Given: 

\[ L \text{ and } C \]

Find: \( C \) to maintain \( \omega \) constant

\[ \omega = \frac{1}{\sqrt{LC}} \implies C \downarrow \times \frac{1}{3} \]
Given:
\[ E = E_{\text{max}} \cos \omega t \]

Show:
(a) \[ I_R = \frac{E_{\text{max}} \cos \omega t}{R} \]
(b) \[ I_L = \frac{E_{\text{max}}}{X_L} \cos (\omega t - 90^\circ) \]
(c) \[ I = I_R + I_L = I_{\text{max}} \cos (\omega t - \delta) \] \[ \sqrt{I_{\text{max}}} = \frac{E_{\text{max}}}{Z} \]

Loop Rule:
\[ E - I_R R = 0 \]
\[ I_R = \frac{E}{R} = \frac{E_{\text{max}} \cos \omega t}{R} \]

Loop Rule
\[ E - L \frac{dI_L}{dt} = 0 \Rightarrow \frac{dI_L}{dt} = \frac{E}{L} - \frac{E_{\text{max}} \cos \omega t}{L} \]
\[ \int dI_L = \frac{E_{\text{max}}}{L} \int \cos \omega t \, dt = -\frac{E_{\text{max}}}{\omega L} \sin \omega t = I_L \]

\[ X_L = wL \]
\[ \sin \theta = \cos (90^\circ - \theta) \Rightarrow -\sin \theta = \sin (\theta) = \cos (\theta - 90^\circ) \]
\[ \therefore I_L = \frac{E_{\text{max}}}{X_L} \cos (\omega t - 90^\circ) \]

Junction Rule
\[ I = I_R + I_L = \frac{E_{\text{max}}}{R} \cos (\omega t) + \frac{E_{\text{max}}}{X_L} \cos (\omega t - \delta) \]

\[ I_R = \frac{E_{\text{max}}}{R} \]
\[ I_L = \frac{E_{\text{max}}}{X_L} \]
\[ \delta = \tan^{-1} \left( \frac{\frac{E_{\text{max}}}{X_L}}{\frac{E_{\text{max}}}{R}} \right) \]
\[ = \tan^{-1} \left( \frac{R}{X_L} \right) \]
\[ I = \left( \frac{E_{\text{max}}^2}{R^2} + \frac{E_{\text{max}}^2}{X_L^2} \right)^{\frac{1}{2}} \cos (\omega t - \delta) \]

\[ = E_{\text{max}} \left( \frac{X_L^2 + R^2}{X_L^2 R^2} \right)^{\frac{1}{2}} \cos (\omega t - \delta) \]

\[ Z = \frac{X_L R}{\sqrt{X_L^2 + R^2}} \]

\[ I = \frac{E_{\text{max}}}{Z} \cos (\omega t - \delta) \]
Given: (a) \( i_t \) \( \rightarrow \) \( (b) V_0 \) \( \rightarrow \) "Rectified" \( V_0 = 12V \)

Find: \( V_{RMS} \) for both cases:

(a) \( V_{RMS} = \sqrt{\left< V(t)^2 \right>} = \sqrt{\left< V_0^2 \right>} \)

\[
V(t) = \begin{cases} +V_0 & 0 \rightarrow \frac{T}{2} \\ -V_0 & \frac{T}{2} \rightarrow T \end{cases} \Rightarrow V(t)^2 = V_0^2
\]

\[
= \sqrt{\frac{1}{T} \int_0^T V_0^2 dt} = \sqrt{\frac{V_0^2}{T} \int_0^T dt} = V_0
\]

(b) \( V_{RMS} = \sqrt{\left< V(t)^2 \right>} \)

\[
V(t) = \begin{cases} +V_0 & 0 \rightarrow \frac{T}{2} \\ 0 & \frac{T}{2} \rightarrow T \end{cases} \Rightarrow V(t)^2 = \int_0^{\frac{T}{2}} V_0^2 dt + \int_{\frac{T}{2}}^{T} 0 dt
\]

\[
= \sqrt{\frac{1}{T} \left[ \int_0^{\frac{T}{2}} V_0^2 dt + \int_{\frac{T}{2}}^{T} 0 dt \right]} = \sqrt{\frac{1}{T} \left( \frac{V_0^2}{2} \right)} = \frac{1}{\sqrt{2}} V_0
\]