Problem 2.14  Determine currents $I_1$ to $I_3$ in the circuit of Fig. P2.14.

Solution: For the loop containing the 18-V source,

\[-18 + 3 \times 2 + 8I_1 = 0.\]

Hence, $I_1 = 1.5$ A.

KCL at node $a$ gives

\[3 - 1 - I_1 - I_2 = 0\]
\[I_2 = 2 - I_1 = 2 - 1.5 = 0.5\text{ A}.\]

KCL at node $b$ gives

\[1 + I_2 - I_3 = 0\]
\[I_3 = 1 + I_2 = 1 + 0.5 = 1.5\text{ A}.


**Problem 2.15**  Determine $I_x$ in the circuit of Fig. P2.15.

![Circuit Diagram](image)

**Figure P2.15: Circuit for Problem 2.15.**

**Solution:**

KVL gives: $-12 + 5I + 2I_x = 0$.

KCL gives: $I + 1 - I_x = 0$.

Solution of the two equations yields $I_x = \frac{17}{7} = 2.43$ A.
**Problem 2.22**  Find $I$ in the circuit of Fig. P2.22.

![Figure P2.22: Circuit for Problem 2.22.](image)

**Solution:**

\[-10 + 2I + 3I = 0.\]

Hence,

\[I = \frac{10}{5} = 2 \text{ A.}\]
Problem 2.29  Given that $I_1 = 1$ A in the circuit of Fig. P2.29, determine $I_0$.

![Circuit for Problem 2.29](image)

Solution: Since the 16-Ω and 8-Ω resistors are connected in parallel, they have the same voltage across them, namely

$$V = 16 \times I_1 = 16 \times 1 = 16 \text{ V}.$$  

By KCL, $I_0$ equals the sum of the currents flowing in all five resistors:

$$I_0 = \frac{16}{1} + \frac{16}{2} + \frac{16}{4} + \frac{16}{8} + \frac{16}{16}$$

$$= 31 \text{ A}.$$
Problem 2.30  What should $R$ be in the circuit of Fig. P2.30 so that $R_{eq} = 4 \, \Omega$?

Figure P2.30: Circuit for Problem 2.30.

Solution: The parallel combination of $R$ and 2-$\Omega$ resistor is

$$R_1 = \frac{2R}{2+R}.$$  

$R_1$ is in series with 5-$\Omega$ resistor. Hence

$$R_2 = R_1 + 5 = \frac{2R}{2+R} + 5.$$  

$R_2$ is in parallel with 6-$\Omega$ resistor:

$$R_3 = \frac{6 \times \left( \frac{2R}{2+R} + 5 \right)}{6 + \frac{2R}{2+R} + 5},$$

and

$$R_{eq} = 1 + R_3 = 1 + \frac{6 \times \left( \frac{2R}{2+R} + 5 \right)}{11 + \frac{2R}{2+R}} = 4.$$  

Solving for $R$ leads to

$$R = 2 \, \Omega.$$
**Problem 2.31** Find $I_0$ in the circuit of Fig. P2.31.

![Figure P2.31: Circuit for Problem 2.31.](image)

**Solution:** Combining the 3-$\Omega$ and 6-$\Omega$ resistors in parallel gives

$$R = \frac{3 \times 6}{3 + 6} = \frac{18}{9} = 2 \, \Omega.$$  

The new circuit becomes

![New circuit](image)

Current division leads to

$$I_0 = \left( \frac{R_{eq}}{12} \right) 18 = \frac{6 \times 12}{6 + 12} \times 18 = 6 \, \text{A}.$$
Problem 2.38  For the circuit in Fig. P2.38, find $R_{eq}$ at terminals $(a, b)$.

Solution:

\[ R_{eq} = 4 + 5 = 9 \, \Omega. \]
Problem 2.40  Simplify the circuit to the right of terminals \((a, b)\) in Fig. P2.40 to find \(R_{eq}\), and then determine the amount of power supplied by the voltage source. All resistances are in ohms.

Solution:

\[
\begin{align*}
R_{eq} &= 3 + 2 = 5 \, \Omega \\
P &= \frac{V^2}{R_{eq}} = \frac{(25)^2}{5} = 125 \, \text{W}
\end{align*}
\]