6-9 Soln)

$$V_{L\,MAX} = \chi_L I_{MAX} = \omega L\ \frac{\mathcal{E}_{MAX}}{Z} = \mathcal{E}_{MAX} L \frac{\omega}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}}$$

$$= \mathcal{E}_{MAX} L\ \omega \left(R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2\right)^{-1/2}$$

Set $dV_{L\,MAX}/d\omega = 0$ and solve for omega.

$$\mathcal{E}_{MAX} L \left(R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2\right)^{-1/2}$$

$$- \mathcal{E}_{MAX} L\ \omega \left(\frac{-1}{2}\right) \left(R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2\right)^{-\frac{3}{2}} 2\left(\omega L - \frac{1}{\omega C}\right)\left(L + \frac{1}{\omega^2 C}\right) = 0$$

$$\left(R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2\right)^{-1/2} - \omega \left(R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2\right)^{-\frac{3}{2}} \left(\omega L - \frac{1}{\omega C}\right)\left(L + \frac{1}{\omega^2 C}\right) = 0$$

One solution is

$$\left(R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2\right)^{-1/2} = 0\ ,$$

which in turn corresponds to $\omega = 0$ or $\omega = \infty$, which in turn correspond to $V_{L\,MAX} = 0$ Let's clean up some of the mess:

$$1 - \omega \left(R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2\right)^{-1} \left(\omega L - \frac{1}{\omega C}\right)\left(L + \frac{1}{\omega^2 C}\right) = 0$$

$$1 = \omega \left(R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2\right)^{-1} \left(\omega L - \frac{1}{\omega C}\right)\left(L + \frac{1}{\omega^2 C}\right)$$

$$1 = \left(R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2\right)^{-1} \left(\omega^2 L^2 - \frac{1}{\omega^2 C^2}\right)$$

$$R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2 = \omega^2 L^2 - \frac{1}{\omega^2 C^2}$$

$$R^2 + \omega^2 L^2 - 2\frac{L}{C} + \frac{1}{\omega^2 C^2} = \omega^2 L^2 - \frac{1}{\omega^2 C^2}$$

$$R^2 + -2\frac{L}{C} + \frac{2}{\omega^2 C^2} = 0$$

$$\frac{1}{\omega^2} = LC - \frac{R^2}{2}$$

$$\omega = \left(LC - \frac{R^2 C^2}{2}\right)^{-1/2}$$