30-21. (a)

$$\begin{aligned} i = \frac{\mathcal{E}}{R}\left(1 - e^{-t/\tau}\right) &= \frac{\mathcal{E}}{2R} \\ \left(1 - e^{-t/\tau}\right) &= \frac{1}{2} \\ \frac{1}{2} &= e^{-t/\tau} \\ \ln(1/2) &= -t/\tau \\ -\ln(1/2)\tau &= t \\ \ln(2)\frac{L}{R} &= t = \frac{\ln(2)1.25 \times 10^{-3}}{50} = 1.73 \times 10^{-5} \text{ s} \end{aligned}$$

(b) Since $U = \frac{1}{2}LI^2$, to have half the energy the current must be $I = i_{\max}/\sqrt{2}$

$$\begin{aligned} i = \frac{\mathcal{E}}{R}\left(1 - e^{-t/\tau}\right) &= \frac{\mathcal{E}}{\sqrt{2}R} \\ \left(1 - e^{-t/\tau}\right) &= \frac{1}{\sqrt{2}} \\ \frac{\sqrt{2}-1}{\sqrt{2}} &= e^{-t/\tau} \\ \ln\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right) &= -t/\tau \\ -\ln\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right)\tau &= t \\ -\ln\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right)\frac{L}{R} &= t = -\ln\left(\frac{\sqrt{2}-1}{\sqrt{2}}\right)\frac{1.25 \times 10^{-3}}{50} = 3.07 \times 10^{-5} \text{ s} \end{aligned}$$

30-32. (a)

$$\begin{aligned} f &= \frac{1}{2\pi\sqrt{LC}} \\ \sqrt{L} &= \frac{1}{2\pi f\sqrt{C}} \\ L &= \frac{1}{(2\pi f)^2 C} = \frac{1}{(2\pi 1.6 \times 10^6)^2 \cdot 4.18 \times 10^{-12}} = 2.37 \times 10^{-3} \text{ H} \end{aligned}$$

(b)

$$\begin{aligned} f &= \frac{1}{2\pi\sqrt{LC}} \\ \sqrt{C} &= \frac{1}{2\pi f\sqrt{L}} \\ C &= \frac{1}{(2\pi f)^2 L} = \frac{1}{(2\pi .54 \times 10^6)^2 \cdot 2.37 \times 10^{-3}} = 37.7 \text{ pF} \end{aligned}$$

30-38. (a)

$$\begin{aligned} 2\pi f' = \omega' &= \sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}} \\ f' &= \frac{1}{2\pi}\sqrt{\frac{1}{22\times 10^{-3}\cdot 15\times 10^{-9}} - \frac{75^2}{4(22\times 10^{-3})^2}} = 8750 \text{ Hz} \end{aligned}$$

(b)

$$\begin{aligned} A &= A_0 e^{-Rt/2L} \\ \ln(A/A_0) &= -Rt/2L \\ -2L\ln(A/A_0)/R &= t = -2\cdot 22\times 10^{-3}\ln(.1)/75 = 1.35\times 10^{-3} \text{ s} \end{aligned}$$

(c) At critical damping $R = \sqrt{4L/C} = \sqrt{4\cdot 22\times 10^{-3}/15\times 10^{-9}} = 2420\ \Omega$

30-64. (a) At the instant the switch is closed the current is zero, so V_1 is zero and $V_2 = 25$ V

(b) At long times di/dt is zero so V_2 is zero and $V_1 = 25$ V. The current is then given by Ohm's Law $I = 25/15 = 1.67$ A.

(c) Nothing would change.