WYE-DELTA TRANFORMATION

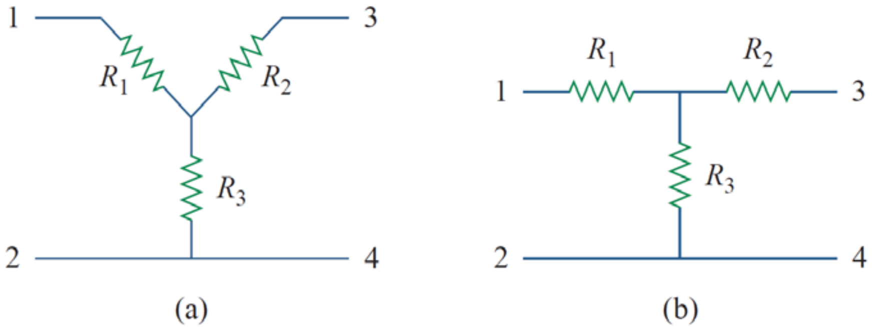


Figure 2.47
Two forms of the same network: (a) Y, (b) T.

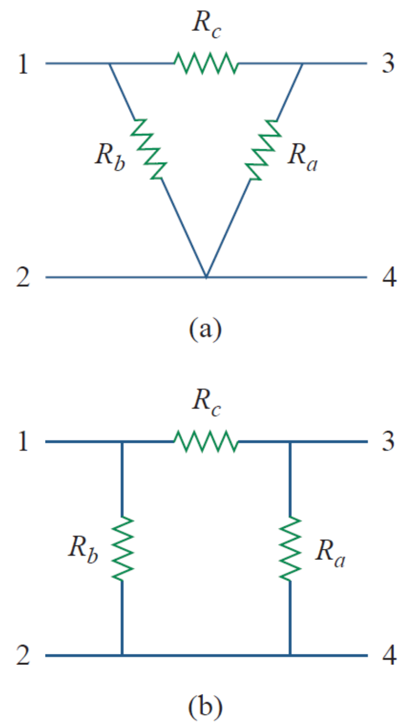


Figure 2.48
Two forms of the same network: (a) Δ, (b) Π.

The formulas for a wye-to-delta transformation are

$$R_a = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_1}, \qquad R_b = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_2}$$

$$R_c = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_3}$$

The formulas for a delta-to-wye transformation are

$$R_1 = \frac{R_bR_c}{R_a + R_b + R_c}, \qquad R_2 = \frac{R_cR_a}{R_a + R_b + R_c}$$

$$R_3 = \frac{R_aR_b}{R_a + R_b + R_c}$$

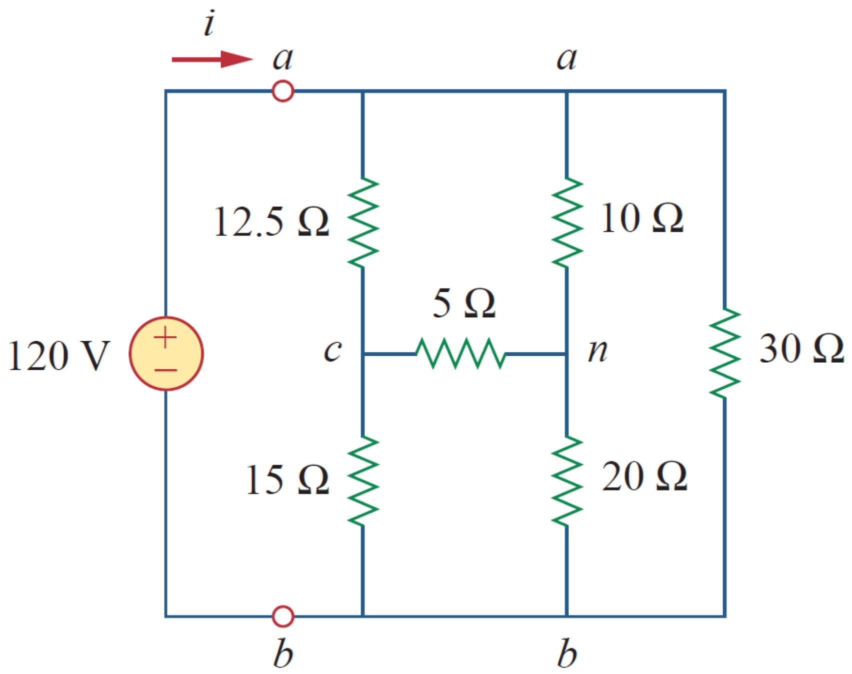


Figure 2.52
For Example 2.15.

$$R_1 = 10\ \Omega, \qquad R_2 = 20\ \Omega, \qquad R_3 = 5\ \Omega$$

Thus from Eqs. (2.53) to (2.55) we have

$$R_a = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_1} = \frac{10 \times 20 + 20 \times 5 + 5 \times 10}{10}$$

$$= \frac{350}{10} = 35\ \Omega$$

$$R_b = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_2} = \frac{350}{20} = 17.5\ \Omega$$

$$R_c = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_3} = \frac{350}{5} = 70\ \Omega$$

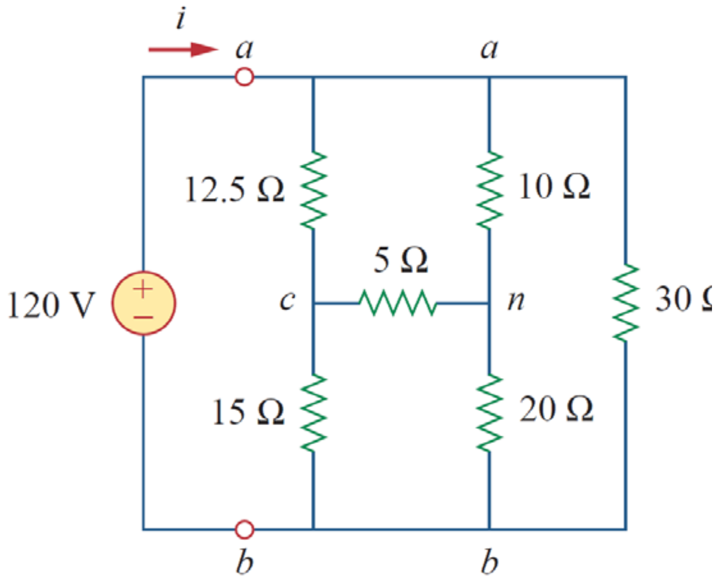
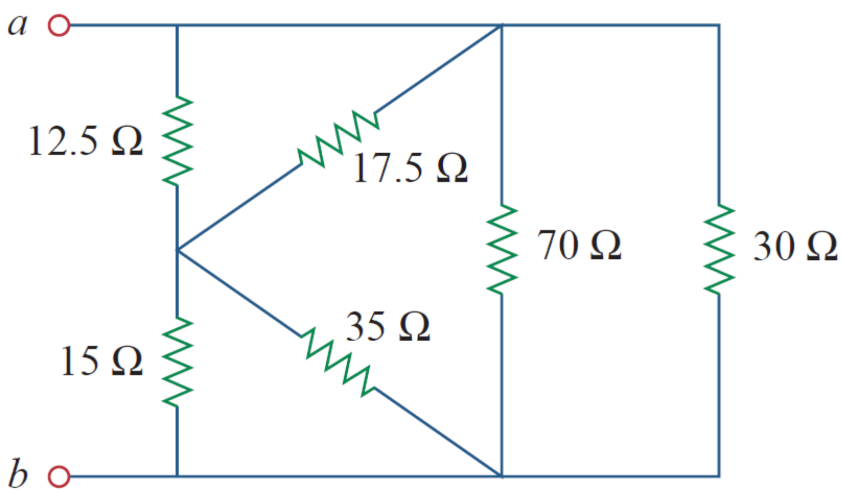


Figure 2.52
For Example 2.15.



(a)

Chapter 3 Methods of Analysis

Steps to Determine Node Voltages:

1. Select a node as the reference node. Assign voltages v_1, $v_2, \ldots, v_{n-1}$ to the remaining $n - 1$ nodes. The voltages are referenced with respect to the reference node.
2. Apply KCL to each of the $n - 1$ nonreference nodes. Use Ohm's law to express the branch currents in terms of node voltages.
3. Solve the resulting simultaneous equations to obtain the unknown node voltages.

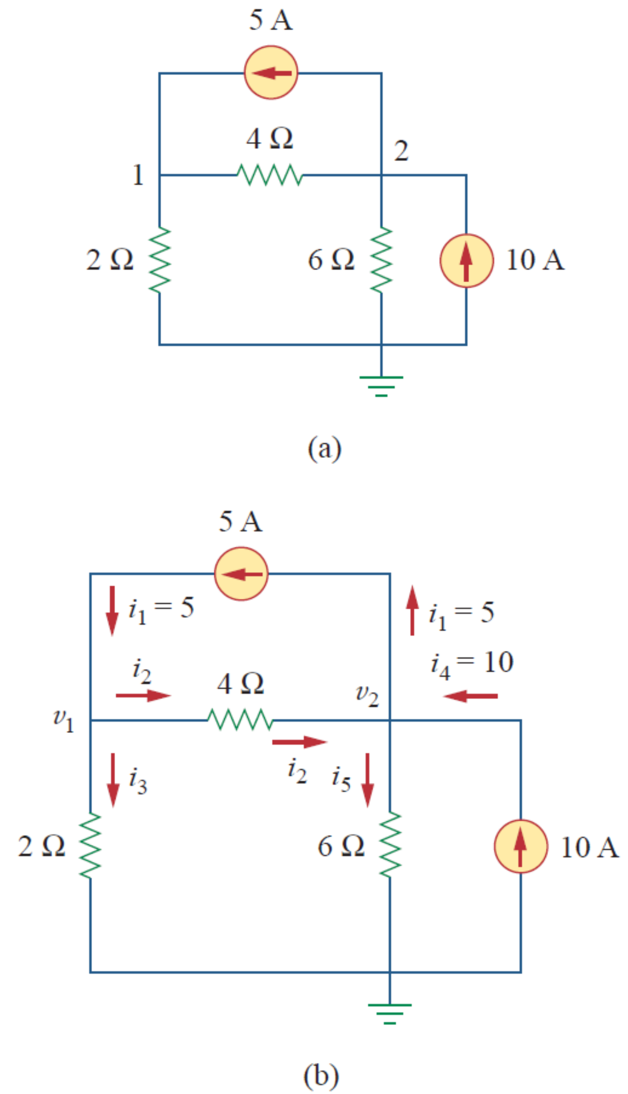
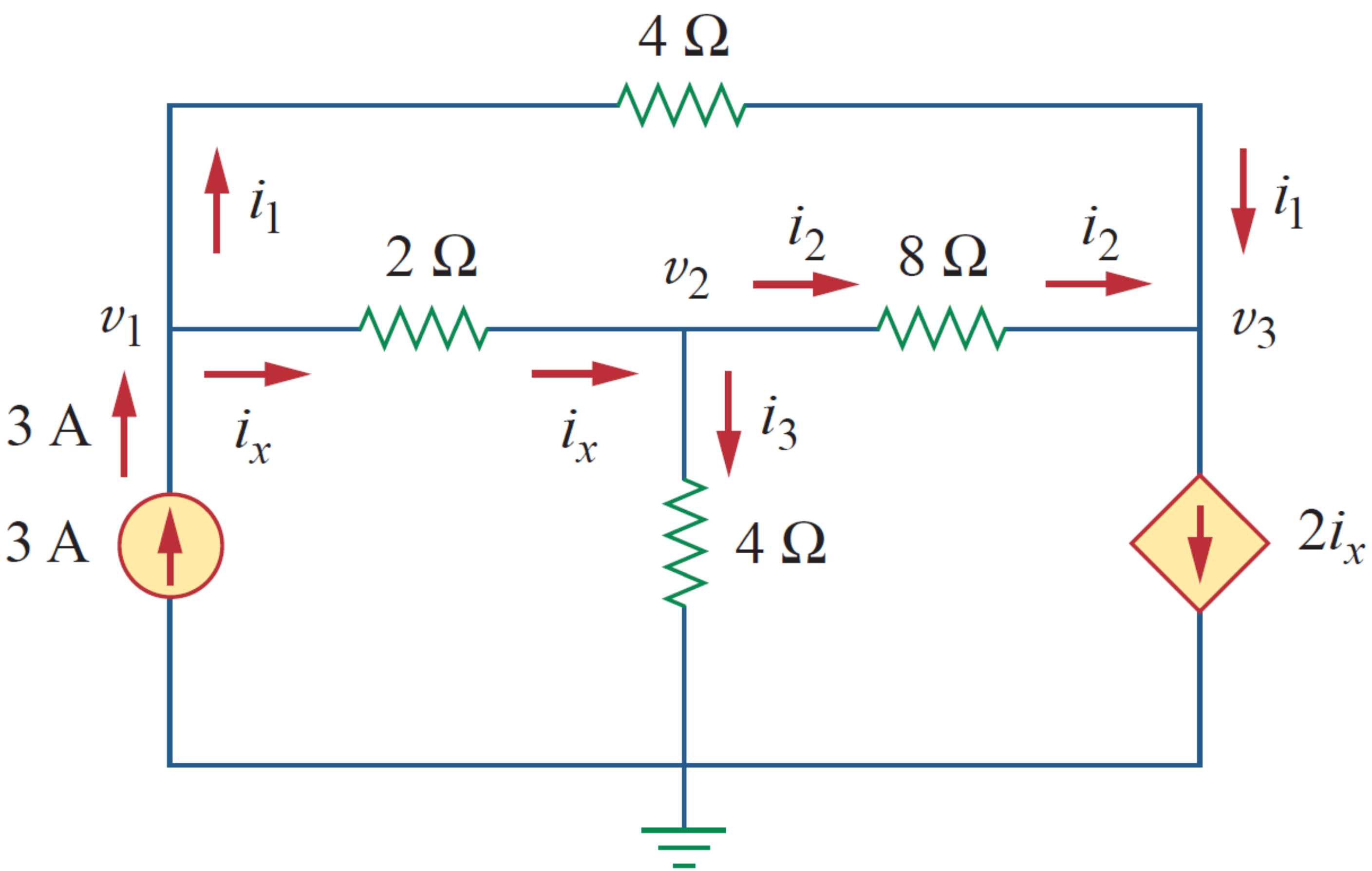


Figure 3.3
For Example 3.1: (a) original circuit, (b) circuit for analysis.



(b)

Nodal Analysis with Voltage Sources

A supernode is formed by enclosing a (dependent or independent) voltage source connected between two nonreference nodes and anyelements connected in parallel with it.

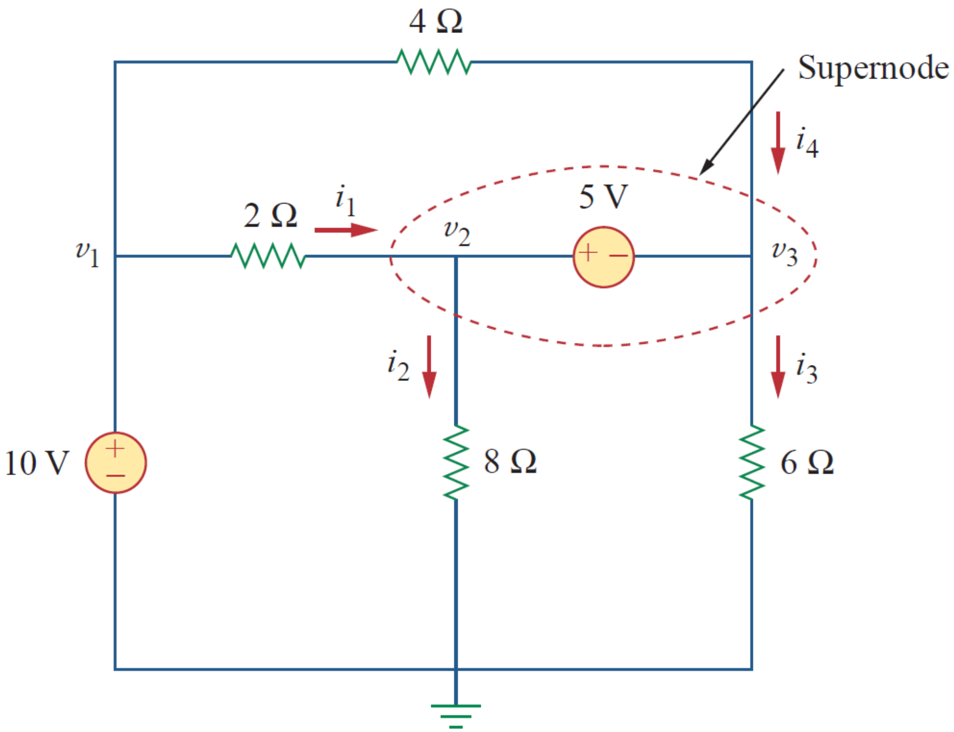


Figure 3.7
A circuit with a supernode.

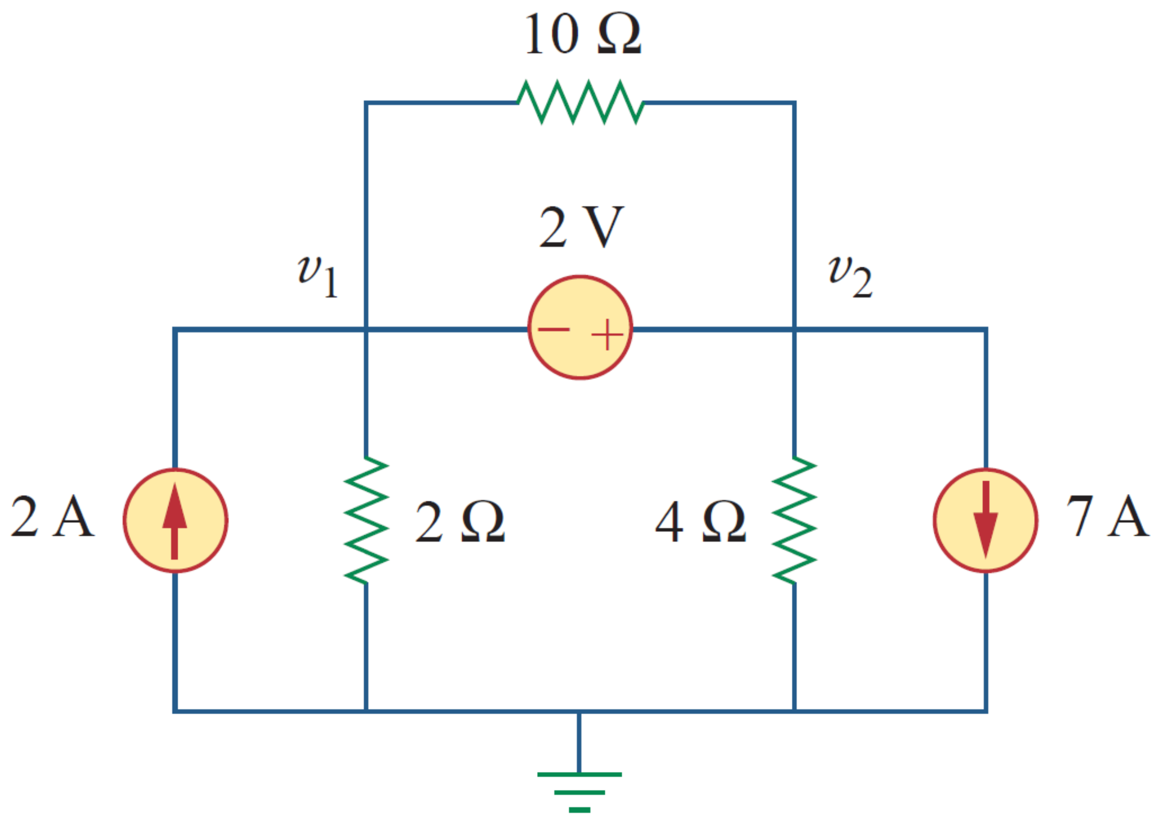


Figure 3.9
For Example 3.3.

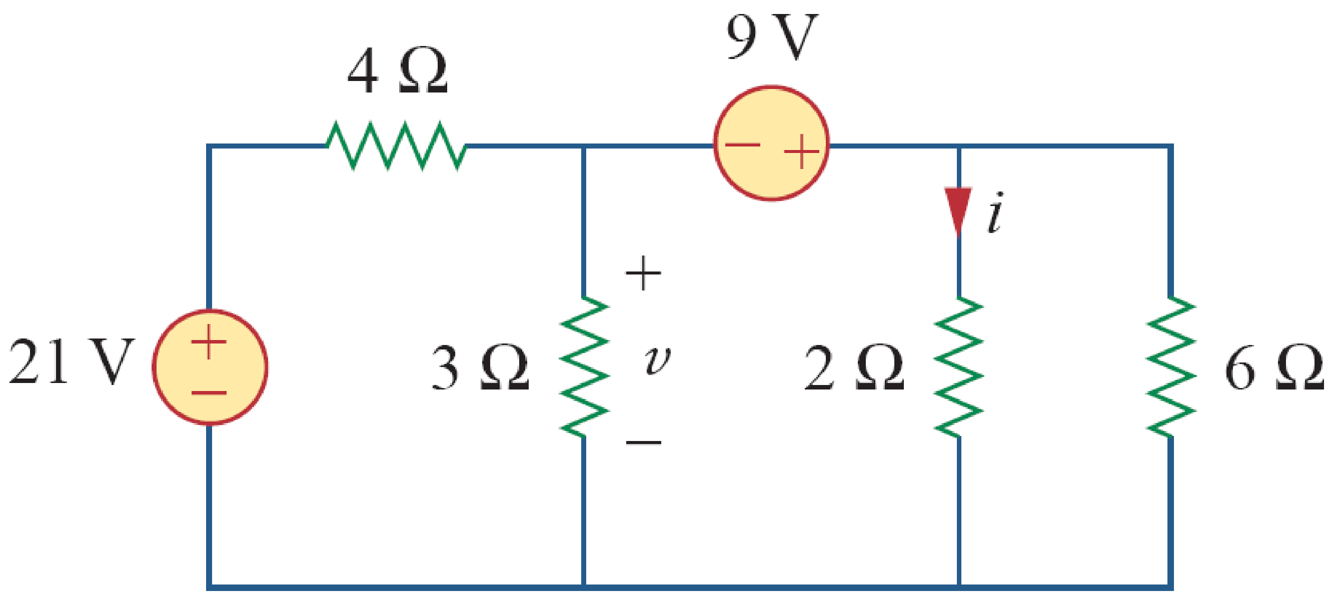


Figure 3.11
For Practice Prob. 3.3.

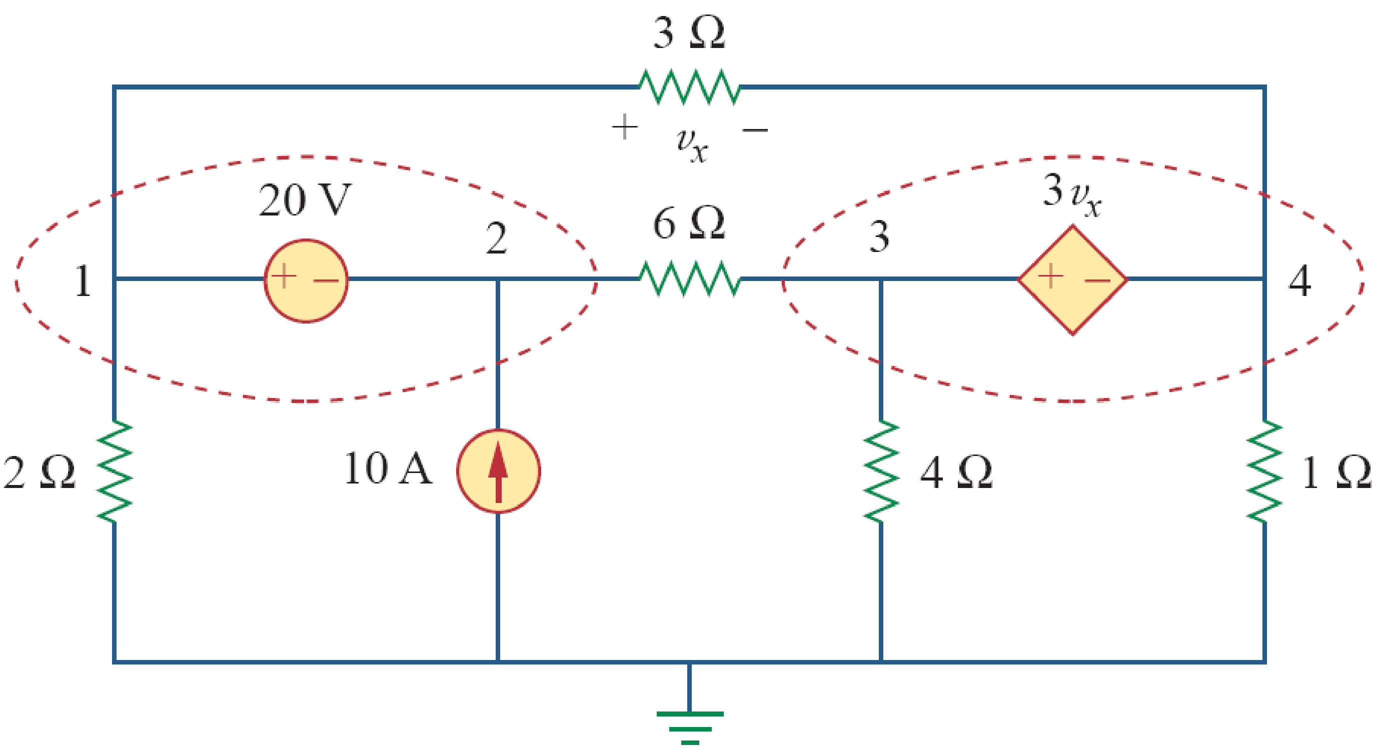
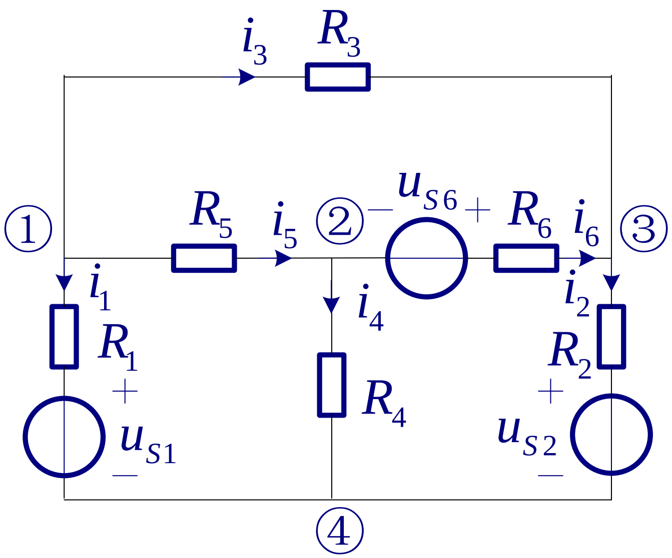


Figure 3.12
For Example 3.4.

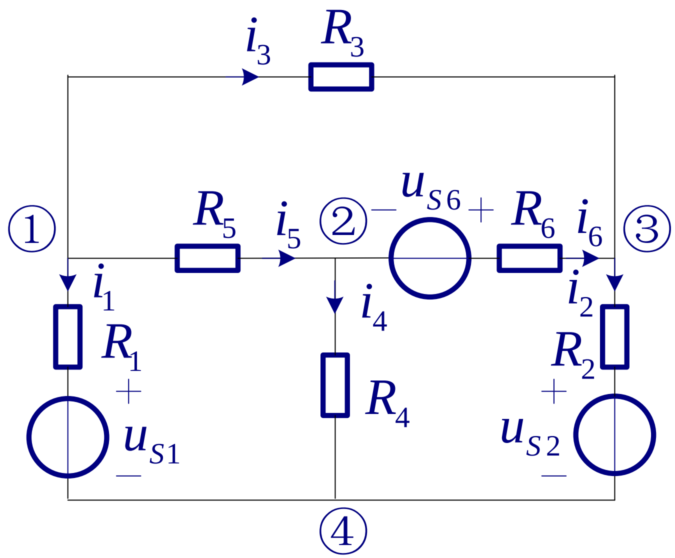


Voltage source with resistor inseries
Node 4 is Ground.

$$\frac{u_{n1}-u_{S1}}{R_1}+\frac{u_{n1}-u_{n3}}{R_3}+\frac{u_{n1}-u_{n2}}{R_5}=0$$

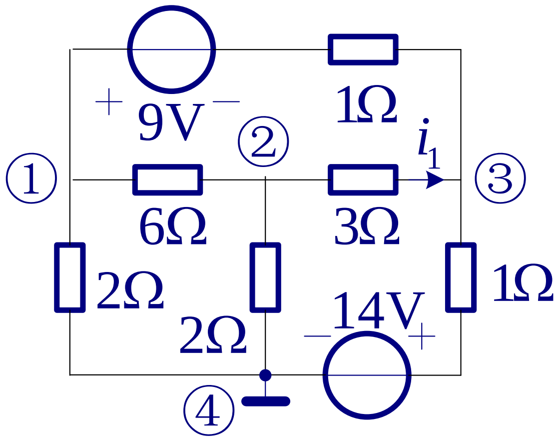
$$\frac{u_{n2}}{R_4}-\frac{u_{n1}-u_{n2}}{R_5}+\frac{u_{n2}-u_{n3}+u_{S6}}{R_6}=0$$

$$\frac{u_{n3}-u_{S2}}{R_2}-\frac{u_{n1}-u_{n3}}{R_3}-\frac{u_{n2}-u_{n3}+u_{S6}}{R_6}=0$$



$$\begin{bmatrix} G_1+G_3+G_5 & -G_5 & -G_3 \\ -G_5 & G_4+G_5+G_6 & -G_6 \\ -G_3 & -G_6 & G_2+G_3+G_6 \end{bmatrix}\begin{bmatrix} u_{n1} \\ u_{n2} \\ u_{n3} \end{bmatrix} = \begin{bmatrix} G_1 u_{S1} \\ -G_6 u_{S6} \\ G_2 u_{S2} + G_6 u_{S6} \end{bmatrix}$$

$$\begin{bmatrix} G_{11} & G_{12} & G_{13} \\ G_{21} & G_{22} & G_{23} \\ G_{31} & G_{32} & G_{33} \end{bmatrix}\begin{bmatrix} u_{n1} \\ u_{n2} \\ u_{n3} \end{bmatrix} = \begin{bmatrix} i_{S11} \\ i_{S22} \\ i_{S33} \end{bmatrix}$$



+
9V
−
1Ω
②
i_1
①
③
6Ω
3Ω
2Ω
1Ω
14V
2Ω
−
+
④

MESH ANALYSIS

A mesh is a loop which does not contain any other loops within it.

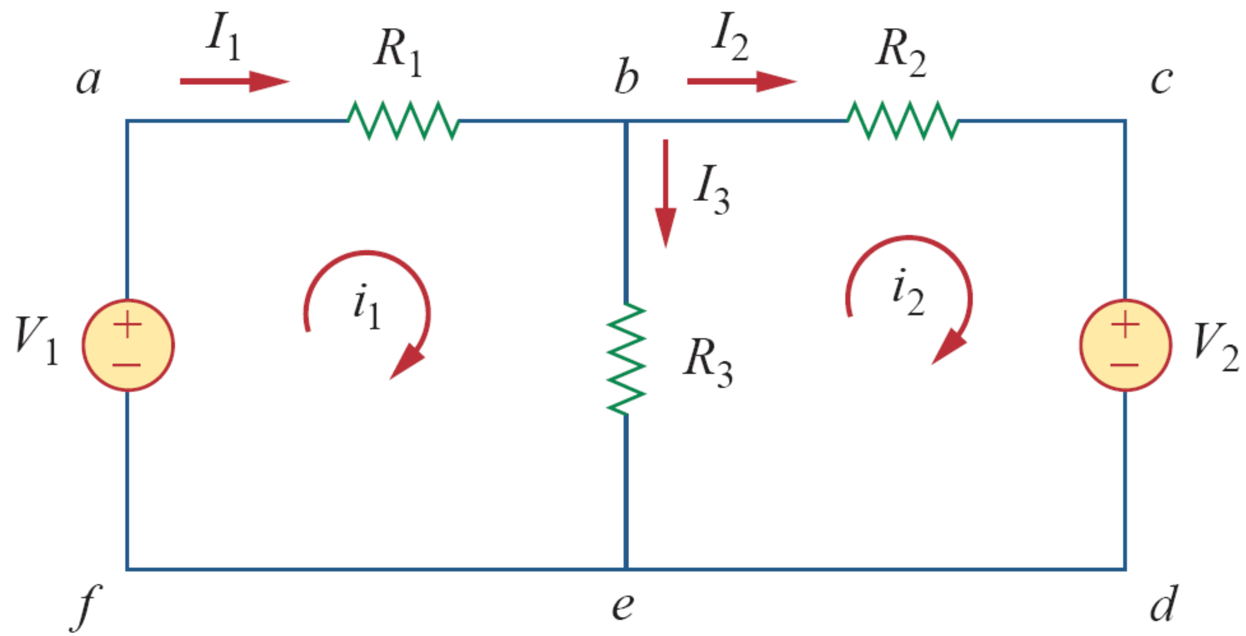


Figure 3.17

A circuit with two meshes.

Steps to Determine Mesh Currents:

1. Assign mesh currents $i_1, i_2, \ldots, i_n$ to the n meshes.
2. Apply KVL to each of the n meshes. Use Ohm's law to express the voltages in terms of the mesh currents.
3. Solve the resulting n simultaneous equations to get the mesh currents.

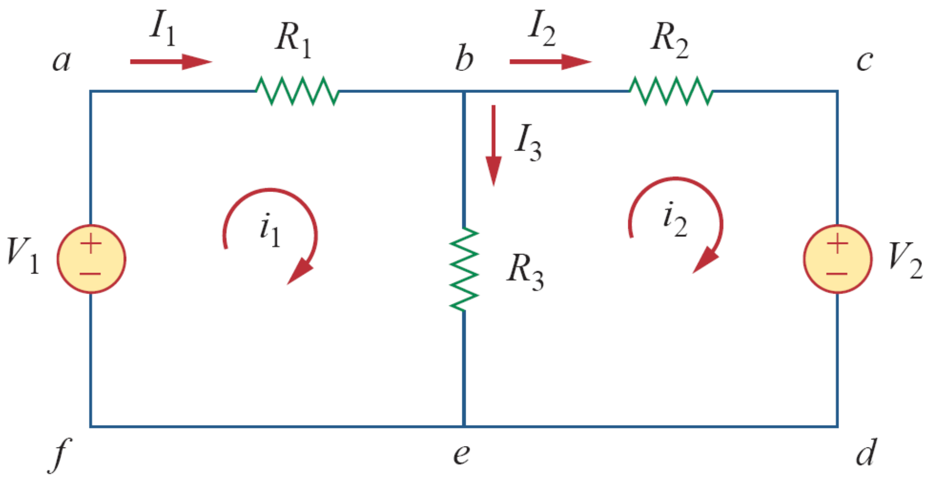


Figure 3.17
A circuit with two meshes.

$$\begin{bmatrix} R_1 + R_3 & -R_3 \\ -R_3 & R_2 + R_3 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} V_1 \\ -V_2 \end{bmatrix} \qquad (3.15)$$

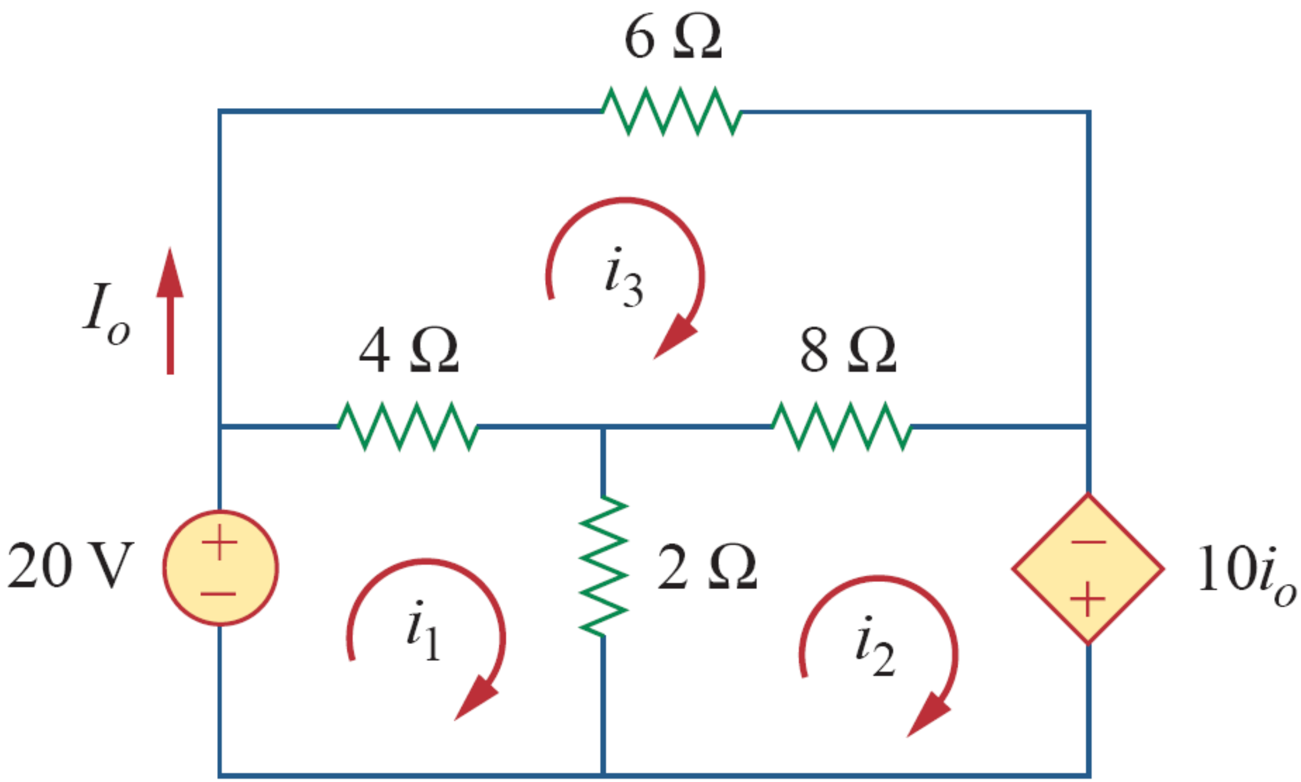


Figure 3.21
For Practice Prob. 3.6.

TWO METHODS

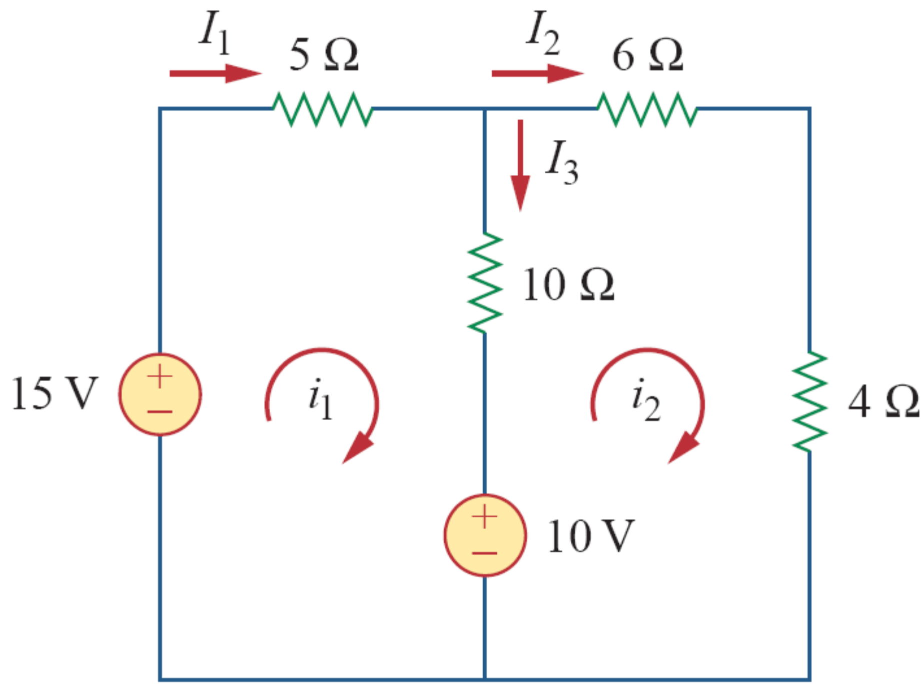


Figure 3.18
For Example 3.5.

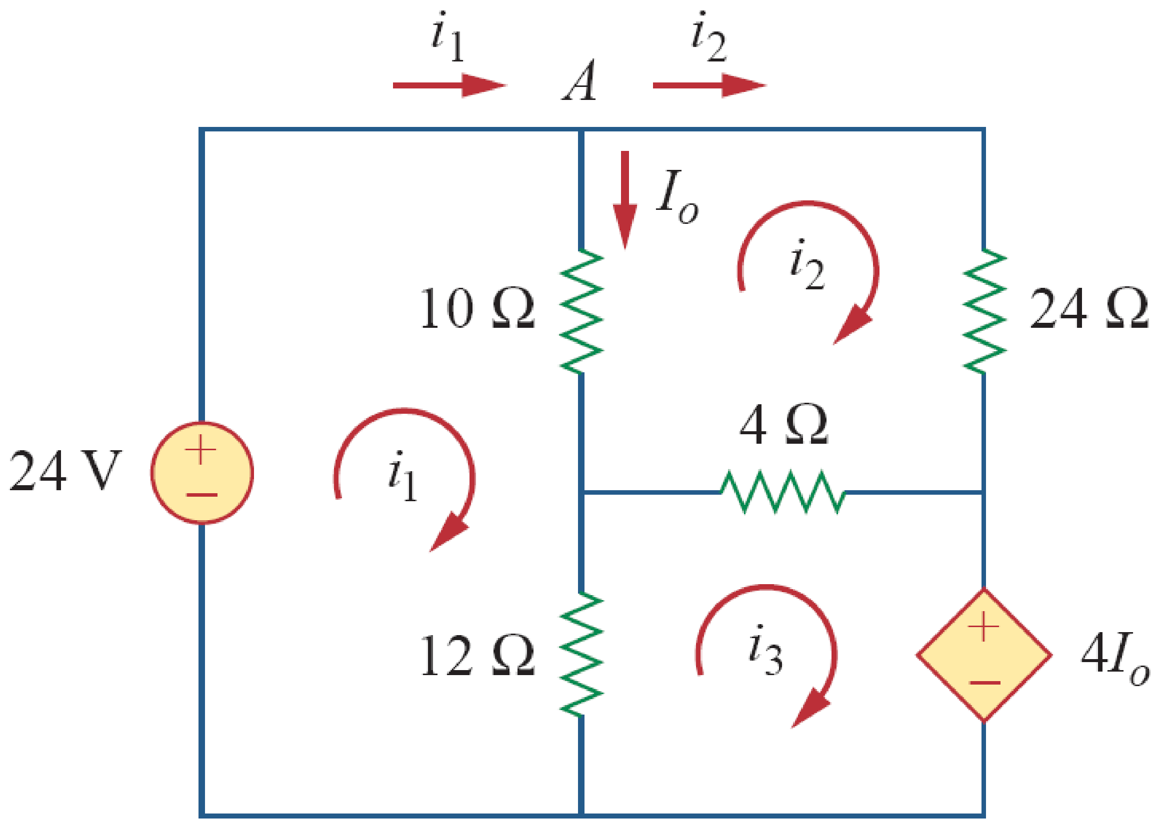


Figure 3.20
For Example 3.6.