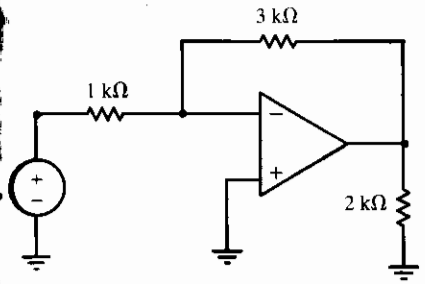
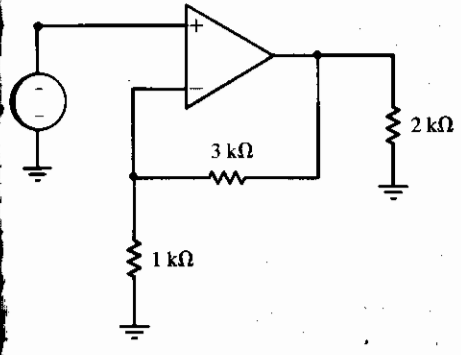
4.36 For the op-amp circuit shown in Fig. P4.36, find the average power absorbed by each element for the case that $v_s(t) = \cos \omega t$ V.



P4.36

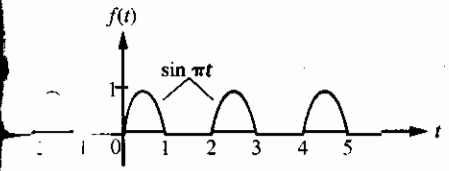
4.37 For the op-amp circuit shown in Fig. P4.37, find the average power absorbed by each element for the case that $v_s(t) = \cos \omega t$ V.



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:* $\sin^2 x = \frac{1}{2}(1 - \cos 2x)$.]



P4.39

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

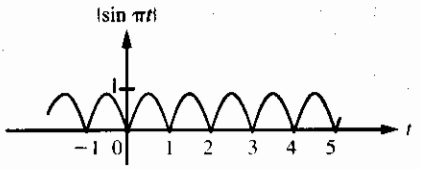


Fig. P4.40

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)?

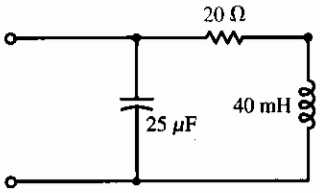


Fig. P4.41

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

4.54 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 reactive power absorbed by each impedance. (b) Find the reactive power supplied by each source.

4.55 An R-ohm resistor has the voltage $v(t) = V\cos(\omega t + \phi_1)$ across it and it has the current $i(t) = I\cos(\omega t + \phi_2)$ through it. Show that the complex power absorbed by the resistor is given by

$$\mathbf{S}_R = \tfrac{1}{2}RI^2 = \tfrac{1}{2}V^2/R$$

4.56 An L-henry inductor has the voltage $v(t) = V\cos(\omega t + \phi_1)$ across it and it has the current $i(t) = I\cos(\omega t + \phi_2)$ through it. Show that the complex power absorbed by the inductor is given by

$$\mathbf{S}_L = \frac{j\omega LI^2}{2} = \frac{jV^2}{2\omega L}$$

4.57 An C-farad capacitor has the voltage $v(t) = V\cos(\omega t + \phi_1)$ across it and it has the current $i(t) = I\cos(\omega t + \phi_2)$ through it. Show that the complex power absorbed by the capacitor is given by

$$\mathbf{S}_C = \frac{-jI^2}{2\omega C} = \frac{-j\omega CV^2}{2}$$

4.58 For the single-phase, three-wire circuit shown in Fig. P4.58, suppose that $\mathbf{V}_s = 120\angle 0°$ V rms. Find the average power supplied by each source if $\mathbf{Z}_1 = 60\ \Omega$, $\mathbf{Z}_2 = 80\ \Omega$, $\mathbf{Z}_3 = 40\ \Omega$, and $R_g = R_n = 0\ \Omega$.

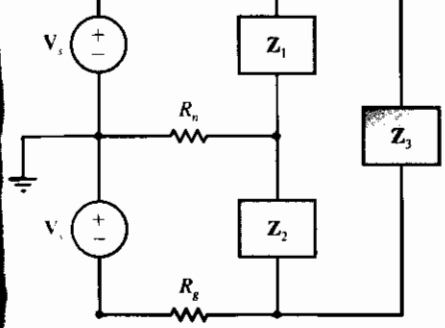


Fig. P4.58

4.59 For the single-phase, three-wire circuit shown in Fig. P4.58, suppose that $\mathbf{V}_s = 115\angle 0°$ V rms. Find the average power supplied by each source if $\mathbf{Z}_1 = 60\ \Omega$, $\mathbf{Z}_2 = 80\ \Omega$, $\mathbf{Z}_3 = 40\ \Omega$, $R_g = 1\ \Omega$, and $R_n = 2\ \Omega$.

4.60 For the single-phase, three-wire circuit shown in Fig. P4.58, suppose that $R_g = R_n = 0\ \Omega$. For the case that $\mathbf{Z}_1$ absorbs 500 W at a lagging pf of 0.8, $\mathbf{Z}_2$ absorbs 1000 W at a lagging pf of 0.9, and $\mathbf{Z}_3$ absorbs 1500 W at a leading pf of 0.95, find the average power supplied by each source.

4.61 A balanced Y-Y three-phase circuit has 130-V rms phase voltages and a per-phase impedance of $\mathbf{Z} = 12 + j12\ \Omega$. Find the line currents and the total power absorbed by the load.

4.62 A balanced Y-Y three-phase circuit has 210-V rms, 60-Hz line voltages. Suppose that the load absorbs a total of 3 kW of power at a lagging pf of 0.85. (a) Find the per-phase impedance. (b) What value capacitors should be connected in parallel with the per-phase impedances to result in a unity pf (pf = 1)?

4.63 A balanced, three-phase Y-connected source, whose phase voltages are 115 V rms, has the unbalanced Y-connected load $\mathbf{Z}_{AN} = 3 + j4\ \Omega$, $\mathbf{Z}_{BN} = 10\ \Omega$, and $\mathbf{Z}_{CN} = 5 + j12\ \Omega$. Find the line currents and the total power absorbed by the load for the case that there is a neutral wire.

4.64 A balanced, three-phase Y-connected source, whose phase voltages are 120 V rms, has the unbalanced Y-connected load $\mathbf{Z}_{AN} = 10\ \Omega$, $\mathbf{Z}_{BN} = 20\ \Omega$, and $\mathbf{Z}_{CN} = 60\ \Omega$. Find the line currents and the total power absorbed by the load for the case that there is no neutral wire.

4.65 Suppose that the balanced Y-Δ three-phase circuit shown in Fig. 4.40 on p. 241 has a line voltage of 130 V rms and $\mathbf{Z} = 4\sqrt{2}\angle 45°\ \Omega$. Find the line currents and the total power absorbed by the load.

4.66 A balanced, three-phase Y-connected source with 230-V rms line voltages has an unbalanced Δ-connected load whose impedances are $\mathbf{Z}_{AB} = 8\ \Omega$, $\mathbf{Z}_{BC} = 4 + j3\ \Omega$, and $\mathbf{Z}_{AC} = 12 - j5\ \Omega$. Find the