin deducting points.

Make sure each member of the group understands how to use the voltmeter and the ammeter 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.

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

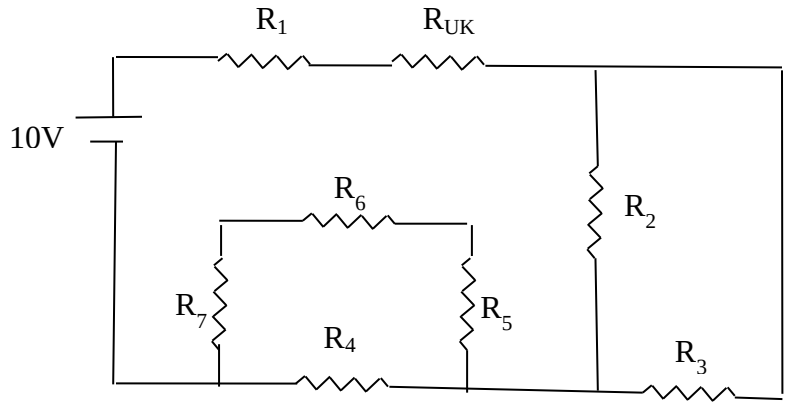






Part II: Series and Parallel Combinations using Four Resistors (60 pts total)

After your TA provides your group with a value for the total resistance of your circuit, your group will use the schematic below (also located on the Data Sheet) to calculate the value of R_{UK}, the overall current of the circuit, the voltage across R_1, the current through R_2, and the current through R_3.



In addition, individuals from your group will be randomly selected to use the voltmeter to determine the voltage across R_1. Individuals will also be randomly selected to use the ammeter to determine the current through R_2 and R_3. 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.

After you have determined your predictions, take your predictions to your TA, and the TA will witness the testing of your predictions on a circuit located at the front of the room.

R	Resistance (Ω)	R	Resistance (Ω)
R_1	100	R_4	100
R_2	50	R_5	100
R_3	50	R_6	200
		R_7	100

Name: _____ **Name: _____**

Name: _____ **Name: _____**

Data Sheet
Physics 1000 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 MΩ. Consider a 100 Ω resistor in parallel with a 1,000,000Ω resistor. What percentage of the current will go through the 1,000,000 Ω 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.

Part I (40 points total)

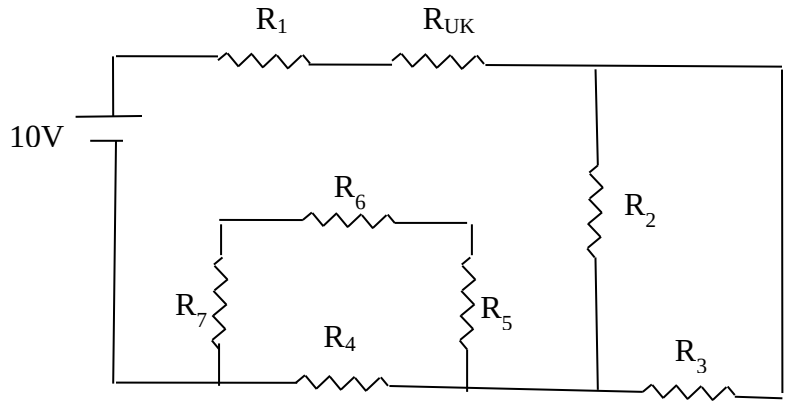
Blown Fuse #	1	2	3	4	5
Point Deduction	0 pts	0 pts	5 pts	5 pts	5 pts

Score (0-40 pts): _____

Part II (60 points total)

Your TA will prescribe the Total Resistance of the circuit and record it below. You will need to use this total resistance to make your predictions. (255, 305, or 405 ohms)

Part II (continued)



Predictions:

Value of R_{UK} necessary to make the above circuit have the total resistance as prescribed by your TA:

_____(Ω)

Power Supply Current: _____(mA) Voltage Across R_1: _____(V)

Current through R_2: _____(mA) Current through R_3: _____(mA)

Testing of the Circuit while witnessed by your TA:

Verification of the Total Resistance of the circuit as read by the TA prior to connecting to the Power Supply (20, 10, 5, or 0 points) _____

Verification of the group's predicted value for the Power Supply Current (5 or 0 points) _____

Student use of voltimeter to read voltage across R_1 (10, 5, or 0 pts)
Turn the power supply off while connecting the volimeter. _____

Verification of the group's predicted value of the voltage across R_1 (5 or 0 points) _____

Student use of ammeter to read current through R_2 (10, 7, 3, or 0 pts)
Turn the power supply off while connecting the multimeter. _____

Verification of the group's predicted value of current through R_2 (5 or 0 points) _____

Verification of the group's predicted value of current through R_3 (5 or 0points) _____