**4.18** For the circuit shown in Fig. P4.17, find the Thévenin equivalent of the circuit in the shaded box when $v_s(t) = 4\cos(2t - 60°)$ V. Use this to determine $v_o(t)$.

**4.19** Find the frequency-domain Thévenin equivalent (to the left of terminals $a$ and $b$) of the circuit shown in Fig. 4.20 on p. 211. (*Hint:* Use the fact that $Z_o = \mathbf{V}_{oc}/\mathbf{I}_{sc}$.)

**4.20** The frequency-domain Thévenin equivalent of a circuit having $\omega = 5$ rad/s has $\mathbf{V}_{oc} = 3.71\angle{-15.9°}$ V and $\mathbf{Z}_o = 2.38 - j0.667\ \Omega$. Determine a corresponding time-domain Thévenin-equivalent circuit.

**4.21** For the op-amp circuit shown in Fig. P4.21, find $v_o(t)$ when $v_s(t) = 6 \sin 2t$ V.

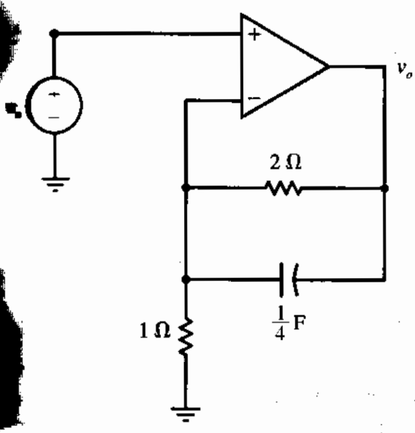


**Fig. P4.21**

**4.22** For the op-amp circuit given in Fig. P4.22, find $v_o(t)$ when $v_s(t) = 3\cos 2t$ V.

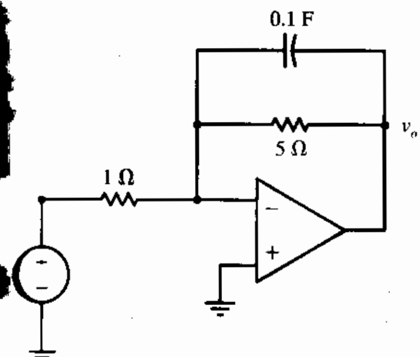


**Fig. P4.22**

**4.23** For the op-amp circuit shown in Fig. P4.23, find $v_o(t)$ when $v_s(t) = 4\cos(2t - 30°)$ V. (See p. 258.)

**4.24** For the circuit shown in Fig. P4.24, find the currents $\mathbf{I}_1$ and $\mathbf{I}_2$ when $\mathbf{V}_{s1} = 250\sqrt{2}\angle{-30°}$ V, $\mathbf{V}_{s2} = 250\sqrt{2}\angle{-90°}$ V, and $\mathbf{Z} = 78 - j45\ \Omega$.

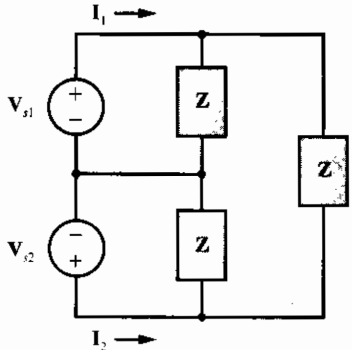


**Fig. P4.24**

**4.25** Use mesh analysis to find $\mathbf{I}_1$ and $\mathbf{I}_2$ for the circuit given in Fig. P4.25 when $\mathbf{V}_{s1} = 250\sqrt{2}\angle{-30°}$ V, $\mathbf{V}_{s2} = 250\sqrt{2}\angle{-90°}$ V, and $\mathbf{Z} = 26 - j15\ \Omega$.

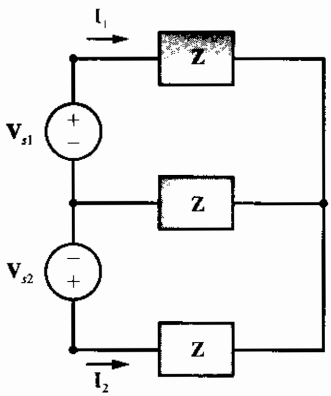


**Fig. P4.25**

**4.26** For the circuit shown in Fig. P4.9, when $i_s(t) = 5\cos 3t$ A then $v_o(t) = 4.47\cos(3t + 26.6°)$ V. Find the average power absorbed by each element in the circuit.

**4.27** For the circuit shown in Fig. P4.17, when $v_s(t) = 10\cos 4t$ V, then the Thévenin equivalent of the portion of the circuit in the shaded box is $\mathbf{V}_{oc} =$

**4.36** For the op-amp circuit shown in Fig. P4.36, find the average power absorbed by each element for the case that $v_s(t) = \cos \omega t$ V.

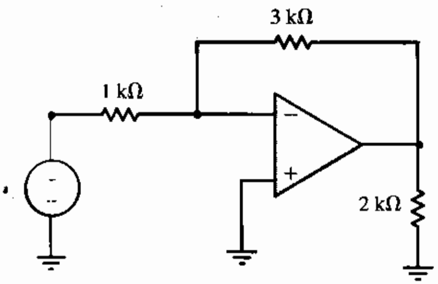


**Fig. P4.36**

**4.37** For the op-amp circuit shown in Fig. P4.37, find the average power absorbed by each element for the case that $v_s(t) = \cos \omega t$ V.

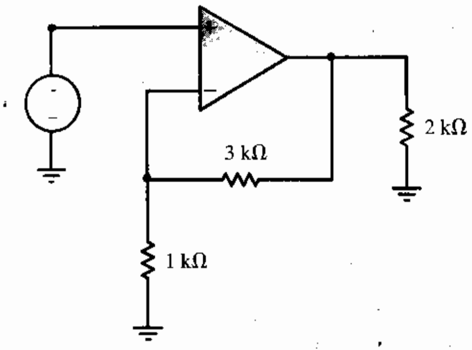


**Fig. P4.37**

**4.38** Find the rms value of each function given in Fig. P4.38. (See p. 260.)

**4.39** Find the rms value of the "half-wave rectified" sine wave that is shown in Fig. P4.39. [*Hint:* $\sin^2 x = \frac{1}{2}(1 - \cos 2x)$.]

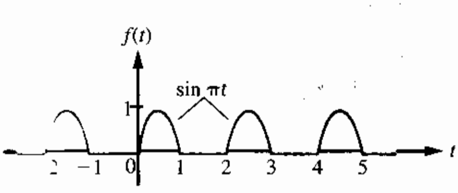


**Fig. P4.39**

**4.40** Find the rms value of the "full-wave rectified" sine wave that is shown in Fig. P4.40. [*Hint:* $\sin^2 x = \frac{1}{2}(1 - \cos 2x)$.]

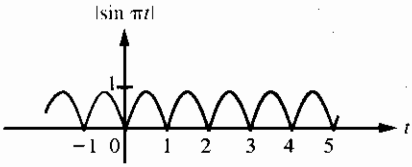


**Fig. P4.40**

**4.41** The load shown in Fig. P4.41 operates at 60 Hz. (a) What are the pf and the pf angle of this load? (b) Is the pf leading or lagging? (c) To what value should the capacitor be changed to get a unity pf (pf = 1)?

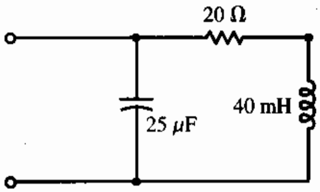


**Fig. P4.41**

**4.42** A 115-V rms, 60-Hz electric hair dryer absorbs 500 W at a lagging pf of 0.95. What is the rms value of the current drawn by this dryer?

**4.43** An electric motor which operates at 220 V rms, 20 A rms, 60 Hz, absorbs 2200 W. (a) What is the pf of the motor. (b) For the case that the pf is lagging, what value capacitor should be connected in parallel with the motor such that the resulting combination has a unity pf (pf = 1)?

**4.44** An electric motor operating at 220 V rms, 60 Hz, draws a current of 20 A rms at a pf of 0.75 lagging. (a) What is the average power absorbed by the motor? (b) What value capacitor should be connected in parallel with the motor such that the resulting combination has a unity pf (pf = 1)?

**4.45** Two loads, which are connected in parallel, operate at 230 V rms. One load absorbs 500 W at a pf of 0.8 lagging, and the other absorbs 1000 W at

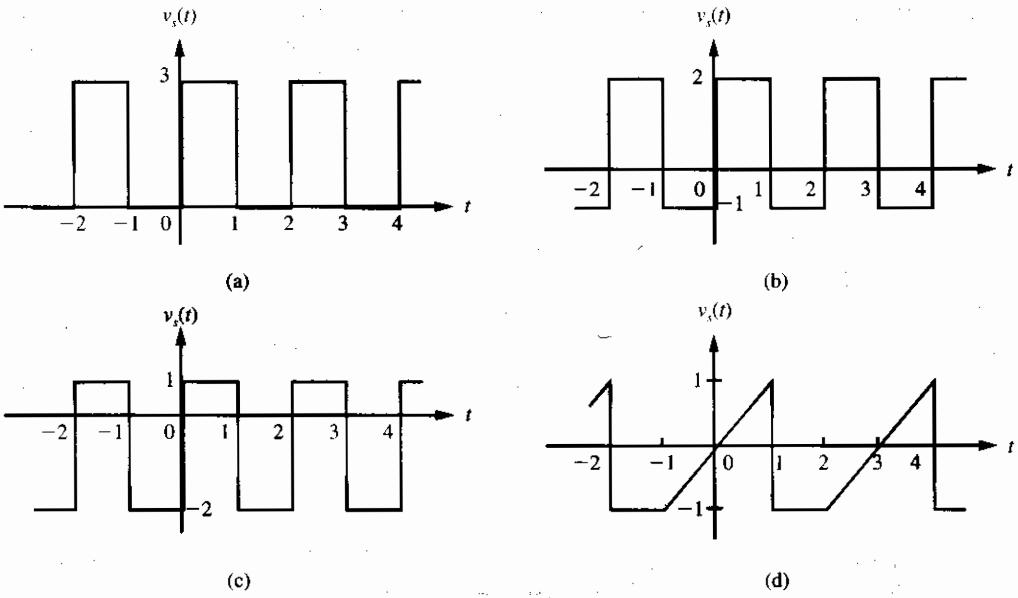


**Fig. P4.38**

a pf of 0.9 lagging. Find the pf of the combined load. Is this pf leading or lagging?

**4.46** Three loads, which are connected in parallel, operate at 230 V rms. One load absorbs 500 W at a pf of 0.8 lagging. The second absorbs 1000 W at a pf of 0.9 lagging. The third absorbs 1500 W at a pf of 0.9 leading. Find the pf of the combined load. Is this pf leading or lagging?

**4.47** The parallel connection of two 115-V rms loads absorbs 2000 W at a lagging pf of 0.95. Suppose that one load absorbs 1200 W at a pf of 0.8 lagging. What are the power absorbed and the pf of the second load?

**4.48** A load, which operates at 220 V rms, draws 5 A rms at a lagging pf of 0.95. (a) Find the complex power absorbed by the load. (b) Find the average power absorbed by the load. (c) Find the reactive power absorbed by the load. (d) Find the apparent power absorbed by the load. (e) Find the impedance of the load.

**4.49** Consider the circuit shown in Fig. P4.28. Suppose that $v_s(t) = 12\sqrt{2}\cos 3t$ V and $C = \frac{1}{6}$ F. Find the complex power absorbed by each element. Is complex power conserved?

**4.50** Consider the circuit shown in Fig. P4.28. Suppose that $v_s(t) = 12\sqrt{2}\cos 3t$ V and $C = \frac{1}{6}$ F. Find the apparent power absorbed by each element. Is apparent power conserved?

**4.51** Consider the circuit shown in Fig. P4.28. Suppose that $v_s(t) = 12\sqrt{2}\cos 3t$ V and $C = \frac{1}{6}$ F. Find the reactive power absorbed by each element. Is reactive power conserved?

**4.52** For the circuit given in Fig. P4.24, when $\mathbf{V}_{s1} = 250\sqrt{2}\angle{-30°}$ V, $\mathbf{V}_{s2} = 250\sqrt{2}\angle{-90°}$ V, and $\mathbf{Z} = 78 - j45\ \Omega$, then $\mathbf{I}_1 = 6.8\angle{30°}$ A and $\mathbf{I}_2 = 6.8\angle{-90°}$ A. (a) Find the complex power absorbed by each impedance. (b) Find the complex power supplied by each source.

**4.53** For the circuit given in Fig. P4.24, when $\mathbf{V}_{s1} = 250\sqrt{2}\angle{-30°}$ V, $\mathbf{V}_{s2} = 250\sqrt{2}\angle{-90°}$ V, and $\mathbf{Z} = 78 - j45\ \Omega$, then $\mathbf{I}_1 = 6.8\angle{30°}$ A and $\mathbf{I}_2 = 6.8\angle{-90°}$ A. (a) Find the apparent power absorbed by each impedance. (b) Find the apparent power supplied by each source.