Most electrical circuits have more than one energy source and more than one energy-consuming device. We analyze more complicated circuits using

Two or more resistors are in series if there is a single current path through all of them, so that the current through each is the same.

Using Ohm's Law, \( R = \)

The equivalent resistance for the series combination is

\[ R_s = \]

Can draw an "equivalent circuit":

In general,

Q. What is the current in this circuit? How much power is used?

A. \( R_s = \)

Ohm's law \( \Rightarrow I = \)

\( P = \)
Analyze: Adding a second resistor in series reduces the current in the circuit, and thus reduces the amount of voltage used by each resistor since $P = V^2$.

Two or more resistors are in parallel when they are all connected between the same two points on a circuit, and so the voltage across each is the same. (Example: X-mas lights).

\[
\begin{align*}
\text{Ohm's Law: } R_{\text{eq}} &= \\
\frac{1}{R_{\text{eq}}} &= \\
\end{align*}
\]

In general,

\[
\frac{1}{R_{\text{eq}}} =
\]

Q. What is the equivalent resistance of 2 resistors in parallel ($R_1 = 8\Omega$, $R_2 = 18\Omega$) with a 12-V battery? What is the current through each component?

A. \[
\begin{align*}
\frac{1}{R_{\text{eq}}} &= \\
R_{\text{eq}} &= \\
I_1 &= \\
I_2 &= \\
I &= 
\end{align*}
\]
\[ P_1 = \]
\[ P_2 = \]
\[ P = \]

Analyze:

More complicated circuits.

Q. What is the current through the battery \( I \)?
Q. What is the equivalent resistance of these three resistors?

A.