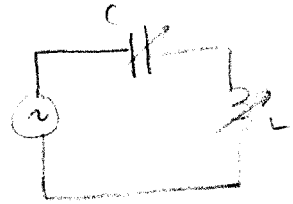
29-10 GIVEN:

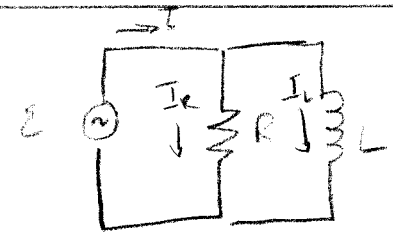


$L \uparrow \times 3$

FIND: C TO MAINTAIN ω_0 CONSTANT

$$\omega_0 = \frac{1}{\sqrt{LC}} \Rightarrow C \downarrow \times \frac{1}{3}$$

29-40 GIVEN:



$\mathcal{E} = \mathcal{E}_{max} \cos \omega t$

SHOW: (a) $I_R = \frac{\mathcal{E}_{max}}{R} \cos \omega t$

(b) $I_L = \frac{\mathcal{E}_{max}}{X_L} \cos(\omega t - 90°)$

(c) $I = I_R + I_L = I_{max} \cos(\omega t - \delta)$ w/ $I_{max} = \frac{\mathcal{E}_{max}}{Z}$

LOOP RULE: $\mathcal{E} - I_R R = 0$

$$I_R = \frac{\mathcal{E}}{R} = \frac{\mathcal{E}_{max} \cos \omega t}{R}$$

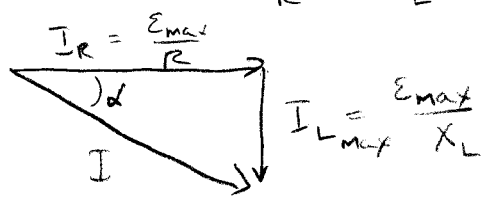
LOOP RULE $\mathcal{E} - L \frac{dI_L}{dt} = 0 \Rightarrow \frac{dI_L}{dt} = \frac{\mathcal{E}}{L} = \frac{\mathcal{E}_{max} \cos \omega t}{L}$

$$\int dI_L = \frac{\mathcal{E}_{max}}{L} \int \cos \omega t \, dt = -\frac{\mathcal{E}_{max}}{L\omega} \sin \omega t = I_L$$

$X_L = \omega L$ $\quad \sin \theta = \cos(90 - \theta) \Rightarrow -\sin\theta = \sin(-\theta) = \cos(\theta - 90)$

$$\therefore I_L = \frac{\mathcal{E}_{max}}{X_L} \cos(\omega t - 90°)$$

JUNCTION RULE $\quad I = I_R + I_L = \frac{\mathcal{E}_{max}}{R} \cos(\omega t) + \frac{\mathcal{E}_{max}}{X_L} \cos(\omega t - 90)$



$$\delta = \tan^{-1}\left(\frac{\frac{\mathcal{E}_{max}}{X_L}}{\frac{\mathcal{E}_{max}}{R}}\right) = \tan^{-1}\left(\frac{R}{X_L}\right)$$

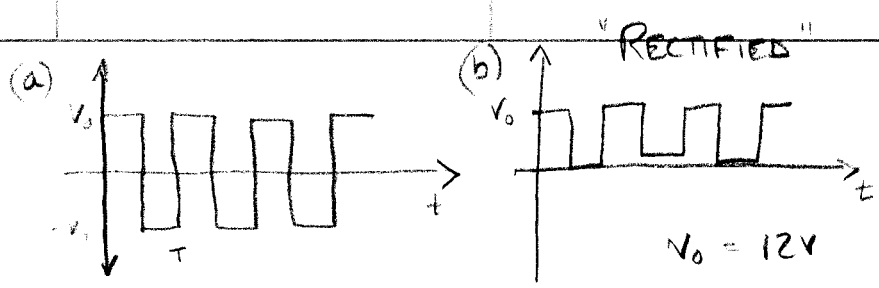
$$I = \left(\frac{\mathcal{E}_{max}^2}{R^2} + \frac{\mathcal{E}_{max}^2}{X_L^2}\right)^{1/2} \cos(\omega t - \delta)$$

$$= \mathcal{E}_{max} \left(\frac{X_L^2}{R^2 X_L^2} + \frac{R^2}{X_L^2 R^2}\right)^{1/2} \cos(\omega t - \delta)$$

$$= \mathcal{E}_{max} \left(\frac{X_L^2 + R^2}{X_L^2 R^2}\right)^{1/2} \cos(\omega t - \delta)$$

$$Z = \frac{X_L R}{\sqrt{X_L^2 + R^2}} \qquad I = \frac{\mathcal{E}_{max}}{Z} \cos(\omega t - \delta)$$

29-85 GIVEN:



FIND: V_{RMS} FOR BOTH CASES

(a) $V_{RMS} = \sqrt{\langle V(t)^2 \rangle} = \sqrt{\langle V_0^2 \rangle}$

$\hookrightarrow V(t) = \begin{cases} +V_0 & 0 \to \frac{T}{2} \\ -V_0 & \frac{T}{2} \to T \end{cases} \Rightarrow V(t)^2 = V_0^2$

$$= \sqrt{\frac{1}{T}\int_0^T V_0^2\, dt} = \sqrt{\frac{V_0^2}{T}\int_0^T dt} = \boxed{V_0}$$

(b) $V_{RMS} = \sqrt{\langle V(t)^2 \rangle}$

$\hookrightarrow V(t) = \begin{cases} +V_0 & 0 \to \frac{T}{2} \\ 0 & \frac{T}{2} \to T \end{cases} \Rightarrow V(t)^2 = \begin{cases} V_0^2 & 0 \to \frac{T}{2} \\ 0 & \frac{T}{2} \to T \end{cases}$

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

$$= \sqrt{\frac{1}{\cancel{T}} V_0^2 \frac{\cancel{T}}{2}} = \boxed{\frac{1}{\sqrt{2}} V_0}$$