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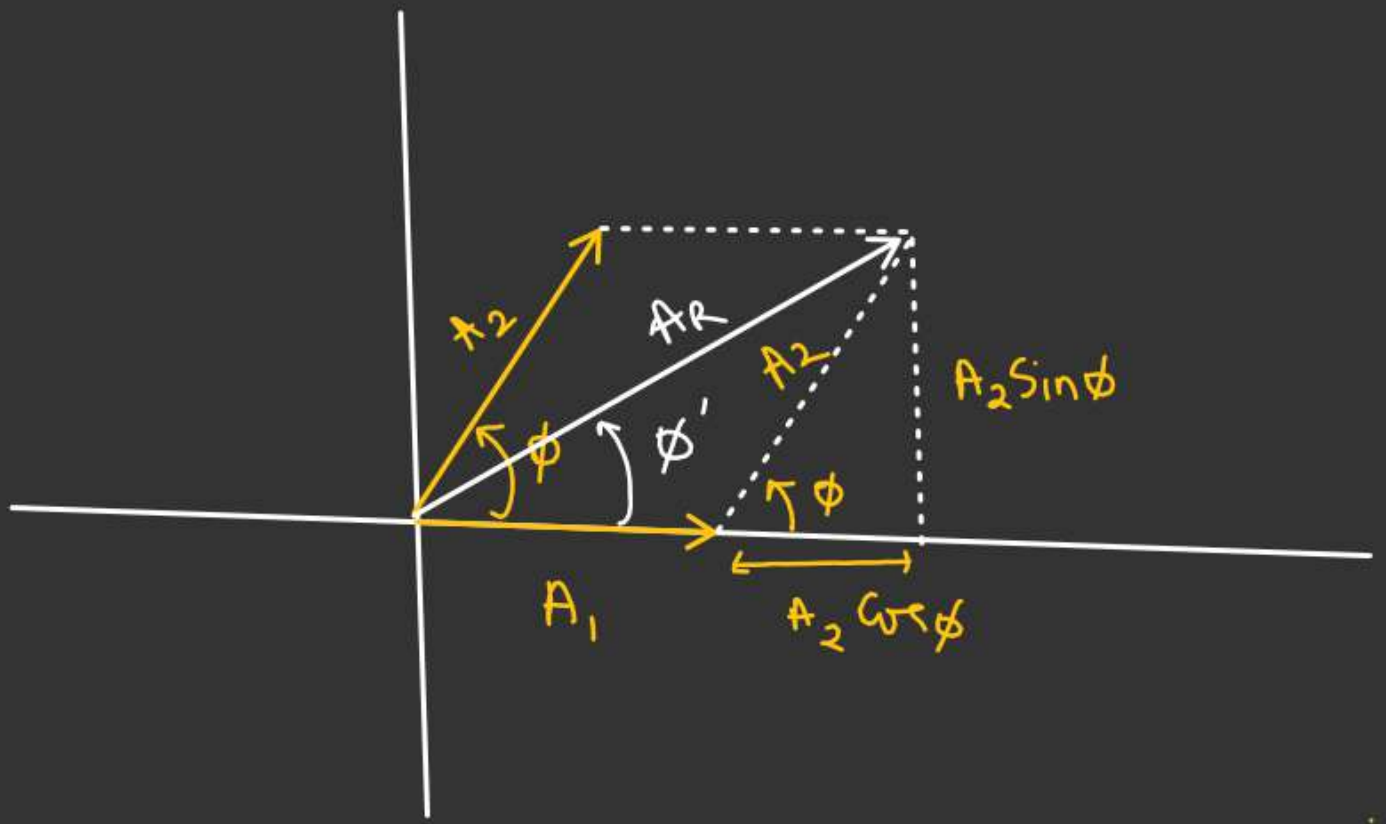
Phasor :→

$y_1 = A_1 \sin \omega t$

$y_2 = A_2 \sin(\omega t + \phi)$

[Take refrance vector whose $\phi = 0$.

[Assume amplitudes as vector]



By Superposition

$$y_R = y_1 + y_2$$

$$= A_1 \sin \omega t + A_2 \sin(\omega t + \phi)$$

$$\Downarrow$$

$$y_R = A_R \sin(\omega t + \phi')$$

$$A_R = \sqrt{A_1^2 + A_2^2 + 2A_1A_2 \cos\phi}$$

$$\tan\phi' = \left(\frac{A_2 \sin\phi}{A_1 + A_2\cos\phi}\right) \Rightarrow \phi' = \tan^{-1}\left(\frac{A_2 \sin\phi}{A_1 + A_2\cos\phi}\right)$$

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Q.

$$y_1 = A \sin \omega t$$

$$y_2 = A \sin(\omega t + \pi/3)$$

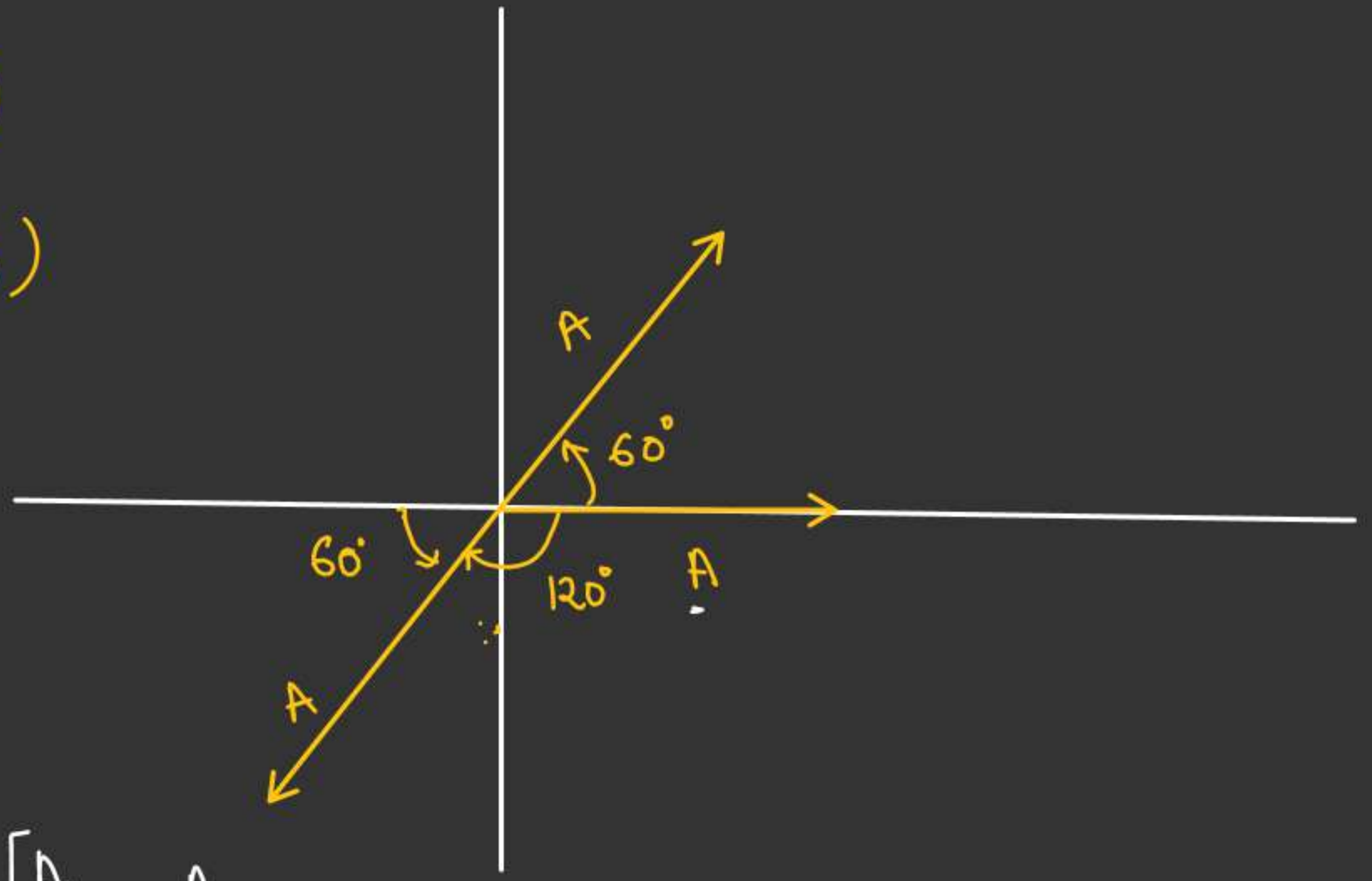
$$y_3 = A \sin(\omega t - 2\pi/3)$$

$$y_R = (y_1 + y_2 + y_3)$$

$$\Downarrow$$

$$y_R = A_R \sin(\omega t + \phi)$$

$$y_R = \underline{A \sin \omega t}$$



$$\left[\begin{array}{l} A_R = A. \\ \phi = 0° \end{array}\right.$$

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$\# \quad y_1 = A \sin \omega t$

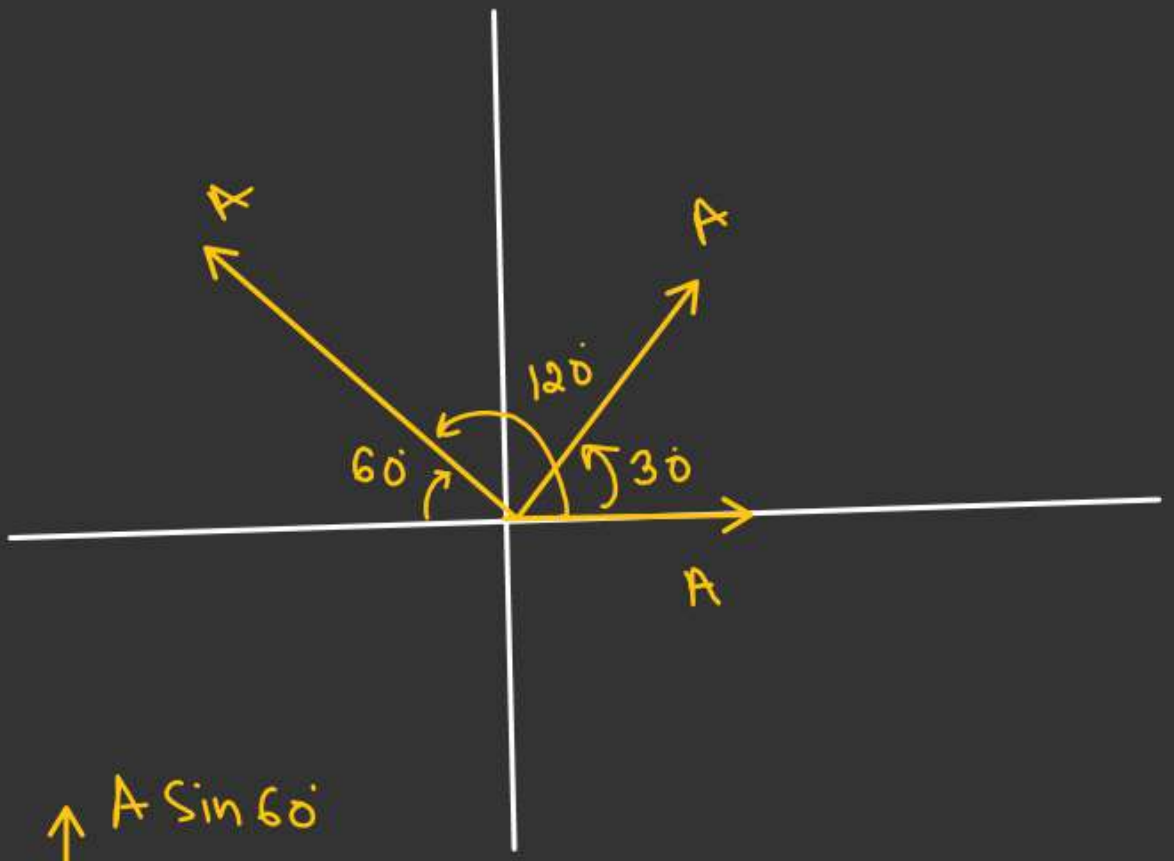
$y_2 = A \sin(\omega t + \pi/6)$

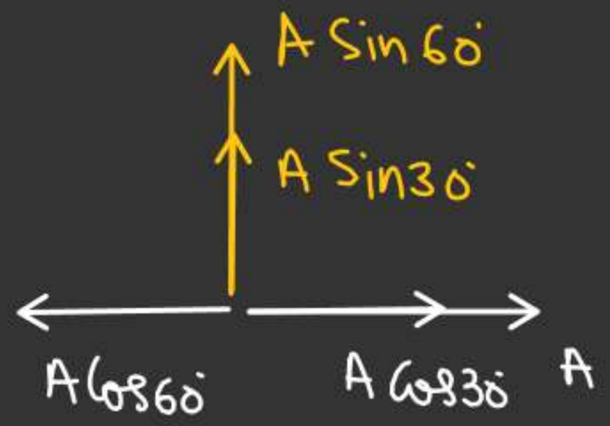
$y_3 = A \sin(\omega t + 2\pi/3)$

$y_R = y_1 + y_2 + y_3$

$y_R = A_R \sin(\omega t + \phi)$

$y_R = (\sqrt{3}+1)\dfrac{A}{\sqrt{2}} \sin(\omega t + \pi/4)$





$A_x = A + \dfrac{\sqrt{3}A}{2} - \dfrac{A}{2}$

$= (\sqrt{3}+1)\dfrac{A}{2}$

$A_y = \dfrac{\sqrt{3}A}{2} + \dfrac{A}{2}$

$A_R = \sqrt{A_x^2 + A_y^2}$

$= \sqrt{2}(\sqrt{3}+1)A/2$

$\tan\phi = \dfrac{A_y}{A_x} = \dfrac{(\sqrt{3}+1)A/2}{(\sqrt{3}+1)A/2}$

$\underline{\phi = 45^\circ}$.

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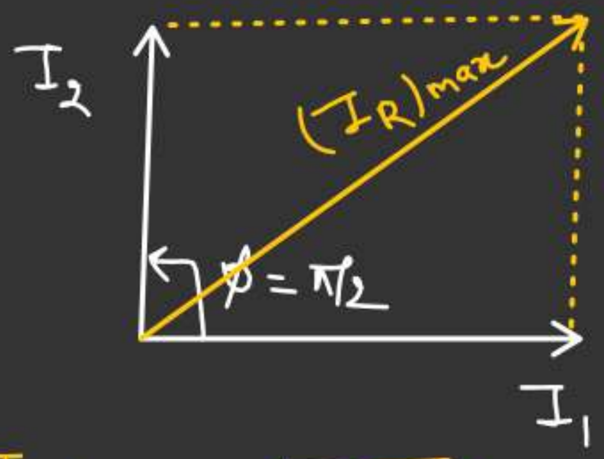
$I = I_1 \sin\omega t + I_2 \cos\omega t$

$$I = I_1 \sin\omega t + I_2 \sin\left(\omega t + \frac{\pi}{2}\right)$$



$$(I_R)_{max} = \sqrt{I_1^2 + I_2^2}$$

$$I_{rms} = \frac{(I_R)_{max}}{\sqrt{2}} = \sqrt{\frac{I_1^2 + I_2^2}{2}}$$

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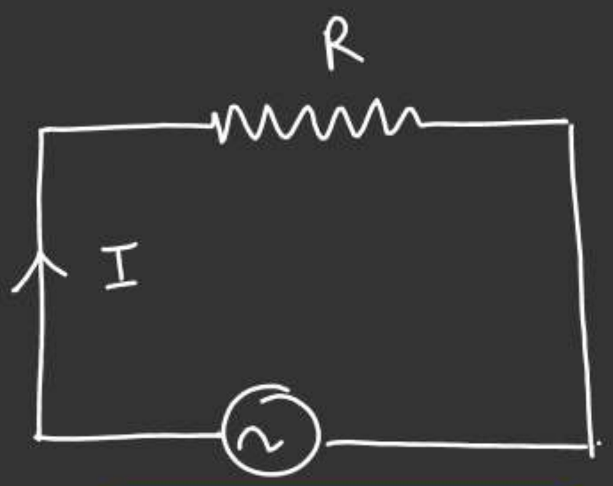
A.C Ckt :-

⇒ Purly resistive ckt



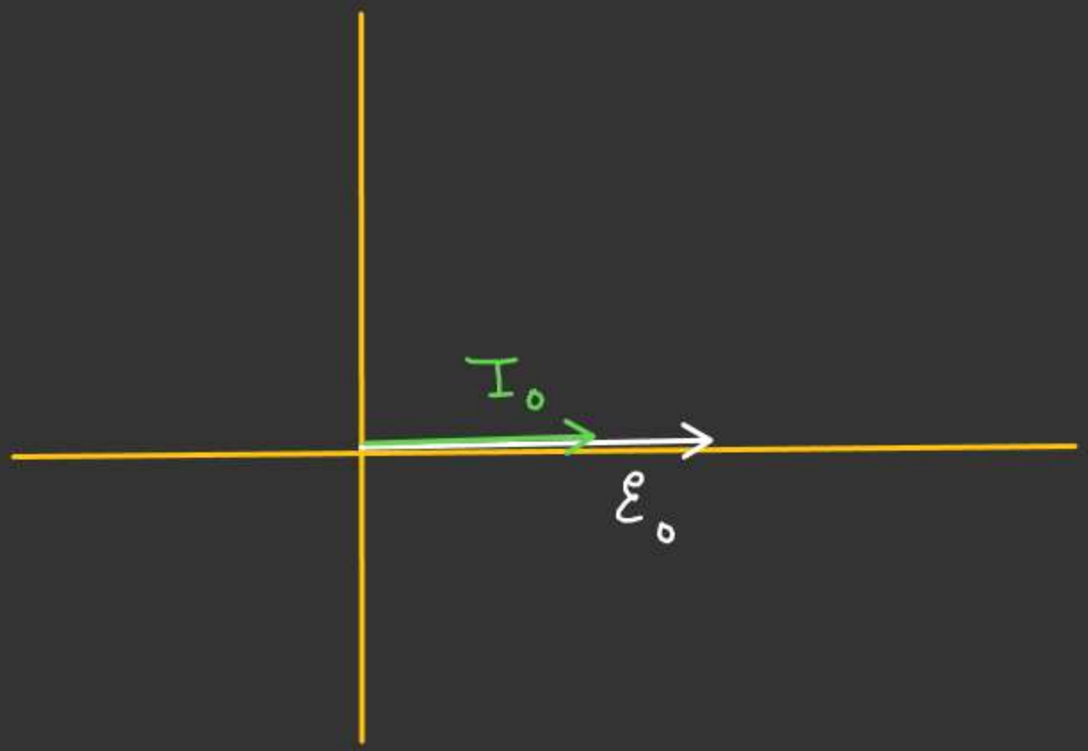
$\boxed{\mathcal{E} = \mathcal{E}_0 \sin\omega t}$

$$\mathcal{E}_0 \sin\omega t = iR$$

$$i = \frac{\mathcal{E}_0 \sin\omega t}{R}$$

$$\boxed{i = i_0 \sin\omega t}$$

$$\phi = 0$$



Note :- In purly resistive ckt voltage and current both are in the same phase.

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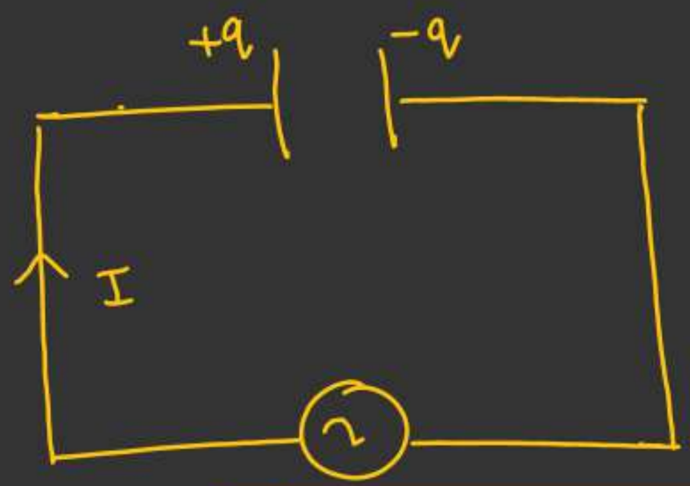
Purly Capacitive Ckt

Capacitance $= C$



$$\boxed{\varepsilon = \varepsilon_0 \sin\omega t}$$

$$i = \frac{dq}{dt}$$

$$\varepsilon_0 \sin\omega t - \frac{q}{C} = 0$$

$$\varepsilon_0 \sin\omega t = \frac{q}{C}$$

Differentiating both side w.r.t time

$$\varepsilon_0 \omega \cos\omega t = \frac{1}{C}\left(\frac{dq}{dt}\right)$$

$$i = \varepsilon_0 (\omega C) \cos\omega t$$

$$i = \frac{\varepsilon_0}{(1/\omega C)} \cdot \cos\omega t$$

$$\Downarrow$$

$$\boxed{i = \frac{\varepsilon_0}{X_C} \sin\left(\omega t + \frac{\pi}{2}\right)}$$

$$X_C = \left(\frac{1}{\omega C}\right)$$

$\Downarrow$

Unit $\rightarrow \Omega$

Reactance of Capacitive Ckt.

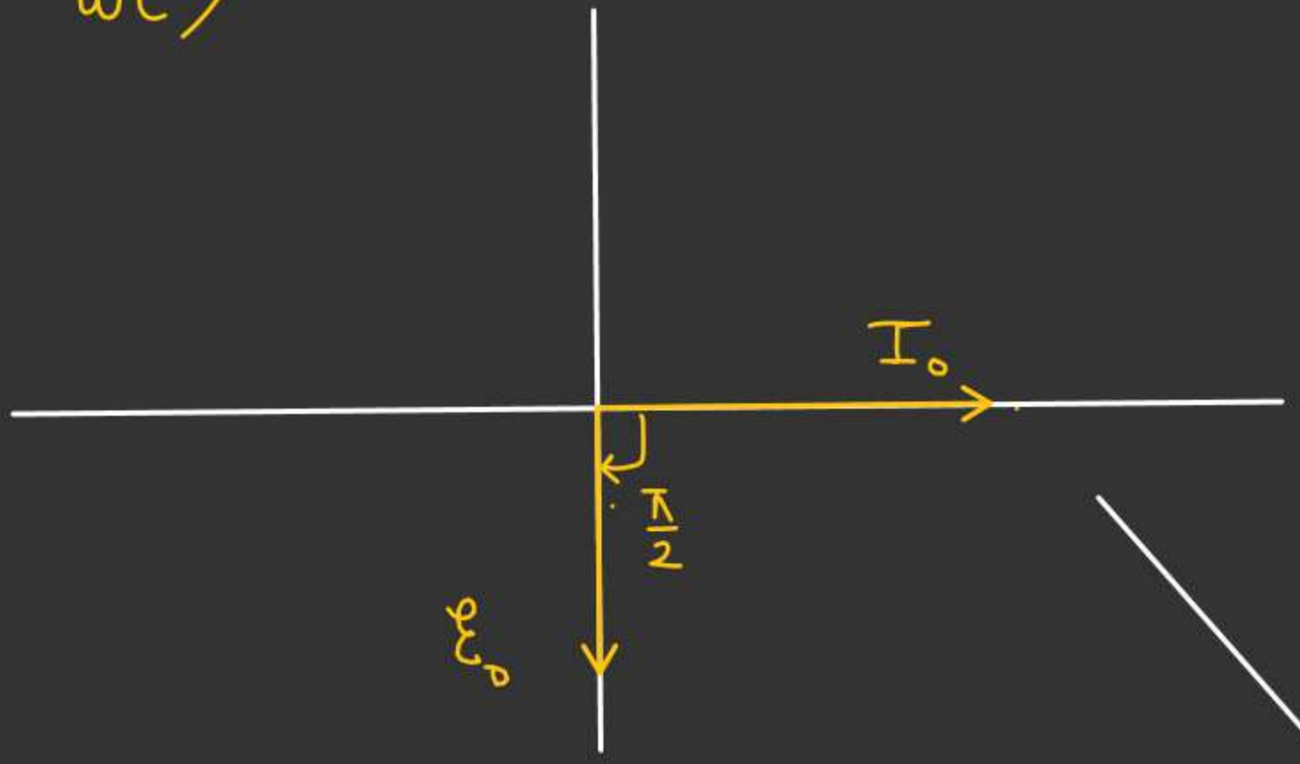
(Current leading the voltage by 90) $\leftarrow \phi = \left(+\frac{\pi}{2}\right)$

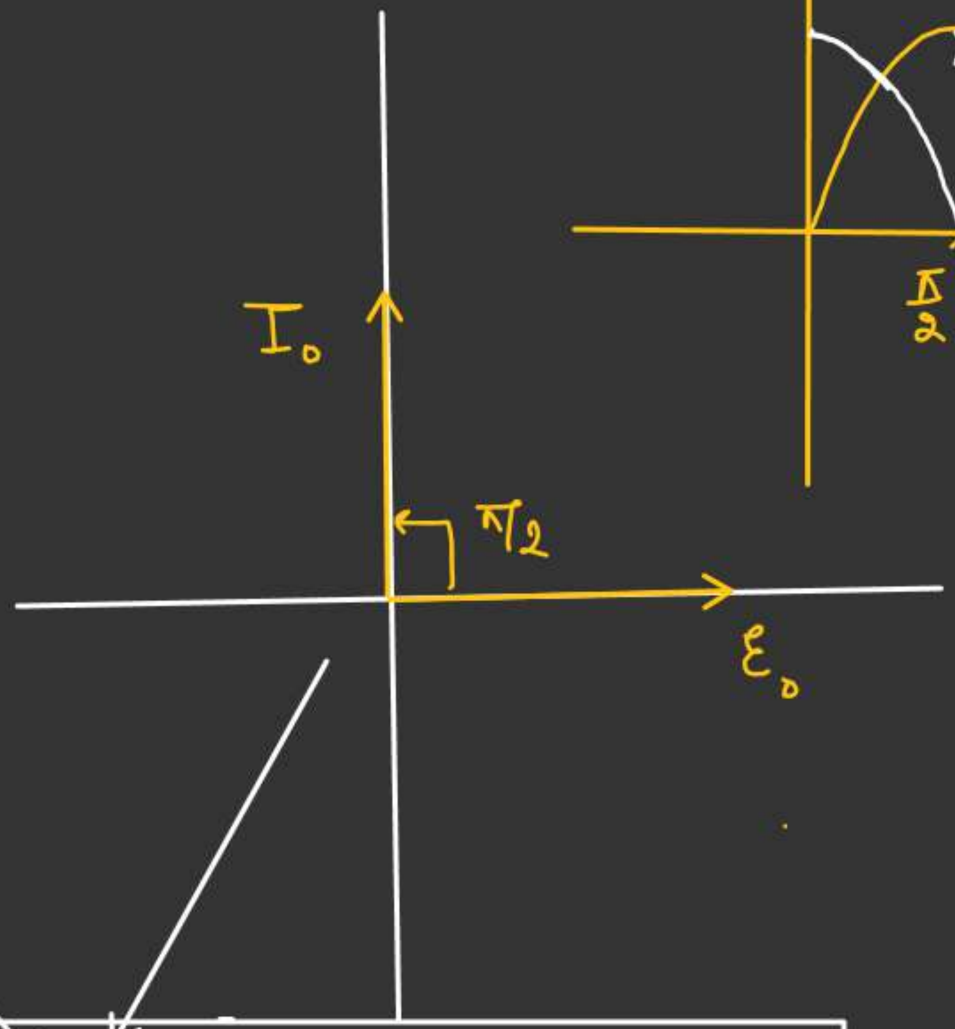
Purly Capacitive ckt

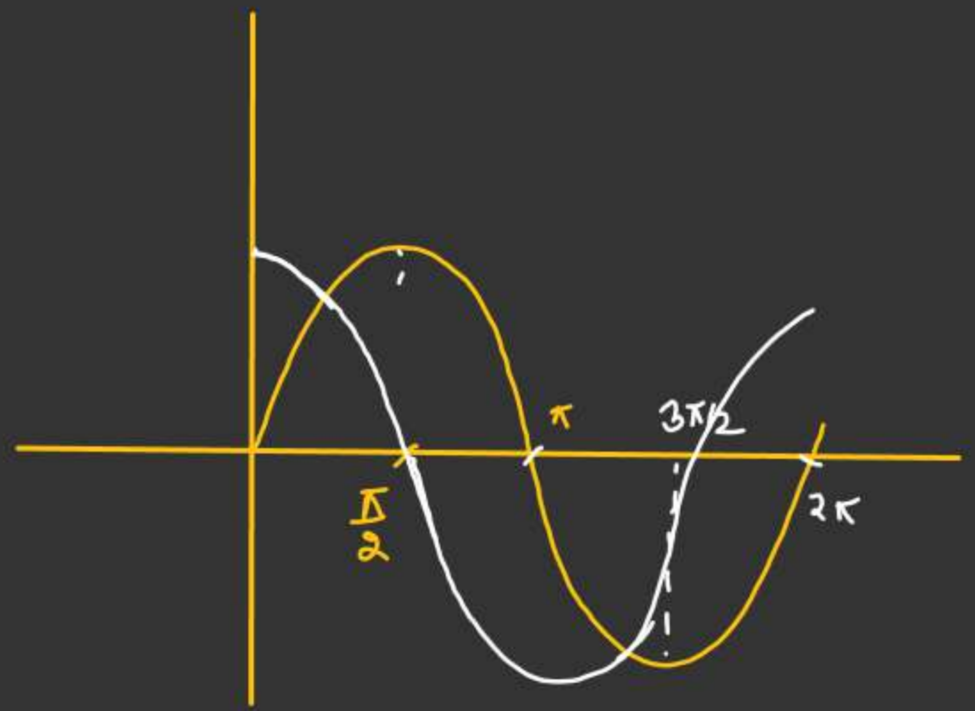
$$\varepsilon = \varepsilon_0 \sin \omega t$$

$$I = \frac{\varepsilon_0}{X_c} \sin\left(\omega t + \frac{\pi}{2}\right)$$

$$\left(X_c = \frac{1}{\omega C}\right)$$







In purly Capacitive Ckt
Current leading the voltage
by $\pi/2$

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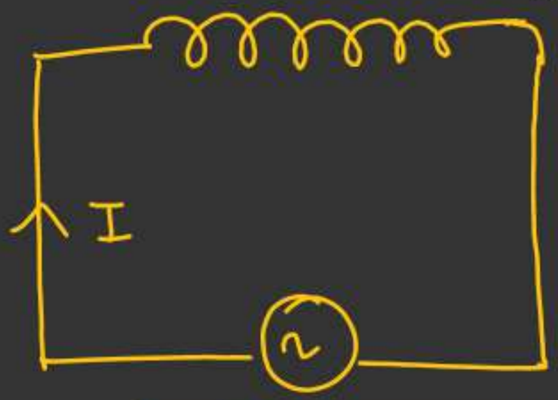
Purly Inductive Ckt

$\mathcal{E}_L = L\frac{di}{dt}$



$$\boxed{\mathcal{E} = \mathcal{E}_0 \sin\omega t} \quad -(1)$$

$$\mathcal{E}_0 \sin\omega t - L\frac{di}{dt} = 0$$

$$\mathcal{E}_0 \sin\omega t = L\frac{di}{dt}$$

$$\frac{\mathcal{E}_0}{L}\int_0^t \sin\omega t = \int_0^i di$$

$$i = -\frac{\mathcal{E}_0}{\omega L}\left[\cos\omega t\right]_0^t$$

$$i = -\frac{\mathcal{E}_0}{\omega L}\left[\cos\omega t - 1\right]$$

$$i = \underbrace{\frac{\mathcal{E}_0}{\omega L}}_{\text{Constant}} - \frac{\mathcal{E}_0}{\omega L}\cos\omega t$$

$$i = -\frac{\mathcal{E}_0}{\omega L}\cos\omega t + C$$

$$\boxed{i = \frac{\mathcal{E}_0}{\omega L}\sin(\omega t - \pi/2) + C} \quad -(2)$$

$$\boxed{\phi = -\pi/2} \rightarrow$$

In purly Inductive Ckt Current lagging the Voltage by $\pi/2$.

$$\left[\begin{array}{l} X_1 = A\sin\omega t \quad -(1) \\ X_2 = \underbrace{K}_{\text{Constant}} + A\sin\omega t \quad -(2) \end{array}\right]$$

For (1)

Mean position is 0.

For (2)

Mean position = (K)

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Purly Inductive Ckt

$$\mathcal{E} = \mathcal{E}_0 \sin\omega t$$

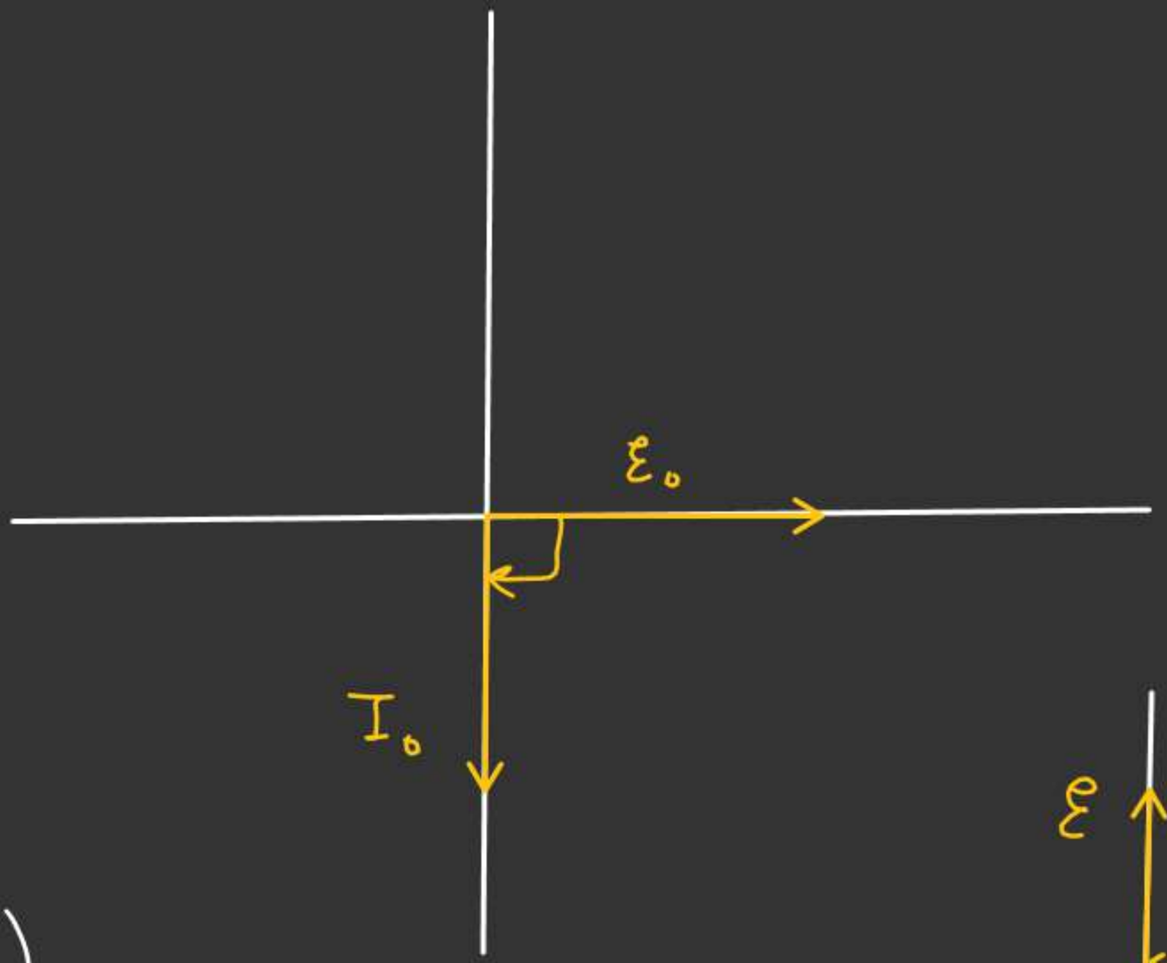
$$I = I_0 \sin(\omega t - \pi/2)$$

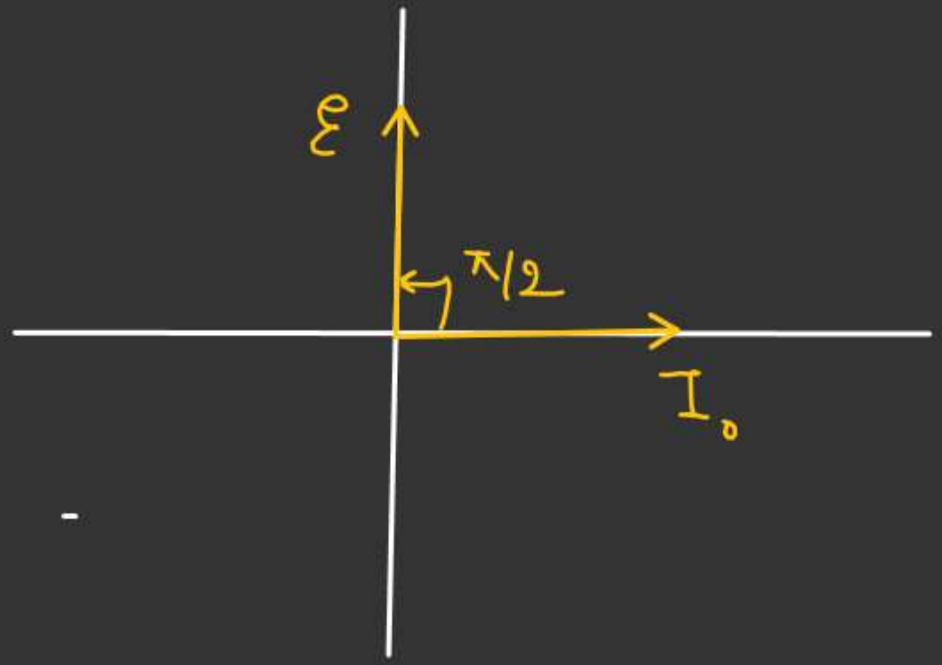
$$\boxed{I_0 = \frac{\mathcal{E}_0}{\omega L} = \frac{\mathcal{E}_0}{X_L}}$$

$X_L = \omega L$

$\Downarrow$

(Reactance of Inductive Ckt)





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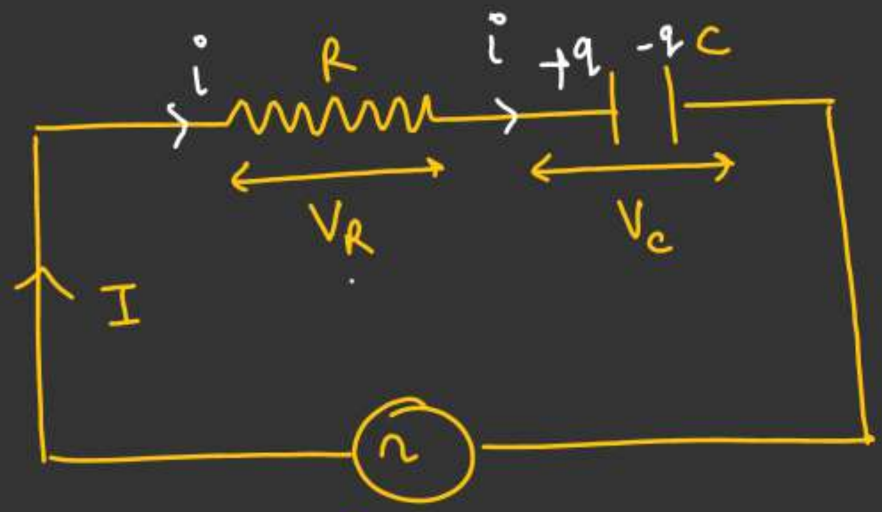
R-C Ckt [R & C in Series]



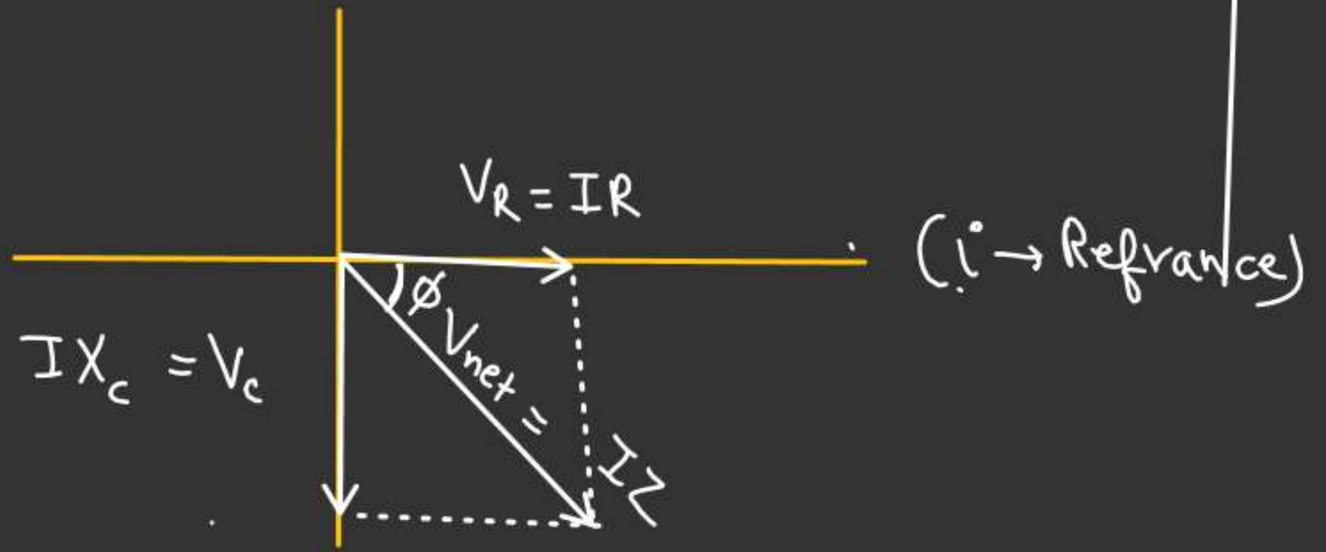
$\mathcal{E} = \mathcal{E}_0 \sin\omega t$

$V_{net} = I Z$

$V_{net} = I\sqrt{R^2 + X_C^2}$

$V_{net} = \sqrt{I^2R^2 + I^2X_C^2}$

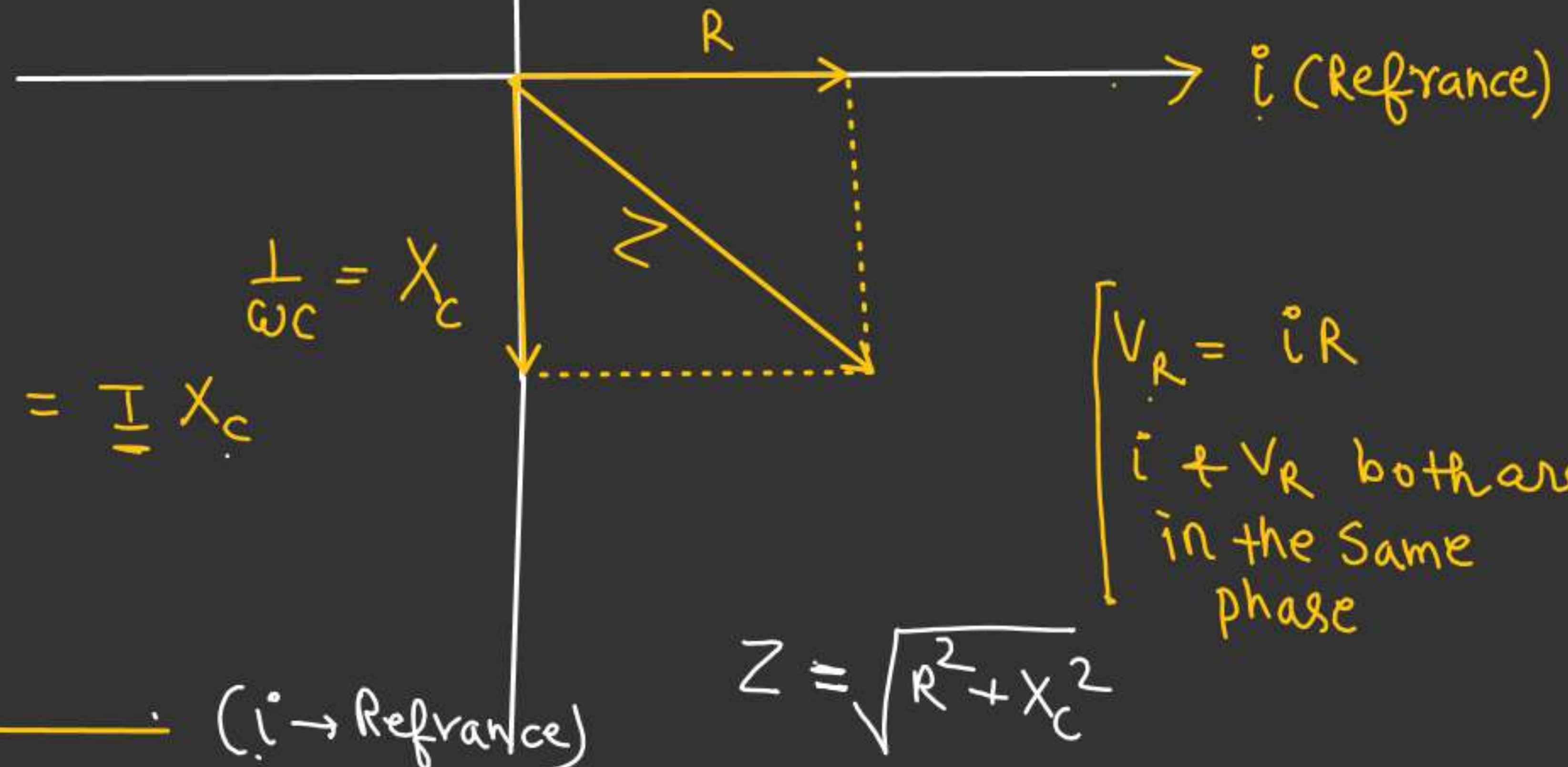
$V_{net} = \sqrt{V_R^2 + V_C^2}$



Impedance phasor of R-C ckt.

$\frac{1}{\omega C} = X_C$

$V_C = I X_C$



$V_R = iR$

i & V_R both are in the same phase

$Z = \sqrt{R^2 + X_C^2}$

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R-C Ckt.

Z = Impedance of R-C Ckt.
$\Downarrow$
(Ω)

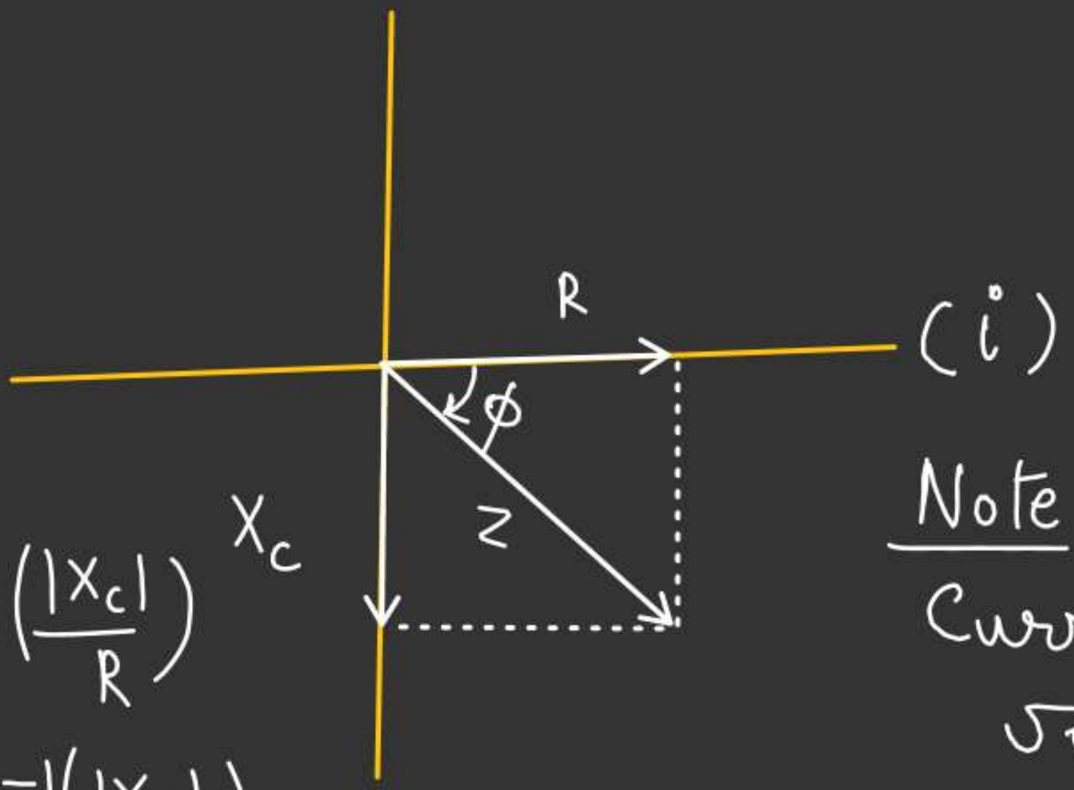
$$\mathcal{E} = \mathcal{E}_0 \sin \omega t$$

$$Z = \sqrt{R^2 + X_c^2}$$

$$i = i_0 \sin(\omega t + \phi)$$

$$\left(i_0 = \frac{\mathcal{E}_0}{|Z|} \right)$$

$$\tan\phi = \left(\frac{|X_c|}{R}\right)$$



$$\phi = \tan^{-1}\left(\frac{|X_c|}{R}\right)$$
$\Downarrow$
Phase Constant of R-C Ckt.

Note:- In R-C Ckt Current leading the voltage by $\phi = \tan^{-1}\left(\frac{|X_c|}{R}\right)$