4.7 Connect a 5-Ω resistor in parallel with the inductor in the circuit shown in Fig. P4.6. Suppose that \( v(t) = 13 \cos(2t - 22.6^\circ) \) V. Find the voltage \( v_a(t) \) 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 \( v(t) = 13 \cos(2t - 22.6^\circ) \) V. Find the voltage \( v_a(t) \) 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 \( v_a(t) \) and \( v(t) \) by using current division.

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

4.11 A voltage of \( v(t) = 10 \cos \omega t \) V is applied to a series RLC circuit. If \( R = 5 \) Ω, \( L = \frac{1}{4} \) H, and \( C = \frac{1}{6} \) F, by how many degrees does \( v_a(t) \) 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 \( v(t) = 10 \cos \omega t \) V is applied to a series RLC circuit. If \( R = 5 \) Ω, \( L = \frac{1}{4} \) H, and \( C = \frac{1}{6} \) F, by how many degrees does \( v_a(t) \) 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.

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.

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

\[
Z = \frac{32}{\omega^2 + 16} + j\frac{\omega(\omega^2 - 16)}{4(\omega^2 + 16)}
\]

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

\[
Y = \frac{1}{2(\omega^2 + 1)} + j\frac{\omega(\omega^2 - 9)}{20(\omega^2 + 1)}
\]

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

4.18 For the circuit shown in Fig. P4.18, find the Thévenin equivalent when \( v_a(t) = 4 \) V and determine \( v_a(t) \).

4.19 Find the current (to the left) shown in Fig. P4.20, when \( Z_1 = V_0 / I_{a1} \).

4.20 The frequency of a circuit has an unchangeable component of 5.71 Hz. Assume a corresponding circuit.

4.21 For the op amp shown in Fig. P4.21, find \( v_a(t) \) when \( v(t) \).