83. When the switch is open, we have a series LRC circuit involving just the one capacitor near the upper right corner. Eq. 33-65 leads to

$$\frac{\omega_d L - \frac{1}{\omega_d C}}{R} = \tan\phi_o = \tan(-20^\circ) \;\; = \;\; -\tan 20^\circ \; .$$

Now, when the switch is in position 1, the equivalent capacitance in the circuit is $2C$. In this case, we have

$$\frac{\omega_d L - \frac{1}{2\omega_d C}}{R} = \tan\phi_1 \;\; = \;\; \tan 10.0^\circ \; .$$

Finally, with the switch in position 2, the circuit is simply an LC circuit with current amplitude

$$I_2 = \frac{\mathcal{E}_m}{Z_{LC}} = \frac{\mathcal{E}_m}{\sqrt{\left(\omega_d L - \frac{1}{\omega_d C}\right)^2}} = \frac{\mathcal{E}_m}{\frac{1}{\omega_d C} - \omega_d L}$$

where we use the fact that $\frac{1}{\omega_d C} > \omega_d L$ in simplifying the square root (this fact is evident from the description of the first situation, when the switch was open). We solve for L, R and C from the three equations above:

$$\begin{aligned}
R &= \frac{-\mathcal{E}_m}{I_2 \tan\phi_o} = \frac{120\,\text{V}}{(2.00\,\text{A})\tan 20.0^\circ} = 165\ \Omega \\
C &= \frac{I_2}{2\omega_d \mathcal{E}_m \left(1 - \frac{\tan\phi_1}{\tan\phi_o}\right)} = \frac{2.00\,\text{A}}{2(2\pi)(60.0\,\text{Hz})(120\,\text{V})\left(1 + \frac{\tan 10.0^\circ}{\tan 20.0^\circ}\right)} = 1.49 \times 10^{-5}\ \text{F} \\
L &= \frac{\mathcal{E}_m}{\omega_d I_2}\left(1 - 2\frac{\tan\phi_1}{\tan\phi_o}\right) = \frac{120\,\text{V}}{2\pi(60.0\,\text{Hz})(2.00\,\text{A})}\left(1 + 2\frac{\tan 10.0^\circ}{\tan 20.0^\circ}\right) 0.313\ \text{H}
\end{aligned}$$