SAMPLE PROBLEM C

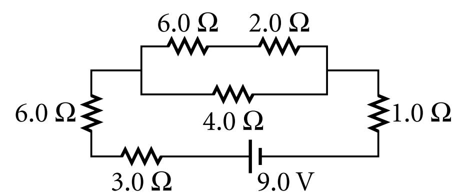
STRATEGY Equivalent Resistance

PROBLEM

Determine the equivalent resistance of the complex circuit shown below.

REASONING

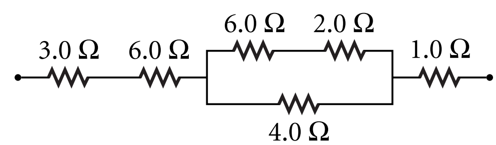
The best approach is to divide the circuit into groups of series and parallel resistors. This way, the methods presented in Sample Problems A and B can be used to calculate the equivalent resistance for each group.



SOLUTION

1. Redraw the circuit as a group of resistors along one side of the circuit.

Because bends in a wire do not affect the circuit, they do not need to be represented in a schematic diagram. Redraw the circuit without the corners, keeping the arrangement of the circuit elements the same, as shown at right.



> **TIP** *For now, disregard the emf source, and work only with the resistances.*

2. Identify components in series, and calculate their equivalent resistance.

Resistors in groups **(a)** and **(b)** are in series.

For group **(a):** $R_{eq} = 3.0\ \Omega + 6.0\ \Omega = 9.0\ \Omega$

For group **(b):** $R_{eq} = 6.0\ \Omega + 2.0\ \Omega = 8.0\ \Omega$

3. Identify components in parallel, and calculate their equivalent resistance.

Resistors in group **(c)** are in parallel.

For group **(c):**

$$\frac{1}{R_{eq}} = \frac{1}{8.0\ \Omega} + \frac{1}{4.0\ \Omega} = \frac{0.12}{1\ \Omega} + \frac{0.25}{1\ \Omega} = \frac{0.37}{1\ \Omega}$$

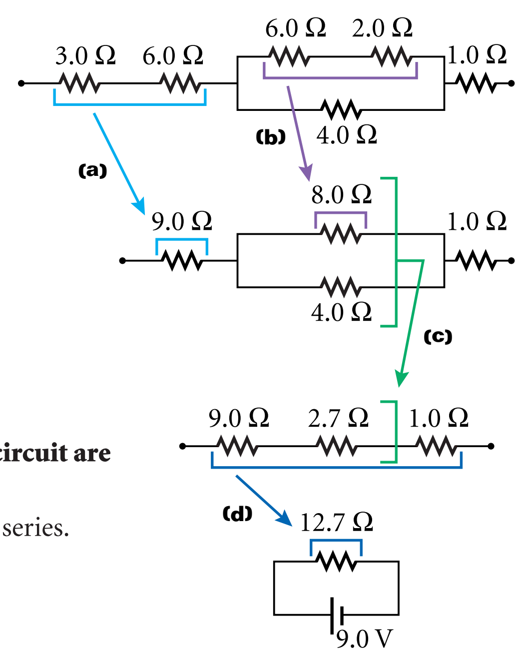
$R_{eq} = 2.7\ \Omega$

4. Repeat steps 2 and 3 until the resistors in the circuit are reduced to a single equivalent resistance.

The remainder of the resistors, group **(d)**, are in series.

For group **(d):** $R_{eq} = 9.0\ \Omega + 2.7\ \Omega + 1.0\ \Omega$

$$\boxed{R_{eq} = 12.7\ \Omega}$$



> **TIP** *It doesn't matter in what order the operations of simplifying the circuit are done, as long as the simpler equivalent circuits still have the same current in and potential difference across the load.*