31.11. (a) \( Q = CV_{\text{max}} = (1.0 \times 10^{-9} \, \text{F})(3.0 \, \text{V}) = 3.0 \times 10^{-9} \, \text{C} \).

(b) From \( U = \frac{1}{2}LI^2 = \frac{1}{2}Q^2 / C \) we get

\[
I = \frac{Q}{\sqrt{LC}} = \frac{3.0 \times 10^{-9} \, \text{C}}{\sqrt{(3.0 \times 10^{-9} \, \text{F})(1.0 \times 10^{-7} \, \text{H})}} = 1.7 \times 10^{-7} \, \text{A}.
\]

(c) When the current is at a maximum, the magnetic field is at maximum:

\[
U_{\text{max}} = \frac{1}{2}LI^2 = \frac{1}{2}(3.0 \times 10^{-9} \, \text{H})(1.7 \times 10^{-7} \, \text{A})^2 = 4.5 \times 10^{-16} \, \text{J}.
\]

31.13. (a) After the switch is thrown to position b the circuit is an LC circuit. The angular frequency of oscillation is \( \omega = 1/\sqrt{LC} \). Consequently,

\[
f = \frac{\omega}{2\pi} = \frac{1}{2\pi \sqrt{LC}} = \frac{1}{2\pi \sqrt{(54.0 \times 10^{-9} \, \text{F})(6.20 \times 10^{-4} \, \text{H})}} = 275 \, \text{Hz}.
\]

(b) When the switch is thrown, the capacitor is charged to \( V = 34.0 \, \text{V} \) and the current is zero. Thus, the maximum charge on the capacitor is \( Q = VC = (34.0 \, \text{V})(6.20 \times 10^{-4} \, \text{F}) = 2.11 \times 10^{-4} \, \text{C} \). The current amplitude is

\[
I = \alpha Q = 2\pi f(275 \, \text{Hz})(2.11 \times 10^{-4} \, \text{C}) = 0.365 \, \text{A}.
\]
(a) From Eq. 32-10,

\[ i_j = -\frac{d\Phi}{dt} = \varepsilon_0 \frac{d\Phi}{dt} \frac{dE}{dt} \frac{dA}{dt} \left[ (4.0 \times 10^3) - (6.0 \times 10^4) \right] = -\varepsilon_0 A (6.0 \times 10^6 \text{ V/m} \cdot \text{s}) \]

\[ = -\left( 8.85 \times 10^{-12} \frac{\text{C}^2}{\text{N} \cdot \text{m}^2} \right) (4.0 \times 10^3 \text{ m}^2) (6.0 \times 10^6 \text{ V/m} \cdot \text{s}) \]

\[ = -2.1 \times 10^{-4} \text{ A}. \]

Thus, the magnitude of the displacement current is \( |i_j| = 2.1 \times 10^{-4} \text{ A}. \)

(b) The negative sign in \( i_j \) implies that the direction is downward.

(c) If one draws a counterclockwise circular loop \( s \) around the plates, then according to Eq. 32-18

\[ \oint_B \vec{B} \cdot d\ell = \mu_0 i_j < 0, \]

which means that \( \vec{B} \cdot d\ell < 0 \). Thus \( \vec{B} \) must be clockwise.

The frequency is the same as the frequency of oscillation of the current in the \( L \) circuit of the generator, that is, \( f = \frac{1}{2\pi \sqrt{LC}} \), where \( C \) is the capacitance and \( L \) is the inductance. Thus

\[ \frac{\lambda}{2\pi \sqrt{LC}} = c. \]

The solution for \( L \) is

\[ L = \frac{\lambda^2}{4\pi^2 CF} = \frac{(5.0 \times 10^{-4} \text{ m})^2}{4\pi^2 (17 \times 10^{-12} \text{ F}) (2.998 \times 10^8 \text{ m/s})} = 5.0 \times 10^{-11} \text{ H}. \]

This is exceedingly small.
46. (a) For the angles of incidence and refraction to be equal, the graph in Fig. 33-48(b) would consist of a "y = x" line at 45° in the plot. Instead, the curve for material 1 falls under such a "y = x" line, which tells us that all refraction angles are less than incident angles. With \( \theta_1 < \theta \), Snell's law implies \( n_2 > n_1 \).

(b) Using the same argument as in (a), the value of \( n_2 \) for material 2 is also greater than that of water \( (n) \).

(c) It's easiest to examine the right end-point of each curve. With \( \theta_1 = 90° \) and \( \theta_2 = \frac{3}{4}(90°) \), and with \( n_1 = 1.33 \) (Table 33-1) we find, from Snell's law, \( n_2 = 1.4 \) for material 1.

(d) Similarly, with \( \theta_1 = 90° \) and \( \theta_2 = \frac{3}{4}(90°) \), we obtain \( n_2 = 1.9 \).

58. When examining Fig. 33-59, it is important to note that the angle \( \theta \) (measured from the central axis) for the light ray in air, \( \theta \), is not the angle for the ray in the glass core, which we denote \( \theta' \). The law of refraction leads to

\[
\sin \theta' = \frac{1}{n_1} \sin \theta
\]

assuming \( n_2 = 1 \). The angle of incidence for the light ray striking the coating is the complement of \( \theta' \), which we denote as \( \theta'_c \), and recall that

\[
\sin \theta'_c = \cos \theta = \sqrt{1 - \sin^2 \theta'}
\]

In the critical case, \( \theta'_c \) must equal \( \theta \), specified by Eq. 33-47. Therefore,

\[
\frac{\theta_j}{n_1} = \sin \theta'_c = \sqrt{1 - \sin^2 \theta'} = \sqrt{1 - \left( \frac{1}{n_1} \sin \theta \right)^2}
\]

which leads to the result: \( \sin \theta = \sqrt{n^2 - n_2^2} \). With \( n_1 = 1.58 \) and \( n_2 = 1.53 \), we obtain

\[
\theta = \sin^{-1} \left( 1.58^2 - 1.53^2 \right) = 23.2°.
\]
(a) The magnitude of the magnetic field is

\[ B = \frac{E}{c} = \frac{100 \text{ V/m}}{3.0 \times 10^8 \text{ m/s}} = 3.3 \times 10^{-6} \text{T}. \]

(b) With \( \vec{E} \times \vec{B} = \mu_0 \vec{J} \), where \( \vec{E} = \vec{E} \hat{k} \) and \( \vec{B} = B \hat{z} \), one can verify easily that since \( \hat{k} \times (-\hat{j}) = \hat{z} \), \( B \) has to be in the negative \( x \) direction.