P33.10 At 50.0 Hz, $X_L = 2\pi(50.0\text{ Hz})L = 2\pi(50.0\text{ Hz})\left(\frac{X_L|_{60.0\text{ Hz}}}{2\pi(60.0\text{ Hz})}\right) = \frac{50.0}{60.0}(54.0\ \Omega) = 45.0\ \Omega$

$$I_{\max} = \frac{\Delta V_{\max}}{X_L} = \frac{\sqrt{2}(\Delta V_{\text{rms}})}{X_L} = \frac{\sqrt{2}(100\text{ V})}{45.0\ \Omega} = \boxed{3.14\text{ A}}.$$

P33.15 $I_{\max} = \sqrt{2}I_{\text{rms}} = \frac{\sqrt{2}(\Delta V_{\text{rms}})}{X_C} = \sqrt{2}(\Delta V_{\text{rms}})2\pi fC$

(a) $I_{\max} = \sqrt{2}(120\text{ V})2\pi(60.0/\text{s})(2.20\times10^{-6}\text{ C/V}) = \boxed{141\text{ mA}}$

(b) $I_{\max} = \sqrt{2}(240\text{ V})2\pi(50.0/\text{s})(2.20\times10^{-6}\text{ F}) = \boxed{235\text{ mA}}$

P33.21 (a) $X_L = \omega L = 2\pi(50.0\text{ s}^{-1})(250\times10^{-3}\text{ H}) = \boxed{78.5\ \Omega}$

(b) $X_C = \frac{1}{\omega C} = \left[2\pi(50.0\text{ s}^{-1})(2.00\times10^{-6}\text{ F})\right]^{-1} = \boxed{1.59\text{ k}\Omega}$

(c) $Z = \sqrt{R^2 + (X_L - X_C)^2} = \boxed{1.52\text{ k}\Omega}$

(d) $I_{\max} = \frac{\Delta V_{\max}}{Z} = \frac{210\text{ V}}{1.52\times10^3\ \Omega} = \boxed{138\text{ mA}}$

(e) $\phi = \tan^{-1}\left[\frac{X_L - X_C}{R}\right] = \tan^{-1}(-10.1) = \boxed{-84.3°}$

P33.26 $X_C = \frac{1}{\omega C} = \frac{1}{2\pi(50.0)(65.0\times10^{-6})} = 49.0\ \Omega$

$X_L = \omega L = 2\pi(50.0)(185\times10^{-3}) = 58.1\ \Omega$

$Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{(40.0)^2 + (58.1 - 49.0)^2} = 41.0\ \Omega$

$I_{\max} = \frac{\Delta V_{\max}}{Z} = \frac{150}{41.0} = 3.66\text{ A}$

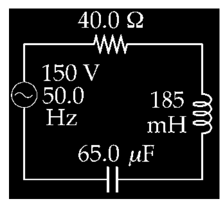

FIG. P33.26

(a) $\Delta V_R = I_{\max}R = (3.66)(40) = \boxed{146\text{ V}}$

(b) $\Delta V_L = I_{\max}X_L = (3.66)(58.1) = 212.5 = \boxed{212\text{ V}}$

(c) $\Delta V_C = I_{\max}X_C = (3.66)(49.0) = 179.1\text{ V} = \boxed{179\text{ V}}$

(d) $\Delta V_L - \Delta V_C = 212.5 - 179.1 = \boxed{33.4\text{ V}}$

P33.32 or $\left(X_L - X_C\right) = \sqrt{Z^2 - R^2}$

P33.40 $L = 20.0 \text{ mH}$, $C = 1.00 \times 10^{-7}$, $R = 20.0\ \Omega$, $\Delta V_{\max} = 100 \text{ V}$

(a) The resonant frequency for a series –*RLC* circuit is $f = \frac{1}{2\pi}\sqrt{\frac{1}{LC}} = \boxed{3.56 \text{ kHz}}$.

(b) At resonance, $I_{\max} = \frac{\Delta V_{\max}}{R} = \boxed{5.00 \text{ A}}$.

(c) From Equation 33.38, $Q = \frac{\omega_0 L}{R} = \boxed{22.4}$.

(d) $\Delta V_{L,\max} = X_L I_{\max} = \omega_0 L I_{\max} = \boxed{2.24 \text{ kV}}$

P33.46 (a) $\left(\Delta V_{2,\text{ rms}}\right) = \frac{N_2}{N_1}\left(\Delta V_{1,\text{ rms}}\right)$ $N_2 = \frac{(2\,200)(80)}{110} = \boxed{1\,600 \text{ windings}}$

(b) $I_{1,\text{ rms}}\left(\Delta V_{1,\text{ rms}}\right) = I_{2,\text{ rms}}\left(\Delta V_{2,\text{ rms}}\right)$ $I_{1,\text{ rms}} = \frac{(1.50)(2\,200)}{110} = \boxed{30.0 \text{ A}}$

(c) $0.950 I_{1,\text{ rms}}\left(\Delta V_{1,\text{ rms}}\right) = I_{2,\text{ rms}}\left(\Delta V_{2,\text{ rms}}\right)$ $I_{1,\text{ rms}} = \frac{(1.20)(2\,200)}{110(0.950)} = \boxed{25.3 \text{ A}}$

P33.54 For the filter circuit, $\frac{\Delta V_{\text{out}}}{\Delta V_{\text{in}}} = \frac{X_C}{\sqrt{R^2 + X_C^2}}$.

(a) At $f = 600 \text{ Hz}$, $X_C = \frac{1}{2\pi f C} = \frac{1}{2\pi(600 \text{ Hz})(8.00 \times 10^{-9} \text{ F})} = 3.32 \times 10^4\ \Omega$

and $\frac{\Delta V_{\text{out}}}{\Delta V_{\text{in}}} = \frac{3.32 \times 10^4\ \Omega}{\sqrt{(90.0\ \Omega)^2 + \left(3.32 \times 10^4\ \Omega\right)^2}} \approx \boxed{1.00}$.

(b) At $f = 600 \text{ kHz}$, $X_C = \frac{1}{2\pi f C} = \frac{1}{2\pi\left(600 \times 10^3 \text{ Hz}\right)\left(8.00 \times 10^{-9} \text{ F}\right)} = 33.2\ \Omega$

and $\frac{\Delta V_{\text{out}}}{\Delta V_{\text{in}}} = \frac{33.2\ \Omega}{\sqrt{(90.0\ \Omega)^2 + (33.2\ \Omega)^2}} = \boxed{0.346}$.

P33.56 The equation for $\Delta v(t)$ during the first period (using $y = mx + b$) is:

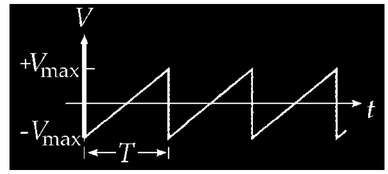

FIG. P33.56

$$\Delta v(t) = \frac{2(\Delta V_{max})t}{T} - \Delta V_{max}$$

$$\left[(\Delta v)^2\right]_{ave} = \frac{1}{T}\int_0^T [\Delta v(t)]^2 dt = \frac{(\Delta V_{max})^2}{T}\int_0^T \left[\frac{2}{T}t - 1\right]^2 dt$$

$$\left[(\Delta v)^2\right]_{ave} = \frac{(\Delta V_{max})^2}{T}\left(\frac{T}{2}\right)\frac{\left[2t/T - 1\right]^3}{3}\Bigg|_{t=0}^{t=T} = \frac{(\Delta V_{max})^2}{6}\left[(+1)^3 - (-1)^3\right] = \frac{(\Delta V_{max})^2}{3}$$

$$\Delta V_{rms} = \sqrt{\left[(\Delta v)^2\right]_{ave}} = \sqrt{\frac{(\Delta V_{max})^2}{3}} = \boxed{\frac{\Delta V_{max}}{\sqrt{3}}}$$

P33.62 (a) With both switches closed, the current goes only through generator and resistor.

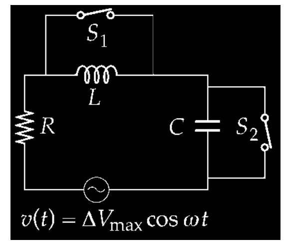

FIG. P33.62

$$\boxed{i(t) = \frac{\Delta V_{max}}{R}\cos\omega t}$$

(b)

(c) $$\boxed{i(t) = \frac{\Delta V_{max}}{\sqrt{R^2 + \omega^2 L^2}}\cos\left[\omega t + \arctan\left(\frac{\omega L}{R}\right)\right]}$$

(d) For $0 = \phi = \arctan\left(\frac{\omega_0 L - (1/\omega_0 C)}{R}\right)$.

We require $\omega_0 L = \frac{1}{\omega_0 C}$, so $\boxed{C = \frac{1}{\omega_0^2 L}}$.

(e) At this resonance frequency, $Z = \boxed{R}$.

(f) $$U = \frac{1}{2}C(\Delta V_C)^2 = \frac{1}{2}CI^2 X_C^2$$

$$U_{max} = \frac{1}{2}CI_{max}^2 X_C^2 = \frac{1}{2}C\frac{(\Delta V_{max})^2}{R^2}\frac{1}{\omega_0^2 C^2} = \boxed{\frac{(\Delta V_{max})^2 L}{2R^2}}$$

(g) $$U_{max} = \frac{1}{2}LI_{max}^2 = \boxed{\frac{1}{2}L\frac{(\Delta V_{max})^2}{R^2}}$$

(h) Now $\omega = 2\omega_0 = \frac{2}{\sqrt{LC}}$.

So $\phi = \arctan\left(\frac{\omega L - (1/\omega C)}{R}\right) = \arctan\left(\frac{2\sqrt{L/C} - (1/2)\sqrt{L/C}}{R}\right) = \boxed{\arctan\left(\frac{3}{2R}\sqrt{\frac{L}{C}}\right)}$.

(i) Now $\omega L = \frac{1}{2}\frac{1}{\omega C}$ $\quad \omega = \boxed{\frac{1}{\sqrt{2LC}}} = \frac{\omega_0}{\sqrt{2}}$.