4.7 Connect a 5-Ω resistor in parallel with the inductor in the circuit shown in Fig. P4.6. Suppose that \( i_L(t) = 15 \cos(2t - 22.6^\circ) \) A. Find the voltage \( v_i(t) \) across the inductor by using voltage division. Draw a phasor diagram. Is this circuit a lag network or a lead network?

4.8 Connect a 5-Ω resistor in parallel with the inductor in the circuit shown in Fig. P4.6. Suppose that \( i_L(t) = 15 \cos(2t - 22.6^\circ) \) A. Find the voltage \( v_i(t) \) across the inductor by using nodal analysis. Draw a phasor diagram. Is this circuit a lag network or a lead network?

4.9 For the circuit given in Fig. P4.9, suppose that \( i(t) = 5 \cos 3t \) A. Find \( v_f(t) \) and \( v_i(t) \) by using current division.

![Fig. P4.9](image)

4.10 For the circuit given in Fig. P4.9, suppose that \( i(t) = 5 \cos 3t \) A. Find \( v_f(t) \) and \( v_i(t) \) by using nodal analysis.

4.11 A voltage of \( V = 10 \cos \omega t \) V is applied to a series RLC circuit. If \( R = 5 \) Ω, \( L = \frac{1}{4} \) H, and \( C = \frac{1}{4} \) F, by how many degrees does \( v_R(t) \) lead or lag \( v(t) \) when (a) \( \omega = 1 \) rad/s, (b) \( \omega = 5 \) rad/s, and (c) \( \omega = 10 \) rad/s?

4.12 A voltage of \( V = 10 \cos \omega t \) V is applied to a series RLC circuit. If \( R = 5 \) Ω, \( L = \frac{1}{4} \) H, and \( C = \frac{1}{4} \) F, by how many degrees does \( v_R(t) \) lead or lag \( v(t) \) when (a) \( \omega = 1 \) rad/s, (b) \( \omega = 5 \) rad/s, and (c) \( \omega = 10 \) rad/s?

4.13 For the RLC connection given in Fig. P4.13, find the impedance \( Z \) when \( \omega \) is (a) 2, (b) 4, and (c) 8 rad/s.

![Fig. P4.13](image)

4.14 For the RLC connection shown in Fig. P4.14, find the admittance \( Y \) when \( \omega \) is (a) 1, (b) 3, and (c) 7 rad/s.

![Fig. P4.14](image)

4.15 Show that a general expression for the impedance \( Z \) depicted in Fig. P4.13 is

\[
Z = \frac{2R}{\omega} + \frac{1}{\frac{1}{R} + j \omega L} = \frac{2R}{\omega} + \frac{-j\omega R L}{\omega^2 L^2 + 1}
\]

4.16 Show that a general expression for the admittance \( Y \) depicted in Fig. P4.14 is

\[
Y = \frac{1}{2R\omega} + \frac{1}{\frac{1}{R} + j \omega L} = \frac{1}{2R\omega} + \frac{-j\omega R L}{\omega^2 L^2 + 1}
\]

4.17 For the circuit shown in Fig. P4.17, find the Thévenin equivalent of the circuit in the shaded box when \( v(t) = 4 \cos(\omega t - 60^\circ) \) V. Use this to determine \( i_L(t) \).

![Fig. P4.17](image)
4.47/63.4° V and \( Z_L = 1.6 + j4.8 \) Ω. (a) Replace the 4-Ω load resistance by an impedance \( Z_L \) that absorbs the maximum average power, and determine this maximum power. (b) Replace the 4-Ω load resistance with a resistance \( R_L \) that absorbs the maximum power for resistive loads, and determine this power.

4.28 For the RLC circuit shown in Fig. P4.28, suppose that \( v(t) = 10 \cos 2t \) V. Find the average power absorbed by the 4-Ω resistor for the case that
(a) \( C = \frac{1}{2} F \); (b) \( C = \frac{1}{3} F \); (c) \( C = \frac{1}{4} F \).

4.30 For the circuit shown in Fig. P4.20, change the value of the resistor to 2 Ω and the value of the capacitor to \( \frac{1}{2} F \). Suppose that \( v(t) = 8 \cos 2t \) V. (a) Find the load impedance \( Z_L \) that absorbs the maximum average power, and determine this power. (b) Find the load resistance \( R_L \) that absorbs the maximum power for resistive loads, and determine this power.

4.31 For the op-amp circuit given in Fig. P4.21, when \( v(t) = 6 \sin 2t \) V, then the output voltage \( v_o(t) = 13.4 \cos(2t - 117°) \) V. Find the average power absorbed by each element.

4.32 For the op-amp circuit given in Fig. P4.22, when \( v(t) = 3 \cos 2t \) V, then the output voltage \( v_o(t) = 10.6 \cos(2t + 135°) \) V. Find the average power absorbed by each element.

4.33 For the op-amp circuit given in Fig. P4.23, when \( v(t) = 4 \cos(2t - 30°) \) V, then \( v_o(t) = 1.66 \cos(2t - 66.9°) \) V and \( v_o(t) = 1.66 \cos(2t + 23.1°) \) V. Find the average power absorbed by each element.

4.34 For the circuit given in Fig. P4.24, when \( V_{in} = 250 \sqrt{2} \cos(30°) \) V, \( V_{out} = 250 \sqrt{2} \cos(90°) \) V, and \( Z = 78 - j5 \) Ω, then \( I_1 = 6.8, \frac{30°}{A} \) and \( I_2 = 6.8, \frac{90°}{A} \). (a) Find the average power absorbed by each impedance. (b) Find the average power supplied by each source.

4.39 For the circuit given in Fig. P4.25, when \( V_{in} = 250 \sqrt{2} \cos(30°) \) V, \( V_{out} = 250 \sqrt{2} \cos(90°) \) V, and \( Z = 26 - j15 \) Ω, then \( I_1 = 6.8, \frac{30°}{A} \) and \( I_2 = 6.8, \frac{90°}{A} \). (a) Find the average power absorbed by each impedance. (b) Find the average power supplied by each source.