Name **Section #**

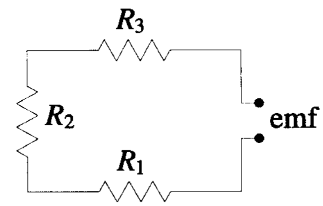
Series Circuits

Purpose

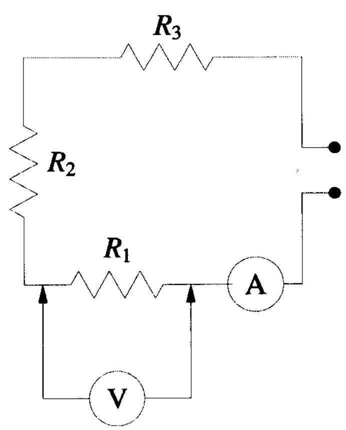
To investigate the relationship between: the total voltage and the voltage across each circuit component; the total current and the current through each component; the circuit's resistance and the resistance of each of its components.

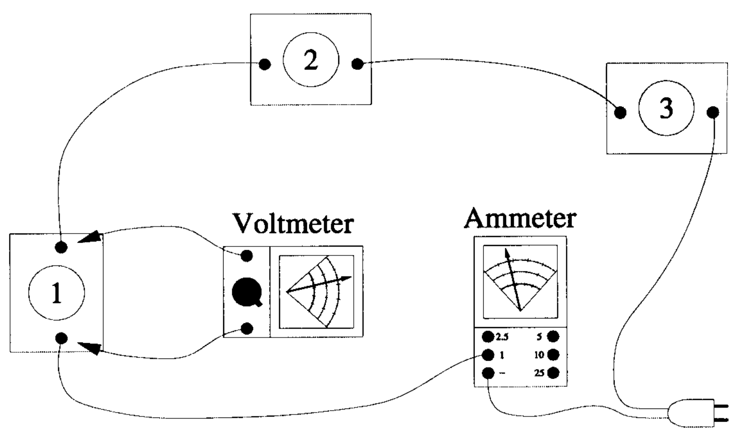
Theory

(1) $V_T = V_1 + V_2 + V_3$
(2) $I_T = I_1 = I_2 = I_3$
(3) $R_T = R_1 + R_2 + R_3$



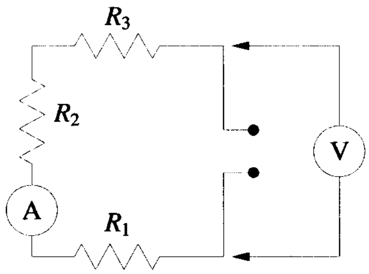
Current is confined to a single path in the series circuit. Charges emerging from the source of emf (e.g., a battery) flow from high to low potential only to be restored again to their original high potential by the source of emf. If V_T represents the potential difference across the source of emf then equation (1) seems reasonable. The source of emf neither creates nor destroys charges, it only does work on them. If an amount of charge enter a circuit element per second, an equal number must also leave that element in the same time and continue along the circuit. Thus equation (2) is justified. Equation (3) is derived by noting that $R_T I_T = V_T$, $R_1 I_1 = V_1$, etc. Substitute these expressions into equation (1). Then factor out the currents which are all equal because of equation (2).

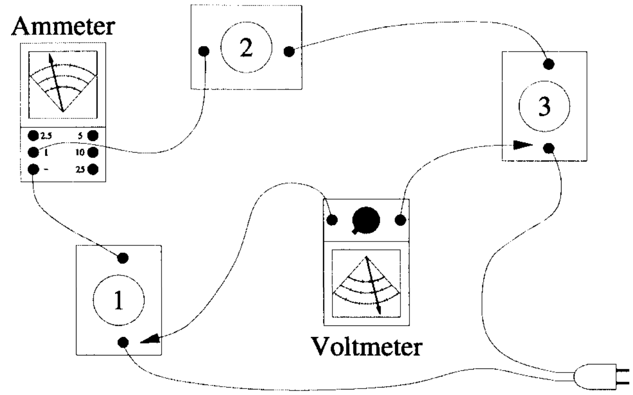




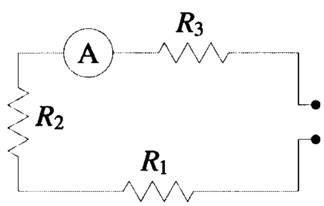
Procedure

The above diagram illustrates the manner in which I_T, the current from the source of emf, is measured. Note that the voltmeter is not connected to the circuit. In order to measure V_1, have the lead wires from the voltmeter touch the posts of R_1 as shown. *Do not allow your skin to contact the posts or the uninsulated section of the lead wires while the power is on.* You can measure V_2 by shifting the voltmeter's lead wires to the post of R_2. Use a similar procedure to measure V_3. To determine V_T, have the voltmeter leads contact each end of the power cord as illustrated in the diagram on the following page. Enter your data for I_T, V_1, V_2, V_3, and V_T in the data table.

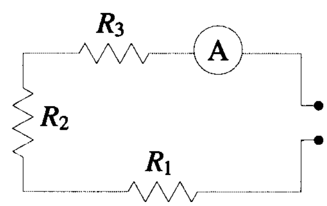




You can determine I_1 by shifting the ammeter so that it is situated between R_1 and R_2 as shown above. *All alterations must be* performed with the power disconnected. Measure I_2 and I_3 according to the schematic diagrams below and enter their values in the data table. The theoretical V_T is the sum of the individual voltages. If the currents are not all the same enter their average for the theoretical I_T. The theoretical R_T is the sum of the individual resistances.



Schematic for determining I_2 and I_3

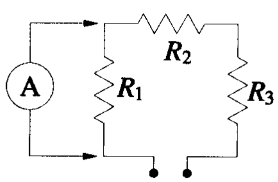


	V	I	$R\ (=\frac{V}{I})$
Bulb #1			
Bulb #2			
Bulb #3			
Total (experimental)			
Total (theoretical)			
Percent Difference			

Questions

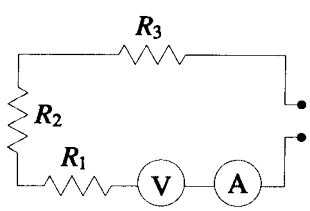
Comment as to whether your data supports equations (1), (2), and (3) of the *theory* section.

Use your voltmeter to measure the potential difference across the ammeter. V_A = ____ V
What property of the ammeter is responsible for your answer?



Remove the ammeter from your circuit and then connect it across the terminals of bulb #1 as shown in the schematic at the left. *Be certain that R_2 and R_3 are in series with the ammeter before applying the power.*

Does the current differ from your previously recorded reading? If it does, explain why, and compare the present brightness of the bulbs to what it was before.



Connect the ammeter and voltmeter in series with each other and with the bulbs as shown in the schematic at the left. Apply the power and record the reading of each meter.

Describe the appearance of the bulbs and offer an explanation for your observations.

Exercise

An electric motor, rated at 0.12 A and 48 V, is connected in series with an unknown resistor R to a 120-volt line. Assume that R has been chosen so that the motor operates at its listed rating.

Draw a schematic and then determine:

(a) the voltage across R;

(b) the current through R; and,

(c) the resistance of R.