31.7

$$V_C = \frac{I}{\omega C} \Rightarrow C = \frac{I}{\omega V_C} = \frac{(0.850\ A)}{2\pi(60\ Hz)(170\ V)}$$

$$= 1.32 \times 10^{-5}\ F.$$

31.15

(a) $$Z = \sqrt{R^2 + (\omega L - 1/\omega C)^2}$$

$$Z = \sqrt{(200\ \Omega)^2 + \left[(250\ rad/s)(0.0400\ H) - \frac{1}{(250\ rad/s)(6.00\times10^{-6}\ F)}\right]^2}$$

$$= 601\ \Omega.$$

(b) $$I = \frac{V}{Z} = \frac{30\ V}{601\ \Omega} = 0.0499\ A$$

(c) $$\phi = \arctan\left[\frac{\omega L - 1/\omega C}{R}\right]$$

$$= \arctan\left[\frac{100\ \Omega - 667\ \Omega}{200\ \Omega}\right]$$

$$= -70.6^\circ$$

and the voltage lags the current.

(d) $$V_R = IR = (0.0499\ A)(200\ \Omega) = 9.98\ V$$

$$V_L = I\omega L = (0.0499 A)(250\ rad/s)(0.400\ H)$$

$$= 4.99\ V$$

$$V_C = \frac{I}{\omega C} = \frac{(0.0499\ A)}{(250\ rad/s)(6.00\times10^{-6}\ F)}$$

$$= 33.3\ V$$

(e) Since C is storing charge, its voltage lags the source voltage. Its voltage will peak after the source voltage.

31.24

$$P_{av} = \frac{V_{rms}^2}{Z}\cos\phi$$

$$= \frac{V_{rms}^2}{Z}\frac{R}{Z}$$

$$= \frac{V_{rms}^2}{Z^2}R = \frac{(80.0\,V)^2}{(105\,\Omega)^2}(75.0\,\Omega)$$

$$= 43.5\ W$$

31.35

(a) $\frac{N_1}{N_2} = \frac{120}{12} = 10.$

(b) $I_{rms} = \frac{V_{rms}}{R} = \frac{12.0\,V}{5.00\,\Omega} = 2.40\,A$

(c) $P_{av} = I_{rms}V_{rms} = (2.40\,A)(12.0\,V)$

$= 28.8\ W$

(d) $R = \frac{V_{rms}^2}{P} = \frac{(120\,V)^2}{28.8\,W} = 500\,\Omega,$

which is the same as

$$(5.00\,\Omega)\left(\frac{N_1}{N_2}\right)^2 = (5.00\,\Omega)\left(\frac{120}{12.0}\right)^2 = 500\,\Omega.$$

31.39

$$\phi = \arctan\left(\frac{\omega L}{R}\right)$$

$$\Rightarrow L = \frac{R}{\omega}\tan\phi = \frac{R}{2\pi f}\tan\phi$$

$$= \frac{(48.0\,\Omega)}{2\pi(80\ Hz)}\tan(52.3^\circ)$$

$$= 0.124\ H$$

31.52

$$V_{out} = V_C = \frac{I}{\omega C}$$

$$\Rightarrow \frac{V_{out}}{V_s} = \frac{1}{\omega C \sqrt{R^2 + (\omega L - 1/\omega C)^2}}$$

If ω is large, $\frac{V_{out}}{V_s} \approx \frac{1}{\omega C \sqrt{(\omega L)^2}} = \frac{1}{(LC)\omega^2}$

If ω is small, $\frac{V_{out}}{V_s} \approx \frac{1}{\omega C \sqrt{(1/\omega C)^2}} = \frac{\omega C}{\omega C} = 1$