# Problems

## 8.1 Constant-Current Sources

1. Find the voltage $V_S$ for the circuit shown in Figure 8–64.
2. Find the voltage $V_S$ for the circuit shown in Figure 8–65.

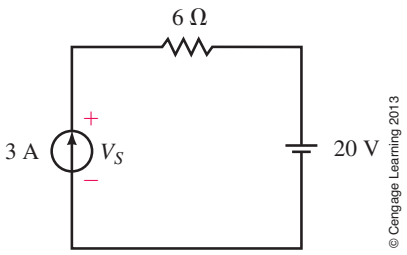


FIGURE 8–64

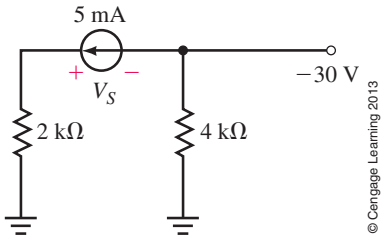


FIGURE 8–65

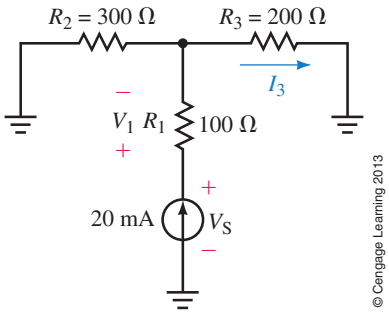


FIGURE 8–66

3. Refer to the circuit of Figure 8–66:
   a. Find the current $I_3$.
   b. Determine the voltages $V_S$ and $V_1$.
4. Consider the circuit of Figure 8–67:
   a. Calculate the voltages $V_2$ and $V_S$.
   b. Find the currents $I$ and $I_3$.

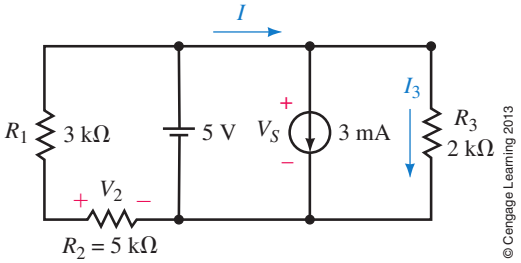


FIGURE 8–67

5. For the circuit of Figure 8–68, find the currents $I_1$ and $I_2$.
6. Refer to the circuit of Figure 8–69:
   a. Find the voltages $V_S$ and $V_2$.
   b. Determine the current $I_4$.

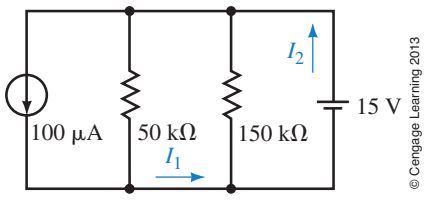


FIGURE 8–68

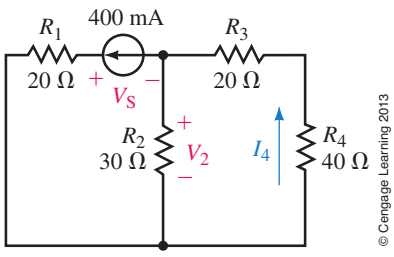


FIGURE 8–69

7. Verify that the power supplied by the sources is equal to the summation of the powers dissipated by the resistors in the circuit of Figure 8–68.
8. Verify that the power supplied by the source in the circuit of Figure 8–69 is equal to the summation of the powers dissipated by the resistors.

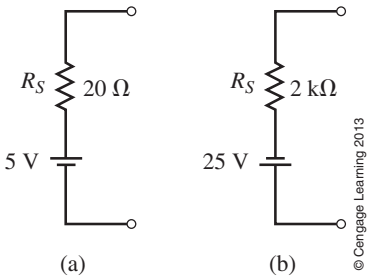


FIGURE 8–70

## 8.2 Source Conversions

9. Convert each of the voltage sources of Figure 8–70 into its equivalent current source.
10. Convert each of the current sources of Figure 8–71 into its equivalent voltage source.

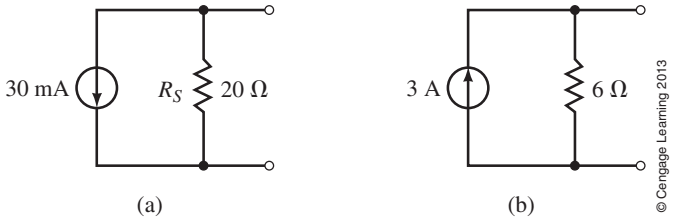


FIGURE 8–71

11. Refer to the circuit of Figure 8–72:
    a. Solve for the current through the load resistor using the current divider rule.
    b. Convert the current source into its equivalent voltage source and again determine the current through the load.
12. Find $V_{ab}$ and $I_2$ for the network of Figure 8–73.

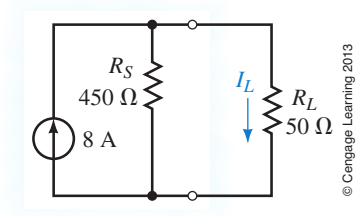


FIGURE 8–72

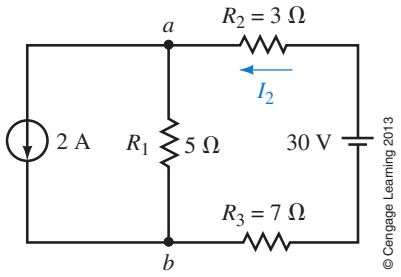


FIGURE 8–73

13. Refer to the circuit of Figure 8–74:
    a. Convert the current source and the 330-Ω resistor into an equivalent voltage source.
    b. Solve for the current $I$ through $R_L$.
    c. Determine the voltage $V_{ab}$.

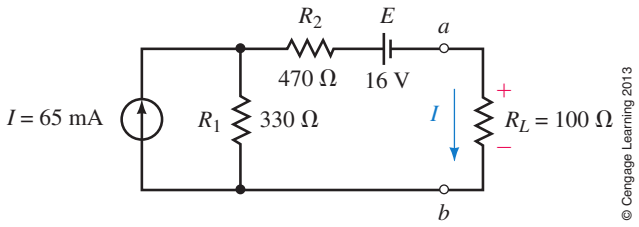


FIGURE 8–74

14. Refer to the circuit of Figure 8–75:
    a. Convert the voltage source and the 36-Ω resistor into an equivalent current source.
    b. Solve for the current $I$ through $R_L$.
    c. Determine the voltage $V_{ab}$.

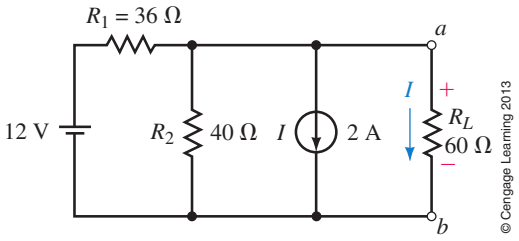


FIGURE 8–75

## 8.3 Current Sources in Parallel and Series

15. Find the voltage $V_2$ and the current $I_1$ for the circuit of Figure 8–76.

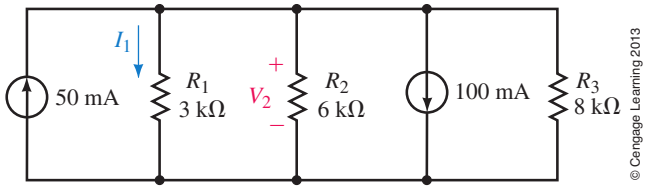


FIGURE 8–76

16. Convert the voltage sources of Figure 8–77 into current sources and solve for the current $I_1$ and the voltage $V_{ab}$.
17. For the circuit of Figure 8–78, convert the current source and the 2.4-kΩ resistor into a voltage source and find the voltage $V_{ab}$ and the current $I_3$.
18. For the circuit of Figure 8–78, convert the voltage source and the series resistors into an equivalent current source.
    a. Determine the current $I_2$.
    b. Solve for the voltage $V_{ab}$.

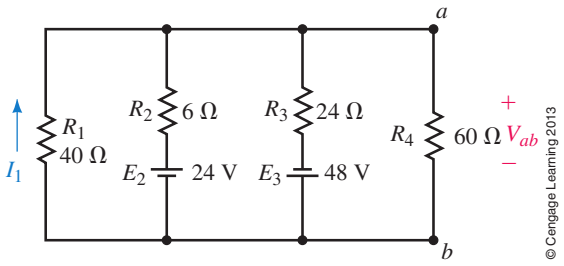


FIGURE 8–77

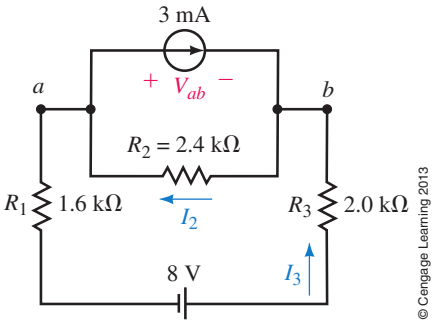


FIGURE 8–78

## 8.4 Branch-Current Analysis

19. Write the branch-current equations for the circuit shown in Figure 8–79 and solve for the branch currents using determinants.
20. Refer to the circuit of Figure 8–80:
    a. Solve for the current $I_1$ using branch-current analysis.
    b. Determine the voltage $V_{ab}$.

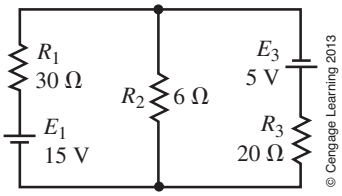


FIGURE 8–79

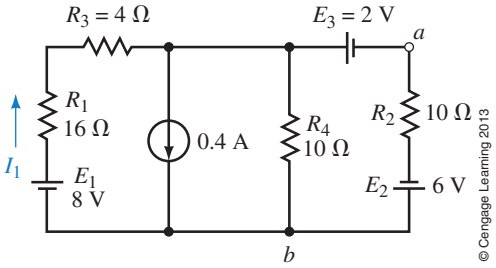


FIGURE 8–80

21. Write the branch-current equations for the circuit shown in Figure 8–81 and solve for the current $I_2$.

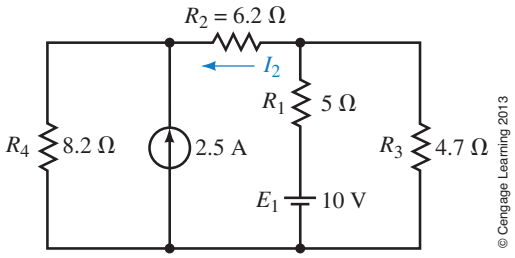


FIGURE 8–81

22. Refer to the circuit shown in Figure 8–82:
    a. Write the branch-current equations.
    b. Solve for the currents $I_1$ and $I_2$.
    c. Determine the voltage $V_{ab}$.
23. Refer to the circuit shown in Figure 8–83:
    a. Write the branch-current equations.
    b. Solve for the current $I_2$.
    c. Determine the voltage $V_{ab}$.

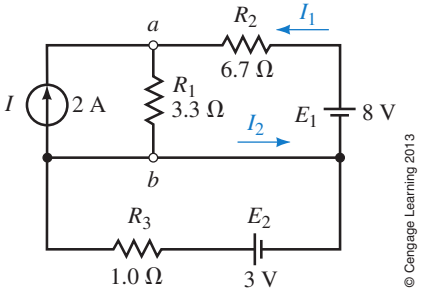


FIGURE 8–82

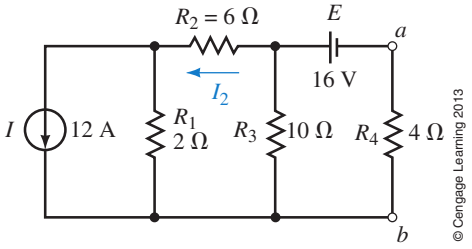


FIGURE 8–83

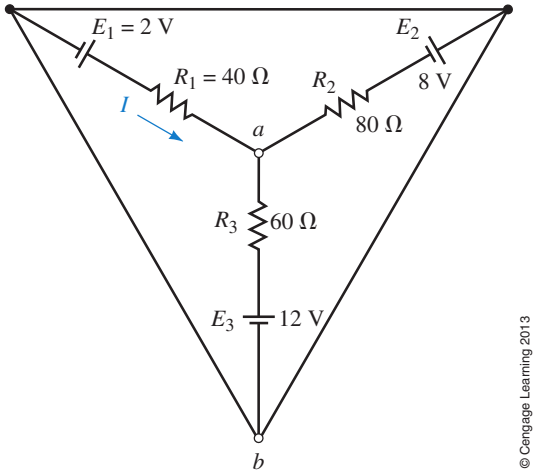


FIGURE 8–84

24. Refer to the circuit shown in Figure 8–84:
    a. Write the branch-current equations.
    b. Solve for the current $I$.
    c. Determine the voltage $V_{ab}$.

## 8.5 Mesh (Loop) Analysis

25. Write the mesh equations for the circuit shown in Figure 8–79 and solve for the loop currents.
26. Use mesh analysis for the circuit of Figure 8–80 to solve for the current $I_1$.
27. Use mesh analysis to solve for the current $I_2$ in the circuit of Figure 8–81.
28. Use mesh analysis to solve for the loop currents in the circuit of Figure 8–83. Use your results to determine $I_2$ and $V_{ab}$.
29. Use mesh analysis to solve for the loop currents in the circuit of Figure 8–84. Use your results to determine $I$ and $V_{ab}$.
30. Using mesh analysis, determine the current through the 6-Ω resistor in the circuit of Figure 8–85.
31. Write the mesh equations for the network in Figure 8–86. Solve for the loop currents using determinants.
32. Repeat Problem 31 for the network in Figure 8–87.

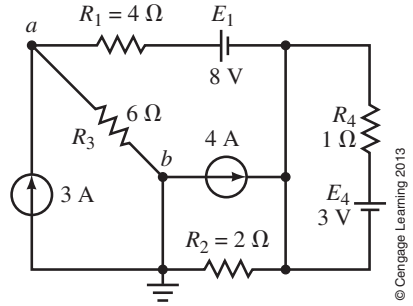


FIGURE 8–85

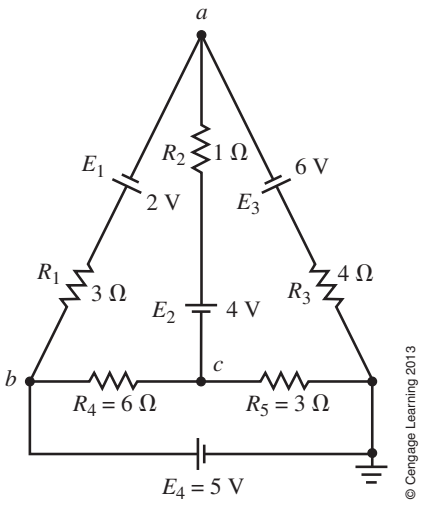


FIGURE 8–86

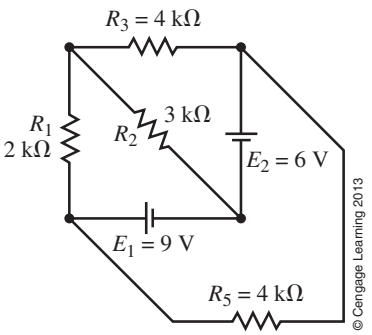


FIGURE 8–87

## 8.6 Nodal Analysis

33. Write the nodal equations for the circuit of Figure 8–88 and solve for the nodal voltages.
34. Write the nodal equations for the circuit of Figure 8–89 and determine the voltage $V_{ab}$.
35. Repeat Problem 33 for the circuit of Figure 8–90.

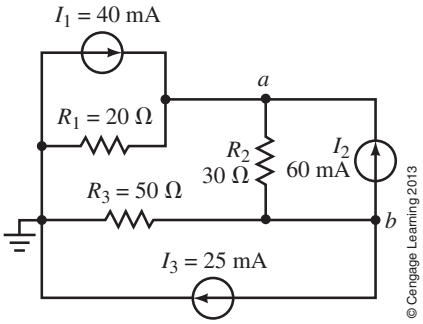


FIGURE 8–89

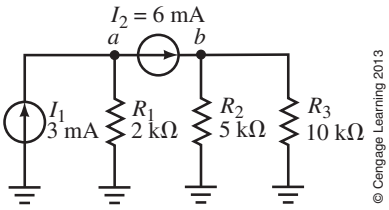


FIGURE 8–90

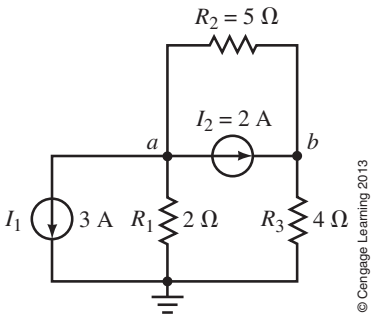


FIGURE 8–88

36. Repeat Problem 34 for the circuit of Figure 8–91.
37. Write the nodal equations for the circuit of Figure 8–86 and solve for $V_{6\,\Omega}$.
38. Write the nodal equations for the circuit of Figure 8–85 and solve for $V_{6\,\Omega}$.

## 8.7 Delta-Wye (Pi-Tee) Conversion

39. Convert each of the Δ networks of Figure 8–92 into its equivalent Y configuration.
40. Convert each of the Δ networks of Figure 8–93 into its equivalent Y configuration.

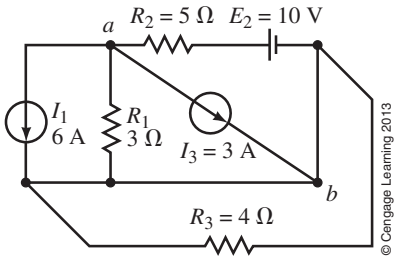


FIGURE 8–91

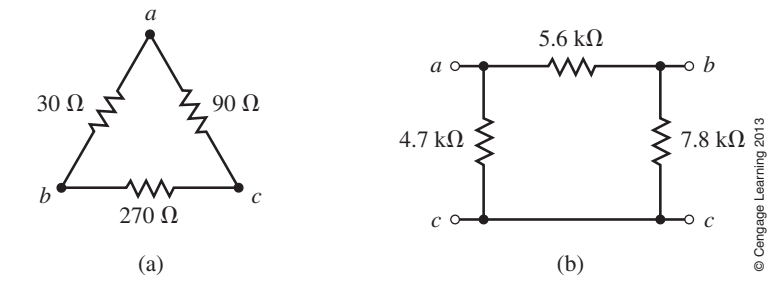


FIGURE 8–92

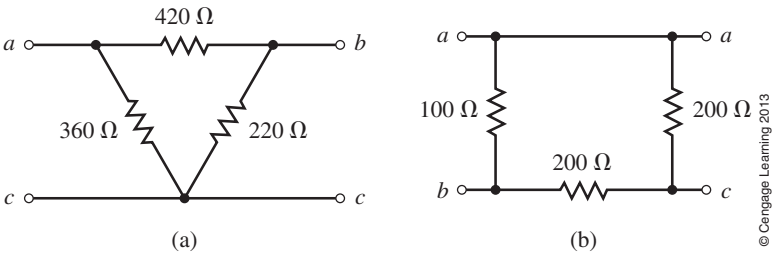


FIGURE 8–93

41. Convert each of the Y networks of Figure 8–94 into its equivalent Δ configuration.

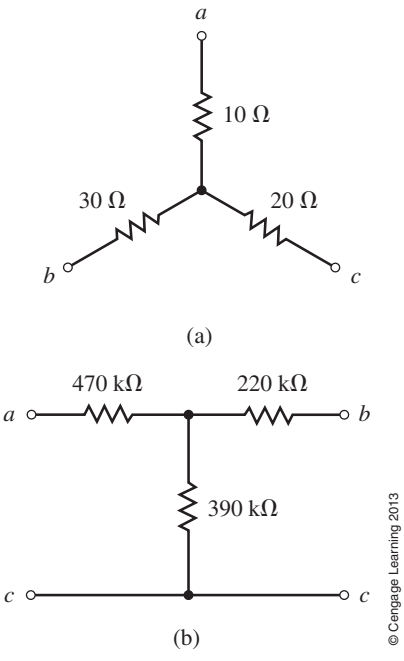


FIGURE 8–94

42. Convert each of the Y networks of Figure 8–95 into its equivalent Δ configuration.

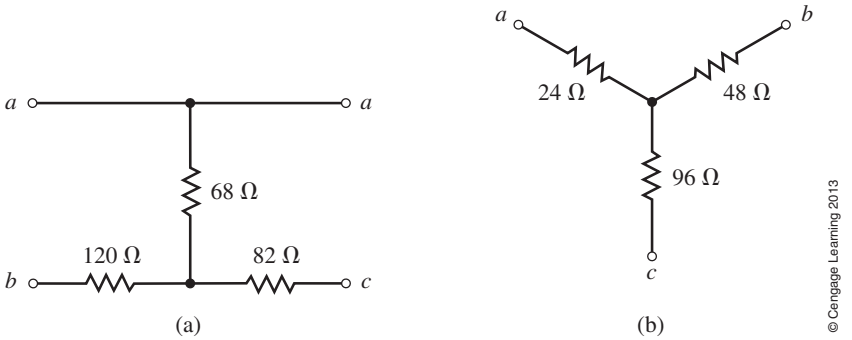


FIGURE 8–95

43. Using Δ-Y or Y-Δ conversion, find the current $I$ for the circuit of Figure 8–96.
44. Using Δ-Y or Y-Δ conversion, find the current $I$ and the voltage $V_{ab}$ for the circuit of Figure 8–97.

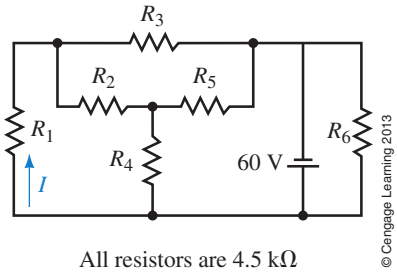


FIGURE 8–96

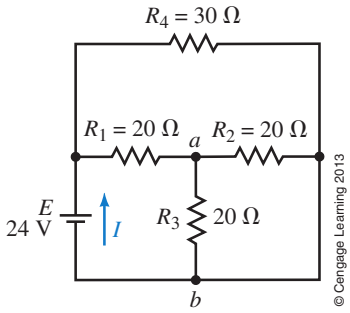


FIGURE 8–97

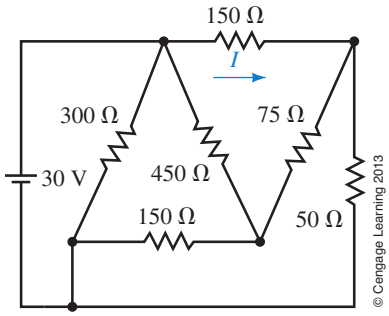


FIGURE 8–98

45. Repeat Problem 43 for the circuit of Figure 8–98.
46. Repeat Problem 44 for the circuit of Figure 8–99.

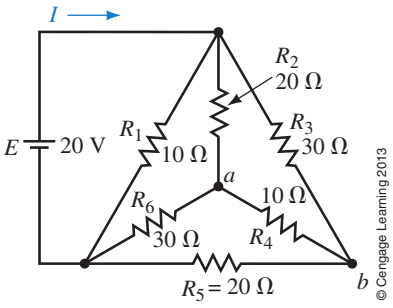


FIGURE 8–99

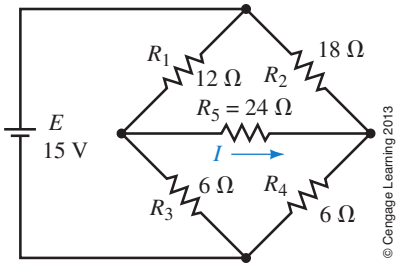


FIGURE 8–100

## 8.8 Bridge Networks

47. Refer to the bridge circuit of Figure 8–100:
    a. Is the bridge balanced? Explain.
    b. Write the mesh equations.
    c. Calculate the current through $R_5$.
    d. Determine the voltage across $R_5$.

48. Consider the bridge circuit of Figure 8–101:
    a. Is the bridge balanced? Explain.
    b. Write the mesh equations.
    c. Determine the current through $R_5$.
    d. Calculate the voltage across $R_5$.
49. Given the bridge circuit of Figure 8–102, find the current through each resistor.
50. Refer to the bridge circuit of Figure 8–103:
    a. Determine the value of resistance $R_x$ such that the bridge is balanced.
    b. Calculate the current through $R_5$ when $R_x = 0\ \Omega$ and when $R_x = 10\ \text{k}\Omega$.

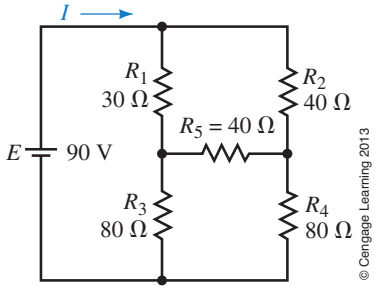


FIGURE 8–101

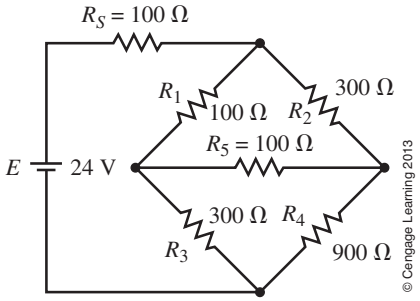


FIGURE 8–102

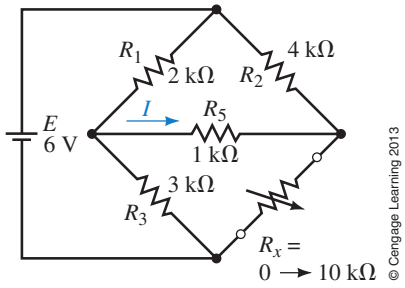


FIGURE 8–103

## 8.9 Circuit Analysis Using Computers

51. Use Multisim to solve for the currents through all resistors of the circuit shown in Figure 8–86.
52. Use Multisim to solve for the voltage across the 5-kΩ resistor in the circuit of Figure 8–87.
53. Use PSpice to solve for the currents through all resistors in the circuit of Figure 8–96.
54. Use PSpice to solve for the currents through all resistors in the circuit of Figure 8–97.

MULTISIM

MULTISIM

PSPICE

PSPICE

## ANSWERS TO IN-PROCESS LEARNING CHECKS

### IN-PROCESS LEARNING CHECK 1

1. A voltage source $E$ in series with a resistor $R$ is equivalent to a current source having an ideal current source $I = E/R$ in parallel with the same resistance, $R$.
2. Current sources are never connected in series.

### IN-PROCESS LEARNING CHECK 2

1. Voltage is zero.
2. Current is zero.
3. $R_5$ can be replaced with either a short circuit or an open circuit.