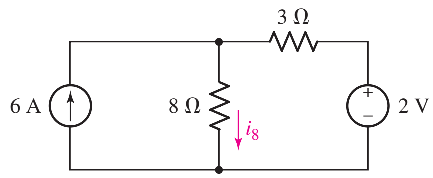


FIGURE 5.48

4. (*a*) Employ superposition to determine the current labeled i in the circuit of Fig. 5.49. (*b*) Express the contribution the 1 V source makes to the total current i in terms of a percentage. (*c*) Changing only the value of the 10 A source, adjust the circuit of Fig. 5.49 so that the two sources contribute equally to the current i.

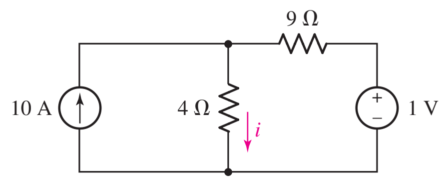


FIGURE 5.49

5. (*a*) Employ superposition to obtain the individual contributions each of the two sources in Fig. 5.50 makes to the current labeled i_x. (*b*) Adjusting only the value of the rightmost current source, alter the circuit so that the two sources contribute equally to i_x.

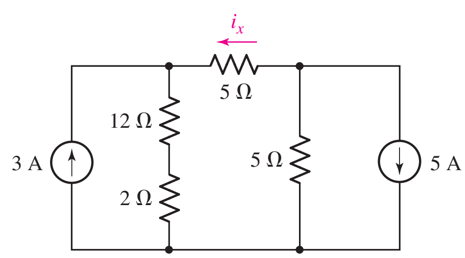


FIGURE 5.50

6. (*a*) Determine the individual contributions of each of the two current sources in the circuit of Fig. 5.51 to the nodal voltage v_1. (*b*) Determine the percentage contribution of each of the two sources to the power dissipated by the 2 Ω resistor.

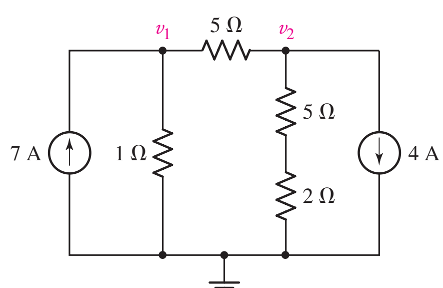


FIGURE 5.51

7. (*a*) Determine the individual contributions of each of the two current sources shown in Fig. 5.52 to the nodal voltage labeled v_2. (*b*) Instead of performing two separate PSpice simulations, verify your answer by using a single dc sweep. Submit a labeled schematic, relevant Probe output, and a short description of the results.

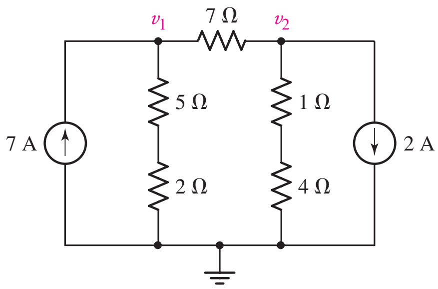


FIGURE 5.52

8. After studying the circuit of Fig. 5.53, change both voltage source values such that (*a*) i_1 doubles; (*b*) the direction of i_1 reverses, but its magnitude is unchanged; (*c*) both sources contribute equally to the power dissipated by the 6 Ω resistor.

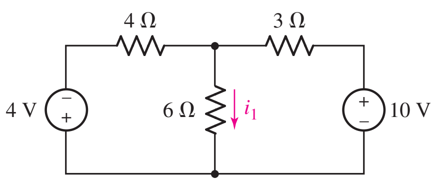


FIGURE 5.53

9. Consider the three circuits shown in Fig. 5.54. Analyze each circuit, and demonstrate that $V_x = V_x' + V_x''$ (i.e., *superposition is most useful when sources are set to zero, but the principle is in fact much more general than that*).

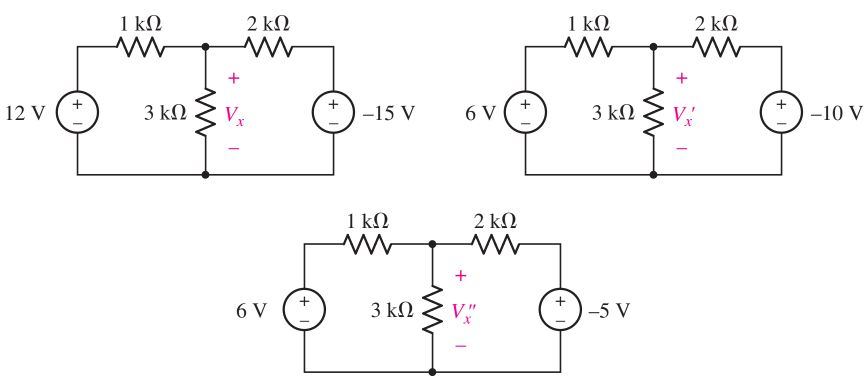


FIGURE 5.54

10. (*a*) Using superposition, determine the voltage labeled v_x in the circuit represented in Fig. 5.55. (*b*) To what value should the 2 A source be changed to reduce v_x by 10%? (*c*) Verify your answers by performing three dc sweeps in PSpice (one for each source). Submit a labeled schematic, relevant Probe output, and a short description of the results.

32. Determine the Thévenin equivalent of the network shown in Fig. 5.74 as seen looking into the two open terminals.

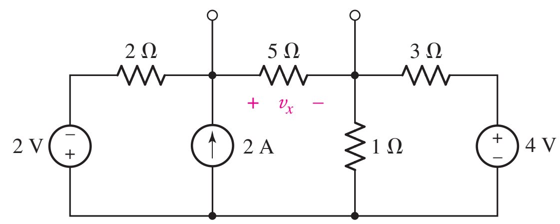


FIGURE 5.74

33. (*a*) Determine the Norton equivalent of the circuit depicted in Fig. 5.74 as seen looking into the two open terminals. (*b*) Compute power dissipated in a 5 Ω resistor connected in parallel with the existing 5 Ω resistor. (*c*) Compute the current flowing through a short circuit connecting the two terminals.

34. For the circuit of Fig. 5.75: (*a*) Employ Norton's theorem to reduce the network connected to R_L to only two components. (*b*) Calculate the downward-directed current flowing through R_L if it is a 3.3 kΩ resistor. (*c*) Verify your answer by simulating both circuits with PSpice or a comparable CAD tool.

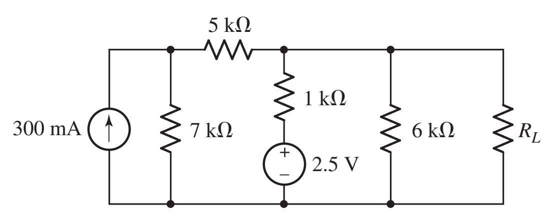


FIGURE 5.75

35. (*a*) Obtain a value for the Thévenin equivalent resistance seen looking into the open terminals of the circuit in Fig. 5.76 by first finding V_{oc} and I_{sc}. (*b*) Connect a 1 A test source to the open terminals of the original circuit after shorting the voltage source, and use this to obtain R_{TH}. (*c*) Connect a 1 V test source to the open terminals of the original circuit after again zeroing the 2 V source, and use this now to obtain R_{TH}.

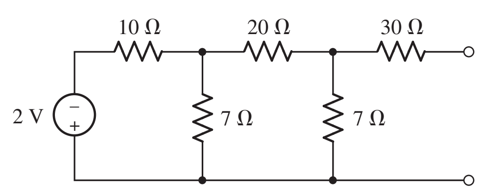


FIGURE 5.76

36. Refer to the circuit depicted in Fig. 5.77. (*a*) Obtain a value for the Thévenin equivalent resistance seen looking into the open terminals by first finding V_{oc} and I_{sc}. (*b*) Connect a 1 A test source to the open terminals of the original

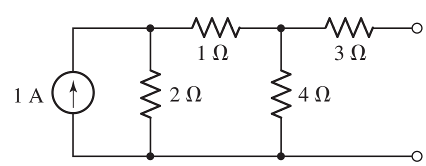


FIGURE 5.77

circuit after deactivating the other current source, and use this to obtain R_{TH}. (*c*) Connect a 1 V test source to the open terminals of the original circuit, once again zeroing out the original source, and use this now to obtain R_{TH}.

37. Obtain a value for the Thévenin equivalent resistance seen looking into the open terminals of the circuit in Fig. 5.78 by (*a*) finding V_{oc} and I_{sc}, and then taking their ratio; (*b*) setting all independent sources to zero and using resistor combination techniques; (*c*) connecting an unknown current source to the terminals, deactivating (zero out) all other sources, finding an algebraic expression for the voltage that develops across the source, and taking the ratio of the two quantities.

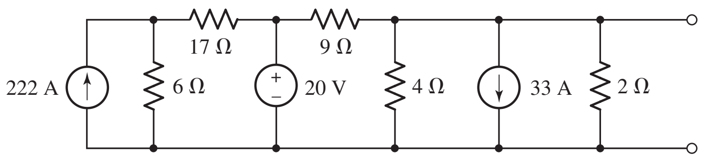


FIGURE 5.78

38. With regard to the network depicted in Fig. 5.79, determine the Thévenin equivalent as seen by an element connected to terminals (*a*) *a* and *b*; (*b*) *a* and *c*; (*c*) *b* and *c*. (*d*) Verify your answers using PSpice or other suitable CAD tool. (*Hint: Connect a test source to the terminals of interest.*)

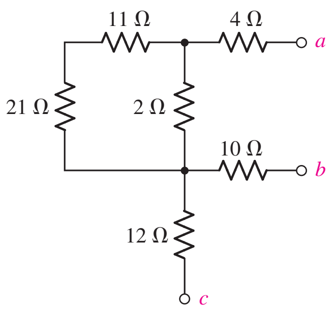


FIGURE 5.79

39. Determine the Thévenin and Norton equivalents of the circuit represented in Fig. 5.80 from the perspective of the open terminals. (There should be no dependent sources in your answer.)

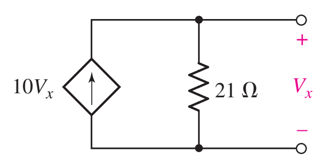


FIGURE 5.80

40. Determine the Norton equivalent of the circuit drawn in Fig. 5.81 as seen by terminals *a* and *b*. (There should be no dependent sources in your answer.)

41. With regard to the circuit of Fig. 5.82, determine the power dissipated by (*a*) a 1 kΩ resistor connected between *a* and *b*; (*b*) a 4.7 kΩ resistor connected between *a* and *b*; (*c*) a 10.54 kΩ resistor connected between *a* and *b*.

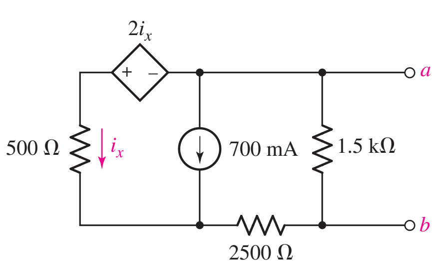


FIGURE 5.81

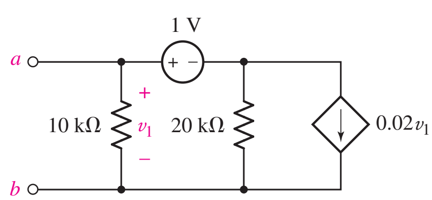
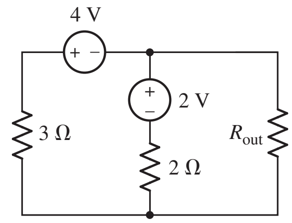


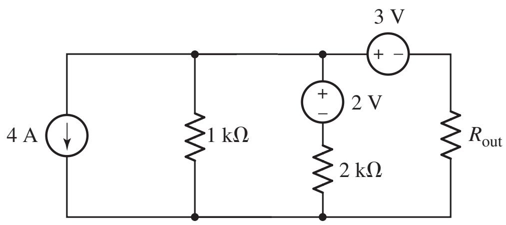
FIGURE 5.82

47. For the circuit drawn in Fig. 5.88, (*a*) determine the Thévenin equivalent connected to R_{out}. (*b*) Choose R_{out} such that maximum power is delivered to it.

48. Study the circuit of Fig. 5.89. (*a*) Determine the Norton equivalent connected to resistor R_{out}. (*b*) Select a value for R_{out} such that maximum power will be delivered to it.



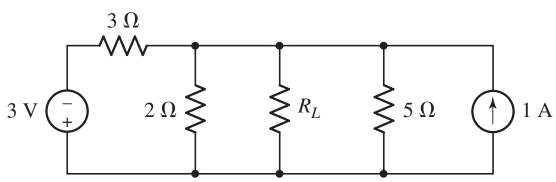
■ FIGURE 5.88



■ FIGURE 5.89

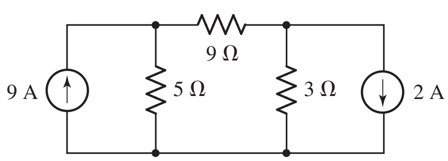
49. Assuming that we can determine the Thévenin equivalent resistance of our wall socket, why don't toaster, microwave oven, and TV manufacturers match each appliance's Thévenin equivalent resistance to this value? Wouldn't it permit maximum power transfer from the utility company to our household appliances?

50. For the circuit of Fig. 5.90, what value of R_L will ensure it absorbs the maximum possible amount of power?



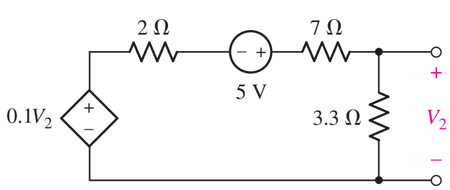
■ FIGURE 5.90

51. With reference to the circuit of Fig. 5.91, (*a*) calculate the power absorbed by the 9 Ω resistor; (*b*) adjust the size of the 5 Ω resistor so that the new network delivers maximum power to the 9 Ω resistor.



■ FIGURE 5.91

52. Referring to the circuit of Fig. 5.92, (*a*) determine the power absorbed by the 3.3 Ω resistor; (*b*) replace the 3.3 Ω resistor with another resistor such that it absorbs maximum power from the rest of the circuit.

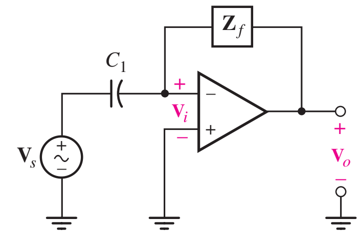


■ FIGURE 5.92

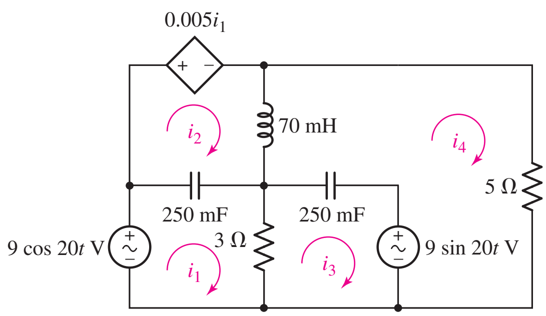
58. Determine the nodal voltages for the circuit of Fig. 10.64, using the bottom node as the reference node, if $v_1 = 0.009\cos(500t + 0.5°)$ V and $v_2 = 0.004\cos(500t + 1.5°)$ V.

59. The op amp shown in Fig. 10.65 has an infinite input impedance, zero output impedance, and a large but finite (positive, real) gain, $A = -\mathbf{V}_o/\mathbf{V}_i$. (*a*) Construct a basic differentiator by letting $\mathbf{Z}_f = R_f$, find $\mathbf{V}_o/\mathbf{V}_s$, and then show that $\mathbf{V}_o/\mathbf{V}_s \to -j\omega C_1 R_f$ as $\mathbf{A} \to \infty$. (*b*) Let $\mathbf{Z}_f$ represent C_f and R_f in parallel, find $\mathbf{V}_o/\mathbf{V}_s$, and then show that $\mathbf{V}_o/\mathbf{V}_s \to -j\omega C_1 R_f/(1 + j\omega C_f R_f)$ as $\mathbf{A} \to \infty$.

60. Obtain an expression for each of the four mesh currents labeled in the circuit of Fig. 10.66.



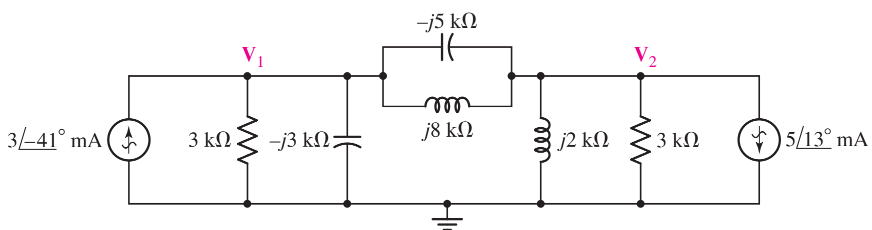
■ FIGURE 10.65



■ FIGURE 10.66

10.7 Superposition, Source Transformations, and Thévenin's Theorem

61. Determine the individual contribution each current source makes to the two nodal voltages $\mathbf{V}_1$ and $\mathbf{V}_2$ as represented in Fig. 10.67.

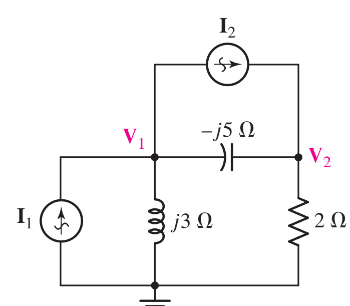


■ FIGURE 10.67

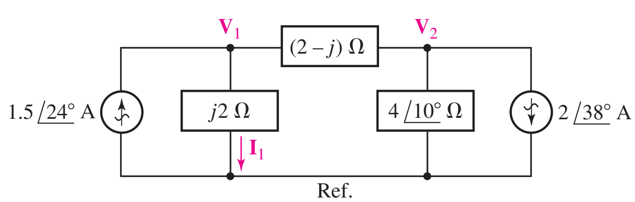
62. Determine $\mathbf{V}_1$ and $\mathbf{V}_2$ in Fig. 10.68 if $\mathbf{I}_1 = 33\angle 3°$ mA and $\mathbf{I}_2 = 51\angle -91°$ mA.

63. The phasor domain circuit of Fig. 10.68 was drawn assuming an operating frequency of 2.5 rad/s. Unfortunately, the manufacturing unit installed the wrong sources, each operating at a different frequency. If $i_1(t) = 4\cos 40t$ mA and $i_2(t) = 4\sin 30t$ mA, calculate $v_1(t)$ and $v_2(t)$.

64. Obtain the Thévenin equivalent seen by the $(2 - j)\ \Omega$ impedance of Fig. 10.69, and employ it to determine the current $\mathbf{I}_1$.



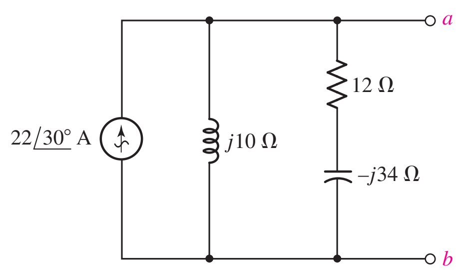
■ FIGURE 10.68



■ FIGURE 10.69

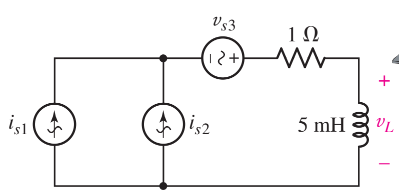
65. The $(2 - j)\ \Omega$ impedance in the circuit of Fig. 10.69 is replaced with a $(1 + j)\ \Omega$ impedance. Perform a source transformation on each source, simplify the resulting circuit as much as possible, and calculate the current flowing through the $(1 + j)\ \Omega$ impedance.

66. With regard to the circuit depicted in Fig. 10.70, (*a*) calculate the Thévenin equivalent seen looking into the terminals marked *a* and *b*; (*b*) determine the Norton equivalent seen looking into the terminals marked *a* and *b*; (*c*) compute the current flowing from *a* to *b* if a $(7 - j2)\ \Omega$ impedance is connected across them.



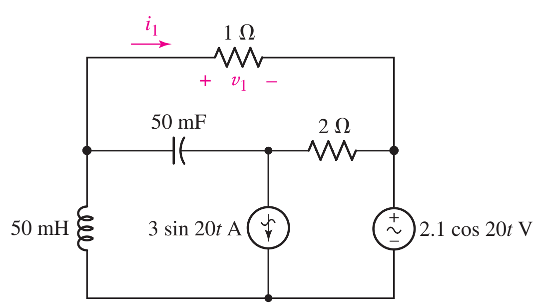
■ FIGURE 10.70

67. In the circuit of Fig. 10.71, $i_{s1} = 8 \cos(4t - 9^\circ)$ mA, $i_{s2} = 5 \cos 4t$ and $v_{s3} = 2 \sin 4t$. (*a*) Redraw the circuit in the phasor domain; (*b*) reduce the circuit to a single current source with the assistance of a source transformation; (*c*) calculate $v_L(t)$. (*d*) Verify your solution with an appropriate PSpice simulation.



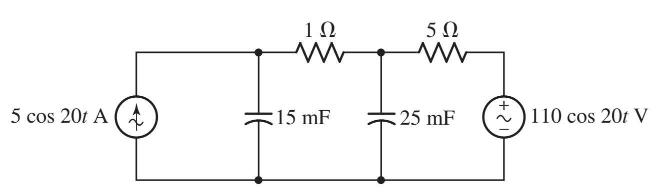
■ FIGURE 10.71

68. Determine the individual contribution of each source in Fig. 10.72 to the voltage $v_1(t)$.

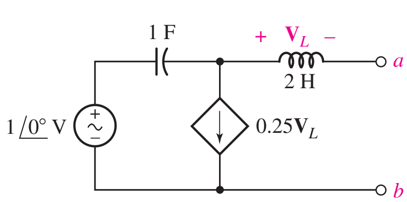


■ FIGURE 10.72

69. Determine the power dissipated by the 1 Ω resistor in the circuit of Fig. 10.73. Verify your solution with an appropriate PSpice simulation.



■ FIGURE 10.73



■ FIGURE 10.74

70. Use $\omega = 1$ rad/s, and find the Norton equivalent of the network shown in Fig. 10.74. Construct the Norton equivalent as a current source $\mathbf{I}_N$ in parallel with a resistance R_N and either an inductance L_N or a capacitance C_N.