## REVIEW QUESTIONS

**10.1** The voltage $\mathbf{V}_o$ across the capacitor in Fig. 10.43 is:
(a) $5\angle 0^\circ$ V (b) $7.071\angle 45^\circ$ V
(c) $7.071\angle -45^\circ$ V (d) $5\angle -45^\circ$ V

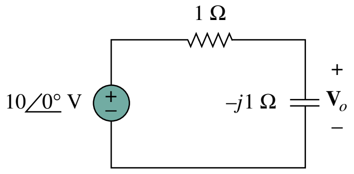


Figure 10.43 For Review Question 10.1.

**10.2** The value of the current $\mathbf{I}_o$ in the circuit in Fig. 10.44 is:
(a) $4\angle 0^\circ$ A (b) $2.4\angle -90^\circ$ A
(c) $0.6\angle 0^\circ$ A (d) $-1$ A

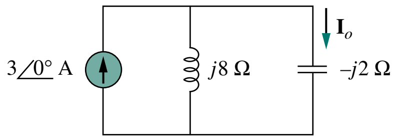


Figure 10.44 For Review Question 10.2.

**10.3** Using nodal analysis, the value of $\mathbf{V}_o$ in the circuit of Fig. 10.45 is:
(a) $-24$ V (b) $-8$ V
(c) 8 V (d) 24 V

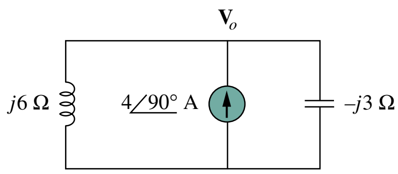


Figure 10.45 For Review Question 10.3.

**10.4** In the circuit of Fig. 10.46, current $i(t)$ is:
(a) $10 \cos t$ A (b) $10 \sin t$ A (c) $5 \cos t$ A
(d) $5 \sin t$ A (e) $4.472 \cos(t - 63.43^\circ)$ A

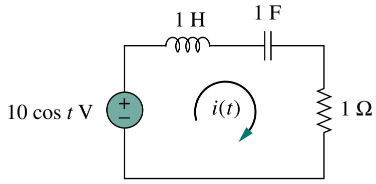


Figure 10.46 For Review Question 10.4.

**10.5** Refer to the circuit in Fig. 10.47 and observe that the two sources do not have the same frequency. The current $i_x(t)$ can be obtained by:
(a) source transformation
(b) the superposition theorem
(c) *PSpice*

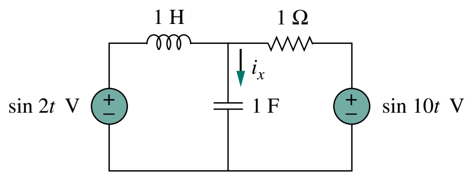


Figure 10.47 For Review Question 10.5.

**10.6** For the circuit in Fig. 10.48, the Thevenin impedance at terminals *a-b* is:
(a) 1 Ω (b) $0.5 - j0.5$ Ω
(c) $0.5 + j0.5$ Ω (d) $1 + j2$ Ω
(e) $1 - j2$ Ω

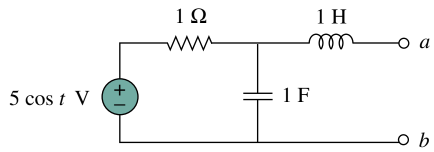


Figure 10.48 For Review Questions 10.6 and 10.7.

**10.7** In the circuit of Fig. 10.48, the Thevenin voltage at terminals *a-b* is:
(a) $3.535\angle -45^\circ$ V (b) $3.535\angle 45^\circ$ V
(c) $7.071\angle -45^\circ$ V (d) $7.071\angle 45^\circ$ V

**10.8** Refer to the circuit in Fig. 10.49. The Norton equivalent impedance at terminals *a-b* is:
(a) $-j4$ Ω (b) $-j2$ Ω
(c) $j2$ Ω (d) $j4$ Ω

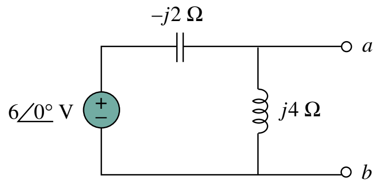


Figure 10.49 For Review Questions 10.8 and 10.9.

**10.9** The Norton current at terminals $a$-$b$ in the circuit of Fig. 10.49 is:

(a) $1\angle 0^\circ$ A (b) $1.5\angle -90^\circ$ A

(c) $1.5\angle 90^\circ$ A (d) $3\angle 90^\circ$ A

**10.10** *PSpice* can handle a circuit with two independent sources of different frequencies.

(a) True (b) False

*Answers: 10.1c, 10.2a, 10.3d, 10.4a, 10.5b, 10.6c, 10.7a, 10.8a, 10.9d, 10.10b.*

## PROBLEMS

### Section 10.2 Nodal Analysis

**10.1** Find $v_o$ in the circuit in Fig. 10.50.

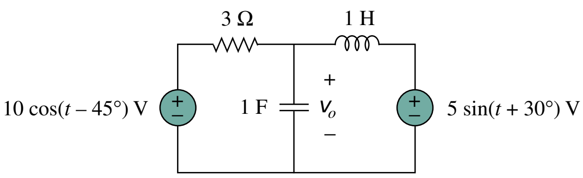


Figure 10.50 For Prob. 10.1.

**10.2** For the circuit depicted in Fig. 10.51 below, determine $i_o$.

**10.3** Determine $v_o$ in the circuit of Fig. 10.52.

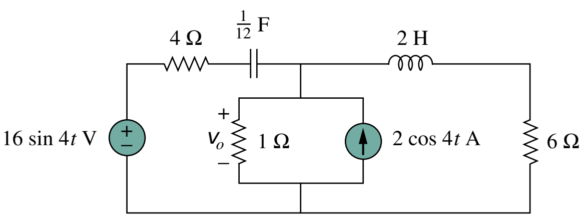


Figure 10.52 For Prob. 10.3.

**10.4** Compute $v_o(t)$ in the circuit of Fig. 10.53.

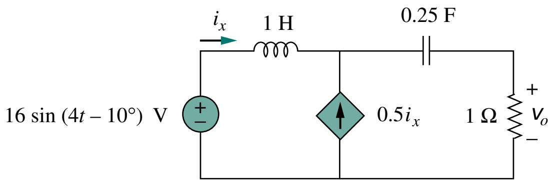


Figure 10.53 For Prob. 10.4.

**10.5** Use nodal analysis to find $v_o$ in the circuit of Fig. 10.54.

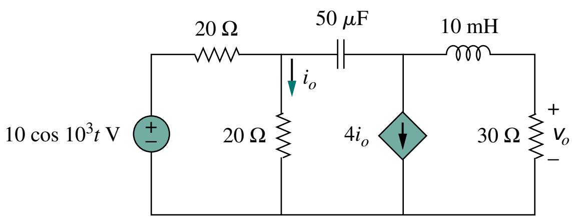


Figure 10.54 For Prob. 10.5.

**10.6** Using nodal analysis, find $i_o(t)$ in the circuit in Fig. 10.55.

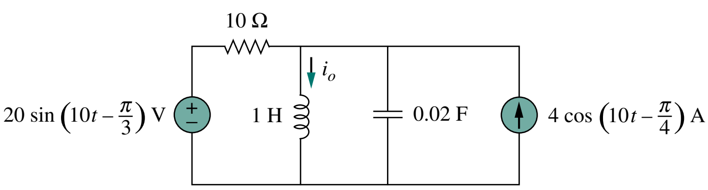


Figure 10.51 For Prob. 10.2.

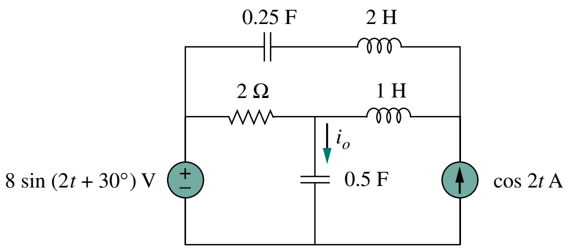


**Figure 10.55** For Prob. 10.6.

**10.7** By nodal analysis, find $i_o$ in the circuit in Fig. 10.56.

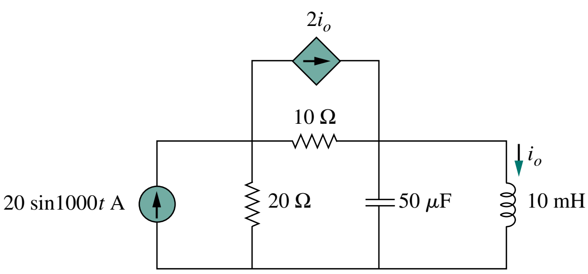


**Figure 10.56** For Prob. 10.7.

**10.8** Calculate the voltage at nodes 1 and 2 in the circuit of Fig. 10.57 using nodal analysis.

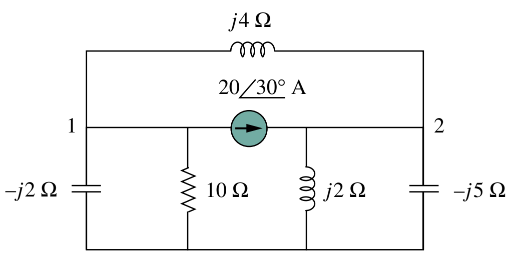


**Figure 10.57** For Prob. 10.8.

**10.9** Solve for the current **I** in the circuit of Fig. 10.58 using nodal analysis.

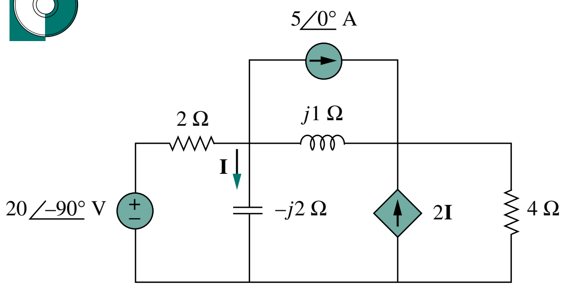


**Figure 10.58** For Prob. 10.9.

**10.10** Using nodal analysis, find $\mathbf{V}_1$ and $\mathbf{V}_2$ in the circuit of Fig. 10.59.

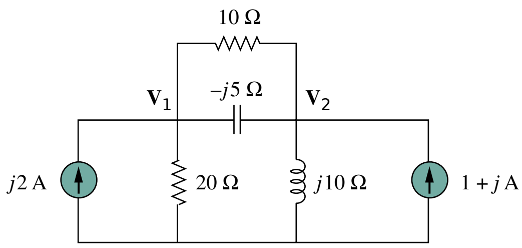


**Figure 10.59** For Prob. 10.10.

**10.11** By nodal analysis, obtain current $\mathbf{I}_o$ in the circuit in Fig. 10.60.

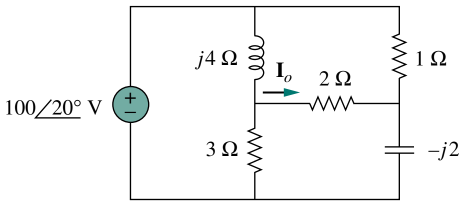


**Figure 10.60** For Prob. 10.11.

**10.12** Use nodal analysis to obtain $\mathbf{V}_o$ in the circuit of Fig. 10.61 below.

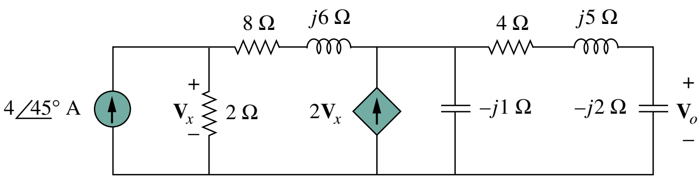


**Figure 10.61** For Prob. 10.12.

**10.13** Obtain $\mathbf{V}_o$ in Fig. 10.62 using nodal analysis.

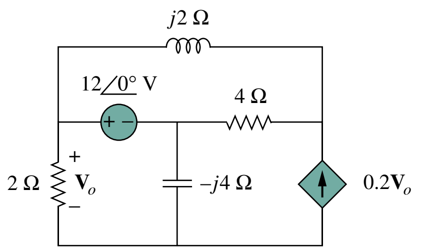


Figure 10.62 For Prob. 10.13.

**10.14** Refer to Fig. 10.63. If $v_s(t) = V_m \sin \omega t$ and $v_o(t) = A \sin(\omega t + \phi)$, derive the expressions for $A$ and $\phi$.

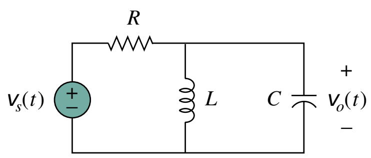


Figure 10.63 For Prob. 10.14.

**10.15** For each of the circuits in Fig. 10.64, find $\mathbf{V}_o/\mathbf{V}_i$ for $\omega = 0$, $\omega \to \infty$, and $\omega^2 = 1/LC$.

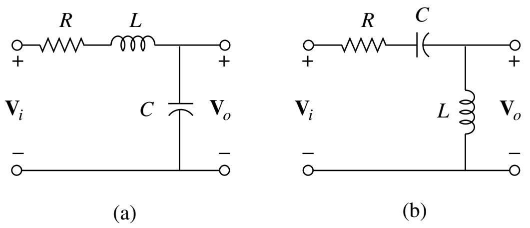


Figure 10.64 For Prob. 10.15.

**10.16** For the circuit in Fig. 10.65, determine $\mathbf{V}_o/\mathbf{V}_s$.

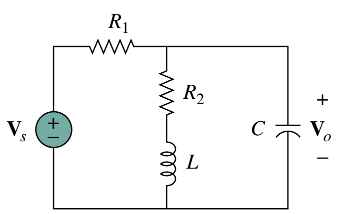


Figure 10.65 For Prob. 10.16.

## Section 10.3 Mesh Analysis

**10.17** Obtain the mesh currents $\mathbf{I}_1$ and $\mathbf{I}_2$ in the circuit of Fig. 10.66.

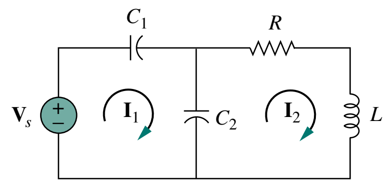


Figure 10.66 For Prob. 10.17.

**10.18** Solve for $i_o$ in Fig. 10.67 using mesh analysis.

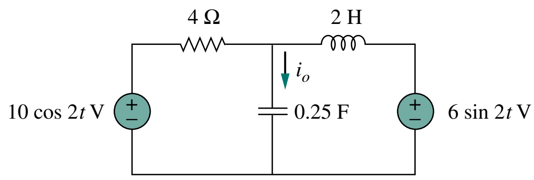


Figure 10.67 For Prob. 10.18.

**10.19** Rework Prob. 10.5 using mesh analysis.

**10.20** Using mesh analysis, find $\mathbf{I}_1$ and $\mathbf{I}_2$ in the circuit of Fig. 10.68.

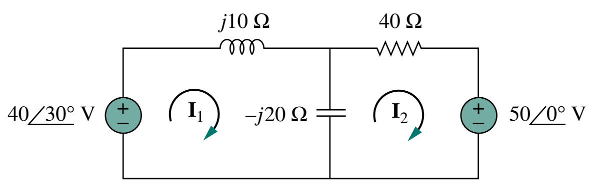


Figure 10.68 For Prob. 10.20.

**10.21** By using mesh analysis, find $\mathbf{I}_1$ and $\mathbf{I}_2$ in the circuit depicted in Fig. 10.69.

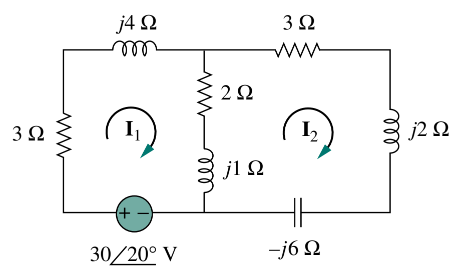


Figure 10.69 For Prob. 10.21.

**10.22** Repeat Prob. 10.11 using mesh analysis.

**10.23** Use mesh analysis to determine current $\mathbf{I}_o$ in the circuit of Fig. 10.70 below.

**10.24** Determine $\mathbf{V}_o$ and $\mathbf{I}_o$ in the circuit of Fig. 10.71 using mesh analysis.

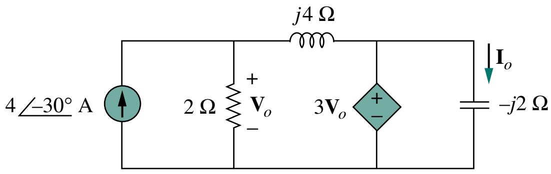


Figure 10.71 For Prob. 10.24.

**10.25** Compute **I** in Prob. 10.9 using mesh analysis.

**10.26** Use mesh analysis to find $\mathbf{I}_o$ in Fig. 10.28 (for Example 10.10).

**10.27** Calculate $\mathbf{I}_o$ in Fig. 10.30 (for Practice Prob. 10.10) using mesh analysis.

**10.28** Compute $\mathbf{V}_o$ in the circuit of Fig. 10.72 using mesh analysis.

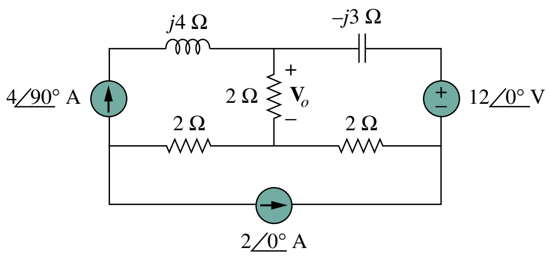


Figure 10.72 For Prob. 10.28.

**10.29** Using mesh analysis, obtain $\mathbf{I}_o$ in the circuit shown in Fig. 10.73.

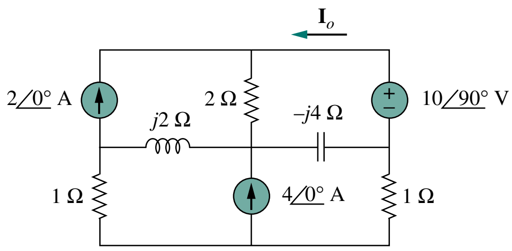


Figure 10.73 For Prob. 10.29.

## Section 10.4 Superposition Theorem

**10.30** Find $i_o$ in the circuit shown in Fig. 10.74 using superposition.

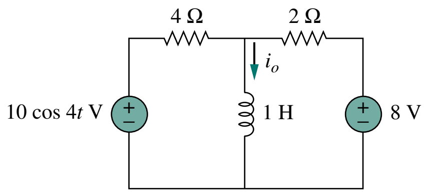


Figure 10.74 For Prob. 10.30.

**10.31** Using the superposition principle, find $i_x$ in the circuit of Fig. 10.75.

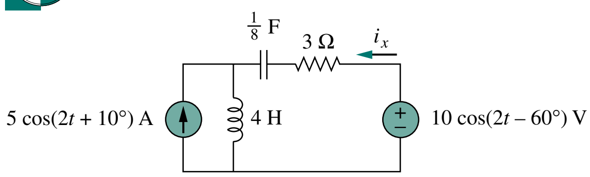


Figure 10.75 For Prob. 10.31.

**10.32** Rework Prob. 10.2 using the superposition theorem.

**10.33** Solve for $v_o(t)$ in the circuit of Fig. 10.76 using the superposition principle.

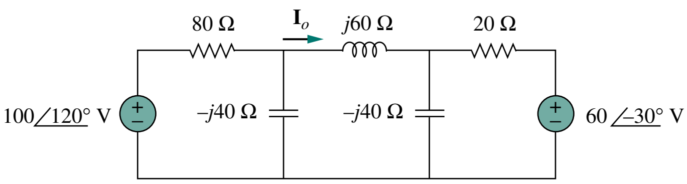


Figure 10.70 For Prob. 10.23.

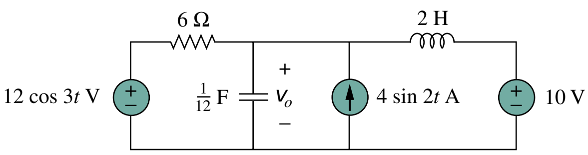


Figure 10.76 For Prob. 10.33.

**10.34** Determine $i_o$ in the circuit of Fig. 10.77.

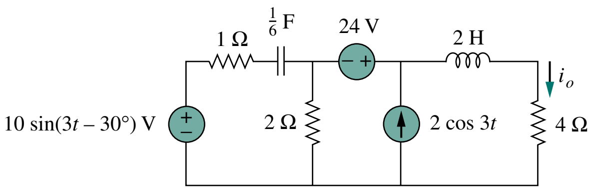


Figure 10.77 For Prob. 10.34.

**10.35** Find $i_o$ in the circuit in Fig. 10.78 using superposition.

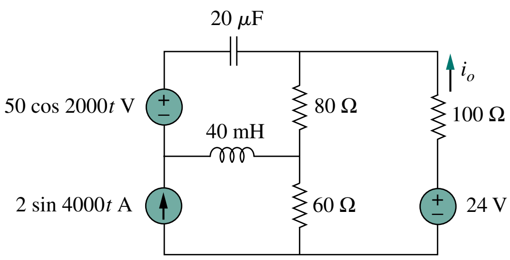


Figure 10.78 For Prob. 10.35.

## Section 10.5 Source Transformation

**10.36** Using source transformation, find $i$ in the circuit of Fig. 10.79.

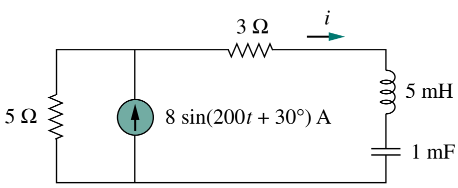


Figure 10.79 For Prob. 10.36.

**10.37** Use source transformation to find $v_o$ in the circuit in Fig. 10.80.

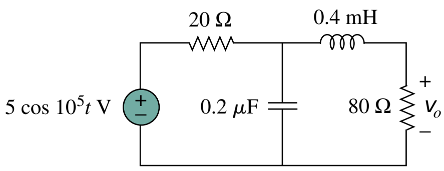


Figure 10.80 For Prob. 10.37.

**10.38** Solve Prob. 10.20 using source transformation.

**10.39** Use the method of source transformation to find $\mathbf{I}_x$ in the circuit of Fig. 10.81.

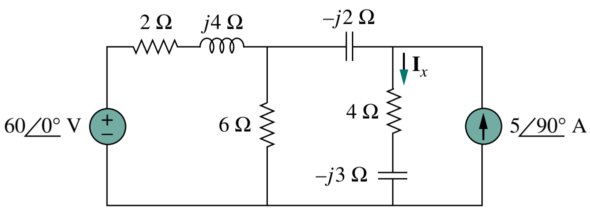


Figure 10.81 For Prob. 10.39.

**10.40** Use the concept of source transformation to find $\mathbf{V}_o$ in the circuit of Fig. 10.82.

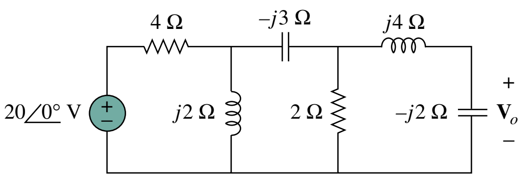


Figure 10.82 For Prob. 10.40.

## Section 10.6 Thevenin and Norton Equivalent Circuits

**10.41** Find the Thevenin and Norton equivalent circuits at terminals *a-b* for each of the circuits in Fig. 10.83.

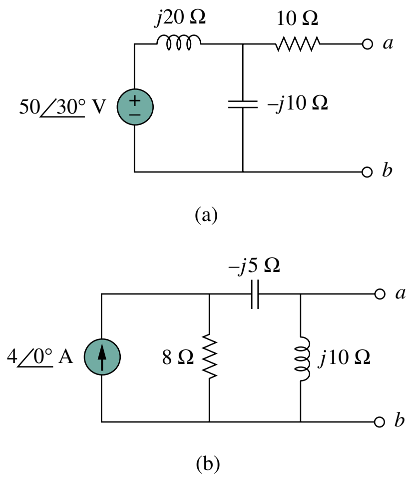


Figure 10.83 For Prob. 10.41.

**10.42** For each of the circuits in Fig. 10.84, obtain Thevenin and Norton equivalent circuits at terminals $a$-$b$.

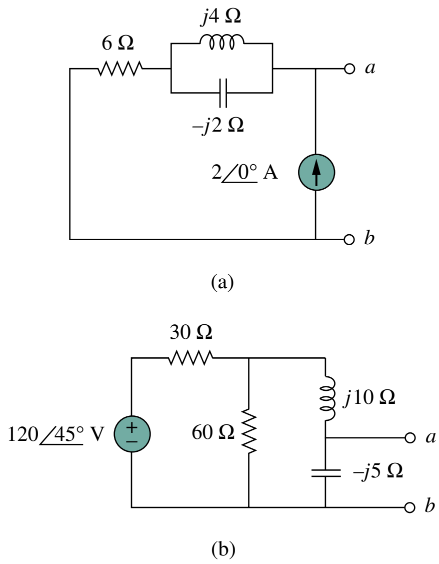


Figure 10.84 For Prob. 10.42.

**10.43** Find the Thevenin and Norton equivalent circuits for the circuit shown in Fig. 10.85.

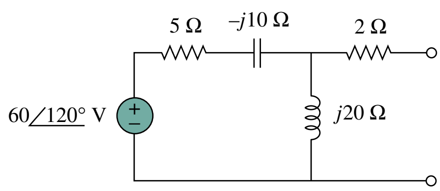


Figure 10.85 For Prob. 10.43.

**10.44** For the circuit depicted in Fig. 10.86, find the Thevenin equivalent circuit at terminals $a$-$b$.

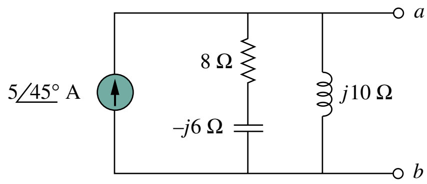


Figure 10.86 For Prob. 10.44.

**10.45** Repeat Prob. 10.1 using Thevenin's theorem.

**10.46** Find the Thevenin equivalent of the circuit in Fig. 10.87 as seen from:

(a) terminals $a$-$b$ (b) terminals $c$-$d$

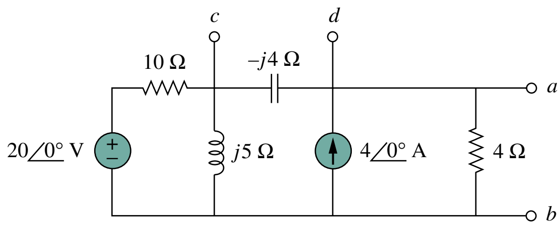


Figure 10.87 For Prob. 10.46.

**10.47** Solve Prob. 10.3 using Thevenin's theorem.

**10.48** Using Thevenin's theorem, find $v_o$ in the circuit in Fig. 10.88.

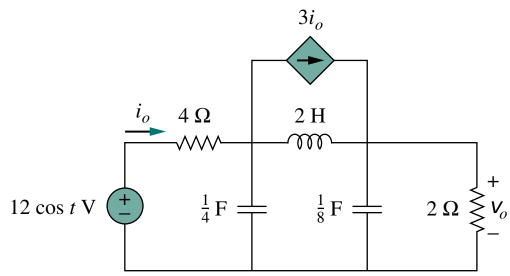


Figure 10.88 For Prob. 10.48.

**10.49** Obtain the Norton equivalent of the circuit depicted in Fig. 10.89 at terminals $a$-$b$.

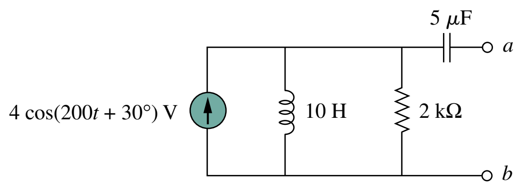


Figure 10.89 For Prob. 10.49.