

Resistors in parallel have the same potential differences across them

To explore the consequences of arranging resistors in parallel, consider the two bulbs connected to a battery in **Figure 13(a)**. In this arrangement, the left side of each bulb is connected to the positive terminal of the battery, and the right side of each bulb is connected to the negative terminal. Because the sides of each bulb are connected to common points, the potential difference across each bulb is the same. If the common points are the battery's terminals, as they are in the figure, the potential difference across each resistor is also equal to the terminal voltage of the battery. The current in each bulb, however, is not always the same.

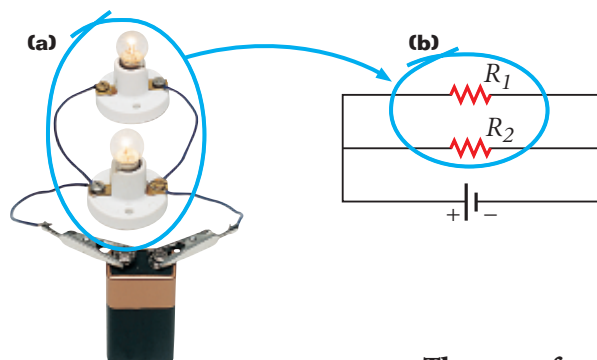


Figure 13

(a) This simple parallel circuit with two bulbs connected to a battery can be represented by (b) the schematic diagram shown on the right.

The sum of currents in parallel resistors equals the total current

In **Figure 13**, when a certain amount of charge leaves the positive terminal and reaches the branch on the left side of the circuit, some of the charge moves through the top bulb and some moves through the bottom bulb. If one of the bulbs has less resistance, more charge moves through that bulb because the bulb offers less opposition to the flow of charges.

Because charge is conserved, the sum of the currents in each bulb equals the current I delivered by the battery. This is true for all resistors in parallel.

$$I = I_1 + I_2 + I_3 \dots$$

The parallel circuit shown in **Figure 13** can be simplified to an equivalent resistance with a method similar to the one used for series circuits. To do this, first show the relationship among the currents.

$$I = I_1 + I_2$$

Then substitute the equivalents for current according to $\Delta V = IR$.

$$\frac{\Delta V}{R_{eq}} = \frac{\Delta V_1}{R_1} + \frac{\Delta V_2}{R_2}$$

Quick Lab

Series and Parallel Circuits

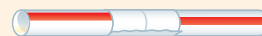
MATERIALS LIST

- 4 regular drinking straws
- 4 stirring straws or coffee stirrers
- tape

Cut the regular drinking straws and thin stirring straws into equal lengths. Tape them end to end in long tubes to form series combinations. Form parallel combinations by taping the straws together side by side.

Try several combinations of like and unlike straws. Blow through each combination of tubes, holding your fingers in front of the opening(s) to compare the airflow (or current) that you achieve with each combination.

Straws in series



Straws in parallel



Rank the combinations according to how much resistance they offer. Classify them according to the amount of current created in each.