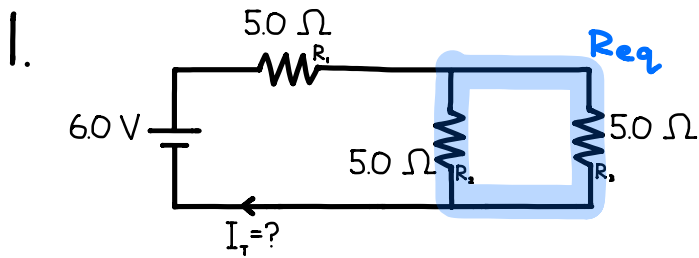


COMBINATION CIRCUITS - SOLUTIONS

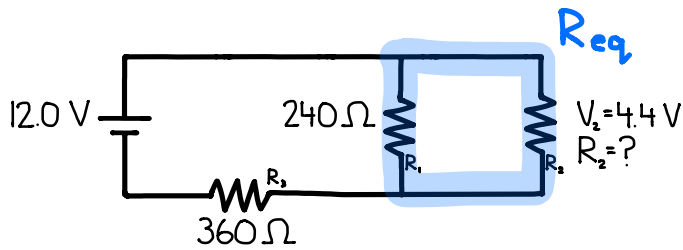


$$\begin{aligned} \textcircled{1} \quad \frac{1}{R_{eq}} &= \frac{1}{R_2} + \frac{1}{R_3} \\ R_{eq} &= \left(\frac{1}{R_2} + \frac{1}{R_3} \right)^{-1} \\ R_{eq} &= \left(\frac{1}{5.0} + \frac{1}{5.0} \right)^{-1} \\ &= 2.5 \Omega \end{aligned}$$

$$\begin{aligned} \textcircled{2} \quad R_T &= R_1 + R_{eq} \\ &= 5.0 + 2.5 \\ &= 7.5 \Omega \end{aligned}$$

$$\begin{aligned} \textcircled{3} \quad V_T &= I_T R_T \\ I_T &= \frac{V_T}{R_T} \\ &= \frac{6.0}{7.5} \\ &= 0.80 \text{ A} \end{aligned}$$

2.



$$\textcircled{1} V_{eq} = V_1 = V_2$$

$$V_{eq} = 4.4\text{ V}$$

$$V_1 = 4.4\text{ V}$$

$$\textcircled{2} V_T = V_{eq} + V_3$$

$$V_3 = V_T - V_{eq}$$

$$= 12.0 - 4.4$$

$$= 7.6\text{ V}$$

$$\textcircled{3} V_3 = I_3 R_3$$

$$I_3 = \frac{V_3}{R_3}$$

$$= \frac{7.6}{360}$$

$$= 0.021\text{ A}$$

$$\textcircled{4} I_1 = I_{eq} = I_3$$

$$I_{eq} = 0.021\text{ A}$$

$$\textcircled{5} V_1 = I_1 R_1$$

$$I_1 = \frac{V_1}{R_1}$$

$$= \frac{4.4}{240}$$

$$= 0.0183\text{ A}$$

$$\textcircled{6} I_{eq} = I_1 + I_2$$

$$I_2 = I_{eq} - I_1$$

$$= 0.021 - 0.0183$$

$$= 0.0027\text{ A}$$

$$\textcircled{7} V_2 = I_2 R_2$$

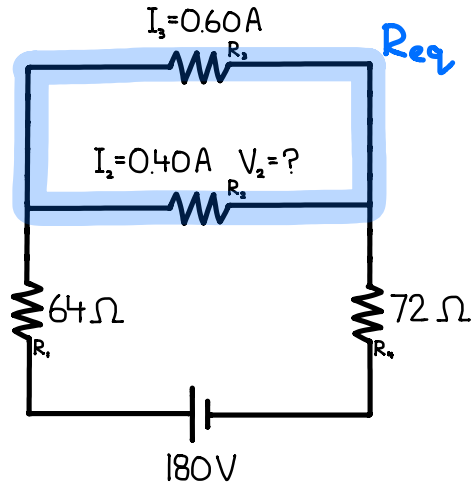
$$R_2 = \frac{V_2}{I_2}$$

$$= \frac{4.4}{0.0027}$$

$$= 1584$$

$$\rightarrow 1600\ \Omega$$

3.



$$\begin{aligned} \textcircled{1} \quad I_{eq} &= I_2 + I_3 \\ &= 0.40 + 0.60 \\ &= 1.00 \text{ A} \end{aligned}$$

$$\begin{aligned} \textcircled{2} \quad I_1 &= I_4 = I_{eq} \\ I_1 &= 1.00 \text{ A} \\ I_4 &= 1.00 \text{ A} \end{aligned}$$

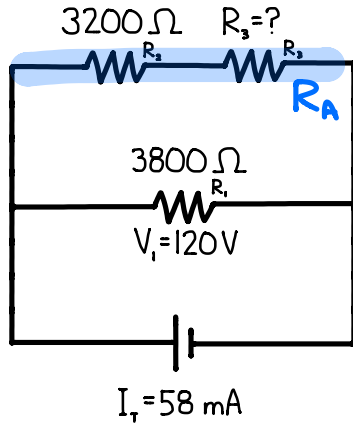
$$\begin{aligned} \textcircled{3} \quad V_1 &= I_1 R_1 \\ &= (1.00)(64) \\ &= 64 \text{ V} \end{aligned}$$

$$\begin{aligned} \textcircled{4} \quad V_4 &= I_4 R_4 \\ &= (1.00)(72) \\ &= 72 \text{ V} \end{aligned}$$

$$\begin{aligned} \textcircled{5} \quad V_T &= V_1 + V_{eq} + V_4 \\ V_{eq} &= V_T - V_1 - V_4 \\ &= 180 - 64 - 72 \\ &= 44 \text{ V} \end{aligned}$$

$$\begin{aligned} \textcircled{6} \quad V_{eq} &= V_2 = V_3 \\ V_2 &= 44 \text{ V} \end{aligned}$$

4.



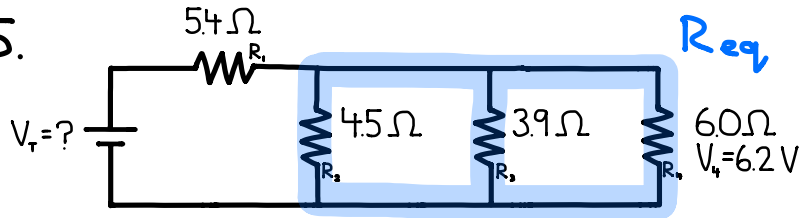
$$\textcircled{1} \quad V_T = V_1 = V_A \\ V_T = 120 \text{ V}$$

$$\textcircled{2} \quad V_T = I_T R_T \\ R_T = \frac{V_T}{I_T} \\ = \frac{120}{0.058} \\ = 2069 \Omega$$

$$\textcircled{3} \quad \frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_A} \\ R_A = \left(\frac{1}{R_T} - \frac{1}{R_1} \right)^{-1} \\ = \left(\frac{1}{2069} - \frac{1}{3800} \right)^{-1} \\ = 4542 \Omega$$

$$\textcircled{4} \quad R_A = R_2 + R_3 \\ R_3 = R_A - R_2 \\ = 4542 - 3200 \\ = 1342 \\ \rightarrow 1300 \Omega$$

5.



$$\begin{aligned} \textcircled{1} \quad \frac{1}{R_{eq}} &= \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} \\ R_{eq} &= \left(\frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} \right)^{-1} \\ &= \left(\frac{1}{4.5} + \frac{1}{3.9} + \frac{1}{6.0} \right)^{-1} \\ &= 1.5497 \Omega \end{aligned}$$

$$\begin{aligned} \textcircled{2} \quad V_{eq} &= V_2 = V_3 = V_4 \\ V_{eq} &= 6.2 \text{ V} \end{aligned}$$

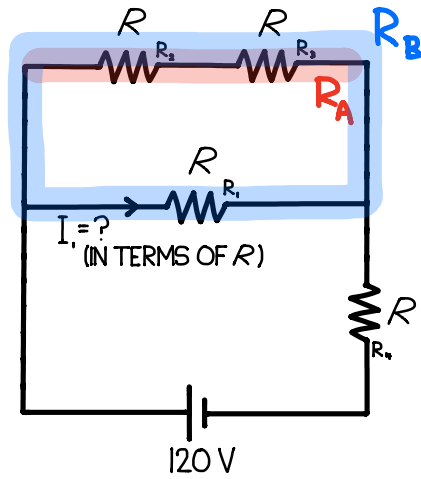
$$\begin{aligned} \textcircled{3} \quad V_{eq} &= I_{eq} R_{eq} \\ I_{eq} &= \frac{V_{eq}}{R_{eq}} \\ &= \frac{6.2}{1.5497} \\ &= 4.0009 \text{ A} \end{aligned}$$

$$\begin{aligned} \textcircled{4} \quad I_T &= I_1 = I_{eq} \\ I_T &= 4.0009 \text{ A} \end{aligned}$$

$$\begin{aligned} \textcircled{5} \quad R_T &= R_1 + R_{eq} \\ &= 5.4 + 1.5497 \\ &= 6.9497 \Omega \end{aligned}$$

$$\begin{aligned} \textcircled{6} \quad V_T &= I_T R_T \\ &= (4.0009)(6.9497) \\ &= 28 \text{ V} \end{aligned}$$

6.



$$\begin{aligned} \textcircled{1} \quad R_A &= R_2 + R_3 \\ &= R + R \\ &= 2R \end{aligned}$$

$$\begin{aligned} \textcircled{2} \quad \frac{1}{R_B} &= \frac{1}{R_1} + \frac{1}{R_A} \\ R_B &= \left(\frac{1}{R_1} + \frac{1}{R_A} \right)^{-1} \\ &= \left(\frac{1}{R} + \frac{1}{2R} \right)^{-1} \\ &= \frac{2R}{3} \end{aligned}$$

$$\begin{aligned} \textcircled{3} \quad R_T &= R_B + R_4 \\ &= \frac{2R}{3} + R \\ &= \frac{5R}{3} \end{aligned}$$

$$\begin{aligned} \textcircled{4} \quad V_T &= I_T R_T \\ I_T &= \frac{V_T}{R_T} \\ &= \frac{120}{\left(\frac{5R}{3}\right)} \\ &= \frac{72}{R} \end{aligned}$$

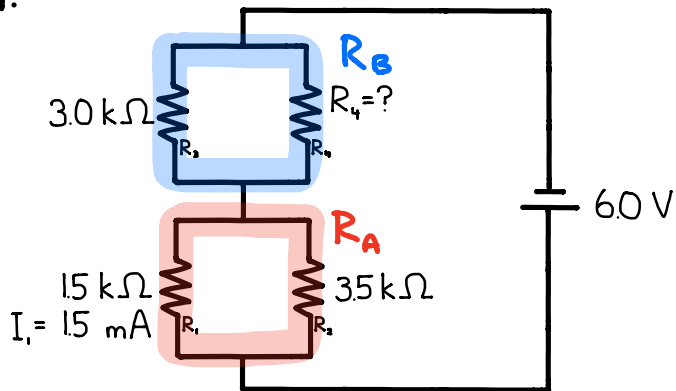
$$\begin{aligned} \textcircled{5} \quad I_T &= I_B = I_4 \\ I_B &= \frac{72}{R} \end{aligned}$$

$$\begin{aligned} \textcircled{6} \quad V_B &= I_B R_B \\ &= \left(\frac{72}{R}\right) \left(\frac{2R}{3}\right) \\ &= 48V \end{aligned}$$

$$\begin{aligned} \textcircled{7} \quad V_B &= V_1 = V_A \\ V_1 &= 48V \end{aligned}$$

$$\begin{aligned} \textcircled{8} \quad V_1 &= I_1 R_1 \\ I_1 &= \frac{V_1}{R_1} \\ &= \frac{48V}{R} \end{aligned}$$

7.



$$\begin{aligned} \textcircled{1} \quad V_1 &= I_1 R_1 \\ &= (0.0015)(1500) \\ &= 2.25 \text{ V} \end{aligned}$$

$$\begin{aligned} \textcircled{2} \quad V_A &= V_1 = V_2 \\ V_A &= 2.25 \text{ V} \end{aligned}$$

$$\begin{aligned} \textcircled{3} \quad \frac{1}{R_A} &= \frac{1}{R_1} + \frac{1}{R_2} \\ \frac{1}{R_A} &= \left(\frac{1}{R_1} + \frac{1}{R_2} \right)^{-1} \\ &= \left(\frac{1}{1500} + \frac{1}{3500} \right)^{-1} \\ &= 1050 \, \Omega \end{aligned}$$

$$\begin{aligned} \textcircled{4} \quad V_A &= I_A R_A \\ I_A &= \frac{V_A}{R_A} \\ &= \frac{2.25}{1050} \\ &= 0.002143 \text{ A} \end{aligned}$$

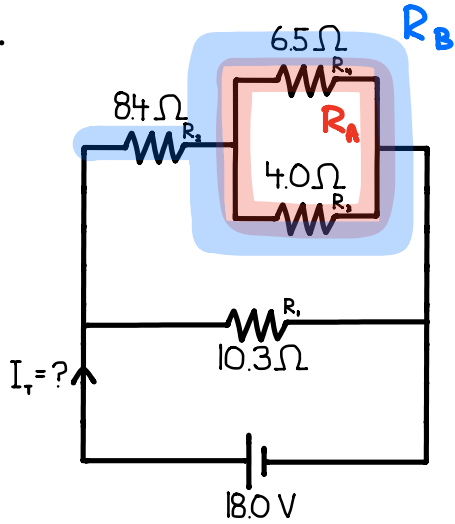
$$\begin{aligned} \textcircled{5} \quad I_T &= I_A = I_B \\ I_T &= 0.002143 \text{ A} \end{aligned}$$

$$\begin{aligned} \textcircled{6} \quad V_T &= I_T R_T \\ R_T &= \frac{V_T}{I_T} \\ &= \frac{6.0}{0.002143} \\ &= 2800 \, \Omega \end{aligned}$$

$$\begin{aligned} \textcircled{7} \quad R_T &= R_A + R_B \\ R_B &= R_T - R_A \\ &= 2800 - 1050 \\ &= 1750 \, \Omega \end{aligned}$$

$$\begin{aligned} \textcircled{8} \quad \frac{1}{R_B} &= \frac{1}{R_3} + \frac{1}{R_4} \\ R_4 &= \left(\frac{1}{R_B} - \frac{1}{R_3} \right)^{-1} \\ &= \left(\frac{1}{1750} - \frac{1}{3000} \right)^{-1} \\ &= 4200 \, \Omega \end{aligned}$$

8.



$$\begin{aligned} \textcircled{1} \quad \frac{1}{R_A} &= \frac{1}{R_3} + \frac{1}{R_4} \\ R_A &= \left(\frac{1}{R_3} + \frac{1}{R_4} \right)^{-1} \\ &= \left(\frac{1}{4.0} + \frac{1}{6.5} \right)^{-1} \\ &= 2.4762 \, \Omega \end{aligned}$$

$$\begin{aligned} \textcircled{2} \quad R_B &= R_2 + R_A \\ &= 8.4 + 2.4762 \\ &= 10.8762 \, \Omega \end{aligned}$$

$$\begin{aligned} \textcircled{3} \quad \frac{1}{R_T} &= \frac{1}{R_1} + \frac{1}{R_B} \\ R_T &= \left(\frac{1}{R_1} + \frac{1}{R_B} \right)^{-1} \\ &= \left(\frac{1}{10.3} + \frac{1}{10.8762} \right)^{-1} \\ &= 5.2901 \, \Omega \end{aligned}$$

$$\begin{aligned} \textcircled{4} \quad V_T &= I_T R_T \\ I_T &= \frac{V_T}{R_T} \\ &= \frac{18.0}{5.2901} \\ &= 3.4 \, \text{A} \end{aligned}$$