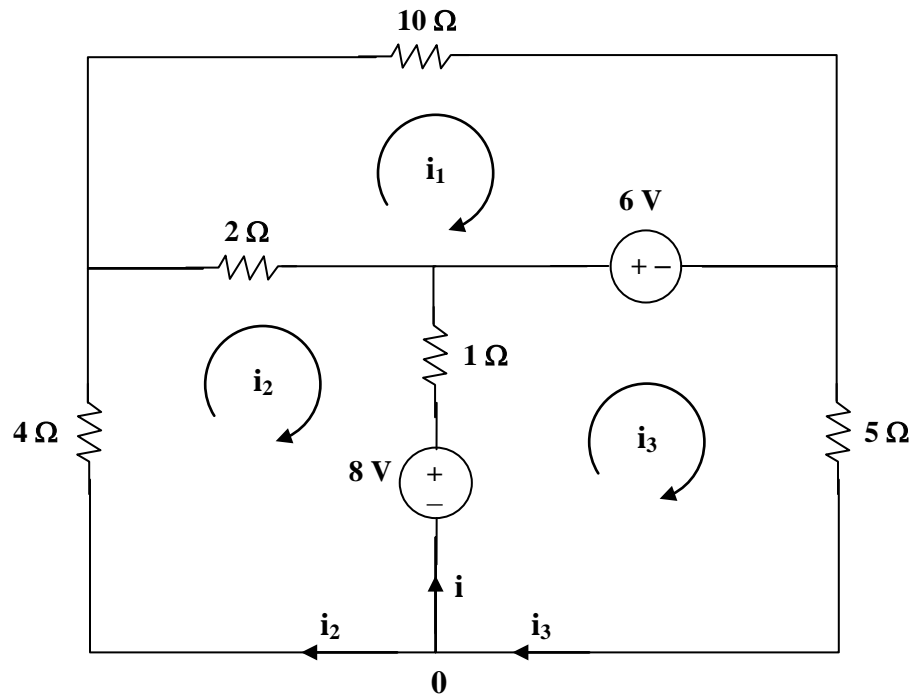


Chapter 3, Solution 41



For loop 1,

$$6 = 12i_1 - 2i_2 \quad \longrightarrow \quad 3 = 6i_1 - i_2 \quad (1)$$

For loop 2,

$$-8 = -2i_1 + 7i_2 - i_3 \quad (2)$$

For loop 3,

$$-8 + 6 + 6i_3 - i_2 = 0 \quad \longrightarrow \quad 2 = -i_2 + 6i_3 \quad (3)$$

We put (1), (2), and (3) in matrix form,

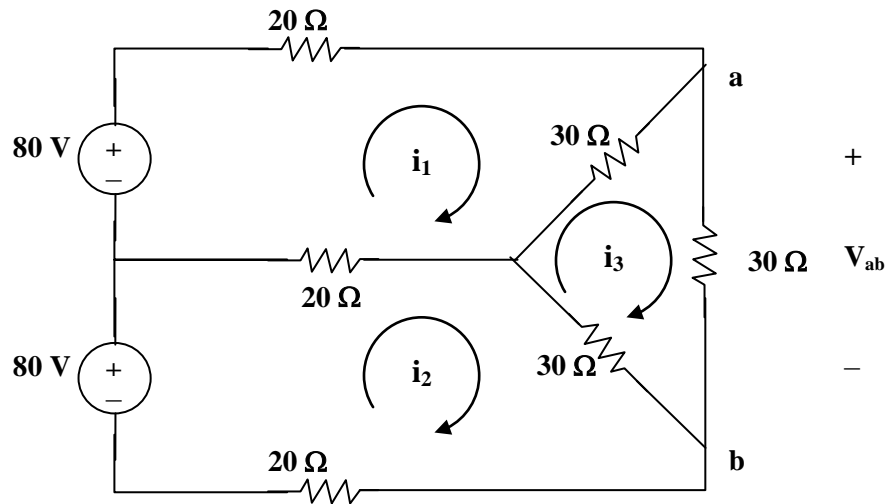
$$\begin{bmatrix} 6 & -1 & 0 \\ 2 & -7 & 1 \\ 0 & -1 & 6 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 3 \\ 8 \\ 2 \end{bmatrix}$$

$$\Delta = \begin{vmatrix} 6 & -1 & 0 \\ 2 & -7 & 1 \\ 0 & -1 & 6 \end{vmatrix} = -234, \quad \Delta_2 = \begin{vmatrix} 6 & 3 & 0 \\ 2 & 8 & 1 \\ 0 & 2 & 6 \end{vmatrix} = 240$$

$$\Delta_3 = \begin{vmatrix} 6 & -1 & 3 \\ 2 & -7 & 8 \\ 0 & -1 & 2 \end{vmatrix} = -38$$

At node 0,  $i + i_2 = i_3$  or  $i = i_3 - i_2 = \frac{\Delta_3 - \Delta_2}{\Delta} = \frac{-38 - 240}{-234} = \underline{\underline{\mathbf{1.188\ A}}}$

Chapter 3, Solution 43



For loop 1,

$$80 = 70i_1 - 20i_2 - 30i_3 \quad \longrightarrow \quad 8 = 7i_1 - 2i_2 - 3i_3 \quad (1)$$

For loop 2,

$$80 = 70i_2 - 20i_1 - 30i_3 \quad \longrightarrow \quad 8 = -2i_1 + 7i_2 - 3i_3 \quad (2)$$

For loop 3,

$$0 = -30i_1 - 30i_2 + 90i_3 \quad \longrightarrow \quad 0 = i_1 + i_2 - 3i_3 \quad (3)$$

Solving (1) to (3), we obtain  $i_3 = 16/9$

$$I_o = i_3 = 16/9 = \underline{\underline{1.7778 \text{ A}}}$$

$$V_{ab} = 30i_3 = \underline{\underline{53.33 \text{ V}}}$$

### Chapter 3, Solution 46

Solve for the mesh currents in Fig. 3.92.

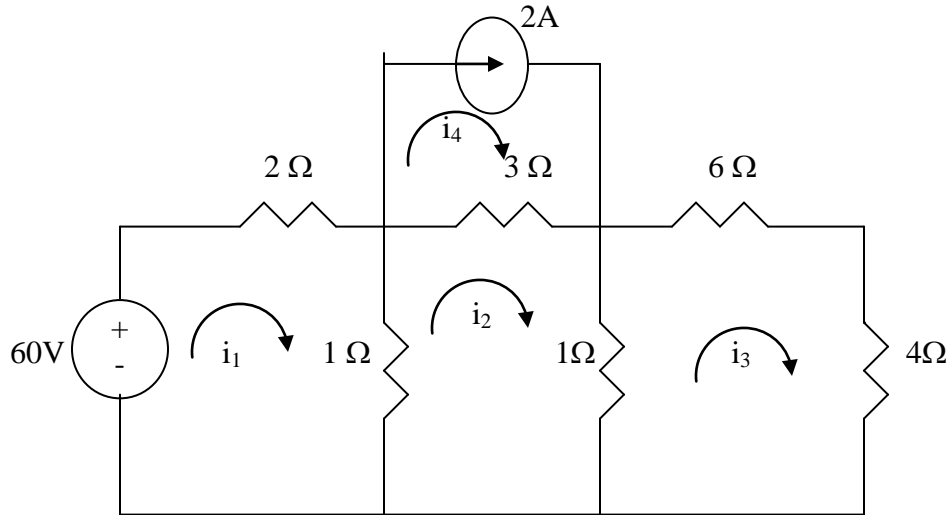


Figure 3.92  
For Prob. 3.46

#### Solution

For mesh 1,

$$-60 + 3i_1 - i_2 = 0 \quad \longrightarrow \quad 60 = 3i_1 - i_2 \quad (1)$$

For mesh 2,

$$5i_2 - i_1 - i_3 - 3i_4 = 0 \quad \longrightarrow \quad 0 = -i_1 + 5i_2 - i_3 - 3i_4 \quad (2)$$

For mesh 3,

$$11i_3 - i_2 = 0 \quad (3)$$

For mesh 4,

$$i_4 = 4A. \quad (4)$$

Substituting (3) and (4) into (2),

$$0 = -i_1 + 55i_3 - i_3 - 6 \quad \longrightarrow \quad i_1 = -6 + 54i_3 \quad (5)$$

Substituting (3) into (1),

$$60 = 3i_1 - 11i_3 \quad (6)$$

Substituting (5) into (6),

$$60 = -18 + 162i_3 - 11i_3 \quad \longrightarrow \quad i_o = i_3 = \frac{78}{151} = \underline{0.5165 \text{ A}}$$

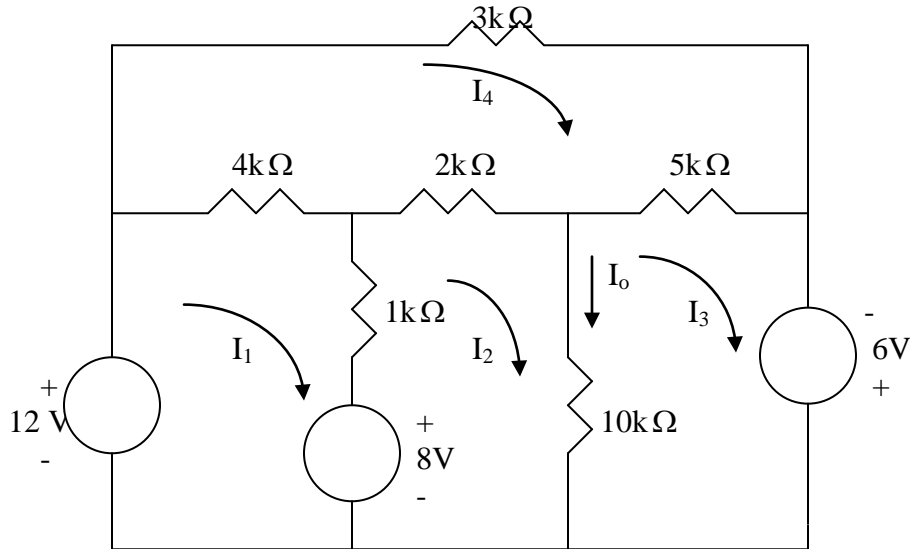
$$i_1 = -6 + 27.89 = 21.89 \text{ A and}$$

$$i_2 = 60 - 3i_1 = 60 - 65.6815 = 0.6815 = 681.5 \text{ mA}$$



### Chapter 3, Solution 48

We apply mesh analysis and let the mesh currents be in mA.



For mesh 1,

$$-12 + 8 + 5I_1 - I_2 - 4I_4 = 0 \quad \longrightarrow \quad 4 = 5I_1 - I_2 - 4I_4 \quad (1)$$

For mesh 2,

$$-8 + 13I_2 - I_1 - 10I_3 - 2I_4 = 0 \quad \longrightarrow \quad 8 = -I_1 + 13I_2 - 10I_3 - 2I_4 \quad (2)$$

For mesh 3,

$$-6 + 15I_3 - 10I_2 - 5I_4 = 0 \quad \longrightarrow \quad 6 = -10I_2 + 15I_3 - 5I_4 \quad (3)$$

For mesh 4,

$$-4I_1 - 2I_2 - 5I_3 + 14I_4 = 0 \quad (4)$$

Putting (1) to (4) in matrix form gives

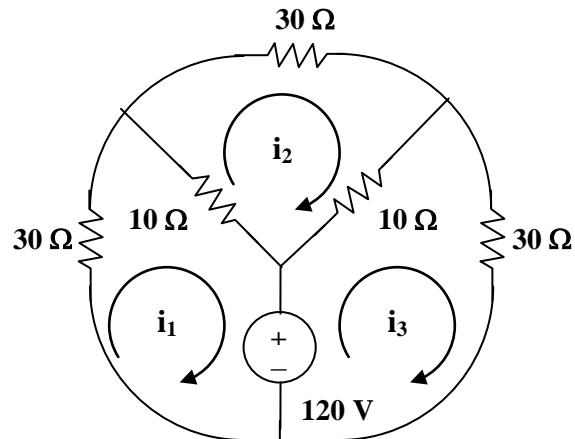
$$\begin{pmatrix} 5 & -1 & 0 & -4 \\ -1 & 13 & -10 & -2 \\ 0 & -10 & 15 & -5 \\ -4 & -2 & -5 & 14 \end{pmatrix} \begin{pmatrix} I_1 \\ I_2 \\ I_3 \\ I_4 \end{pmatrix} = \begin{pmatrix} 4 \\ 8 \\ 6 \\ 0 \end{pmatrix} \quad \longrightarrow \quad AI = B$$

Using MATLAB,

$$I = A^{-1}B = \begin{pmatrix} 7.217 \\ 8.087 \\ 7.791 \\ 6 \end{pmatrix}$$

The current through the  $10\text{k}\Omega$  resistor is  $I_0 = I_2 - I_3 = \underline{0.2957 \text{ mA}}$

### Chapter 3, Solution 58



For loop 1,  $120 + 40i_1 - 10i_2 = 0$ , which leads to  $-12 = 4i_1 - i_2$  (1)

For loop 2,  $50i_2 - 10i_1 - 10i_3 = 0$ , which leads to  $-i_1 + 5i_2 - i_3 = 0$  (2)

For loop 3,  $-120 - 10i_2 + 40i_3 = 0$ , which leads to  $12 = -i_2 + 4i_3$  (3)

Solving (1), (2), and (3), we get,  $i_1 = \underline{-3\text{A}}$ ,  $i_2 = \underline{0}$ , and  $i_3 = \underline{3\text{A}}$