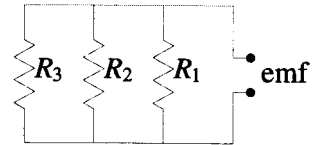# Parallel Circuits

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) $\dfrac{1}{R_T} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}$

Since the bottom ends and the top ends of each of the components in the above circuit are at the same potential, the potential difference across each of them must be the same. Equation (1) follows as a result. Current from the source of emf is divided into three branches from which we obtain equation (2). Equation (3) is derived by noting that $\dfrac{V_T}{R_T} = I_T$, $\dfrac{V_1}{R_1} = I_1$, etc. Substitute these expressions into equation (2). Then factor out the voltages which are all equal because of equation (1).

Note that the equivalent resistance of the circuit, R_T from equation (3) is less any of the individual resistances. This is because providing more paths for current to flow is similar to increasing the cross sectional area of a conductor.
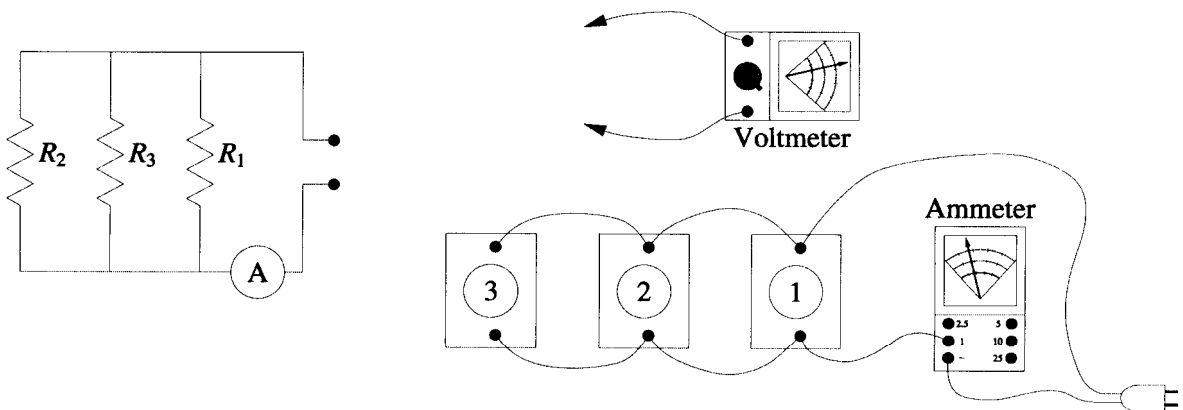
Procedure

The above diagram illustrates how I_T, the current the current supplied to all the bulbs, is measured. You can measure I_1 by unscrewing bulbs 2 and 3. To obtain I_2 unscrew bulbs 1 and 3. I_3 can be obtained by unscrewing bulbs 1 and 2. Use your voltmeter to measure the potential difference across bulbs 1, 2, and 3, and also across the power cord for V_T. Enter your data for the voltages and currents in the data table on the next page. If $V_1, V_2,$ and V_3 are not all the same, calculate the average and enter its value as the theoretical V_T. The theoretical I_T and the theoretical R_T are calculated from equations (2) and (3).

	V	I	$R\ (=\dfrac{V}{I})$
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.

List as many differences as you can between series and parallel circuits.

Cite one instance where it is appropriate to connect electrical devices in parallel rather than in series. Cite one instance where the reverse is true.

Exercise

Two bulbs, each rated at 100 W and 120 V, are connected in parallel across a 120–volt line. Draw a schematic diagram of the circuit. For each bulb, determine:
(a) the voltage across it,
(b) the current through it,
(c) the power dissipated.
Calculate the circuit's equivalent resistance.

The same two bulbs are now connected in series to the same 120-volt line. Draw a schematic diagram for this circuit and calculate parts (a) through (d) as in the previous question.

As shown in the circuit below, 0.4 amps is flowing through the 100 ohm resistor. Supply the readings for the other five meters. You may assume the meters to be `ideal', (the ammeters having practically zero resistance, and the voltmeter—almost infinite resistance.)