4. The resistors should be connected in series. For example, connecting three resistors of 5 Ω, 7 Ω, and 2 Ω in series gives a resultant resistance of 14 Ω.

18.5 (a) The equivalent resistance of the two parallel resistors is

\[ R_p = \left( \frac{1}{7.00 \, \Omega} + \frac{1}{10.0 \, \Omega} \right)^{-1} = 4.12 \, \Omega \]

Thus,

\[ R_{ab} = R_4 + R_p + R_9 = (4.00 + 4.12 + 9.00) \, \Omega = 17.1 \, \Omega \]

(b) \[ I_{ab} = \frac{(\Delta V)_{ab}}{R_{ab}} = \frac{34.0 \, V}{17.1 \, \Omega} = 1.99 \, A \]

so \[ I_4 = I_5 = 1.99 \, A \]

Also, \[ (\Delta V)_p = I_{ab}R_p = (1.99 \, A)(4.12 \, \Omega) = 8.18 \, V \]

Then, \[ I_7 = \frac{(\Delta V)_p}{R_7} = \frac{8.18 \, V}{7.00 \, \Omega} = 1.17 \, A \]

and \[ I_{10} = \frac{(\Delta V)_p}{R_{10}} = \frac{8.18 \, V}{10.0 \, \Omega} = 0.818 \, A \]

18.7 The rules for combining resistors in series and parallel are used to reduce the circuit to an equivalent resistance in the stages shown below. The result is \( R_{eq} = 9.8 \, \Omega \).
18.9 Turn the circuit given in Figure P18.9 90° counterclockwise to observe that it is equivalent to that shown in Figure 1 below. This reduces, in stages, as shown in the following figures.

Figure 1

Figure 2

Figure 3

Figure 4

From Figure 4,

\[ I = \frac{\Delta V}{R} = \frac{25.0 \, \text{V}}{12.9 \, \Omega} = 1.93 \, \text{A} \]

(b) From Figure 3,

\[ (\Delta V)_{ba} = IR_{ba} \]

\[ = (1.93 \, \text{A})(2.94 \, \Omega) = 5.68 \, \text{V} \]

(a) From Figures 1 and 2, the current through the 20.0 Ω resistor is

\[ I_{20} = \frac{(\Delta V)_{bc}}{R_{ba}} = \frac{5.68 \, \text{V}}{25.0 \, \Omega} = 0.227 \, \text{A} \]
The resistance of the parallel combination of the 3.00 Ω and 1.00 Ω resistors is

\[ R_p = \left( \frac{1}{3.00 \, \Omega} + \frac{1}{1.00 \, \Omega} \right)^{-1} = 0.750 \, \Omega \]

The equivalent resistance of the circuit connected to the battery is

\[ R_{eq} = 2.00 \, \Omega + R_p + 4.00 \, \Omega = 6.75 \, \Omega , \]

and the current supplied by the battery is

\[ I = \frac{\Delta V}{R_{eq}} = \frac{18.0 \, V}{6.75 \, \Omega} = 2.67 \, A \]

The power dissipated in the 2.00-Ω resistor is

\[ \varphi_2 = I^2 R_2 = (2.67 \, A)^2 (2.00 \, \Omega) = 14.2 \, W \]

and that dissipated in the 4.00-Ω resistor is

\[ \varphi_4 = I^2 R_4 = (2.67 \, A)^2 (4.00 \, \Omega) = 28.4 \, W \]

Going counterclockwise around the upper loop, applying Kirchhoff's loop rule, gives

\[ +15.0 \, V - (7.00) I_1 - (5.00)(2.00 \, A) = 0 , \]

or

\[ I_1 = \frac{15.0 \, V - 10.0 \, V}{7.00 \, \Omega} = \frac{5.00}{7.00} \, A = 0.714 \, A \]

From Kirchhoff's junction rule, \( I_1 + I_2 - 2.00 \, A = 0 \),

so

\[ I_2 = 2.00 \, A - I_1 = 2.00 \, A - 0.714 \, A = 1.29 \, A \]

Going around the lower loop in a clockwise direction gives

\[ +\varepsilon - (2.00) I_2 - (5.00)(2.00 \, A) = 0 \]

or

\[ \varepsilon = (2.00 \, \Omega)(1.29 \, A) + (5.00 \, \Omega)(2.00 \, A) = 12.6 \, V \]
We name the currents $I_1$, $I_2$, and $I_3$ as shown. Using Kirchhoff's loop rule on the rightmost loop gives

$$+12.0 \text{ V} - (1.00 + 3.00)I_3 - (5.00 + 1.00)I_2 - 4.00 \text{ V} = 0,$$

or
$$2.00I_3 + 3.00I_2 = 4.00 \text{ V} \quad (1)$$

Applying the loop rule to the leftmost loop yields

$$+4.00 \text{ V} + (1.00 + 5.00)I_2 - (8.00)I_1 = 0,$$

or
$$4.00I_1 - 3.00I_2 = 2.00 \text{ V} \quad (2)$$

From Kirchhoff's junction rule, $I_1 + I_2 = I_3 \quad (3)$

Solving equations (1), (2) and (3) simultaneously gives

$$I_1 = 0.846 \text{ A}, \quad I_2 = 0.462 \text{ A}, \quad \text{and} \quad I_3 = 1.31 \text{ A}$$

All currents are in the directions indicated by the arrows in the circuit diagram.