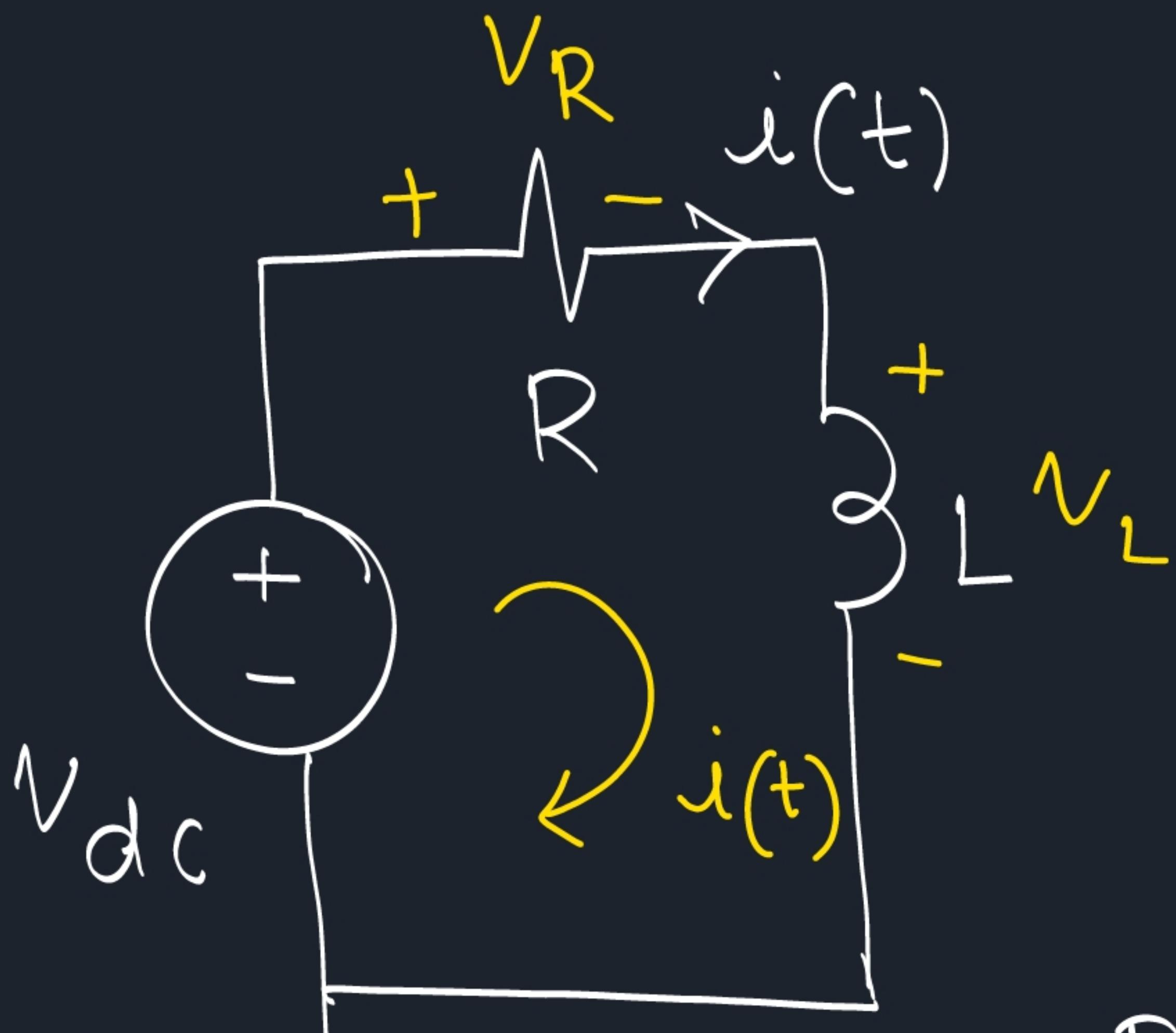


## Basics :-



$$V_{dc} = V_R + V_L$$

$$\Rightarrow L \frac{di(t)}{dt} + R i(t) = V_{dc}$$

$$\Rightarrow \frac{di(t)}{dt} + \underbrace{\frac{R}{L} i(t)}_{P} = \underbrace{\frac{V_{dc}}{L}}_{Q}$$

$$e^{R/L t} \frac{di(t)}{dt} + e^{R/L t} \frac{R}{L} i(t) = e^{R/L t} \frac{V_{dc}}{L}$$

$$\Rightarrow \frac{d}{dt} \left( e^{R/L t} i(t) \right) = e^{R/L t} \cdot \frac{V_{dc}}{L}$$

$$e^{R/L t} i(t) = A + \frac{V_{dc}}{L} \int e^{R/L t} dt$$

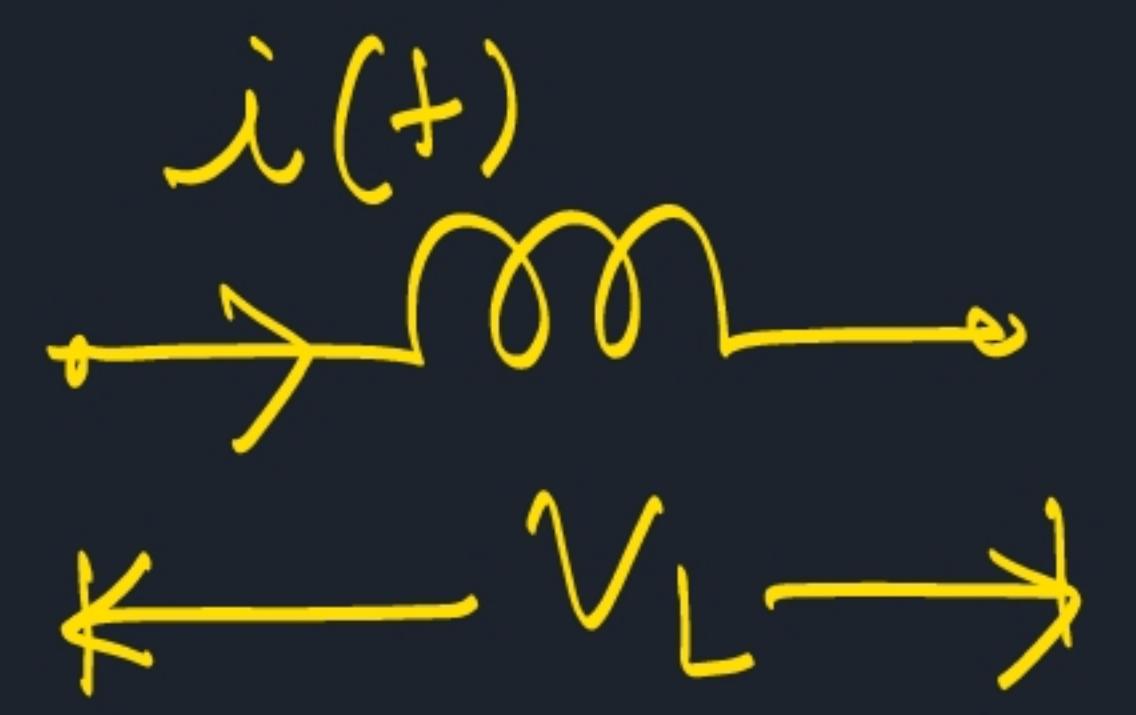
$$i(t) = A e^{-R/L t} + \frac{V_{dc}}{L} \int e^{-R/L t} dt$$

$$i(t) = A e^{-R/L t} + \frac{V_{dc}}{R}$$

$$@ t=0 \quad i(t) = I_0$$

$$I_0 = A + \frac{V_{dc}}{R} \Rightarrow A = I_0 - \frac{V_{dc}}{R}$$

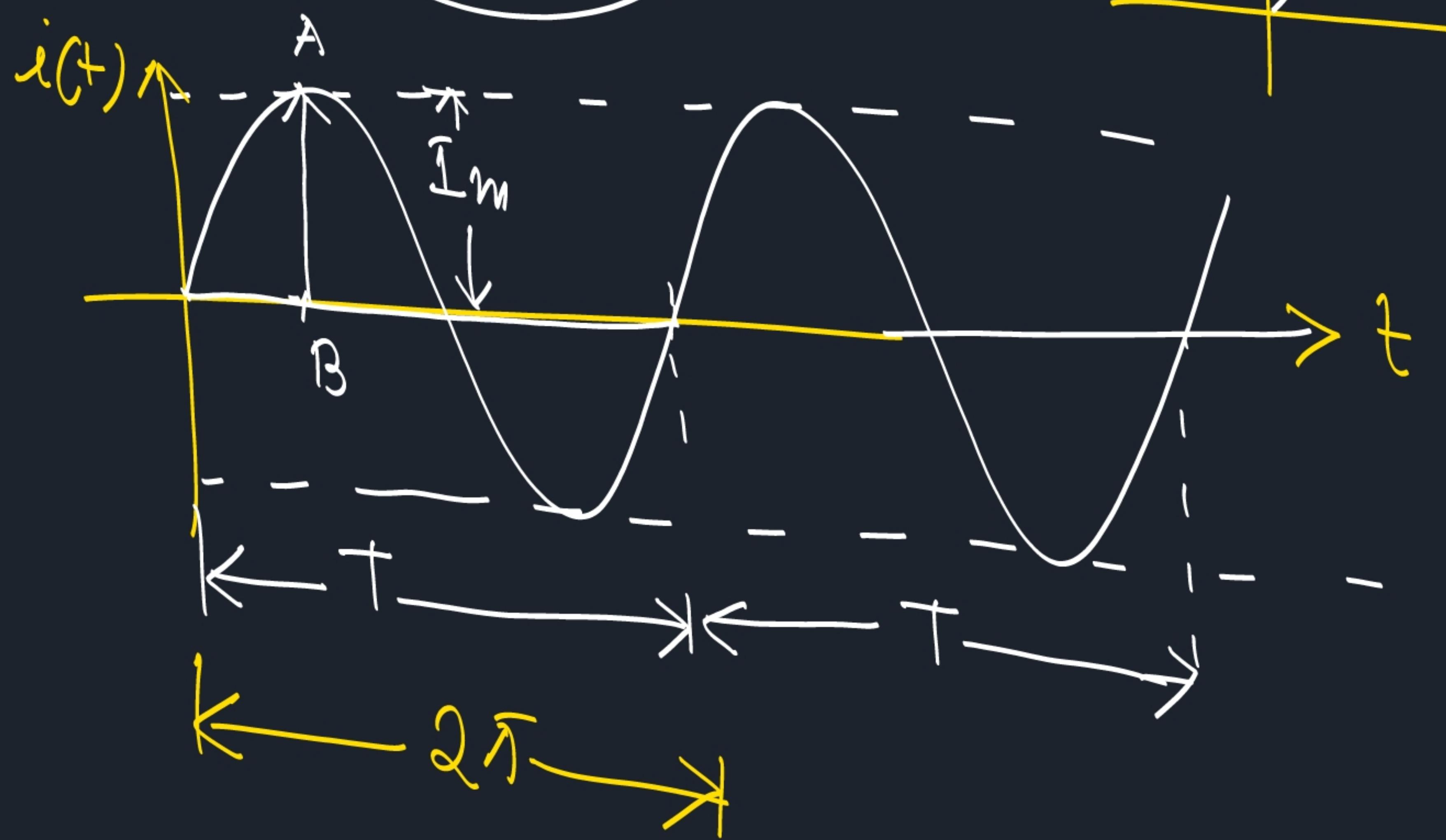
$$i(t) = \frac{V_{dc}}{R} \left( 1 - e^{-R/L t} \right) + I_0 e^{-R/L t}$$



$$V_L(t) = L \frac{di^{(+)}}{dt}$$

$i(t) = e^{\pm \alpha t}$   $\alpha$  is integer.

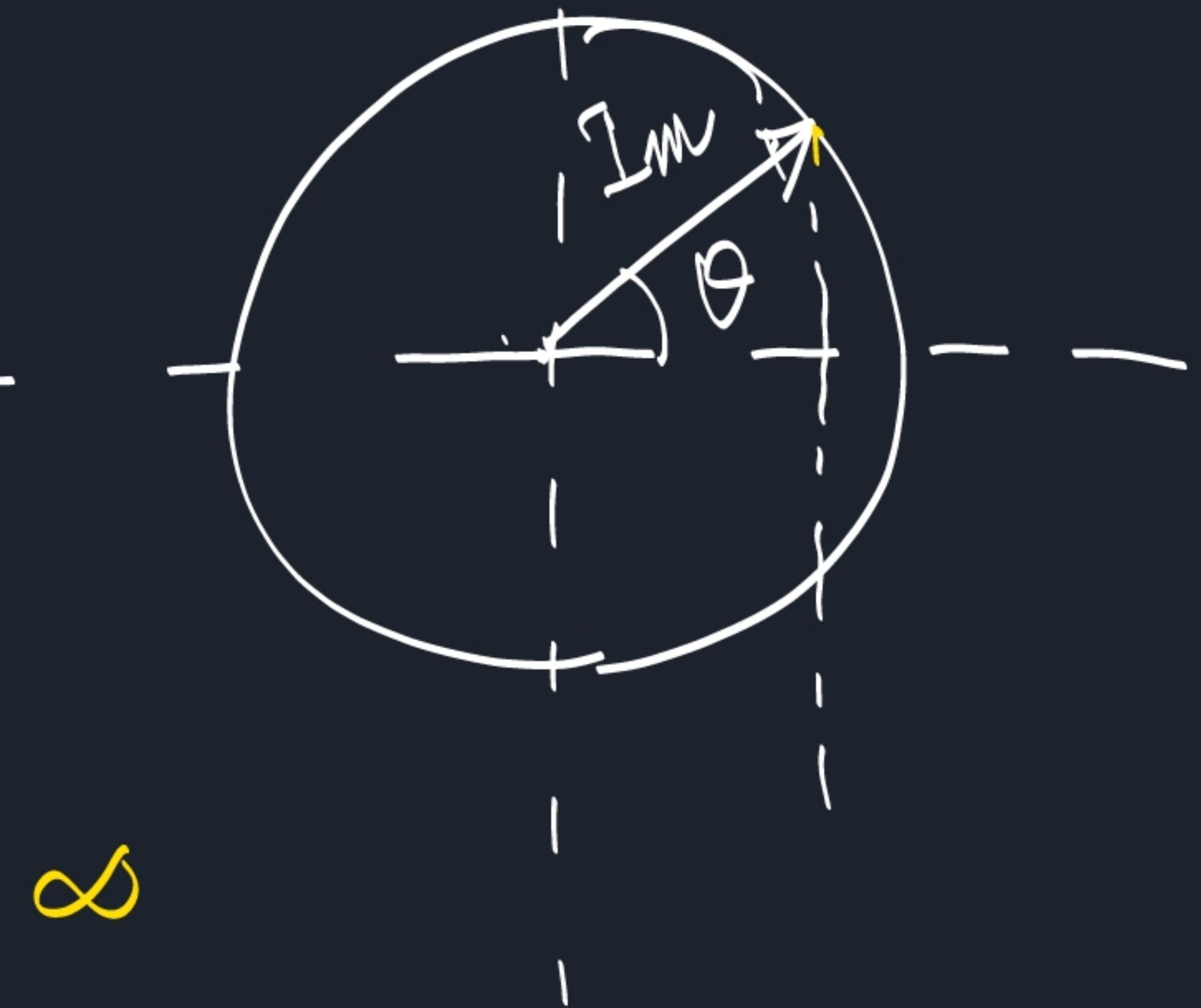
$i(t) = \sin \omega t$



$$i_C(+) = C \frac{dV_C(+)}{dt}$$

$$V_C(+) = \frac{1}{C} \int i_C(+) dt$$

$f \propto \omega$



$m = 1, 2, \dots, \infty$

$f(t)$

$$f(t \pm \omega T) = f(t)$$

periodic waveform

$I_m \sin \theta$

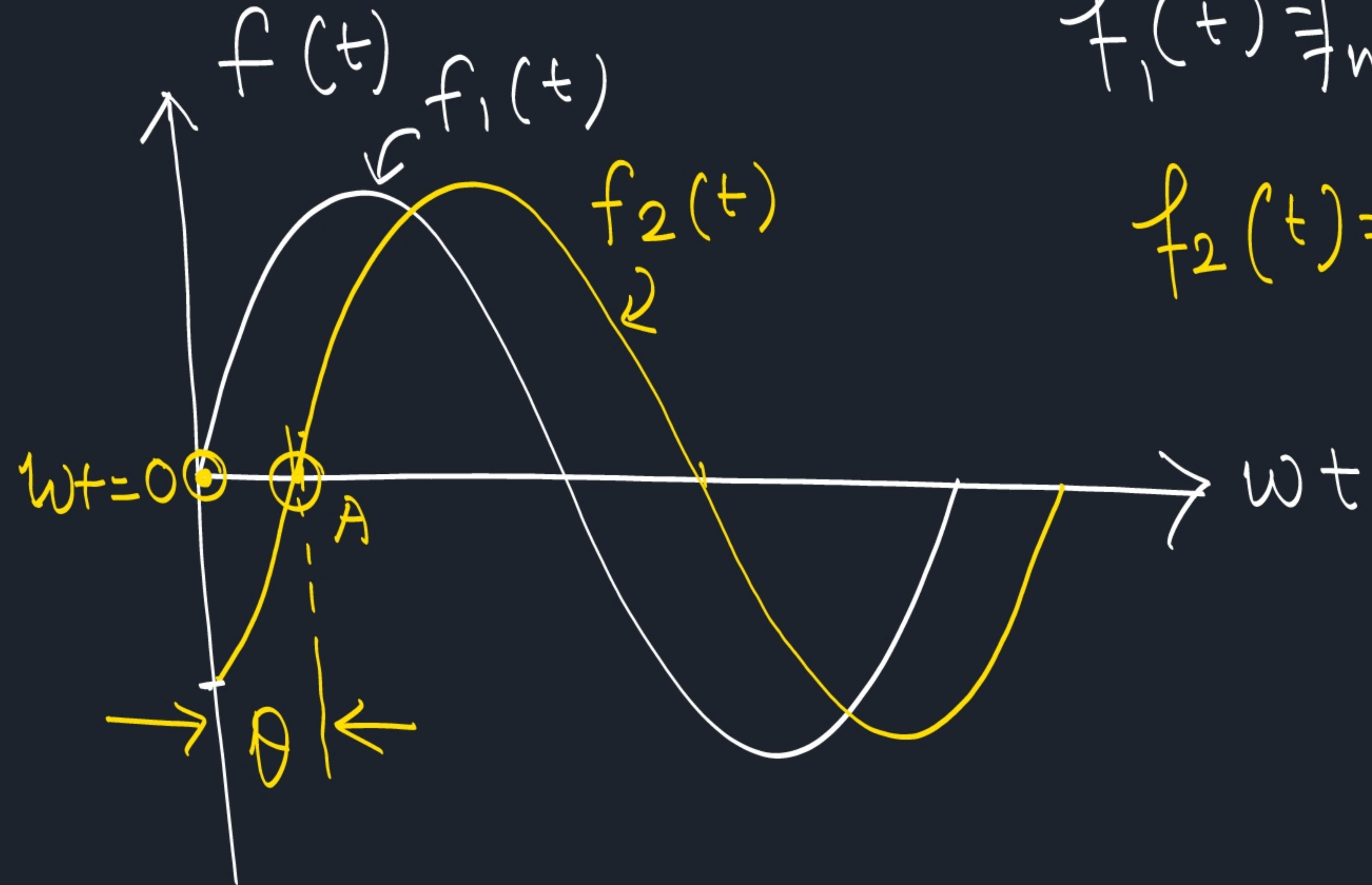
$I_m \sin \omega t$

$$\text{freq} = \frac{1}{T}$$

$$\omega t (t=+T) = 2\pi = 50 \text{ Hz}$$

## Concept of Lagging

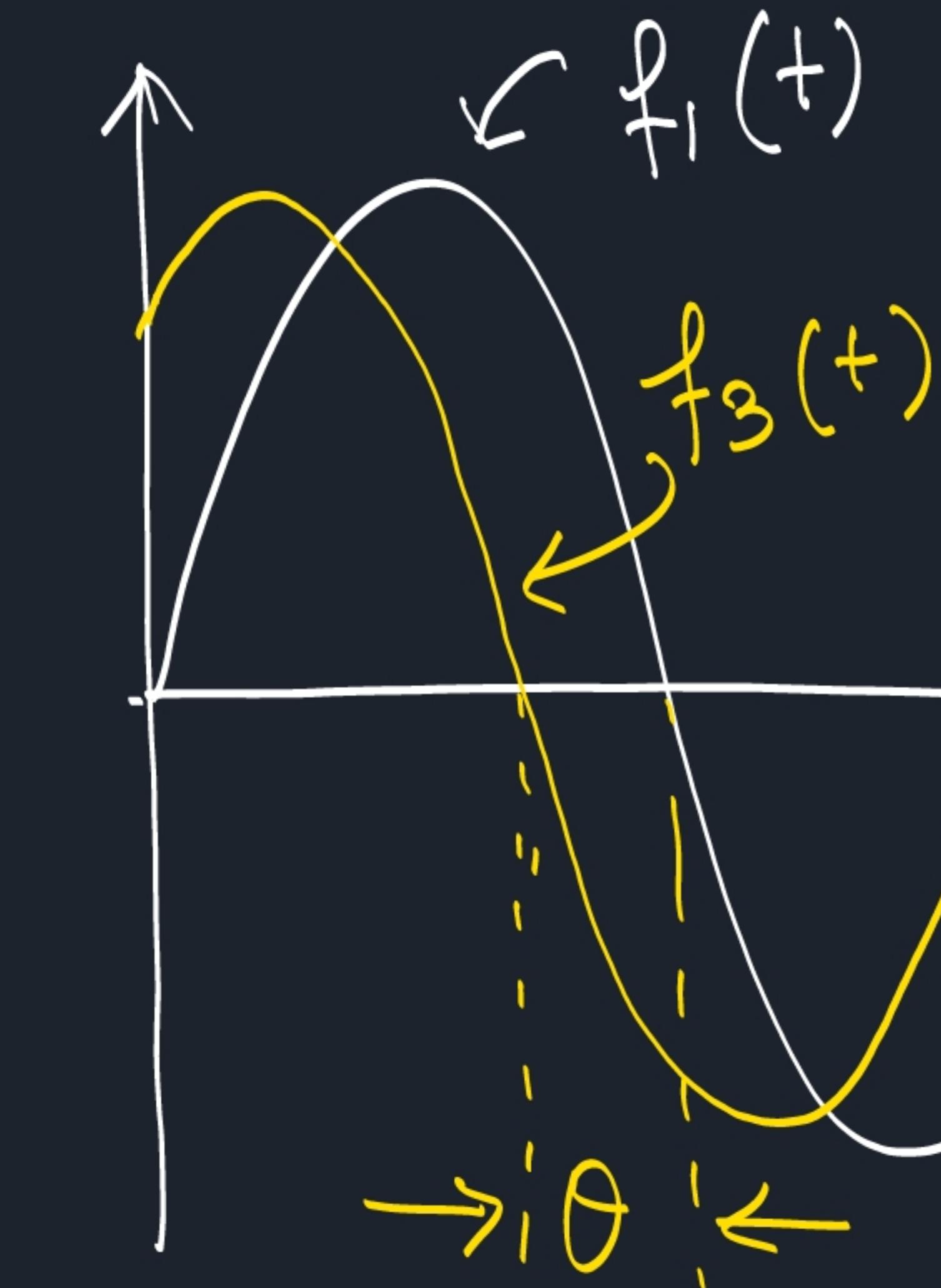
& Leadings :-



$$f_1(t) = f_m \sin(\omega t)$$

$$f_2(t) = f_m \sin(\omega t - \theta)$$

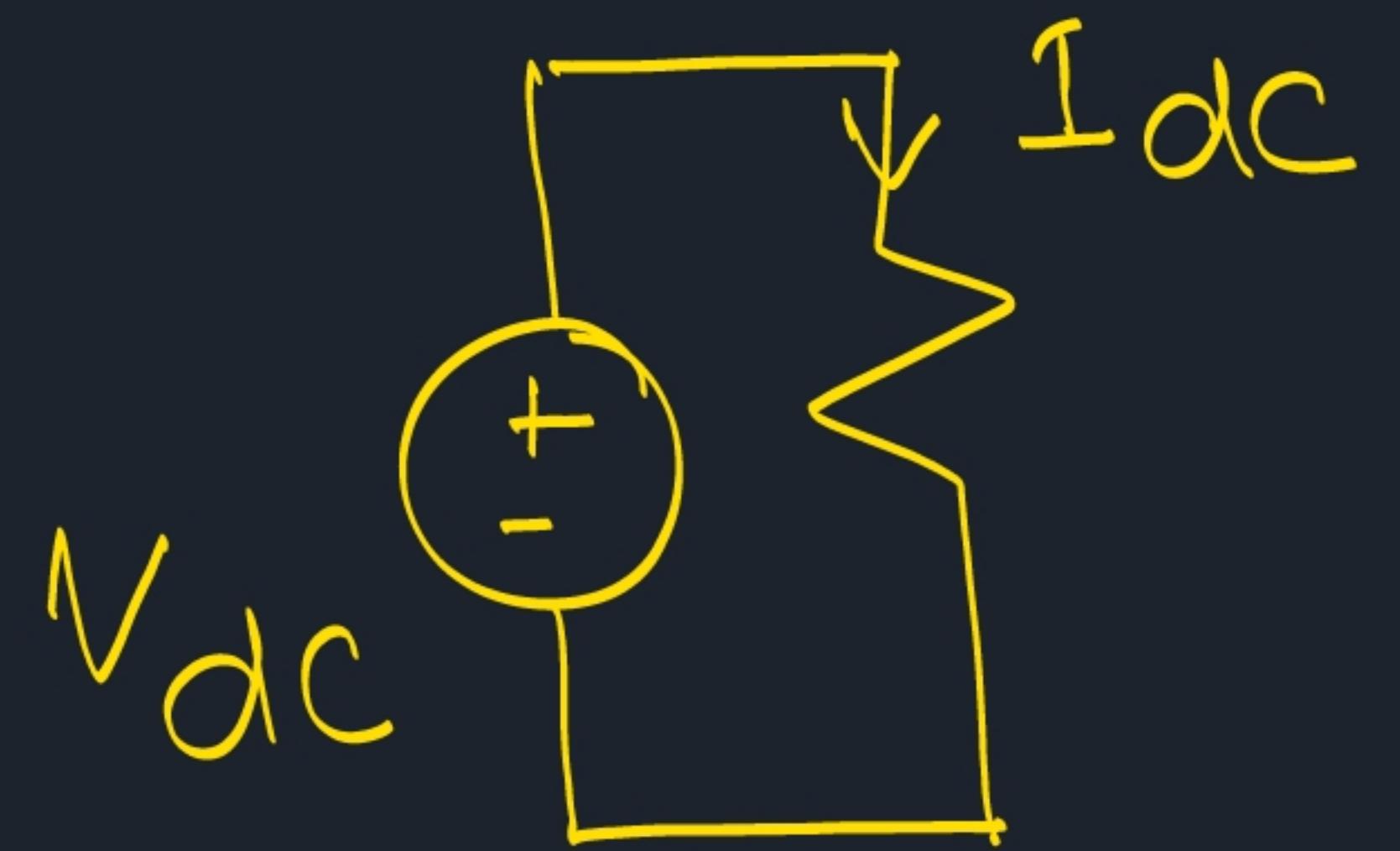
$f_2(t)$  is lagging behind  $f_1(t)$  by an angle of  $\theta$ .



$$f_3(t) = f_m \sin(\omega t + \theta)$$

$f_3(t)$  is leading  $f_1(t)$  by an angle of  $\theta$ .

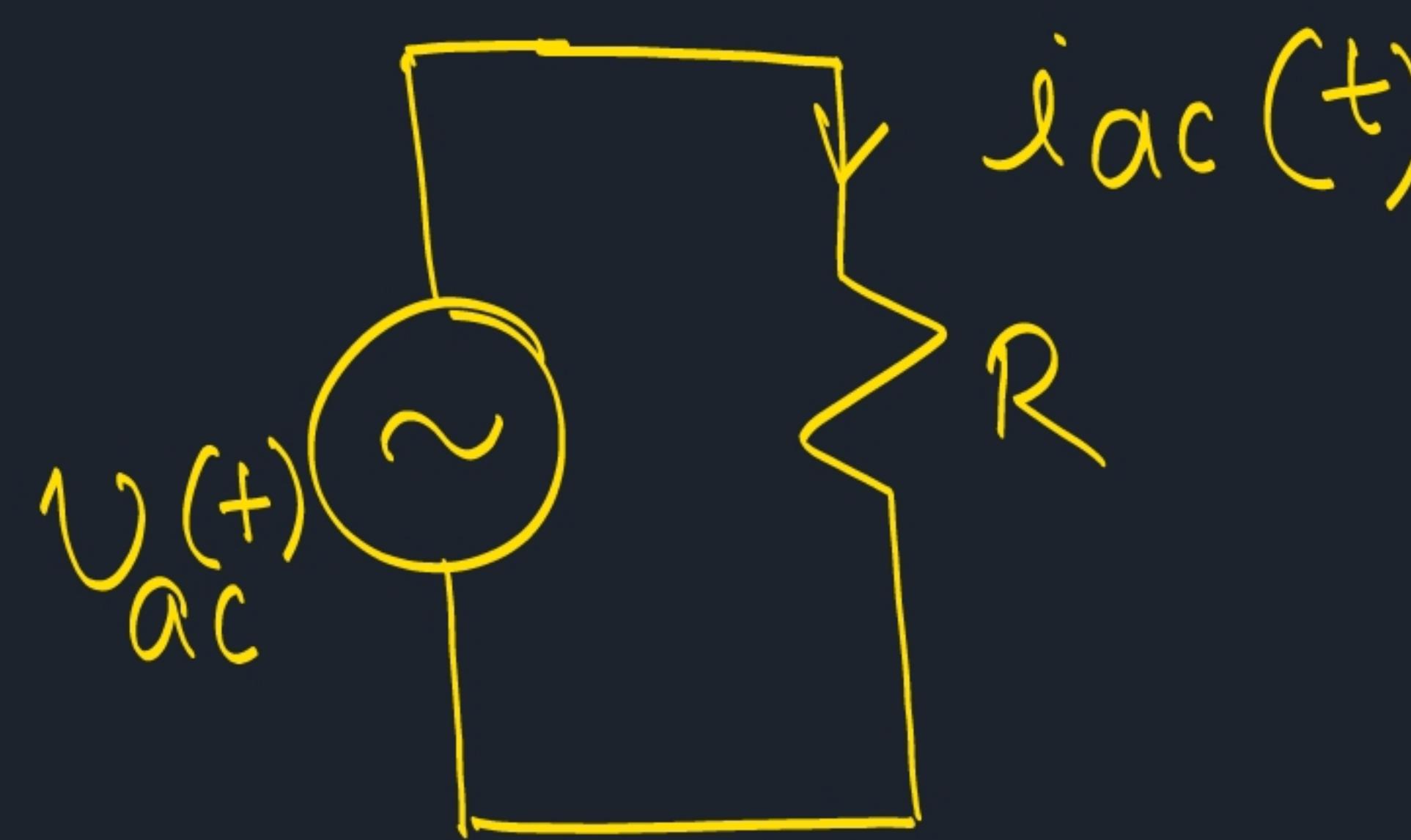
RMS Value :-



$$E_{dc} = I_{dc}^2 \cdot R \cdot T$$

$$I_{dc}^2 \cdot R \cdot T = \int_0^T i_{ac}^2(t) R dt$$

$$\boxed{I_{dc} = \left( \frac{1}{T} \int_0^T i_{ac}^2(t) dt \right)^{\frac{1}{2}}} = \underline{\underline{I_{ac}^{RMS}}}$$



$$E_{AC} = \int_0^T i_{ac}^2(t) R dt$$

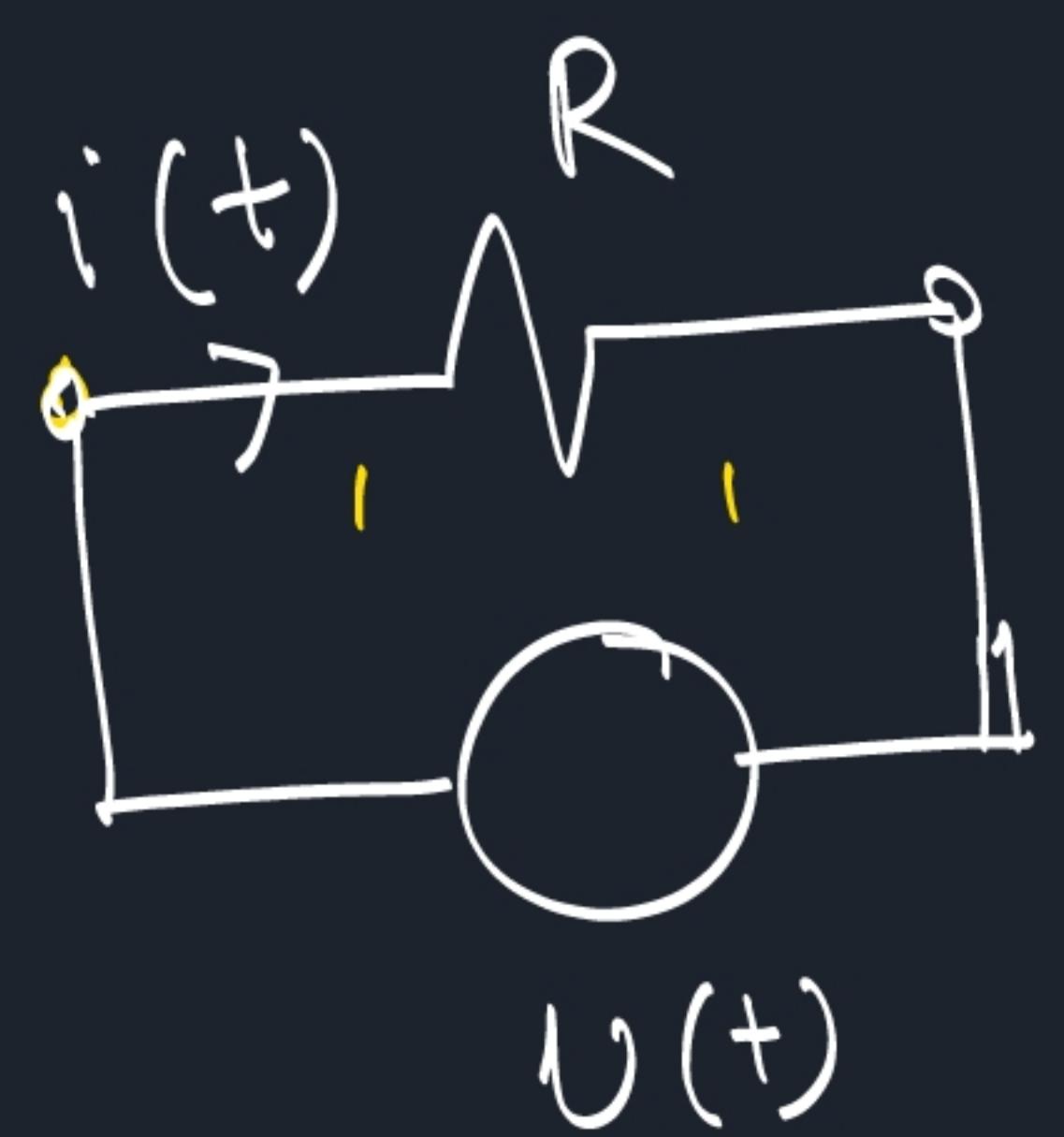
$$I_{RMS} = \sqrt{\frac{1}{T} \int_0^T i^2(t) dt}$$

↳ Effective value

AVERAGE VALUE :-

$$I_{avg} = \frac{1}{T} \int_t^{t+T} i(t) dt$$

## Sinusoidal Forced Response:-



$$v(t) = V_m \cos \omega t$$

$$L \frac{di}{dt} + Ri = v(t)$$

$$= V_m \cos \omega t$$

$$\frac{di}{dt} + \frac{R}{L}i = \frac{V_m}{L} \cos \omega t$$

$$e^{R/L t} \cdot \frac{di}{dt} + \frac{R}{L} e^{R/L t} \cdot i = \frac{V_m}{L} \cos \omega t \cdot e^{R/L t}$$

$$\Rightarrow \frac{d}{dt} (e^{R/L t} i(t)) = \frac{V_m}{L} e^{R/L t} \cos \omega t$$

$$e^{R/L t} i(t) = A + \int_0^t \frac{V_m}{L} e^{R/L t} \cos \omega t dt$$

$$i(t) = Ae^{-R/L t} + e^{-R/L t} \int_0^t \frac{V_m}{L} e^{R/L t} \cos \omega t dt$$

$$\int \frac{V_m}{L} e^{R/L t} e^{j\omega t}$$

$$cos\omega t = \Re \{ e^{j\omega t} \}$$

$$e^{j\omega t} = cos\omega t + j sin\omega t$$

$$\frac{e^{j\omega t} + e^{-j\omega t}}{2}$$

$$\frac{V_m}{\sqrt{R^2 + (\omega L)^2}} \cos(\omega t - \theta)$$

$$\begin{aligned} &= \int \frac{V_m}{L} e^{(R/L + j\omega)t} \\ &= \frac{V_m}{L} \cdot \frac{e^{R/L t} \cdot e^{j\omega t}}{\frac{R}{L} + j\omega} \\ &= V_m \cdot \frac{e^{R/L t} \cdot e^{j\omega t}}{R + j\omega L} \\ &= \frac{V_m \cdot e^{j\omega t}}{|z| e^{j\theta}} \\ &= \frac{V_m}{|z|} e^{j(\omega t - \theta)} \end{aligned}$$

$$\begin{aligned} a + jb &= |z| \angle \theta \\ |z| &= \sqrt{a^2 + b^2} \\ \theta &= \tan^{-1}\left(\frac{b}{a}\right) \end{aligned}$$

$$a + jb = |z| e^{j\theta}$$

$$\theta = \tan^{-1}\left(\frac{\omega L}{R}\right)$$

$$i(t) = A e^{-R/L t} + \frac{V_m}{\sqrt{R^2 + \omega^2 L^2}} \cos(\omega t - \theta)$$

Initial Cond<sup>n</sup>:

@  $t = 0$

$$0 = A + \frac{V_m}{\sqrt{R^2 + (\omega L)^2}} \cos \theta$$

$$A = -\frac{V_m}{\sqrt{R^2 + (\omega L)^2}} \cos \theta$$

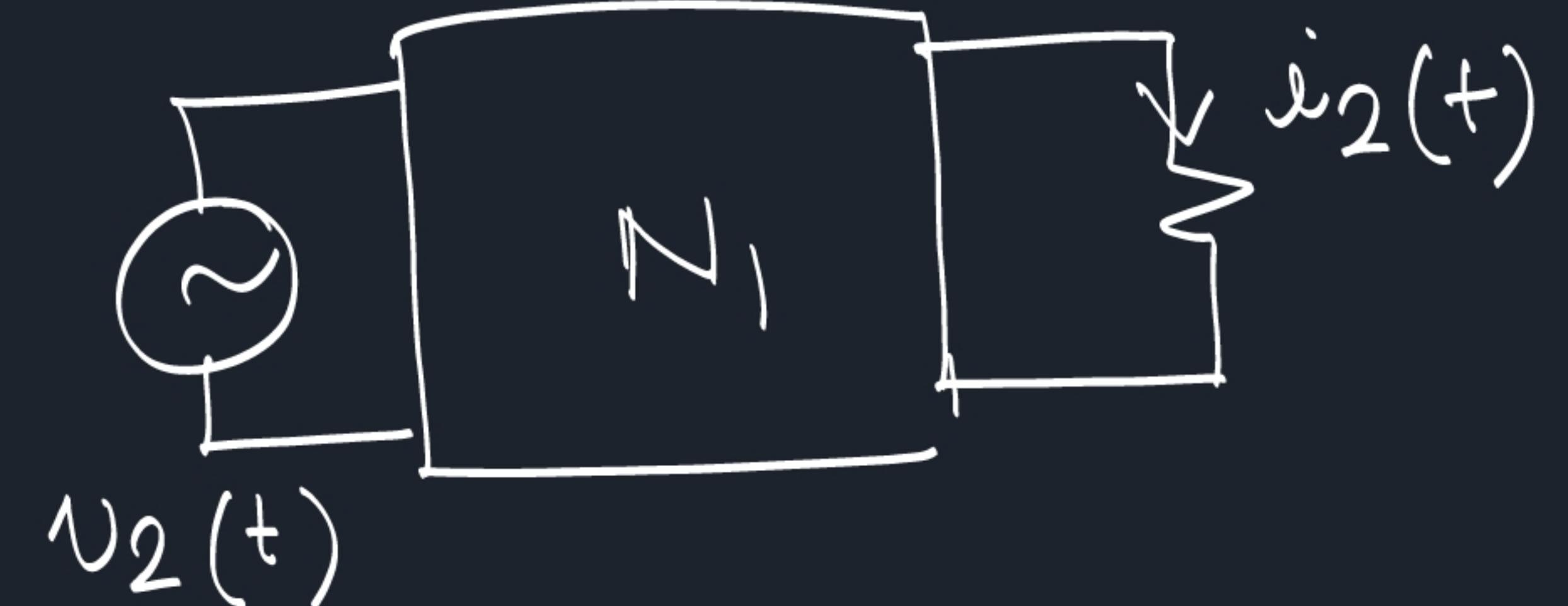
$$i(t) = -\frac{V_m}{\sqrt{R^2 + (\omega L)^2}} e^{-R/L t} + \underbrace{\frac{V_m}{\sqrt{R^2 + (\omega L)^2}} \cos(\omega t - \theta)}_{\text{Steady State}}$$

Steady State



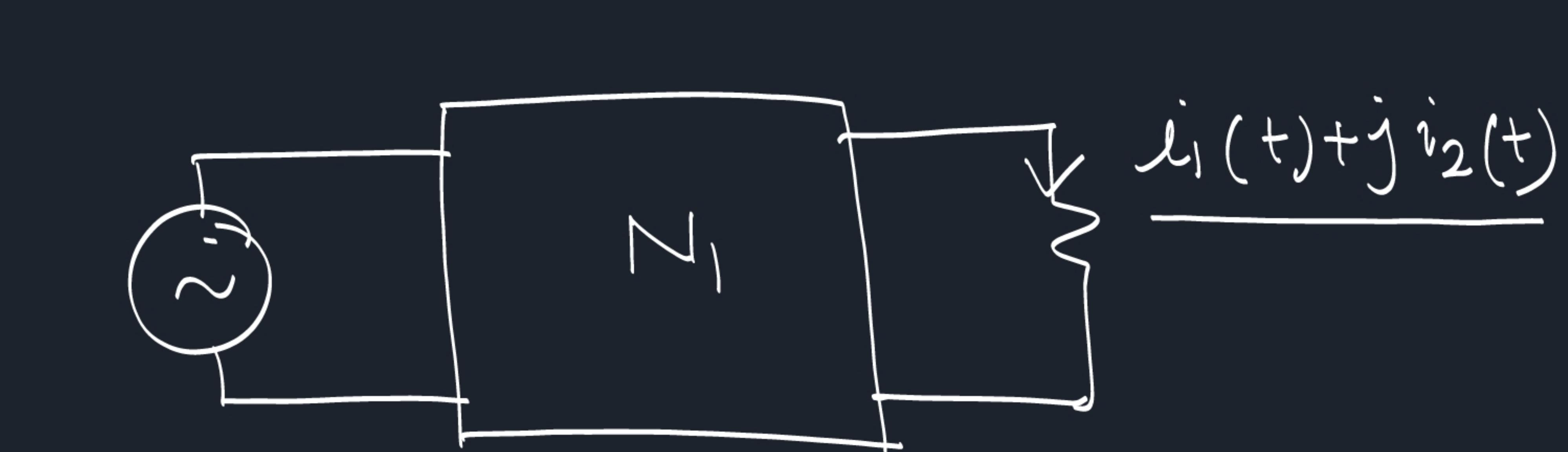
$$v_1(t) = V_m \cos \omega t$$

$$i_1(t) = I_m \cos(\omega t \pm \theta)$$



$$v_2(t) = V_m \sin \omega t$$

$$i_2(t) = I_m \sin(\omega t \pm \theta)$$

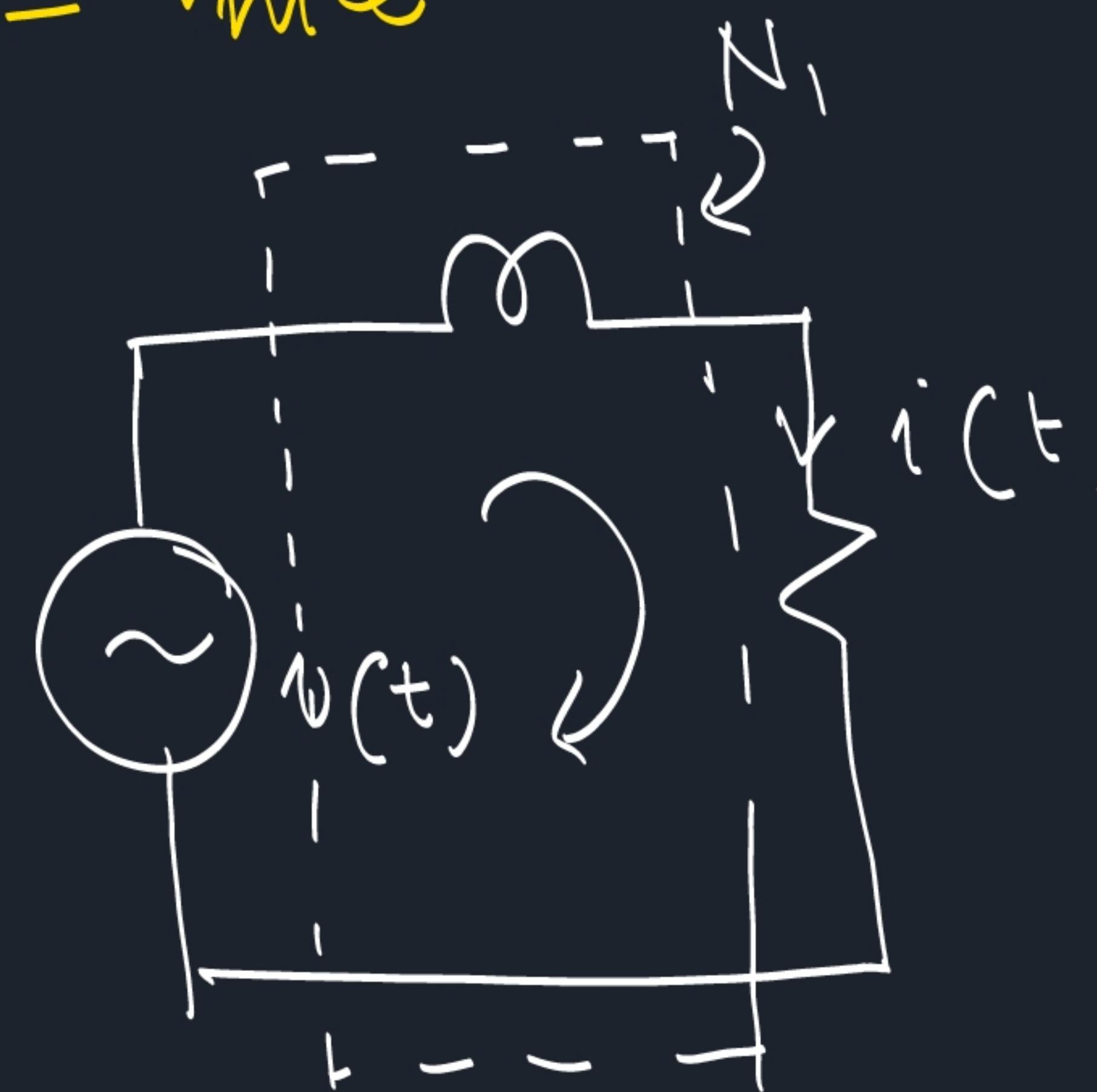


$$\begin{aligned} v_1(t) + j v_2(t) &= V_m \cos \omega t + j V_m \sin \omega t \\ &= V_m e^{j\omega t}. \end{aligned}$$



$$v(t) = V_m e^{j\omega t}$$

$$i(t) = I_m e^{j(\omega t + \theta)}$$



$$v(t) = R i(t) + L \frac{di(t)}{dt}$$

$$\Rightarrow j\omega L I_m e^{j(\omega t + \theta)} + R I_m e^{j(\omega t + \theta)} = V_m e^{j\omega t}$$

$$\Rightarrow j\omega L I_m e^{j\theta} + R I_m e^{j\theta} = V_m$$

$$\Rightarrow I_m e^{j\theta} (R + j\omega L) = V_m$$

$$I_m e^{j\theta} = \frac{V_m}{R + j\omega L}$$

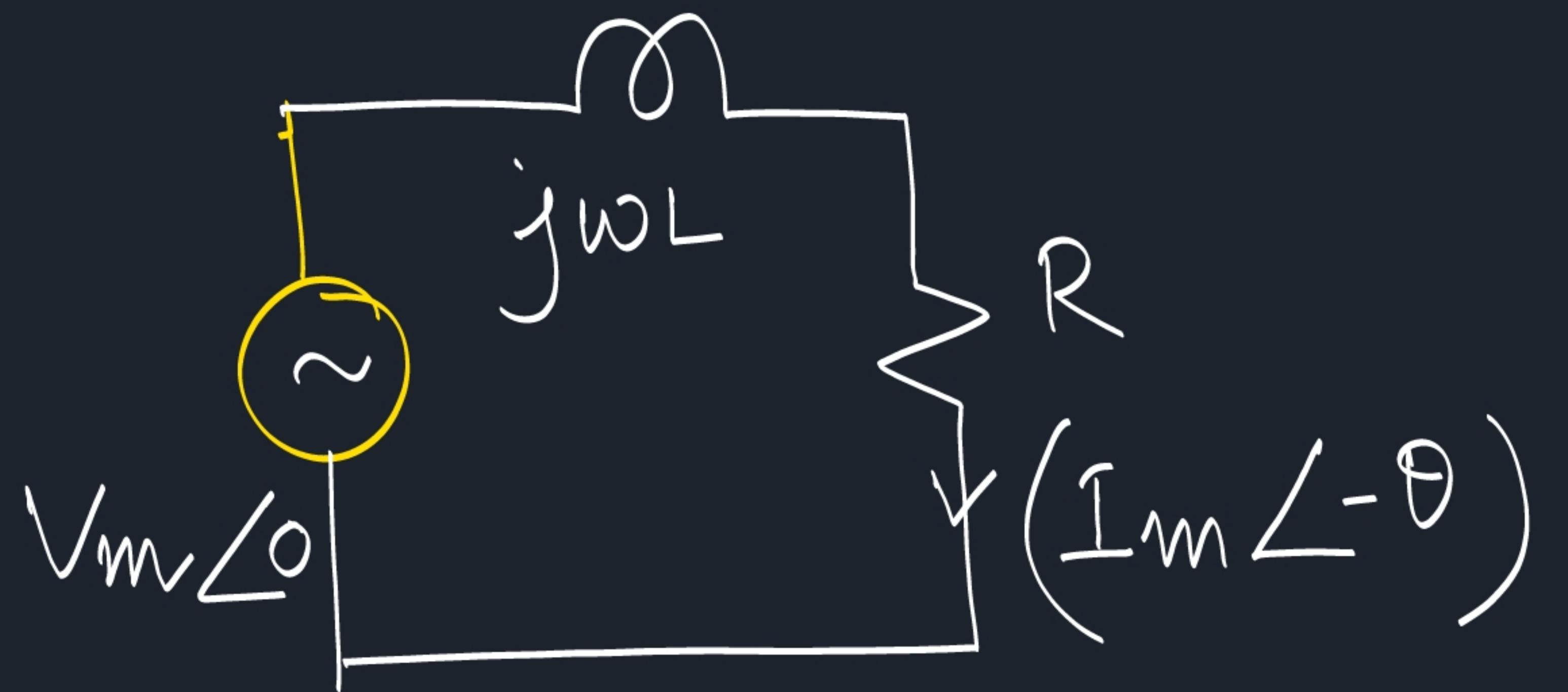
$$I_m = |I_m e^{j\theta}| = \left| \frac{V_m}{R + j\omega L} \right|$$

$$= \frac{V_m}{\sqrt{R^2 + (\omega L)^2}}$$

$$\theta = \angle I_m e^{j\theta}$$

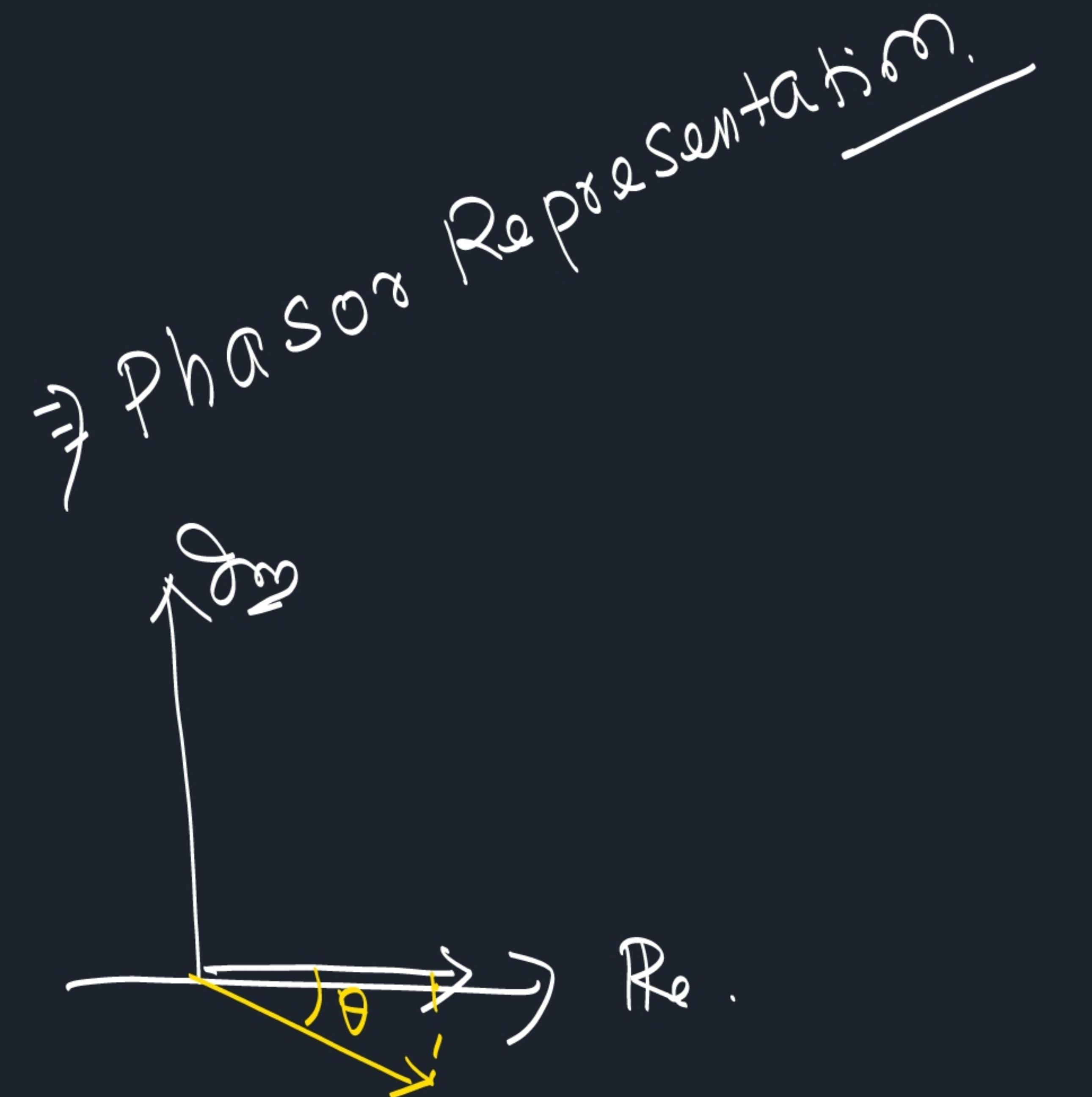
$$= \angle \frac{V_m}{R + j\omega L}$$

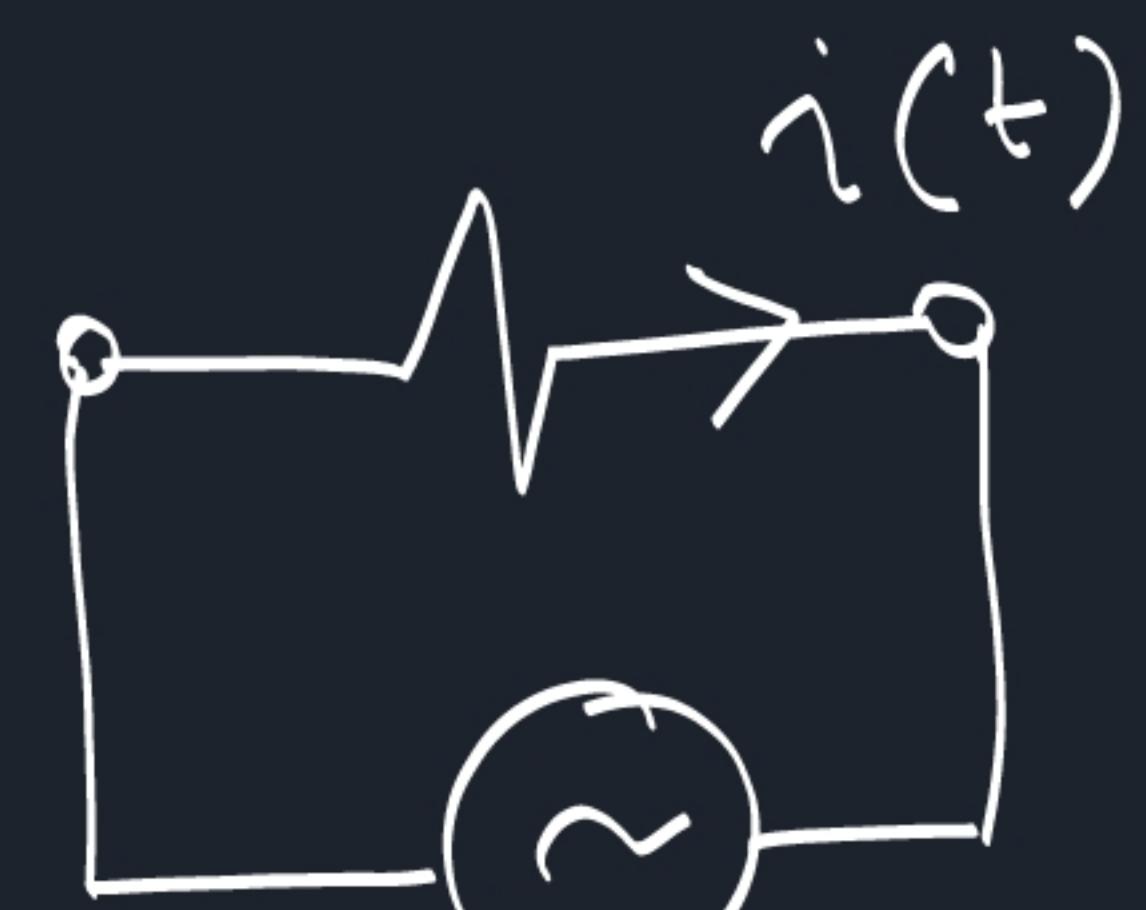
$$= -\tan^{-1}\left(\frac{\omega L}{R}\right)$$



$$\underline{I_m \angle -\theta} = \frac{V_m \angle 0}{R + j\omega L} \quad (\theta = \tan^{-1} \frac{\omega L}{R})$$

$$\begin{matrix} \vec{V} \\ \vec{I} \end{matrix} \rightarrow \begin{matrix} V_m \sin \omega t \\ I_m \sin(\omega t - \theta) \end{matrix}$$





$$v(t) = V_m \cos(\omega t + \phi)$$

∴

$$v(t) = R i(t)$$

$$i(t) = \frac{V_m}{R} \cos(\omega t + \phi)$$

$$v(t) = V_m e^{j(\omega t + \phi)}$$

$$i(t) = I_m e^{j(\omega t + \phi)}$$

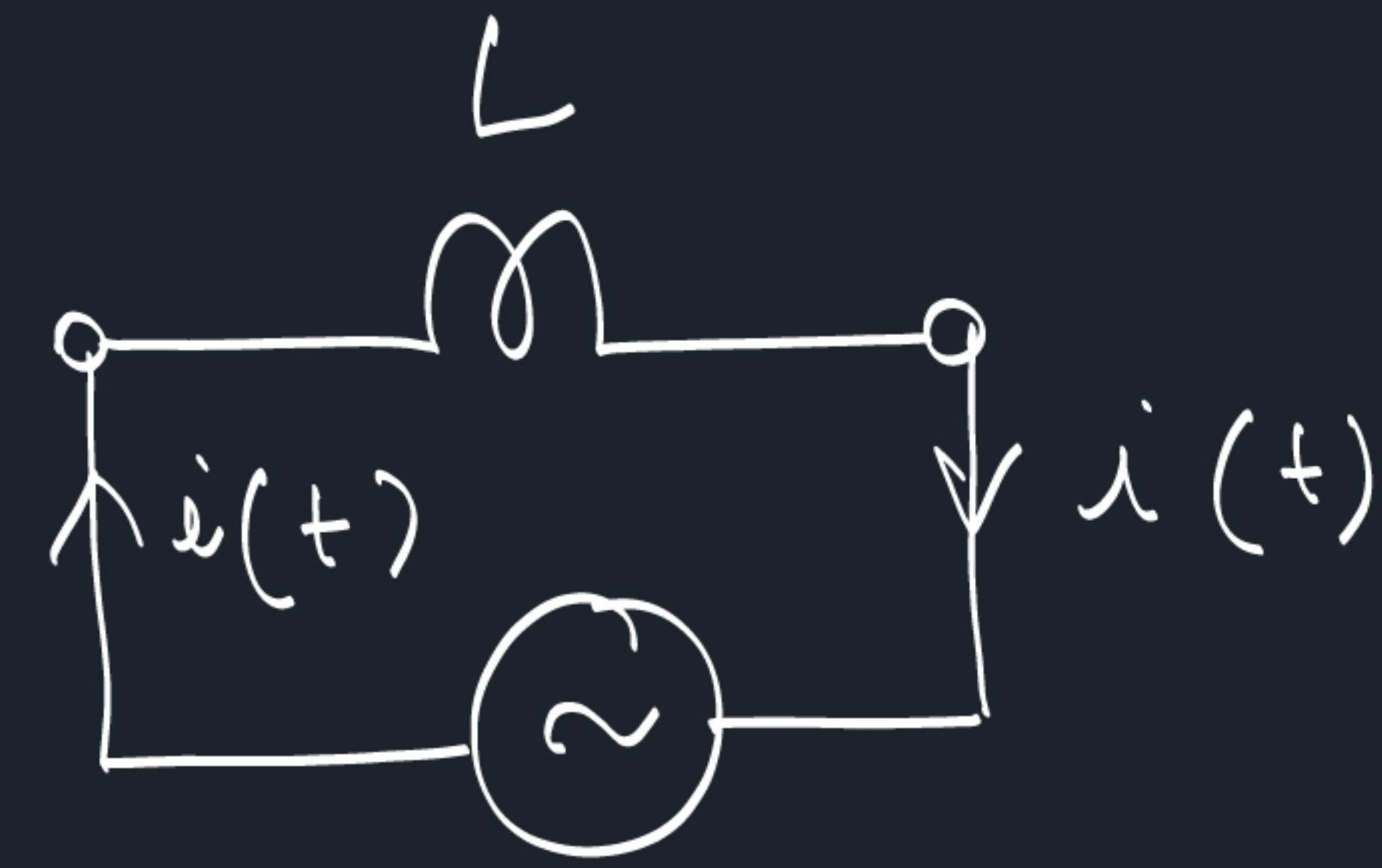


$$\tilde{v} = V_m \angle +\phi = V_m e^{j\phi}$$

$$\tilde{i} = I_m \angle +\phi = I_m e^{j\phi}$$

$(R > 1)$





$$v(t) = V_m \cos(\omega t + \phi)$$

$$i(t) = \frac{1}{L} \int v(t) dt$$

$$= \frac{1}{L} \int V_m \cos(\omega t + \phi) dt$$

$$= \frac{1}{\omega L} V_m \sin(\omega t + \phi)$$

$$v(t) = L \frac{di(t)}{dt}$$

$$\tilde{V} = j\omega L \tilde{I}$$

$\frac{d}{dt}$  is replaced by  
 $(j\omega)$



$$\tilde{V} = V_m \angle +\phi = V_m e^{j\phi}$$

$$\tilde{I} = \frac{V_m}{j\omega L} \cdot e^{j\phi} = \frac{V_m}{jX_L} e^{j\phi}$$

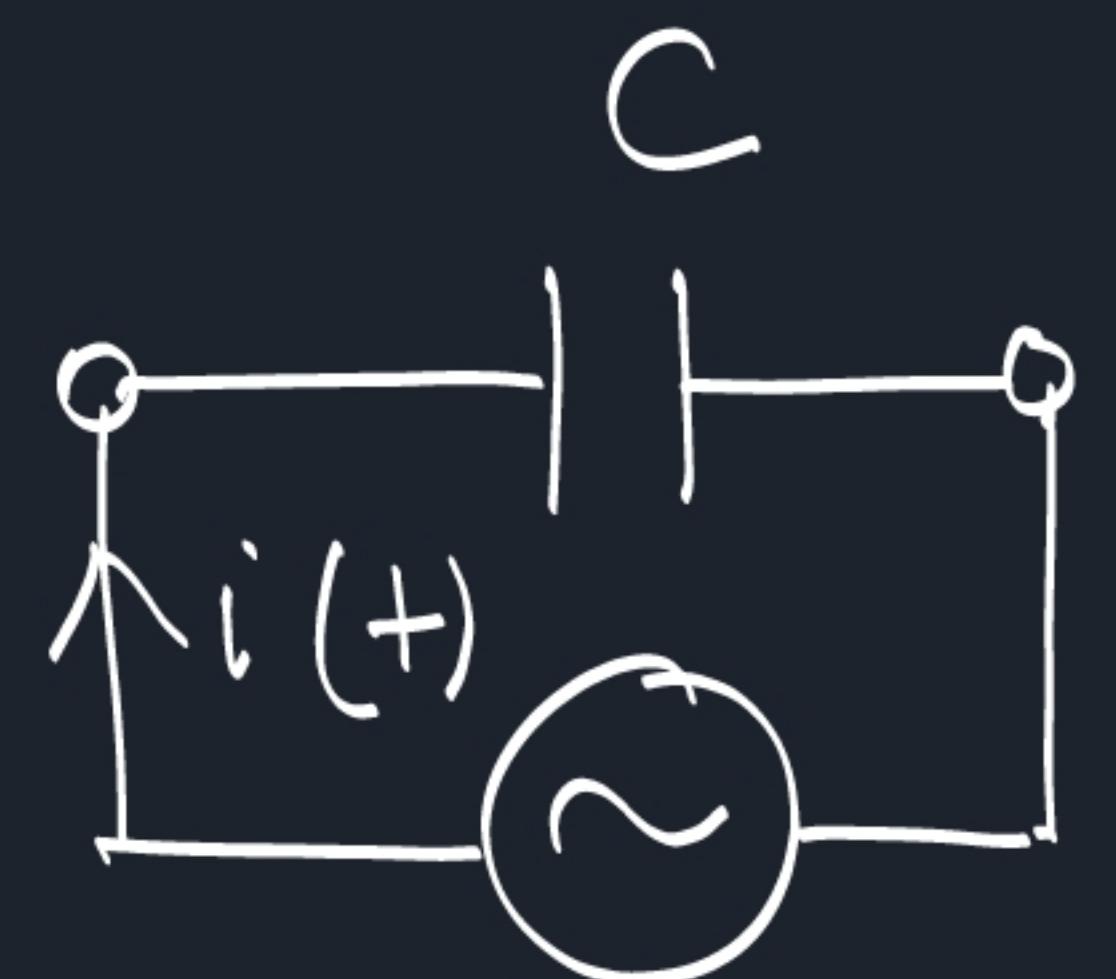
$X_L = \omega L$  = Inductive Resistance.

$$\tilde{V} = (j\omega L) \tilde{I}$$



$$i(t) = \frac{1}{L} \int V_m e^{j(\omega t + \phi)} dt$$

$$= \frac{1}{j\omega L} V_m e^{j(\omega t + \phi)}$$



$$V(t) = V_m \cos(\omega t + \phi) \Leftrightarrow V_m e^{j(\omega t + \phi)}$$

$$i(t) = C \frac{dV(t)}{dt}$$

$$= -C\omega \sin(\omega t + \phi)$$



$$i(t) = j\omega C V_m e^{j(\omega t + \phi)}$$

$$\tilde{V} = \tilde{I} \cdot \left( \frac{1}{j\omega C} \right)$$

$$= -j I(X_C)$$



$$\tilde{V} = V_m e^{j(\omega t + \phi)}$$

$$\begin{aligned}\tilde{I} &= j\omega C V_m e^{j(\omega t + \phi)} \\ &= j\omega C \tilde{V}\end{aligned}$$

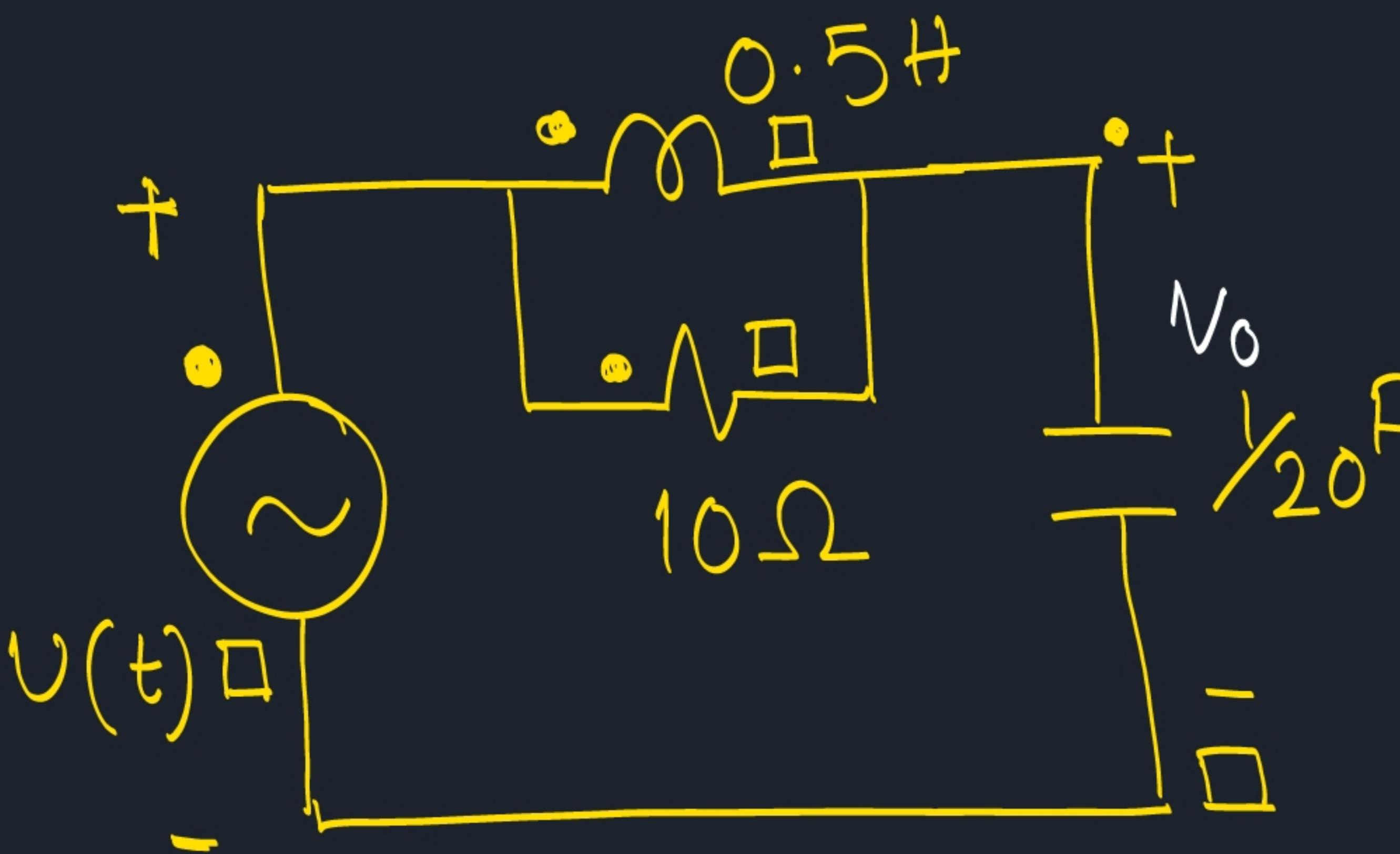
$$\begin{aligned}X_C &= \text{Capacitive Resistance} \\ &= \left( \frac{1}{\omega C} \right)\end{aligned}$$

$$a_2 \frac{d^2 i(t)}{dt^2} + a_1 \frac{di(t)}{dt} + b_1 \int i(t) dt + a_0 = C$$

$$a_2(j\omega)^2 \tilde{I} + a_1(j\omega) \tilde{I} + \frac{b_1}{j\omega} \cdot \tilde{I} = \tilde{C}$$

$$\tilde{I} = \frac{\tilde{C}}{a_2(j\omega)^2 + a_1(j\omega) + \frac{b_1}{j\omega} + a_0}$$

Prob:-

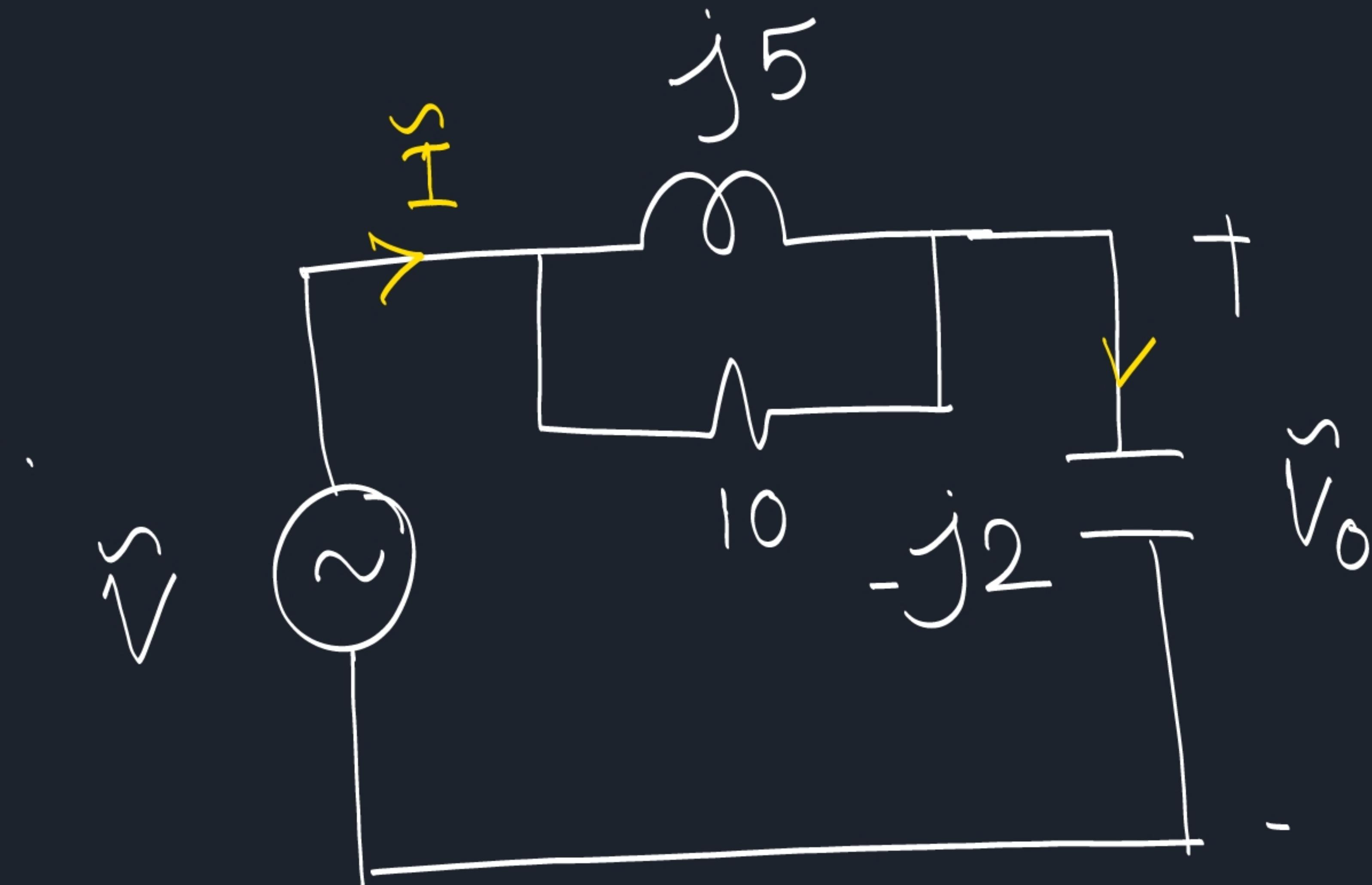


$$V(t) = 50 \cos(10t + 30^\circ) \text{ Volt}$$

$$V_o(t) = ?$$

$$V_o(t) = 35.35 \cos(10t - 105^\circ) \text{ Volt}$$

Phasor Rep.



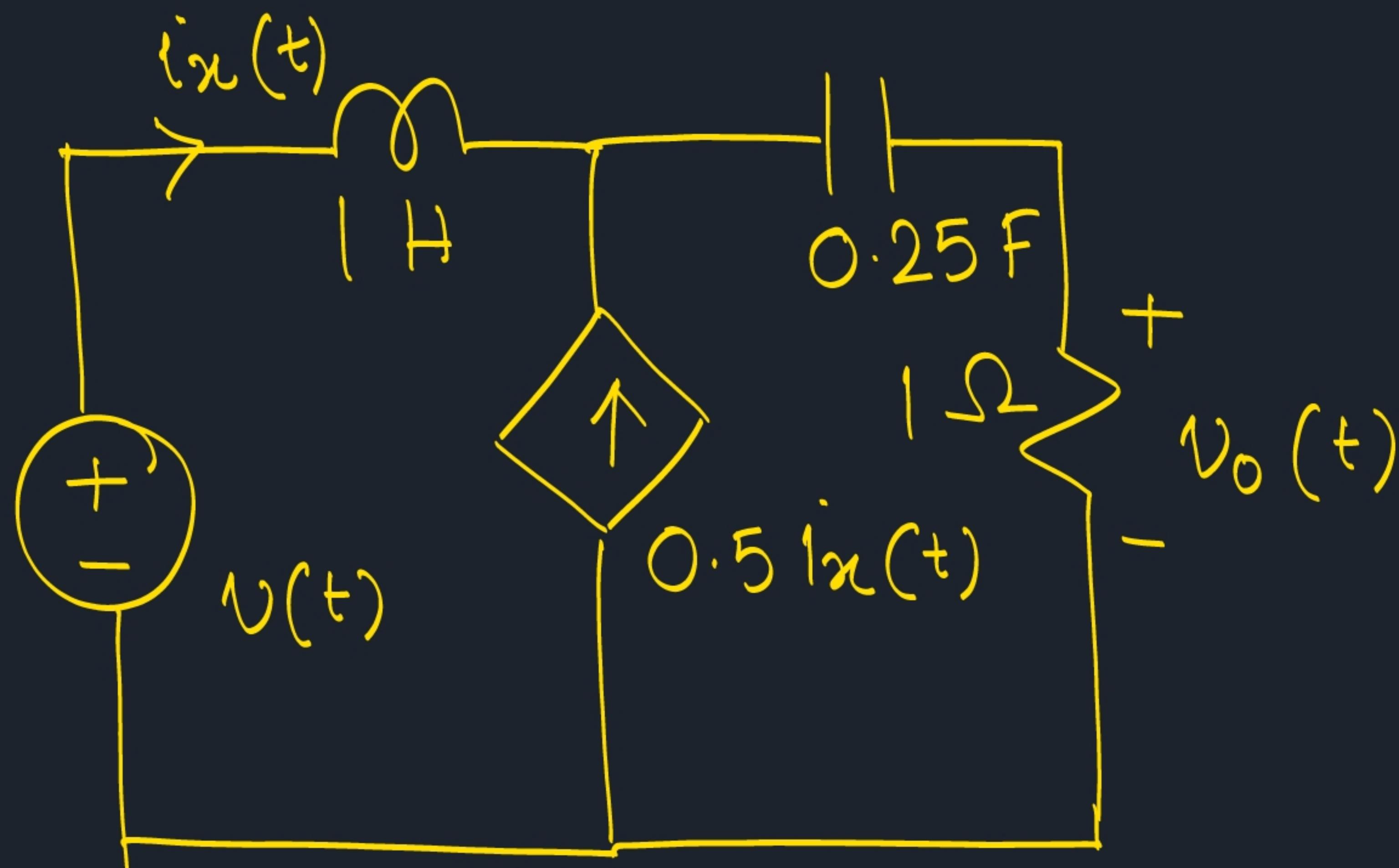
$$\tilde{V} = 50 \angle 30^\circ \text{ V}$$

$$\frac{10 \times j5}{10 + j5} + (-j2)$$

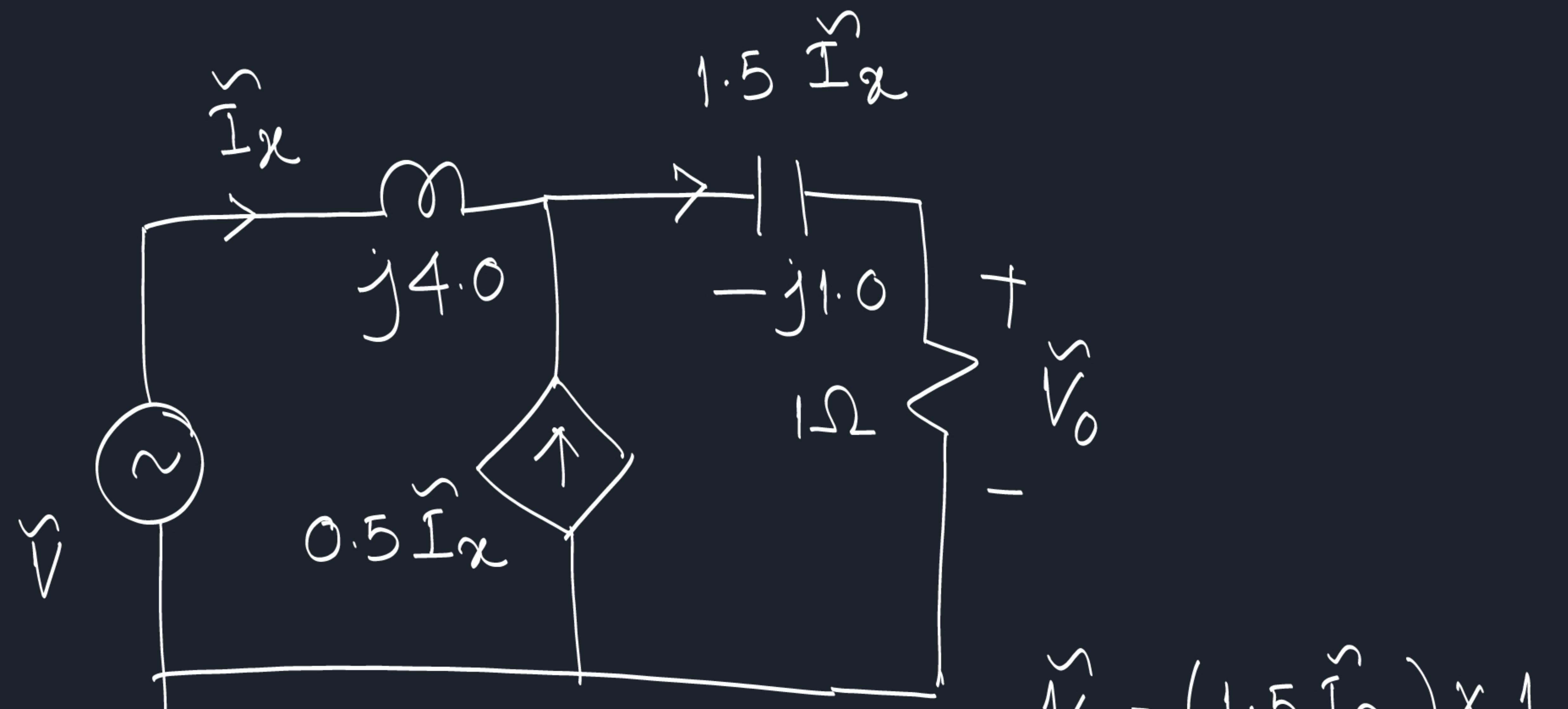
$$\begin{aligned} \tilde{V}_o &= \frac{50 \angle 30^\circ}{(10 + j5) + (-j2)} \times (-j2) \\ &= 35.35 \angle -105^\circ \text{ V} \end{aligned}$$

$$\begin{aligned} \frac{1}{j\omega C} &= -j \cdot \frac{1}{\omega C} \\ \frac{1}{1 \times 20} &= \frac{-j2}{10 \times } \end{aligned}$$

Prob:-



Phasor Repres.



$$V(t) = 16 \sin(4t - 10^\circ) \text{ Volts}$$

$$= -j \frac{1}{\omega C} = -j \frac{1}{4 \times 0.25}$$

$$V_o(t) = ? = 8.2318 \sin(4t - 69.0362^\circ) \text{ Amp.}$$

$$\tilde{I}_x = ?$$

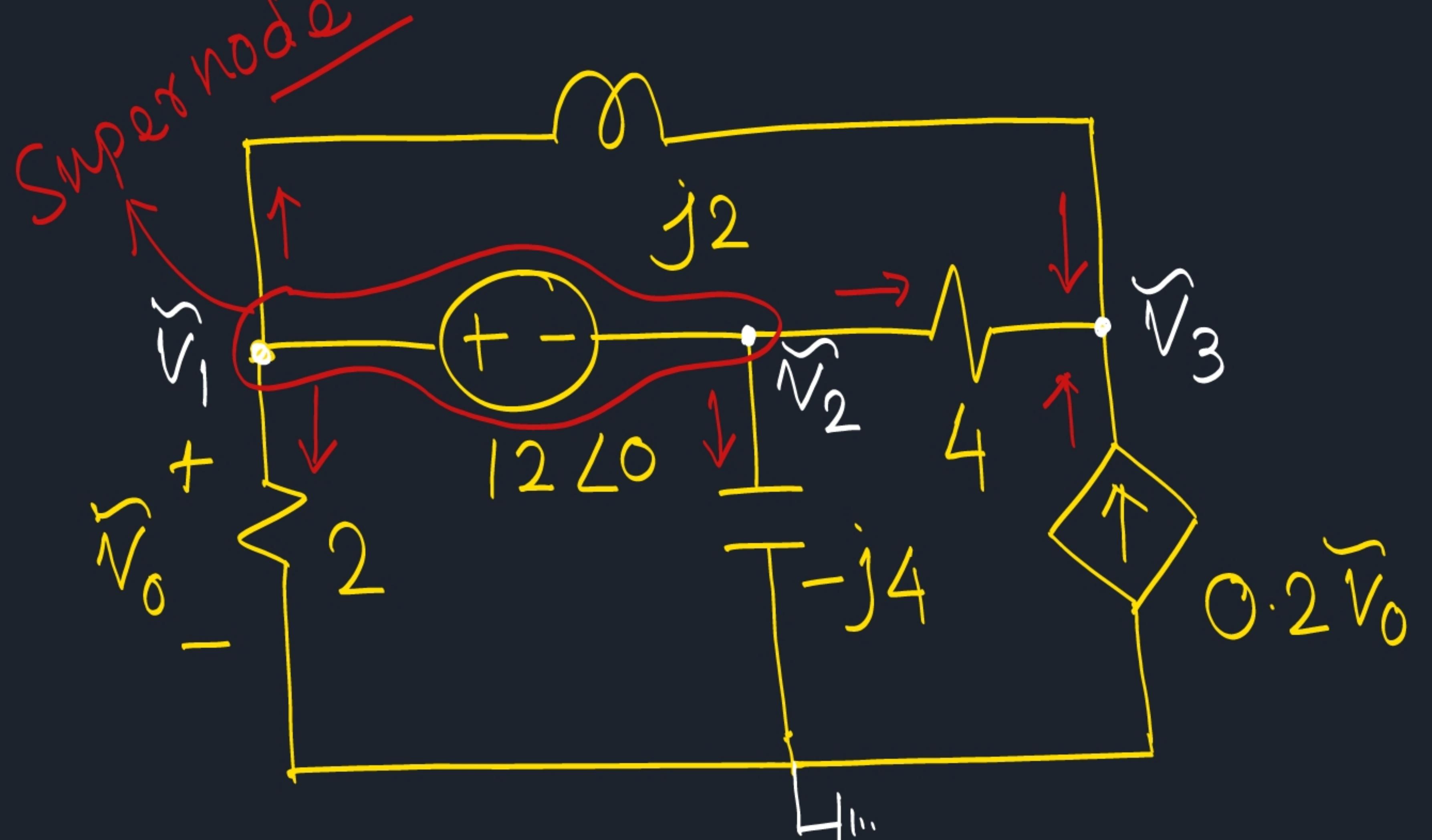
$$\tilde{V} = (16 \angle -10^\circ) V_{01+}$$

$$\tilde{I}_x = 5.4879 \angle -69.0362^\circ \text{ A}$$

$$\tilde{V}_o = 8.2318 \angle -69.0362^\circ \text{ A}$$

$$\tilde{V}_o = (1.5 \tilde{I}_x) \times 1$$

## Nodal Analysis:-



$$\tilde{V}_1 - \tilde{V}_2 = 12\angle 0 \quad \dots \text{(i)}$$

$$\tilde{V}_0 = ? \quad 7.682 \angle 50.19 \text{ V}$$

$$\frac{\tilde{V}_1}{2} + \frac{\tilde{V}_1 - \tilde{V}_3}{j2} + \frac{\tilde{V}_2}{-j4} + \frac{\tilde{V}_2 - \tilde{V}_3}{4} = 0$$

$$\Rightarrow \tilde{V}_1 \left( j_2 + \frac{1}{j2} \right) + \tilde{V}_2 \left( \frac{1}{-j4} + \frac{1}{4} \right) + \tilde{V}_3 \left( -\frac{1}{j2} - \frac{1}{4} \right) = 0 \quad \dots \text{(i)}$$

$$\frac{\tilde{V}_2 - \tilde{V}_3}{4} + \frac{\tilde{V}_1 - \tilde{V}_3}{j2} + 0.2 \tilde{V}_1 = 0$$

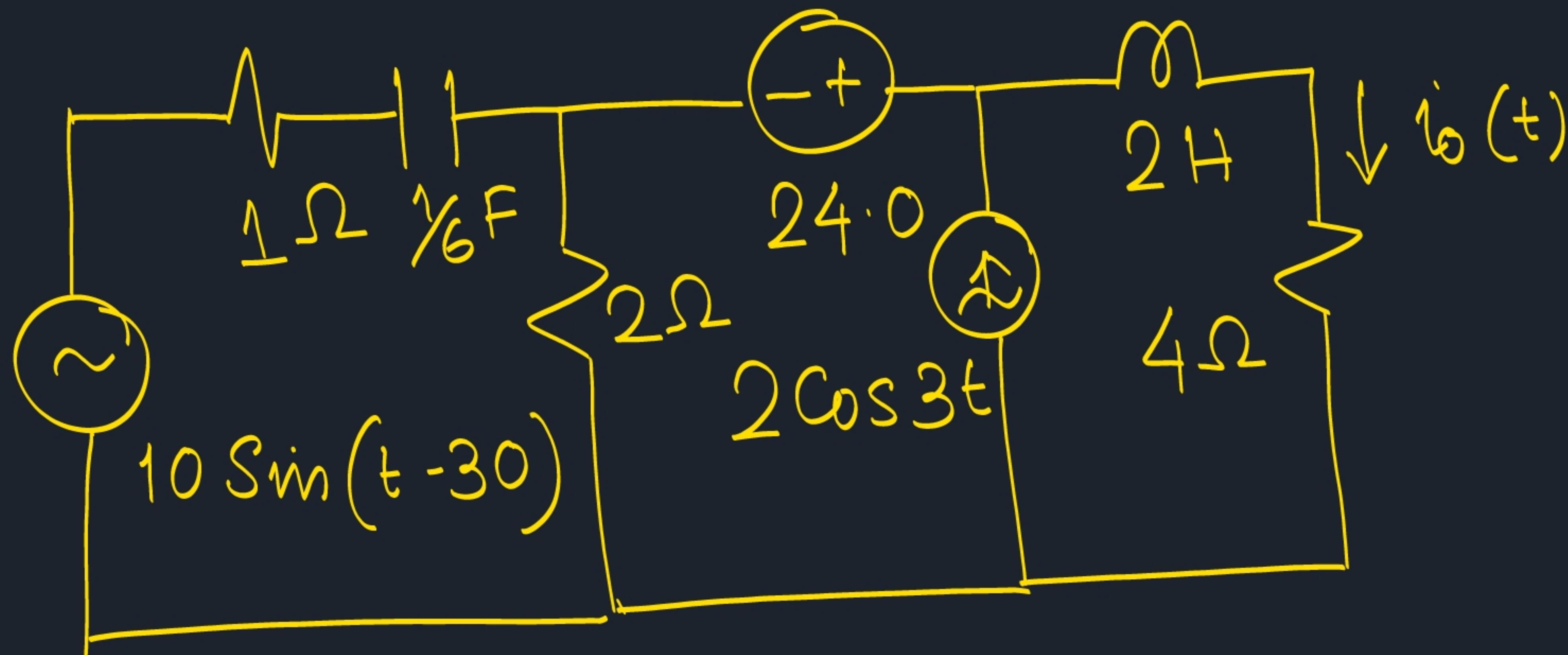
$$\Rightarrow \tilde{V}_1 \left( 0.2 + \frac{1}{j2 \cdot 0} \right) + \tilde{V}_2 \left( \frac{1}{4} \right) + \tilde{V}_3 \left( -\frac{1}{4} - \frac{1}{j2} \right) = 0 \quad \dots \text{(iii)}$$

$$\tilde{V}_0 = \tilde{V}_1$$

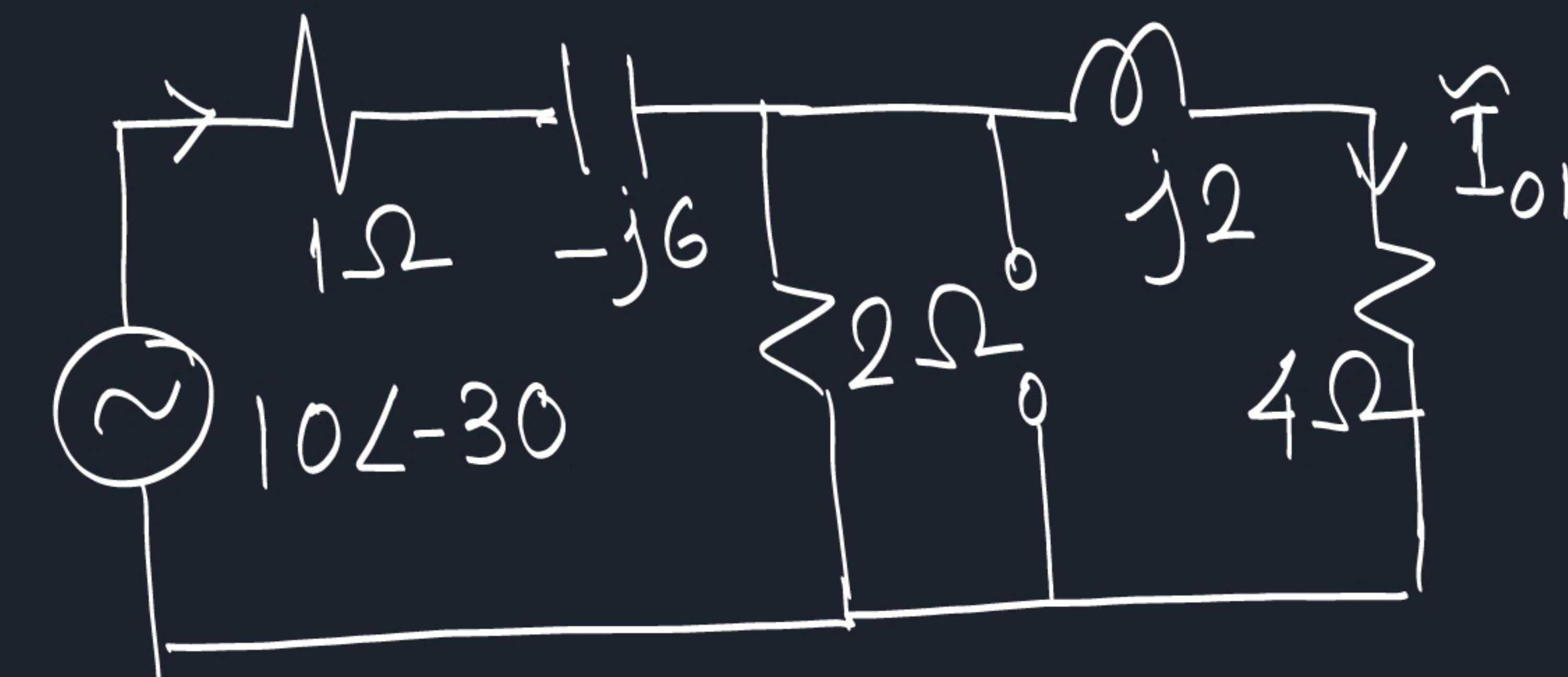
Q1

Problem:-

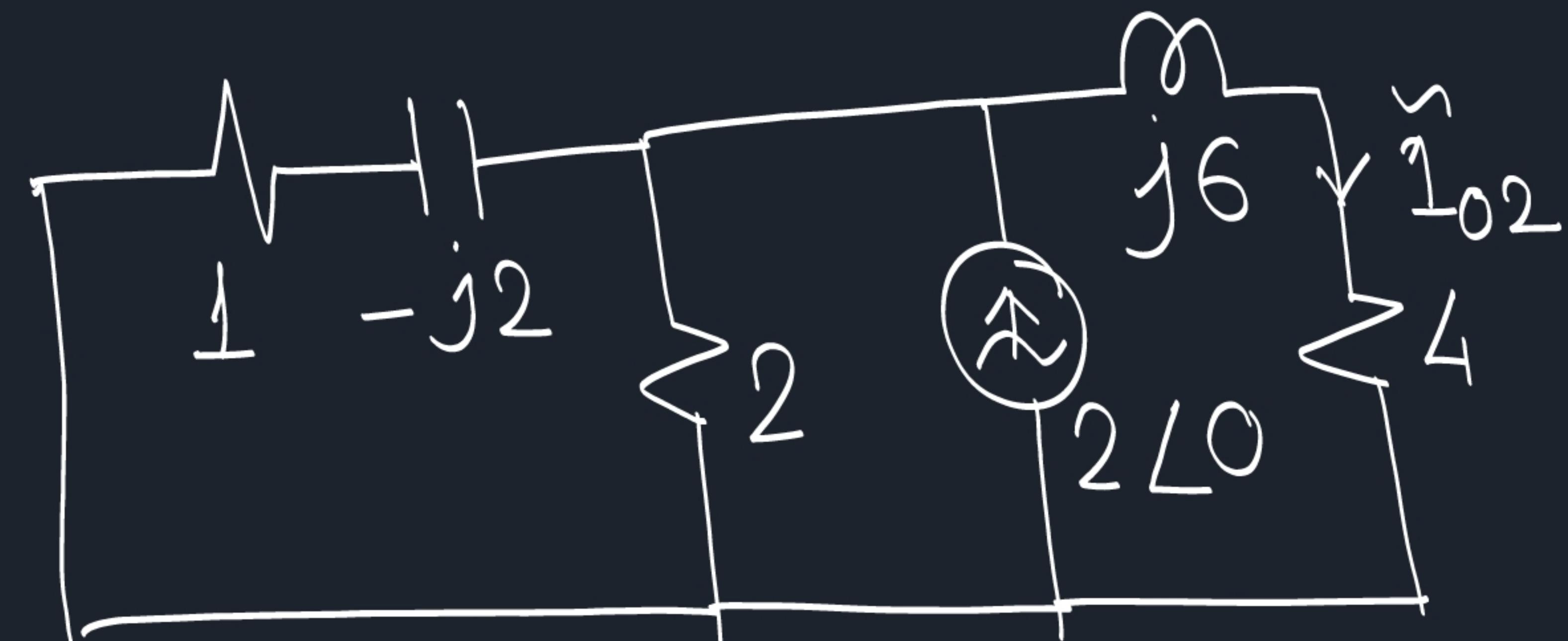
$$i_o(t) = ?$$



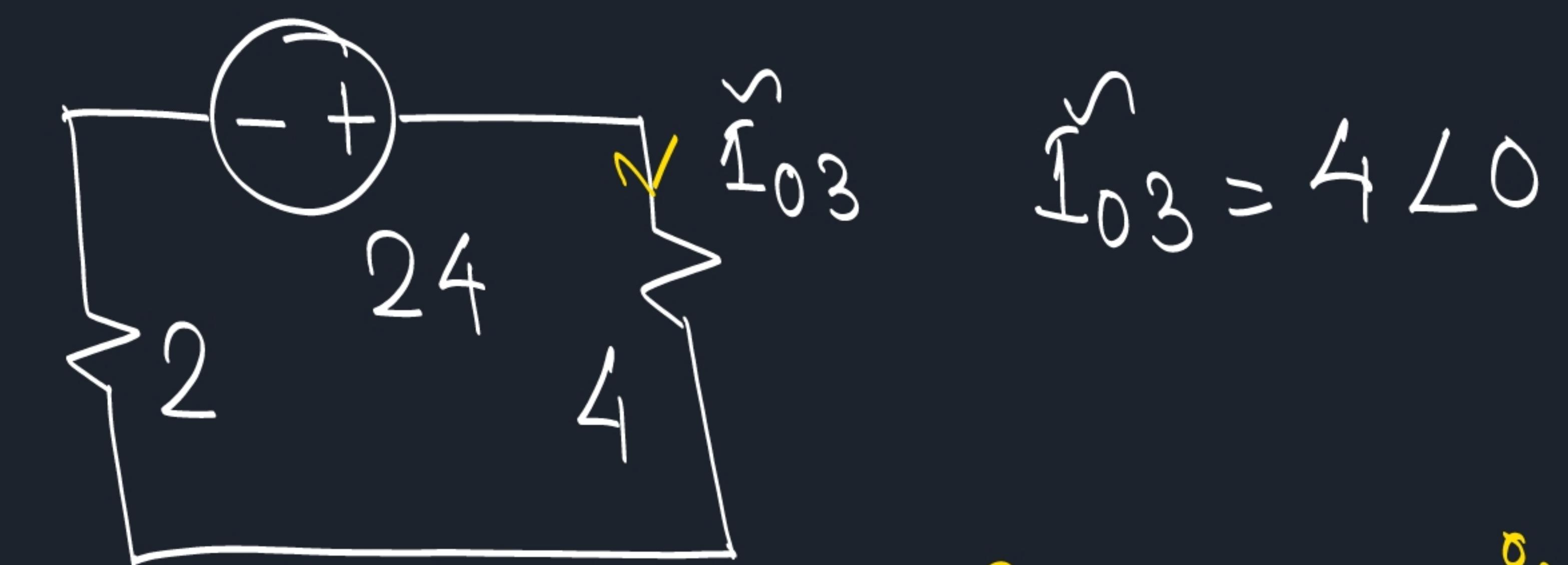
$\Rightarrow$



$$\begin{aligned} \tilde{i}_{o1} &= \frac{10 \angle -30}{(1-j6) + (4+j2) \parallel (2)} \times \frac{2}{2+4+j2} \text{ Amps.} \\ &= 0.5038 \angle 19.0856^\circ \text{ Amp} \end{aligned}$$

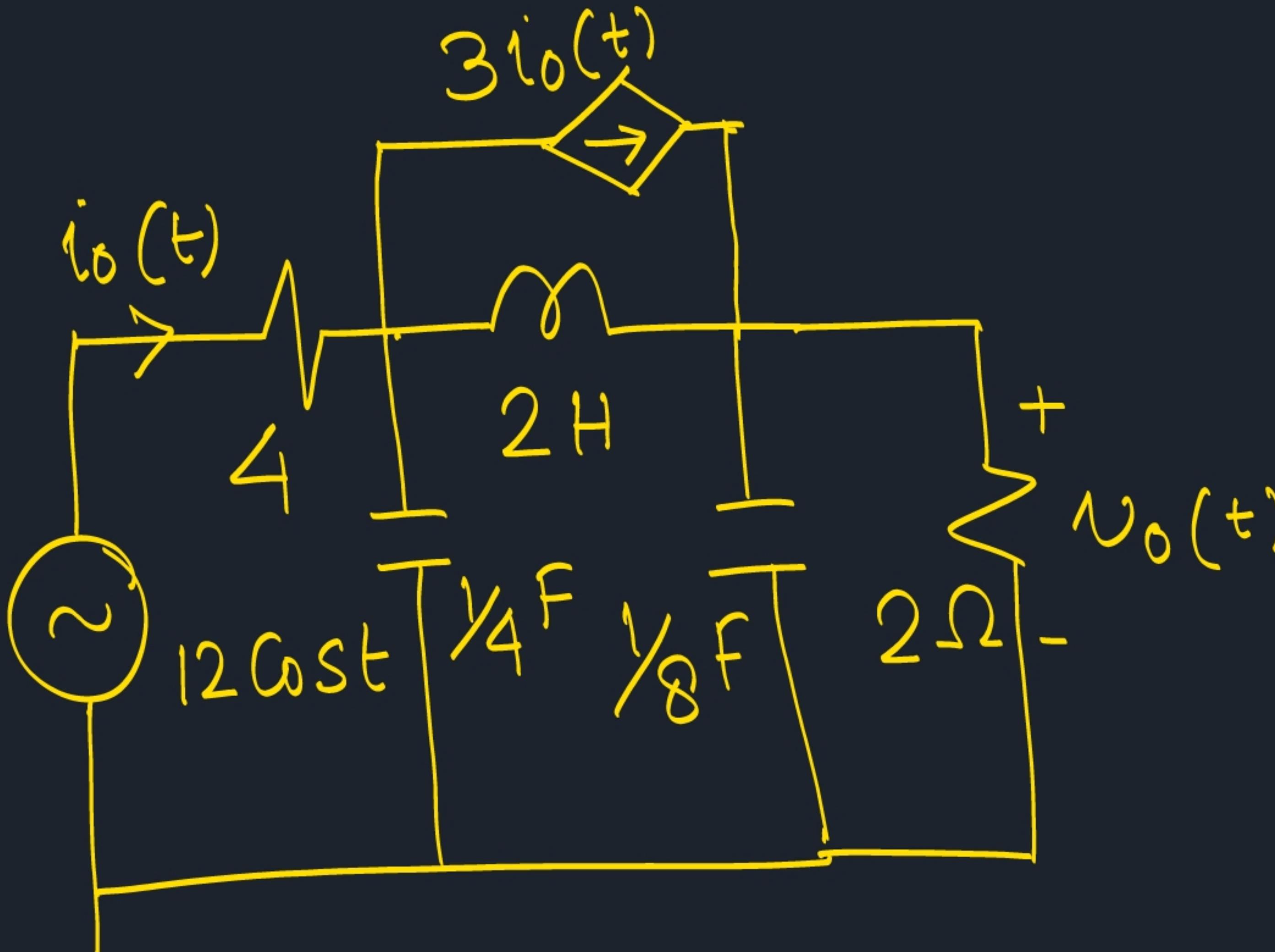


$$\begin{aligned} \tilde{i}_{o2} &= 2L0 \times \frac{2 \parallel (-j2)}{(2 \parallel (-j2)) + (4 + j6)} = 0.33518 \angle -76.4298^\circ \text{ A} \end{aligned}$$

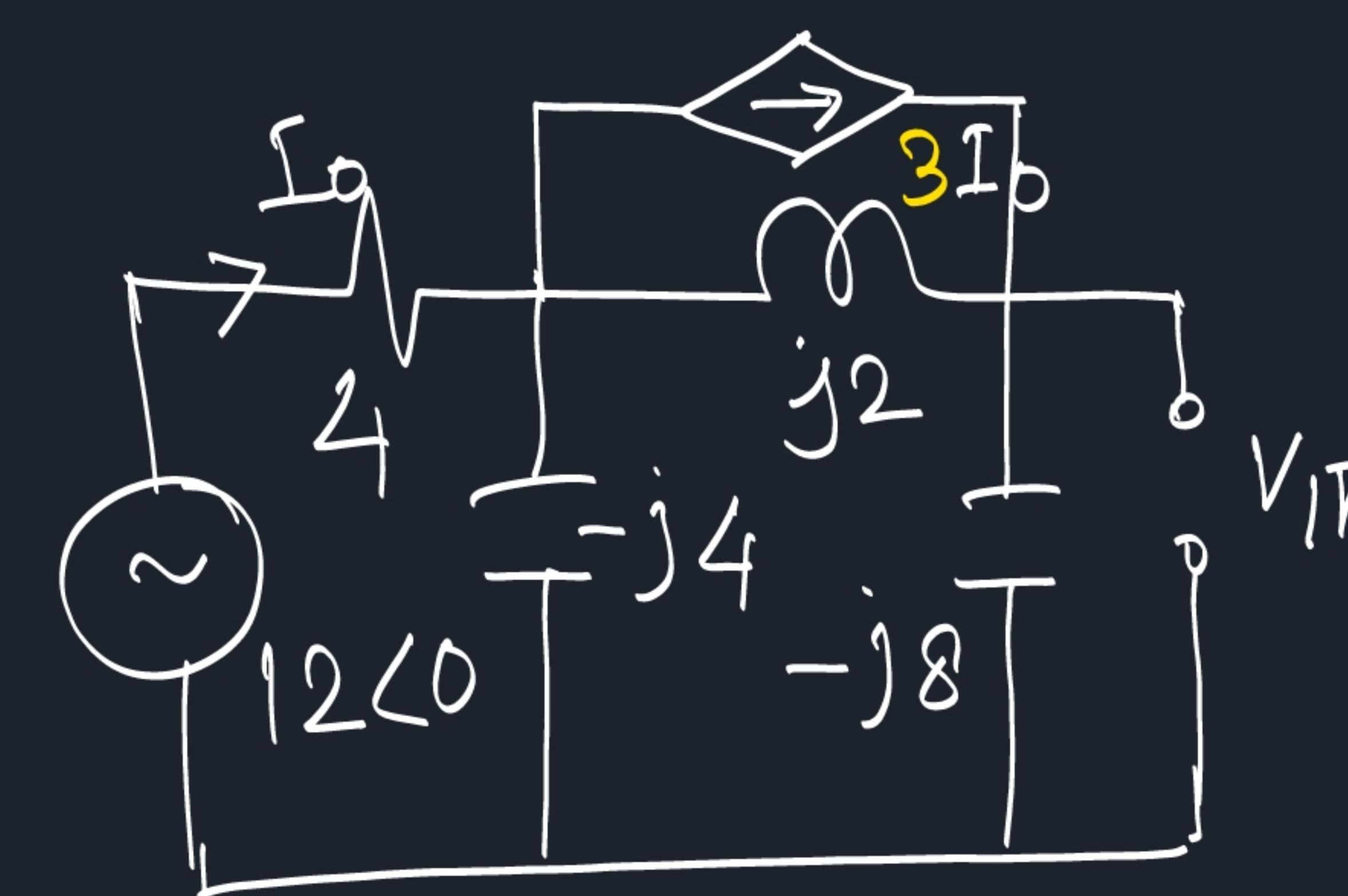
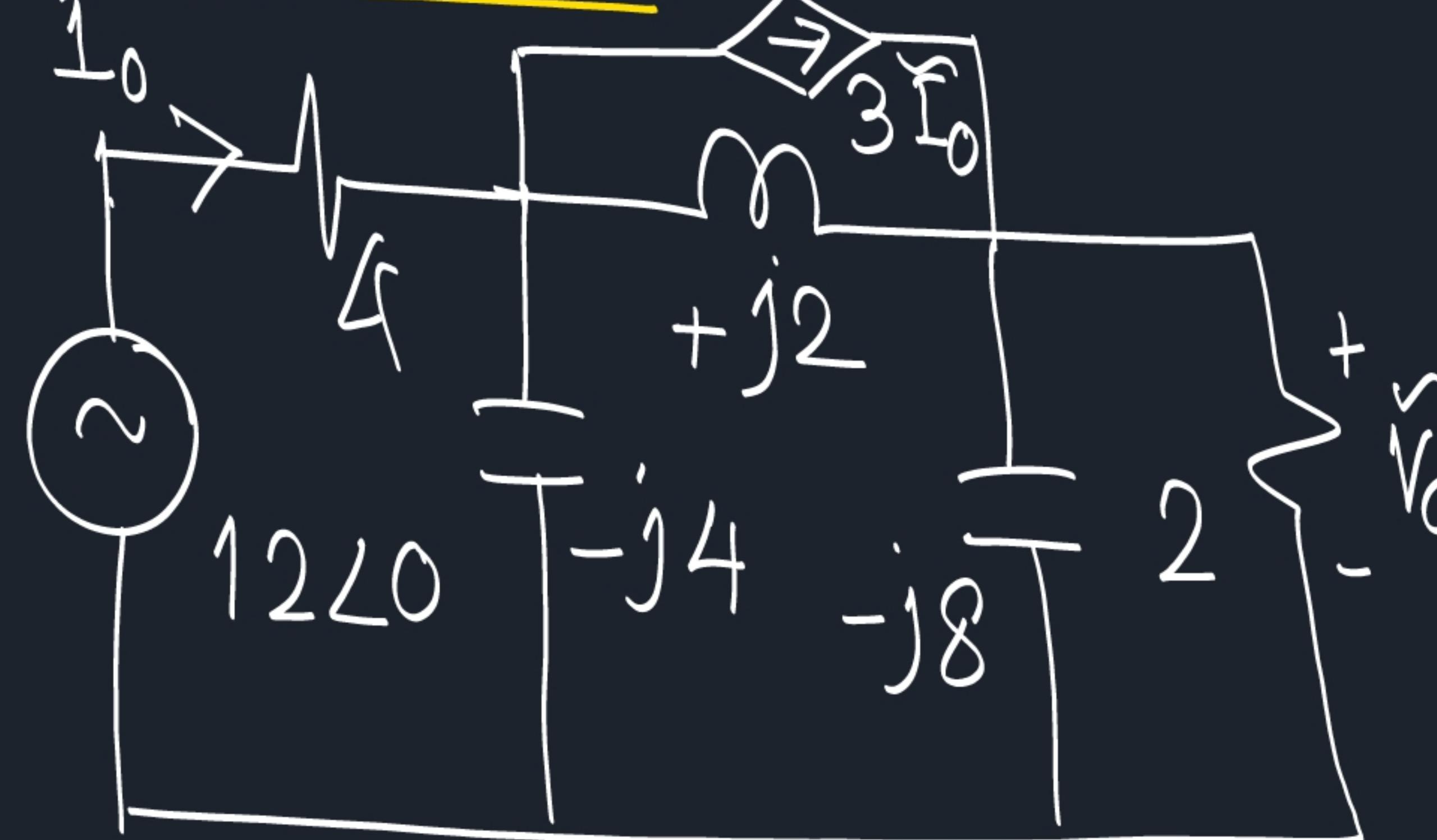


$$\begin{aligned} i_o(t) &= 0.5038 \sin(t + 19.0856^\circ) + \\ &\quad 0.33518 \cos(3t - 76.4298^\circ) + \end{aligned}$$

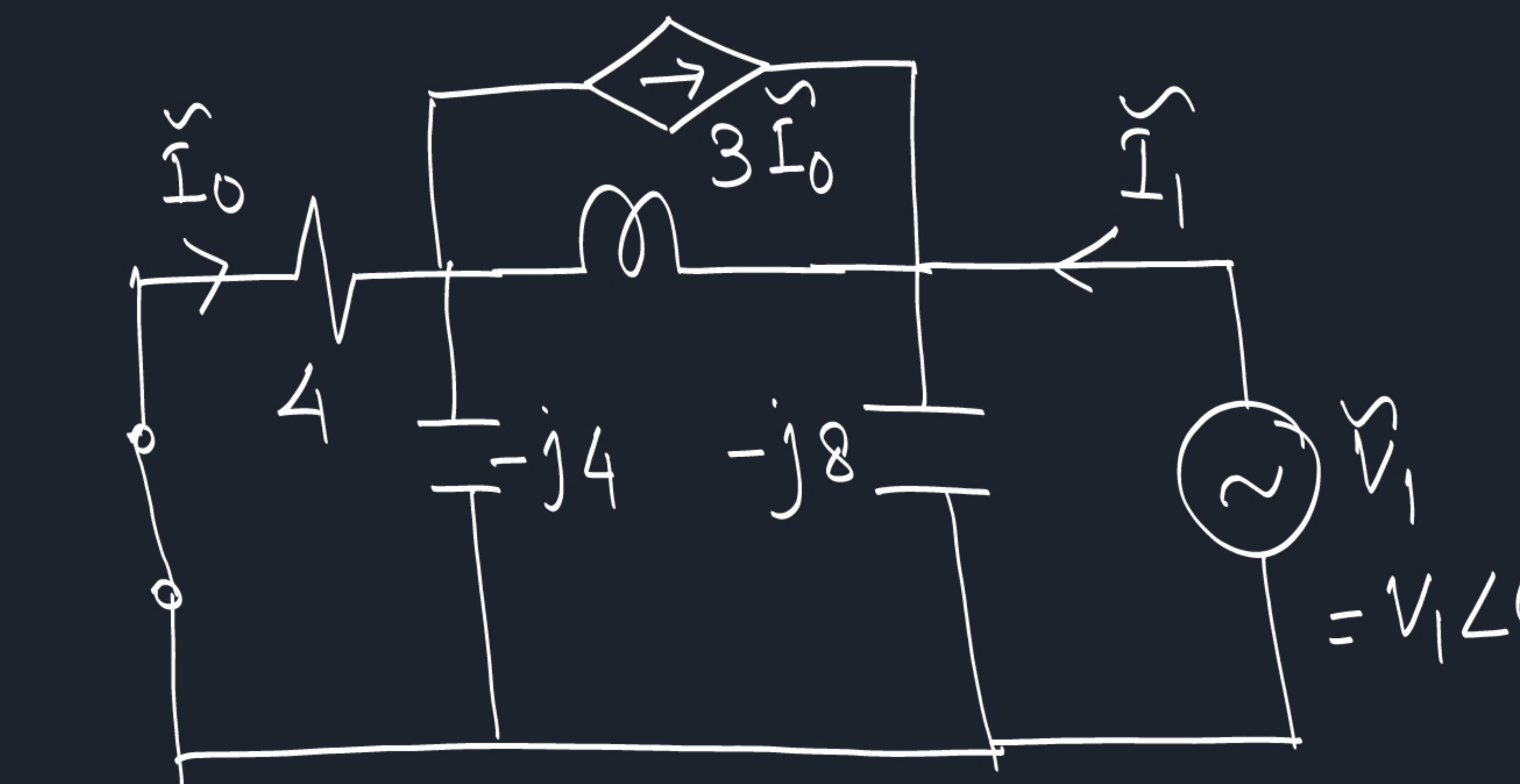
## Thevenin's Theorem:-



$$i_o(t) = ? \quad \omega = 1 \text{ rad/sec.}$$

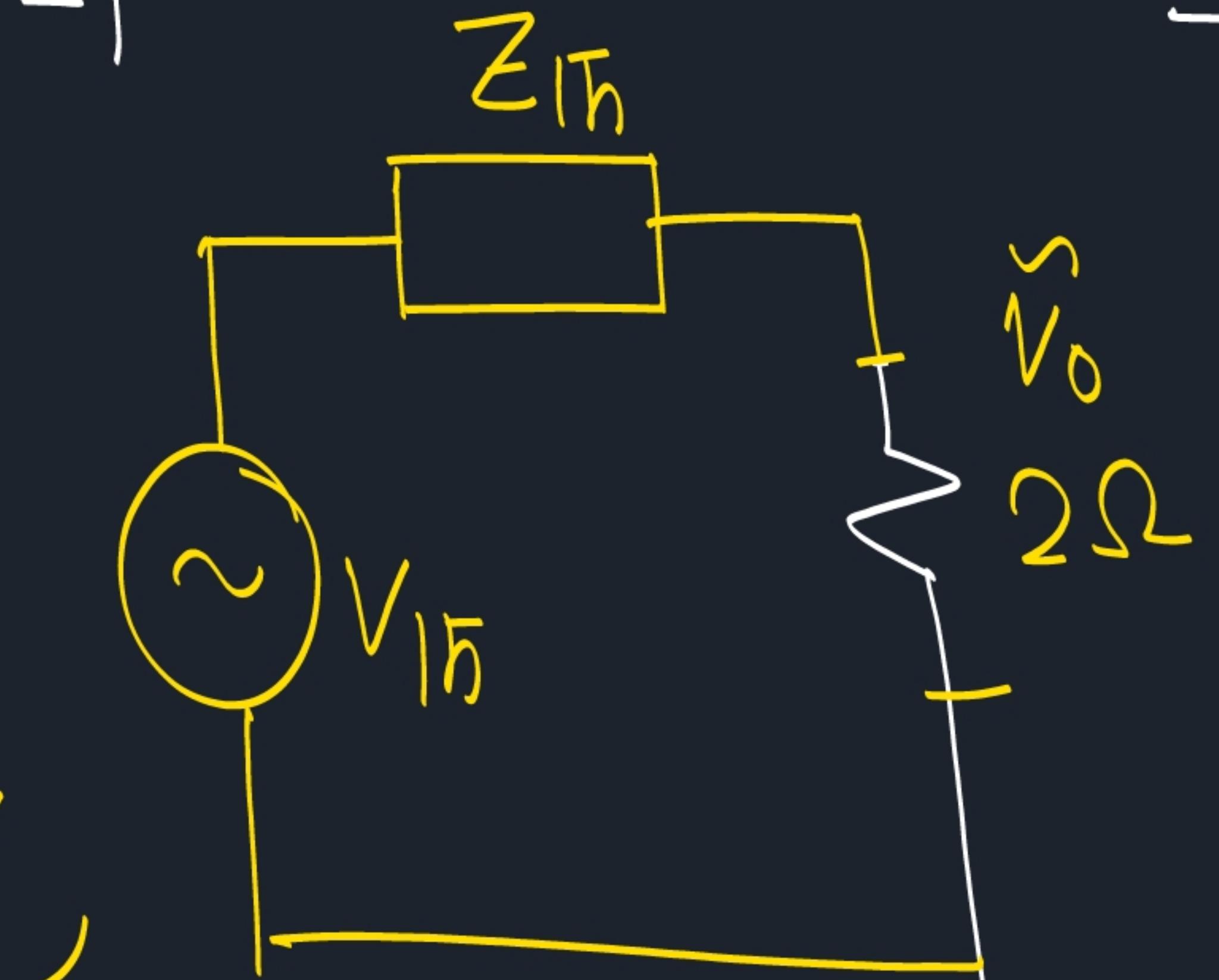


$$\tilde{V}_{Th} = 3.0727 \angle 140.2165^\circ \text{ Volt.}$$

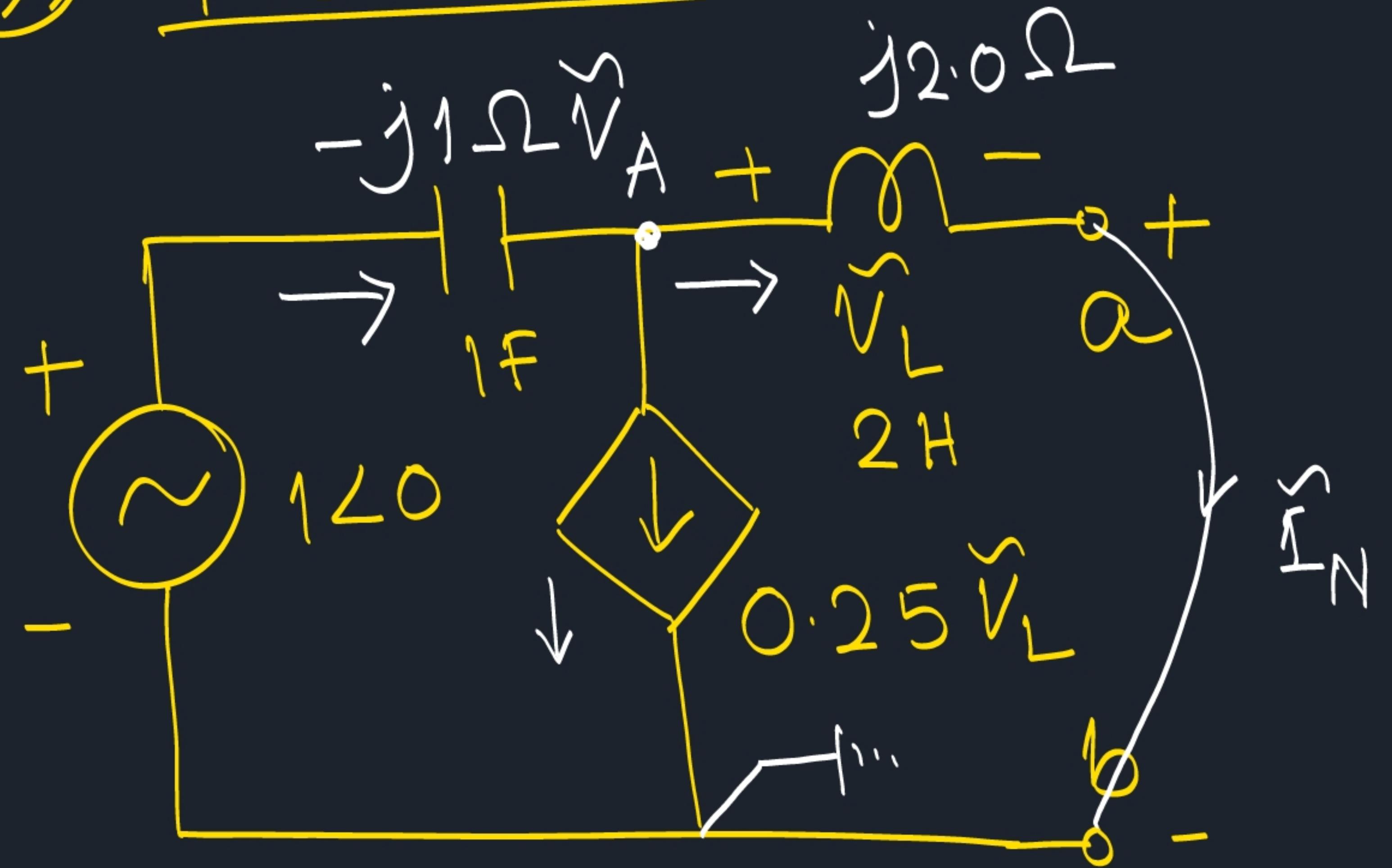


$$\frac{\tilde{V}_1}{I_1} = 2.2904 \angle -103.2405^\circ \Omega$$

$$v_o(t) = 2.2986 \cos(t - 163.2786^\circ) V$$



11/1 Problem:-

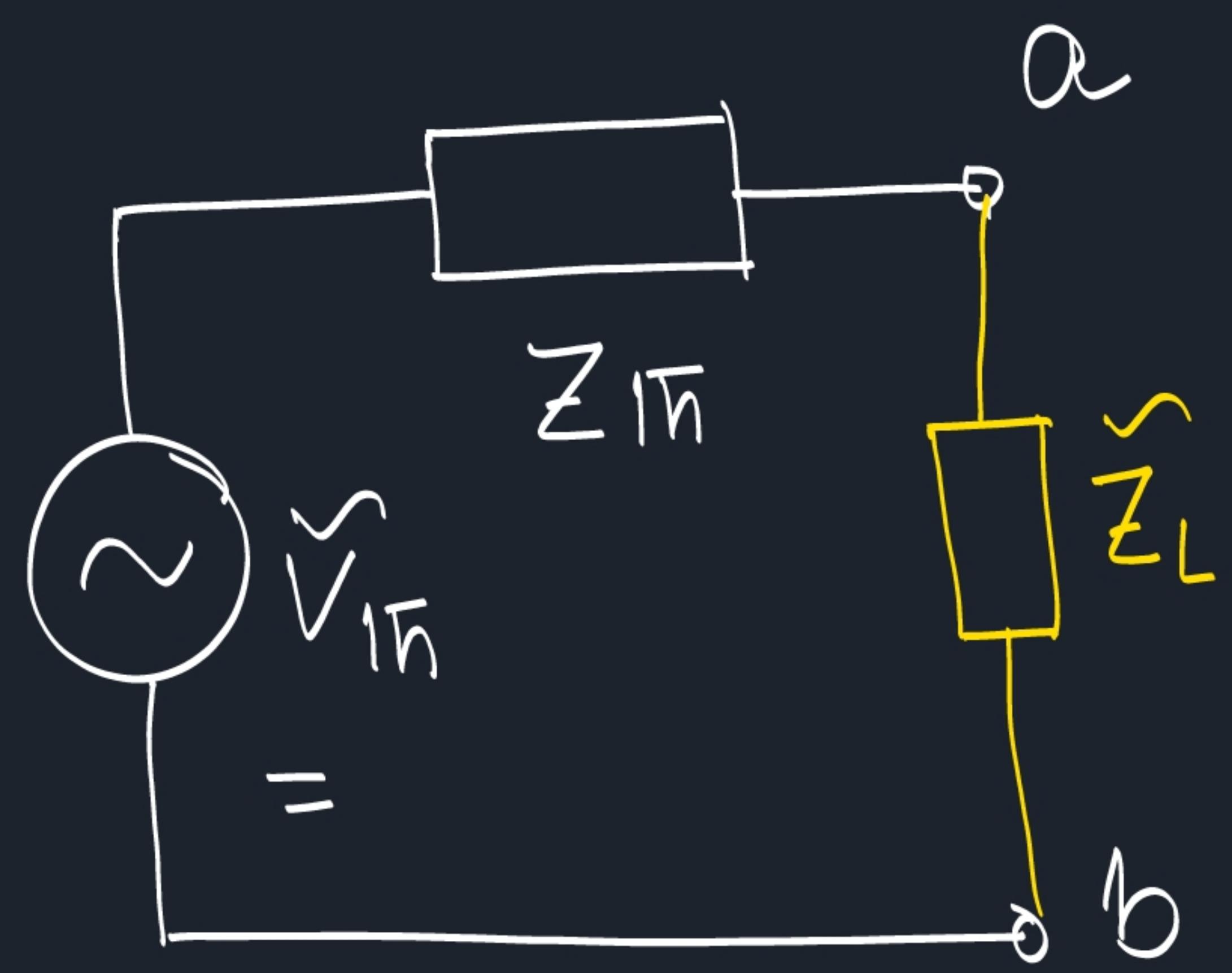


$$\omega = 1 \text{ rad/sec.}$$

Norton's Equivalent.

$$\begin{aligned} \tilde{V}_A &= \tilde{V}_L \\ \frac{1 \angle 0 - \tilde{V}_A}{-j1.0} &= 0.25 \tilde{V}_A + \frac{\tilde{V}_A - 0}{j2.0} \quad \tilde{I}_N = 0.8944 \angle -63.435^\circ \text{ A} \\ \Rightarrow \tilde{V}_A \left( \frac{1}{-j1.0} + 0.25 + \frac{1}{j2.0} \right) &= \frac{1.0 \angle 0}{-j1.0} \\ \Rightarrow \tilde{V}_A = \tilde{V}_L &= 1.7888 \angle 26.565^\circ \text{ Volt.} \end{aligned}$$
$$\begin{aligned} \tilde{V}_L &= \tilde{V}_B - \tilde{V} & \tilde{V}_B &= \tilde{V} - \tilde{I} \times (j2.0) \\ \tilde{I} &= 0.25(\tilde{V}_B - \tilde{V}) + \frac{\tilde{V}_B}{-j1} & \\ Z_N &= 1.1180 \angle 63.4349^\circ \Omega \end{aligned}$$

## Max. Power Transfer:-

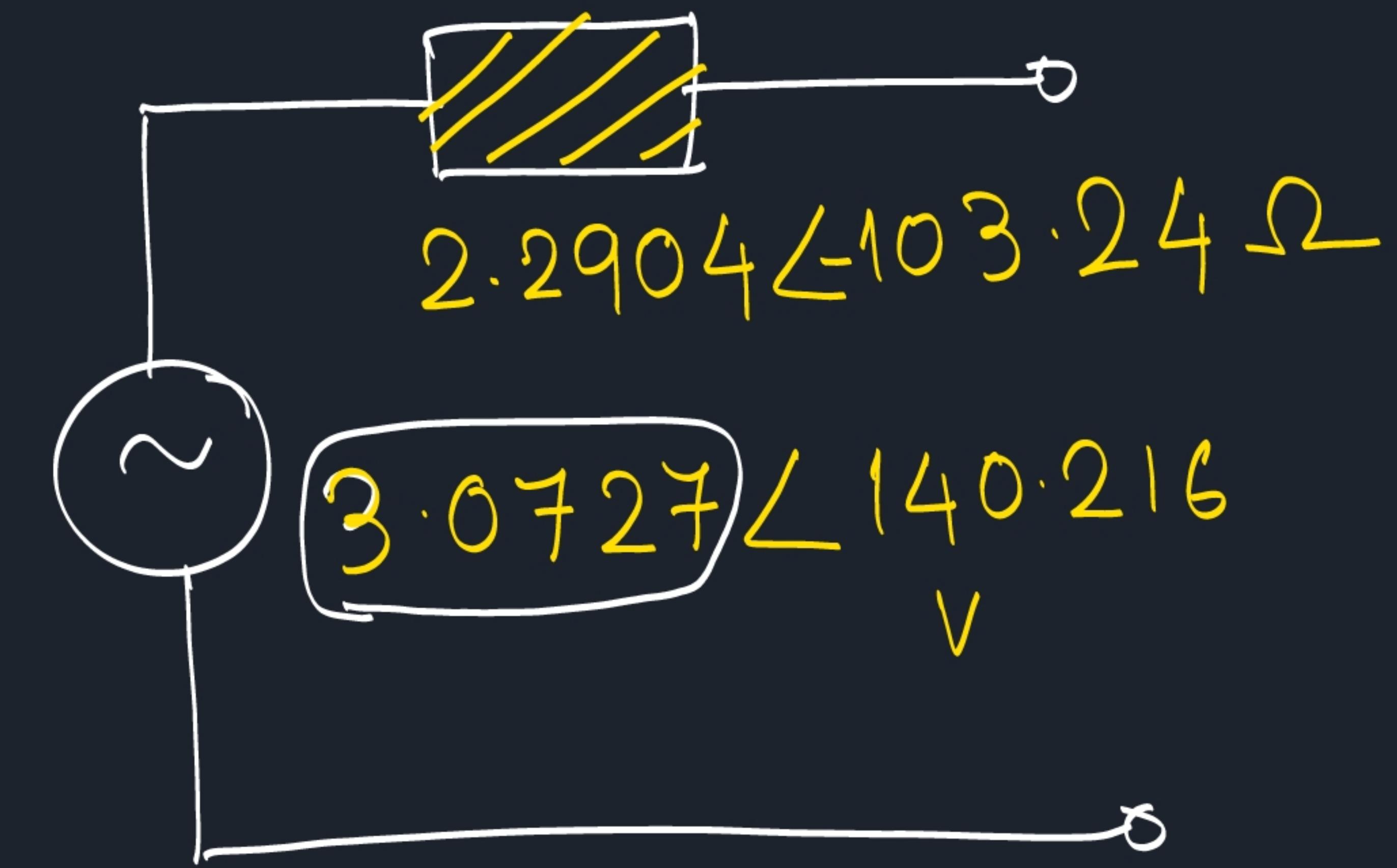


$$Z_{1\bar{n}} = R_{1\bar{n}} \pm jX_{1\bar{n}} = C \angle d^\circ$$

$$\begin{aligned} \tilde{Z}_L &= \tilde{Z}_{1\bar{n}}^* \\ &= R_{1\bar{n}} \mp jX_{1\bar{n}} = C \angle -d^\circ \end{aligned}$$

$$\frac{|V_{1\bar{n}}|^2}{4R_{1\bar{n}}}$$

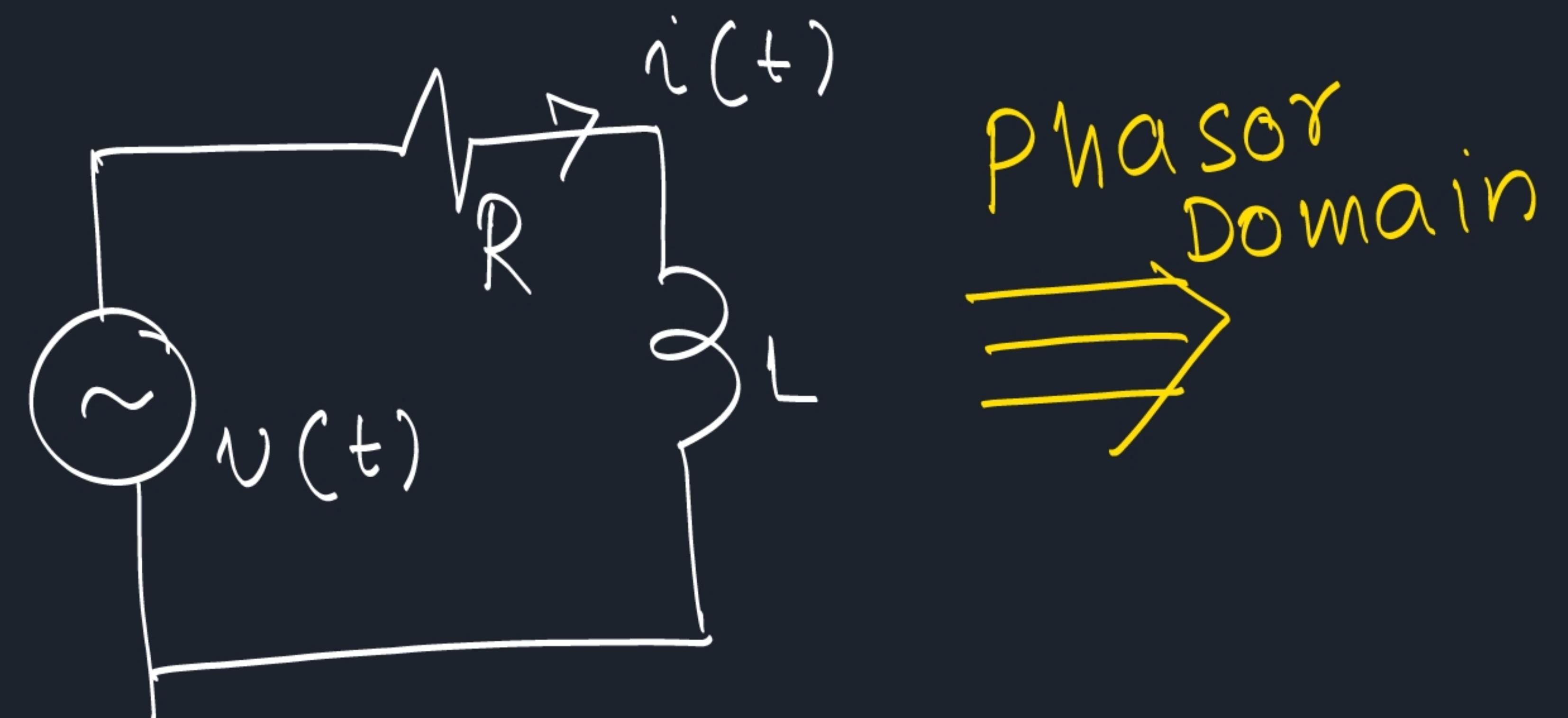
$$P_{\max} = -\frac{(3.0727)^2}{4 \times 0.5245} = -?$$



for transferring the max<sup>m</sup> power to the load

$$\begin{aligned} Z_L &= Z_{1\bar{n}}^* = 2.2904 \angle +103.24^\circ \\ &= -0.5245 + j2.2295 \end{aligned}$$

## Series R-L $\circ^-$



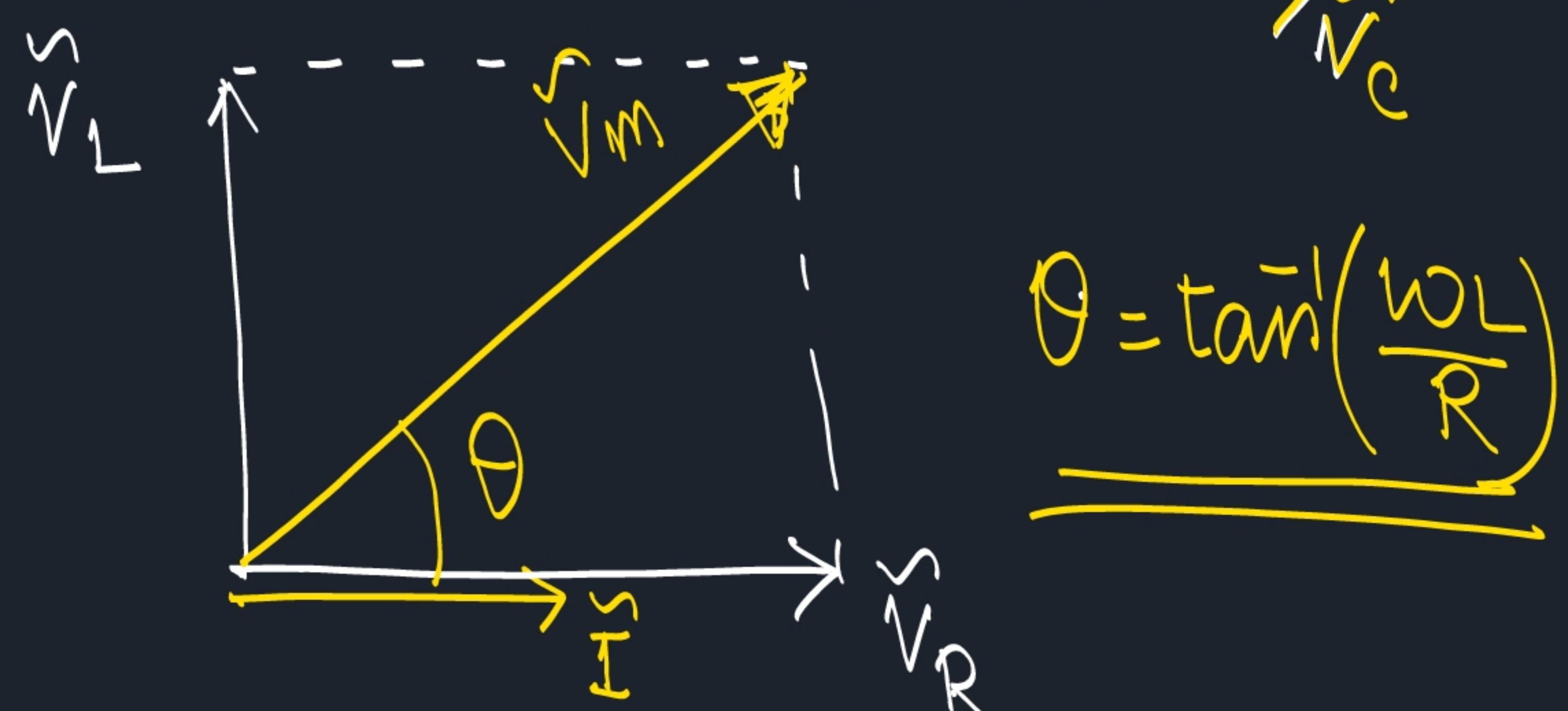
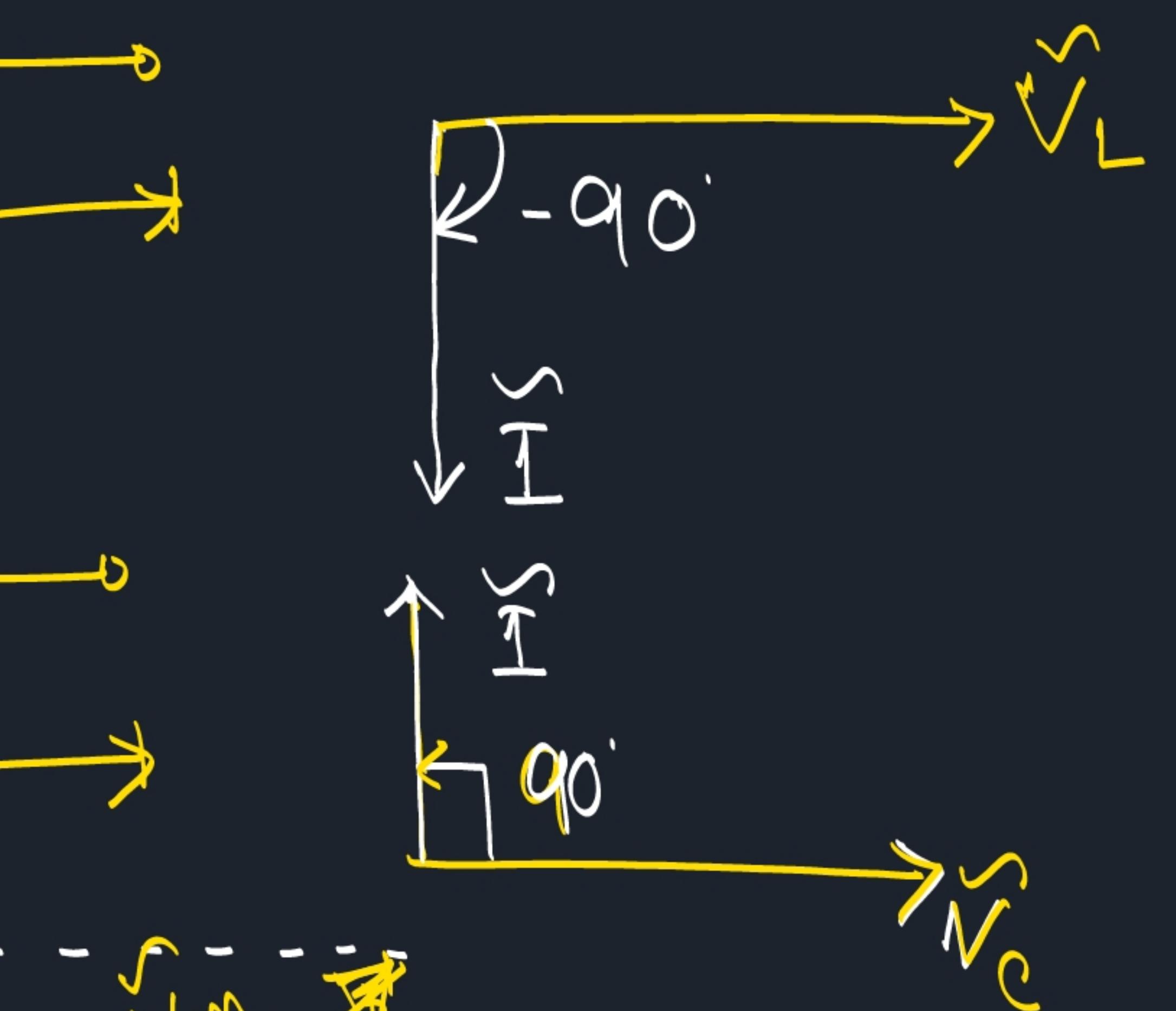
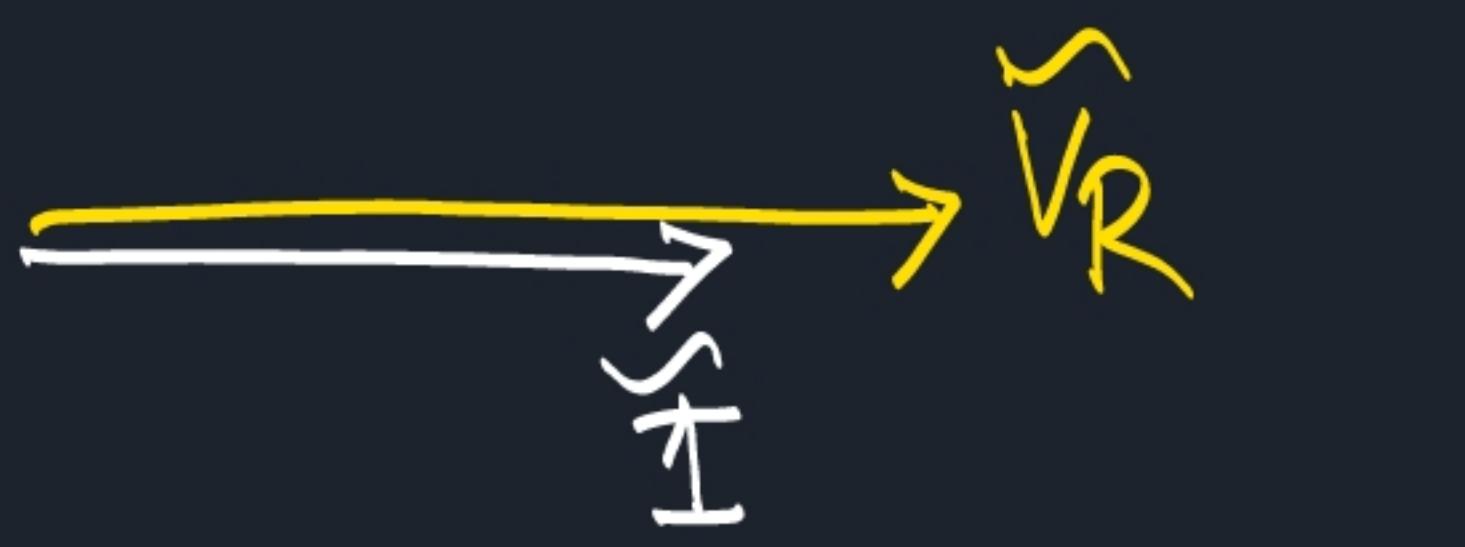
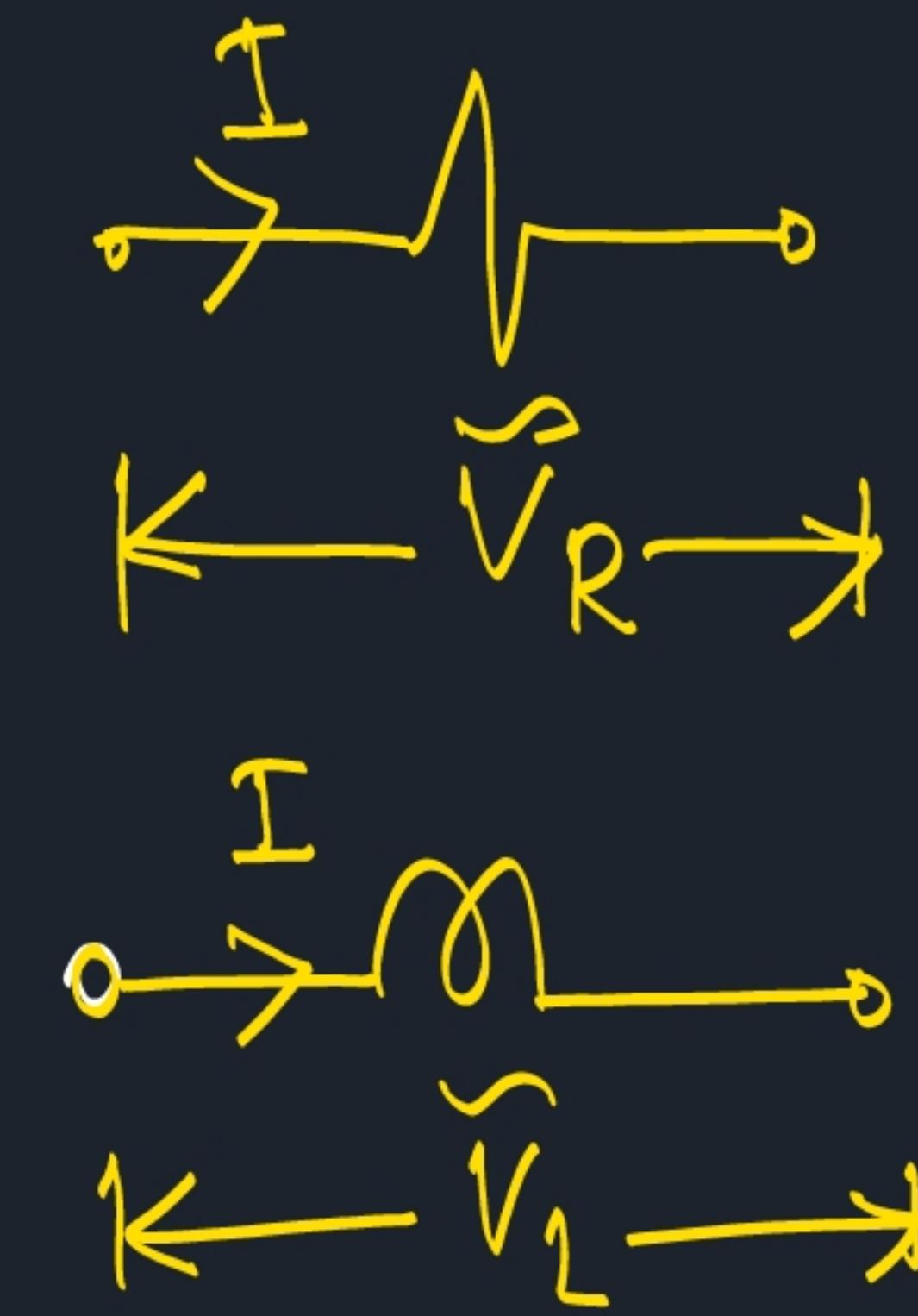
$$V(t) = V_m \cos \omega t$$

$$i(t) = \frac{V_m}{\sqrt{R^2 + (\omega L)^2}} \cos\left(\omega t - \tan^{-1}\left(\frac{\omega L}{R}\right)\right)$$

$$\tilde{I} = \frac{V_m \angle 0}{R + j\omega L}$$

$$\frac{V_m}{\sqrt{R^2 + (\omega L)^2}} \angle 0 - \tan^{-1}\left(\frac{\omega L}{R}\right)$$

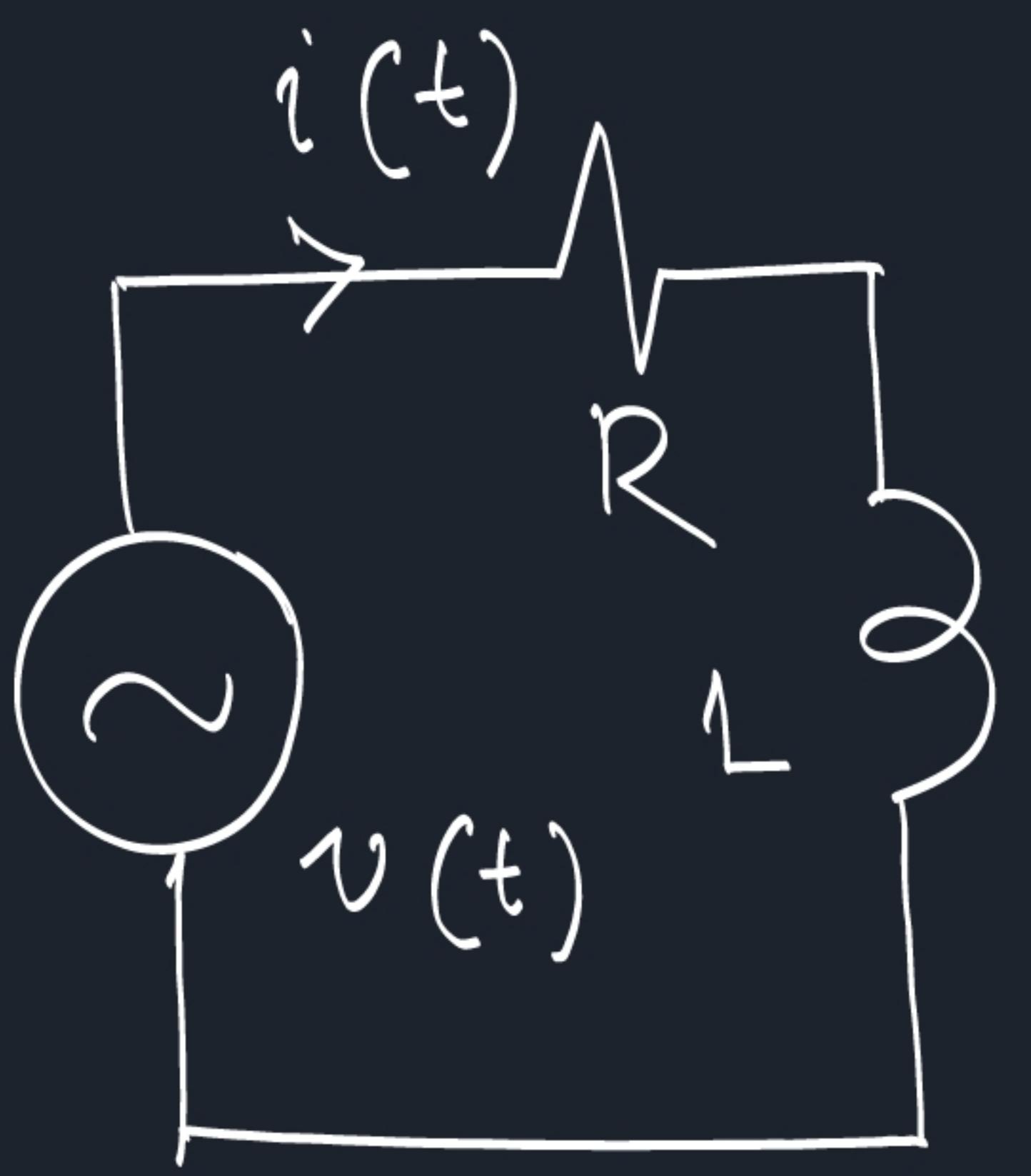
$$\tilde{V}_m = \tilde{V}_R + \tilde{V}_L$$



$$\theta = \tan^{-1}\left(\frac{\omega L}{R}\right)$$

$$Z = R + j\omega L = \text{Impedance.}$$

## Concept of Power :-



$$v(t) = V_m \cos(\omega t)$$

$$i(t) = I_m \cos(\omega t - \theta)$$

$$\theta = \tan^{-1}\left(\frac{\omega L}{R}\right)$$

$$P(t) = v(t) i(t)$$

$$= V_m \cos \omega t \cdot I_m \cos(\omega t - \theta)$$

$$= V_m I_m \cos \omega t \left\{ \cos \omega t \cos \theta + \sin \omega t \sin \theta \right\}$$

$$= V_m I_m \cos^2 \omega t \cos \theta + V_m I_m \sin \omega t \cos \omega t \sin \theta$$

$$P(t) = \frac{V_m I_m}{2} (1 + \cos 2\omega t) \cos \theta + \frac{V_m I_m}{2} \sin 2\omega t \sin \theta$$

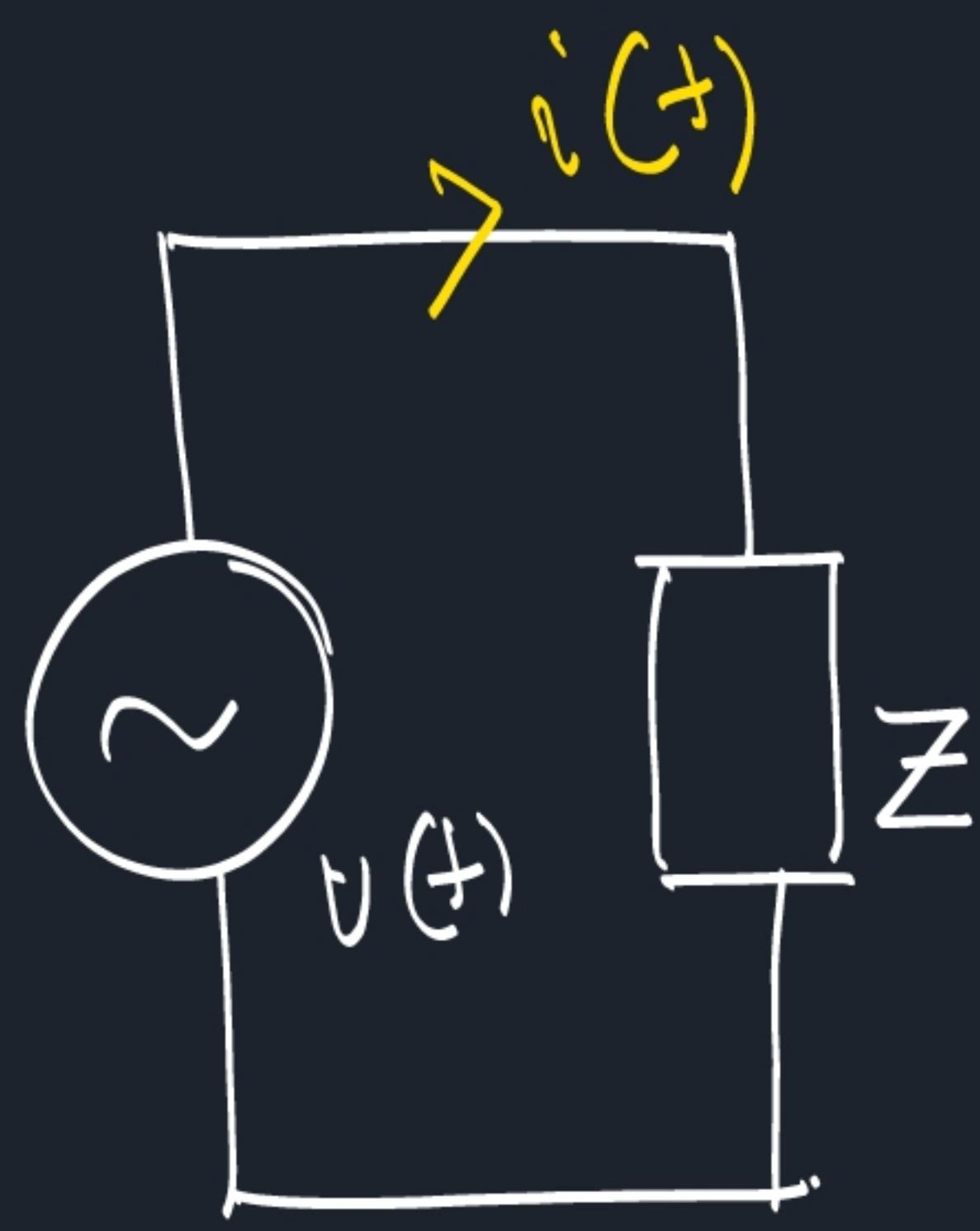
$$P(t) = V_r I_r (1 + \cos 2\omega t) \cos \theta + V_r I_r \sin 2\omega t \sin \theta$$

$$= V_r I_r \cos \theta + V_r I_r \cos 2\omega t \cos \theta + V_r I_r \sin 2\omega t \sin \theta$$

III

$$P = V_r I_r \cos \theta$$

$$\cos \theta = \frac{P}{V_r I_r}$$



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$$v(t) = V_m \cos(\omega t + \phi)$$

$$V_\gamma I_\gamma = V_\gamma I_\gamma (\cos^2 \theta + \sin^2 \theta) \quad i(t) = I_m \cos(\omega t + \psi)$$

$$\cos \theta = \frac{P}{V_\gamma I_\gamma}$$

$$Pf = \frac{\text{Active Power}}{\text{Apparent Power}}$$

Power factor.

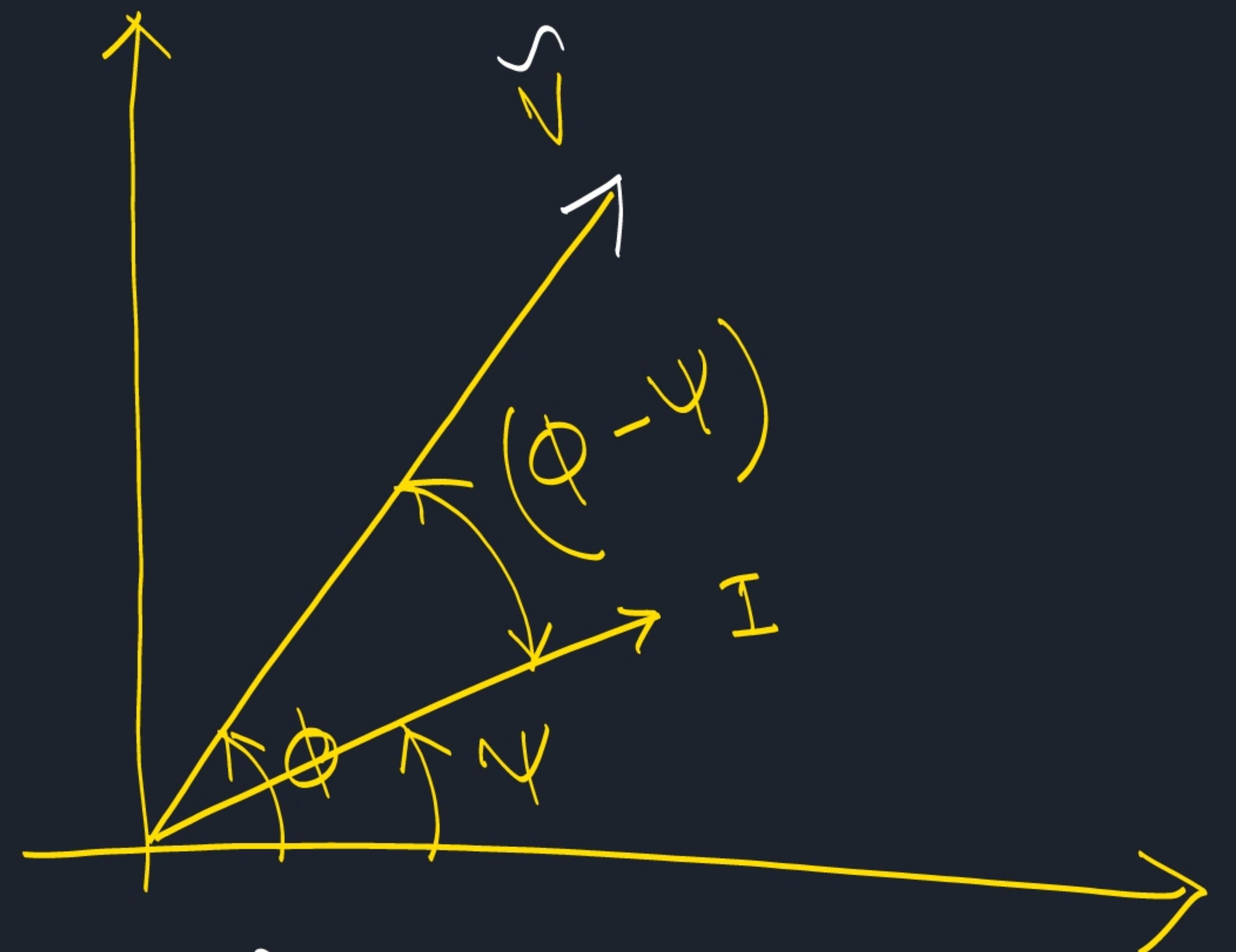
$$P = \frac{V_m I_m}{2} \cos(\phi - \psi)$$

$$= V_\gamma I_\gamma \cos(\phi - \psi)$$

$$P = \Re \left\{ \frac{1}{2} \cdot \vec{V} (\vec{I})^* \right\} = \Re \left\{ \frac{1}{2} \left\{ (\vec{V}^*) \vec{I} \right\} \right\}$$

$\vec{V} = V_m \angle \phi$
$\vec{I} = I_m \angle \psi$

$\phi > \psi$



$$V_\gamma^2 I_\gamma^2 = V_\gamma^2 I_\gamma^2 \cos^2 \theta + V_\gamma^2 I_\gamma^2 \sin^2 \theta$$

$$\underbrace{(Apparent\ power)}_S^2 = P^2 + V_\gamma^2 I_\gamma^2 \sin^2 \theta$$

$$V_\gamma I_\gamma \sin \theta = \sqrt{S^2 - P^2}$$

$Q \Rightarrow$  Reactive power.

$\theta$  = Power factor angle.

$$S^2 = P^2 + Q^2$$

$$S = P + jQ$$

$$\frac{V_m I_m}{2} \cos \theta \quad \frac{V_m I_m}{2} \sin \theta$$

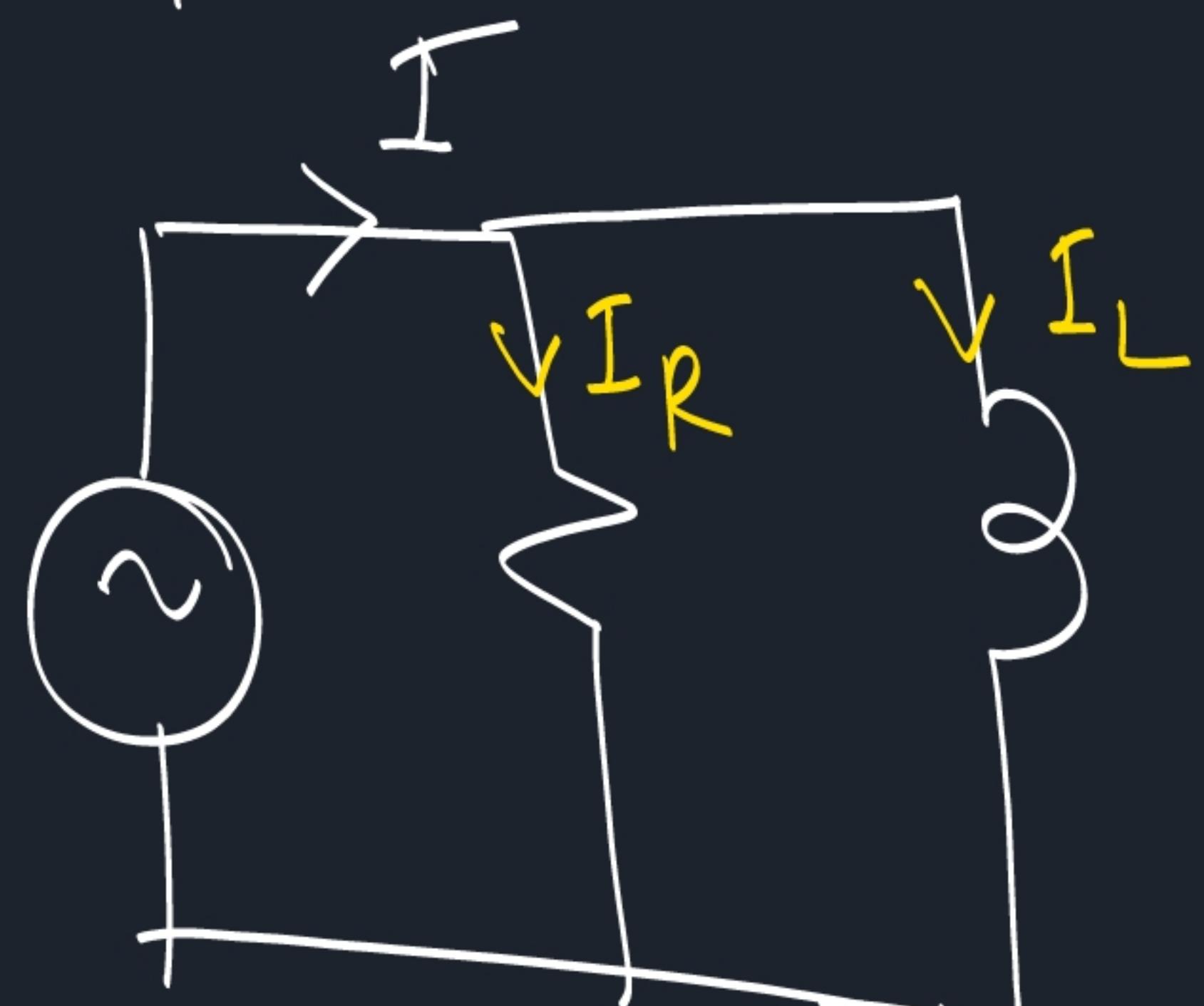
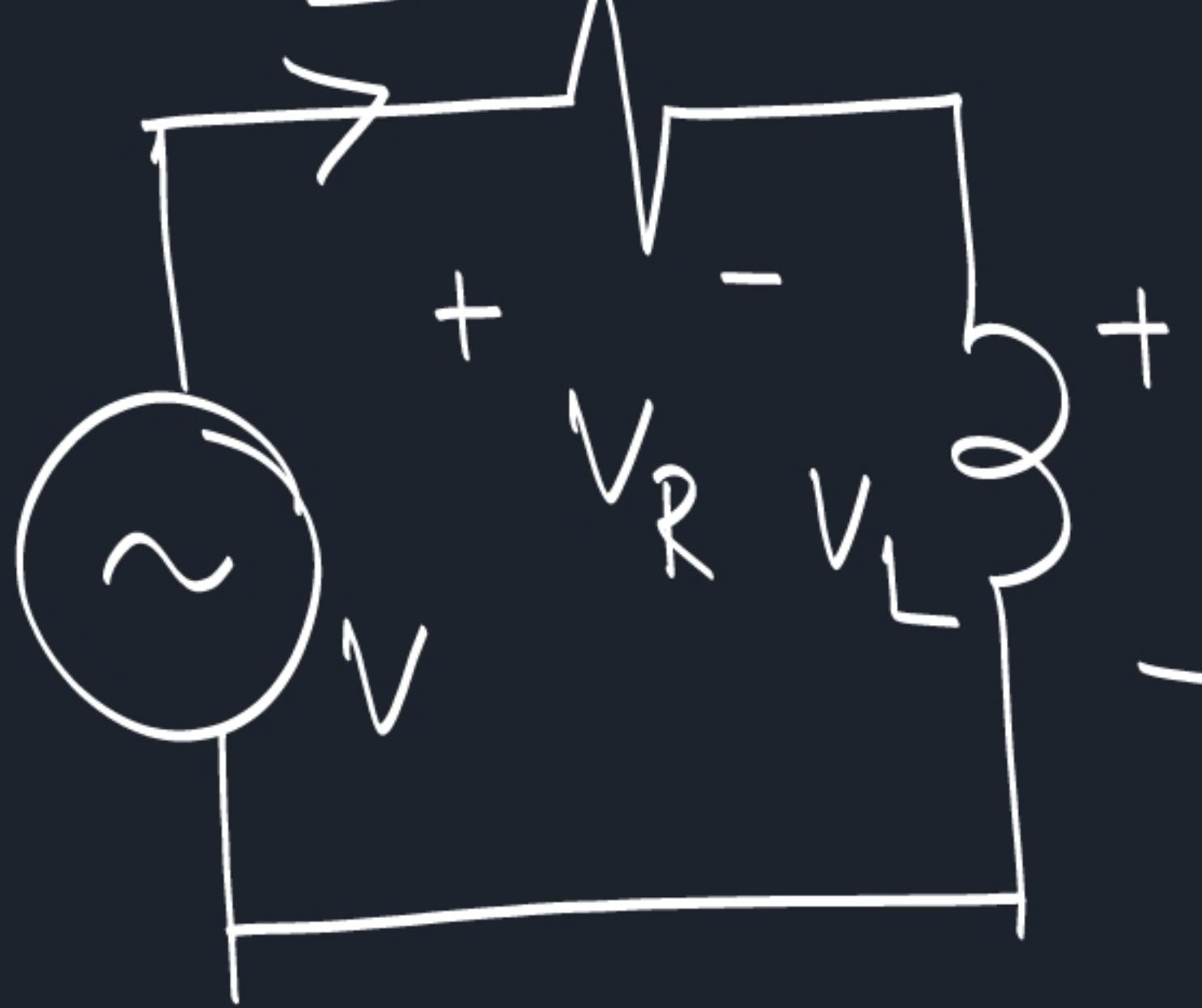
$$S = \frac{V_m I_m}{2}$$

$$P = S \cos \theta \Rightarrow \text{Watt}$$

$$Q = S \sin \theta \Rightarrow \text{VAR}$$

$$S = \sqrt{P^2 + Q^2} \Rightarrow \text{VA}$$

$$\boxed{\tan \theta = \frac{Q}{P}}$$

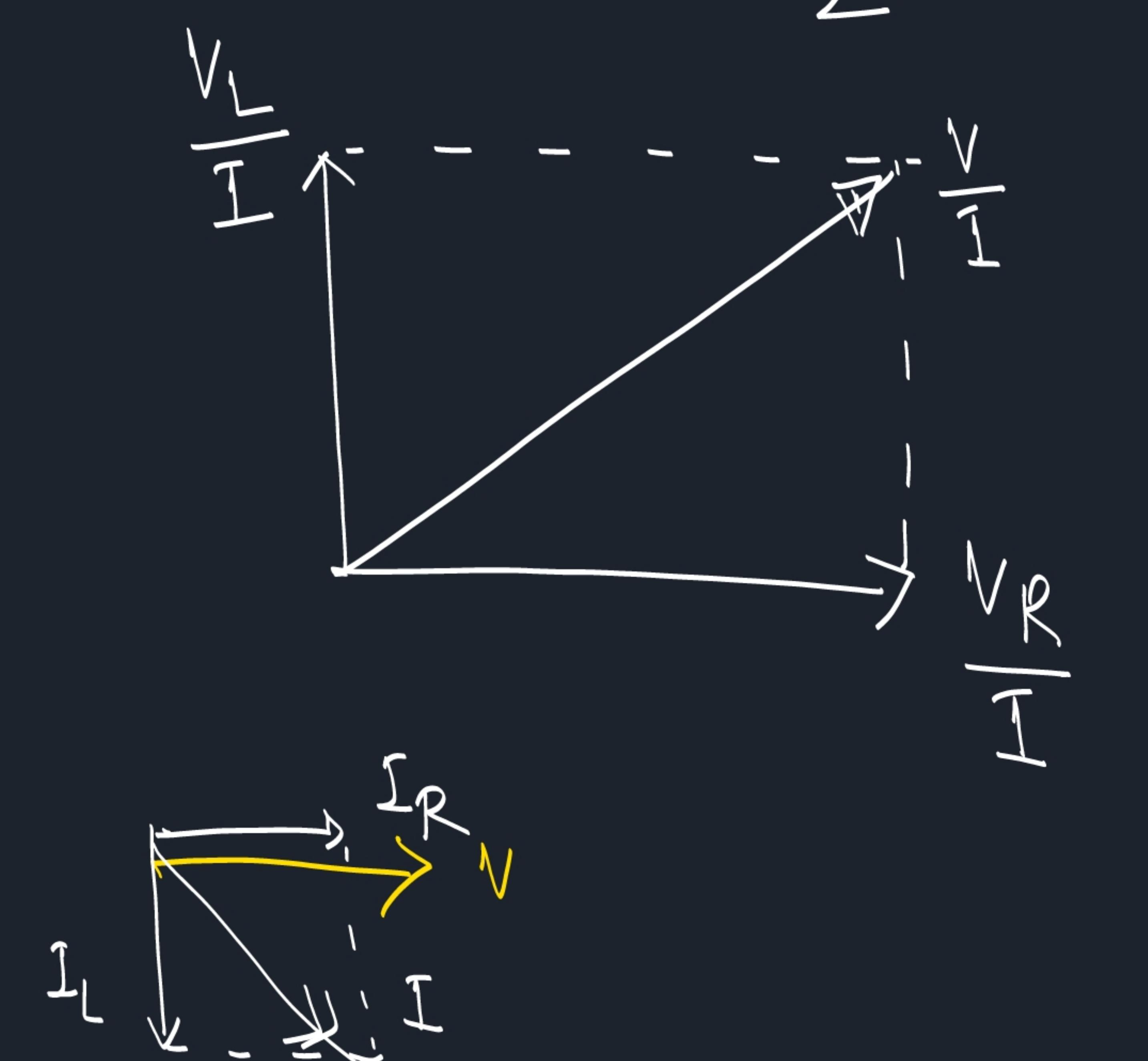
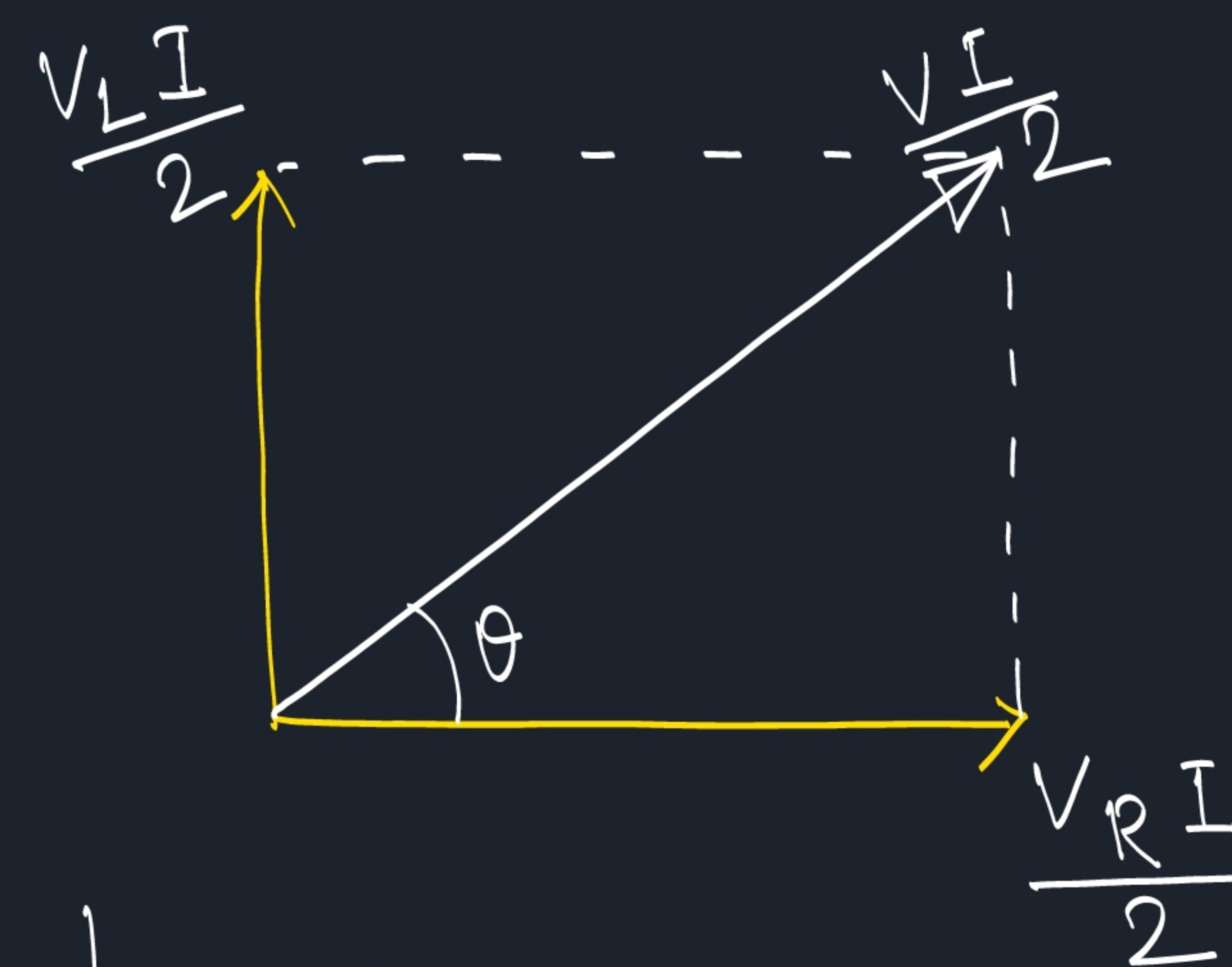


$$V_R = |\vec{V}_R|$$

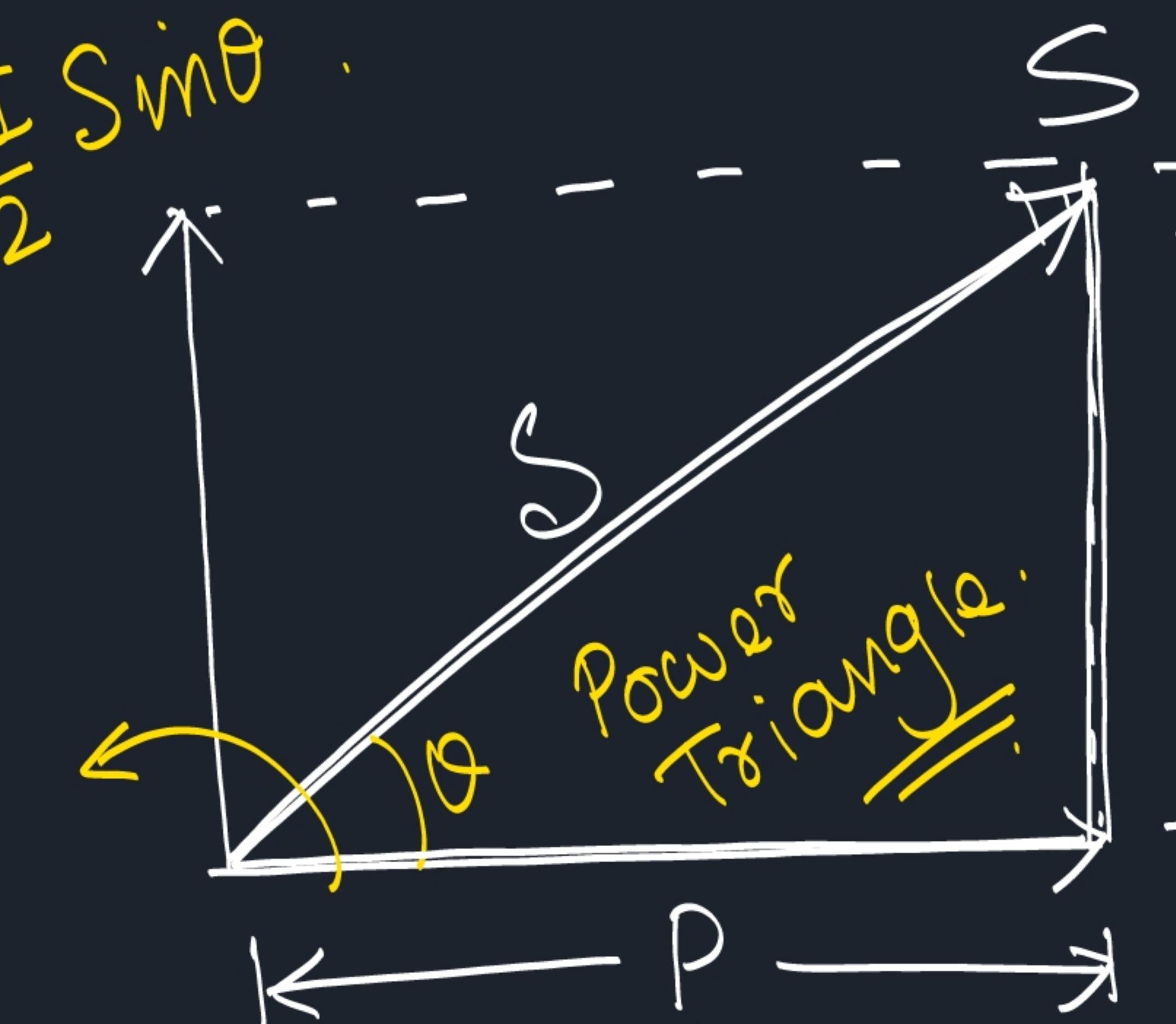
$$V_L = |\vec{V}_L|$$

$$V = |\vec{V}|$$

$$I = |\vec{I}|$$



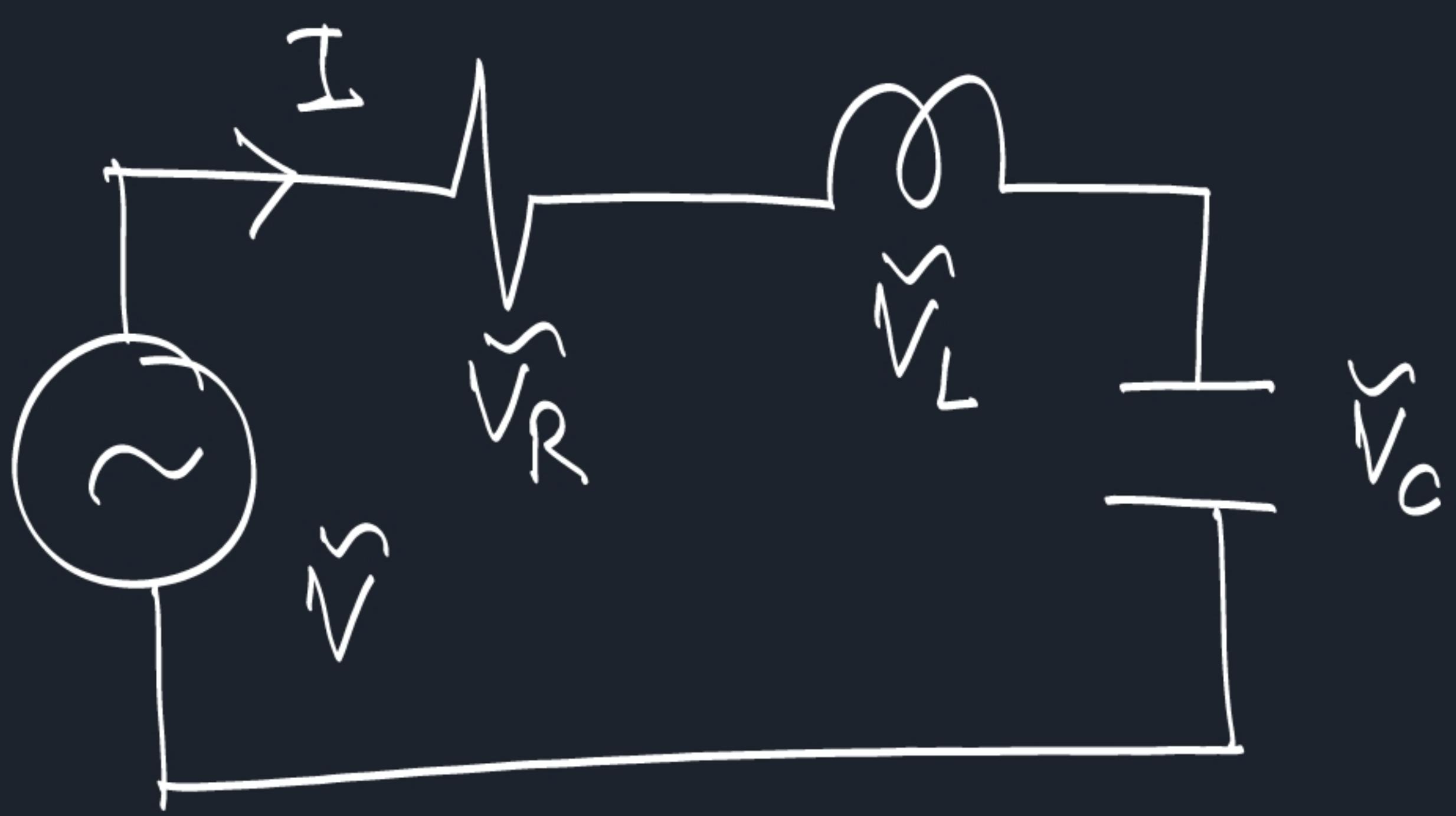
$$Q = \frac{\sqrt{S}}{2} \sin \theta$$



$$S = P + jQ$$

$$Z = R + jX_L$$

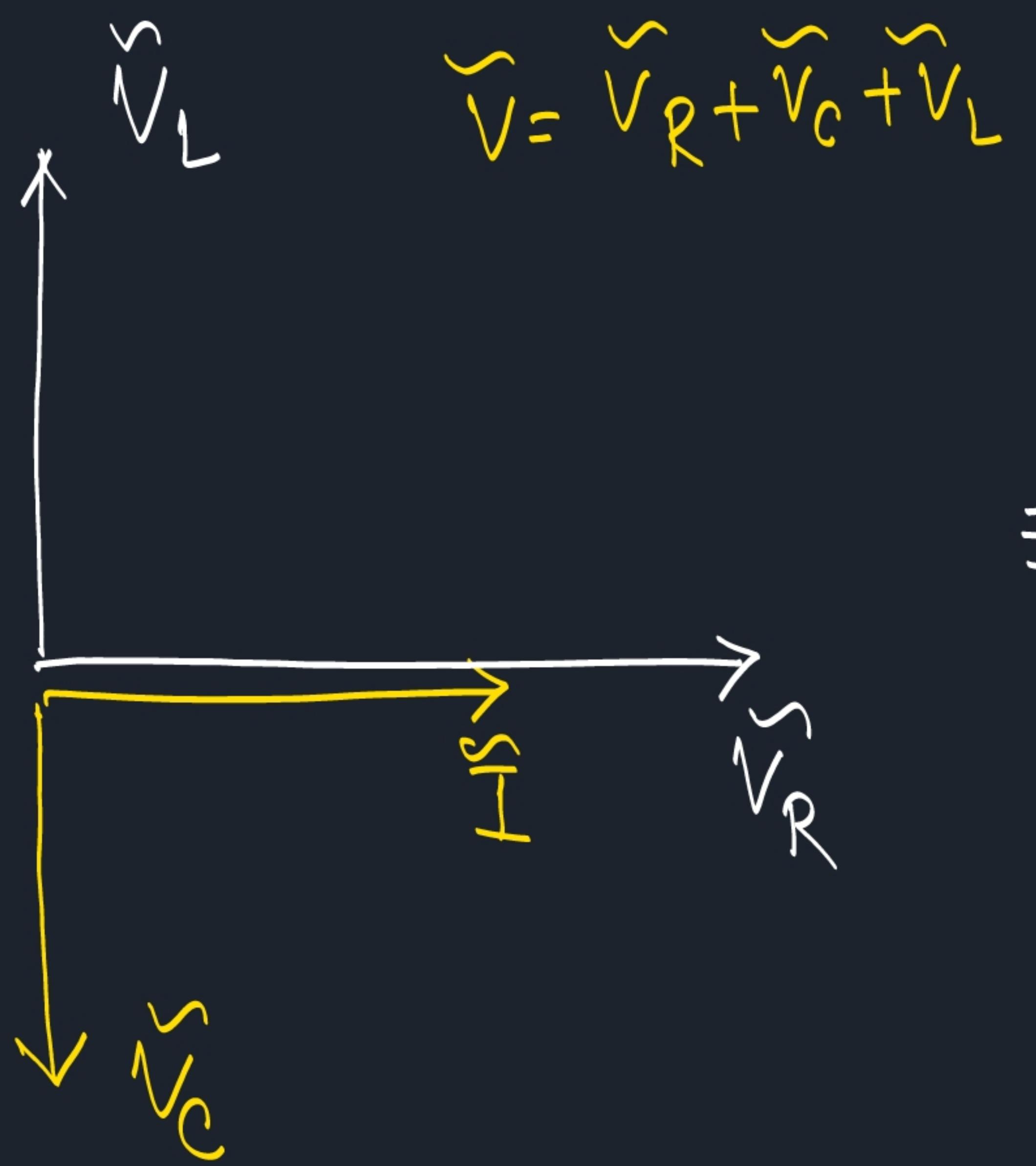




$$Z = R + j(X_L - X_C)$$

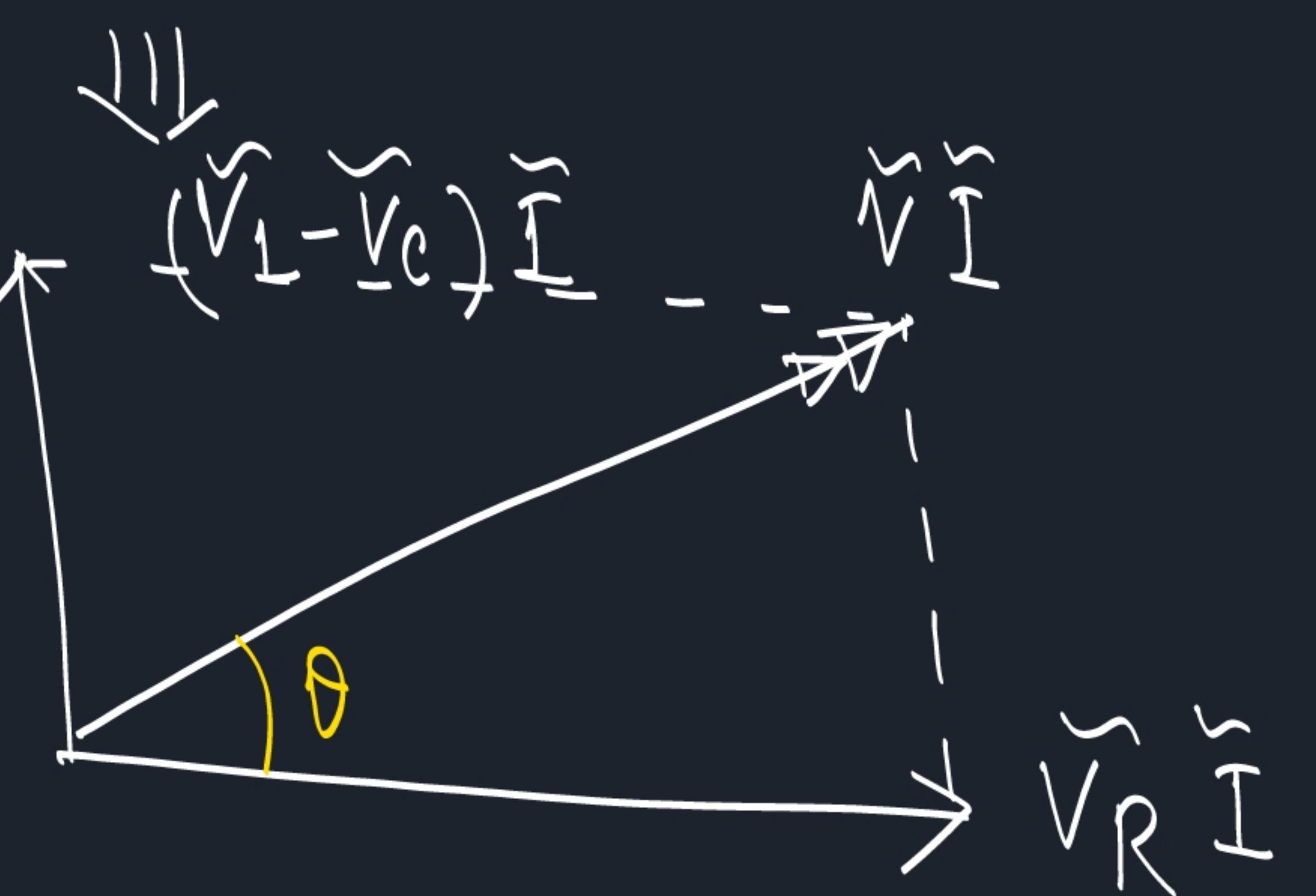
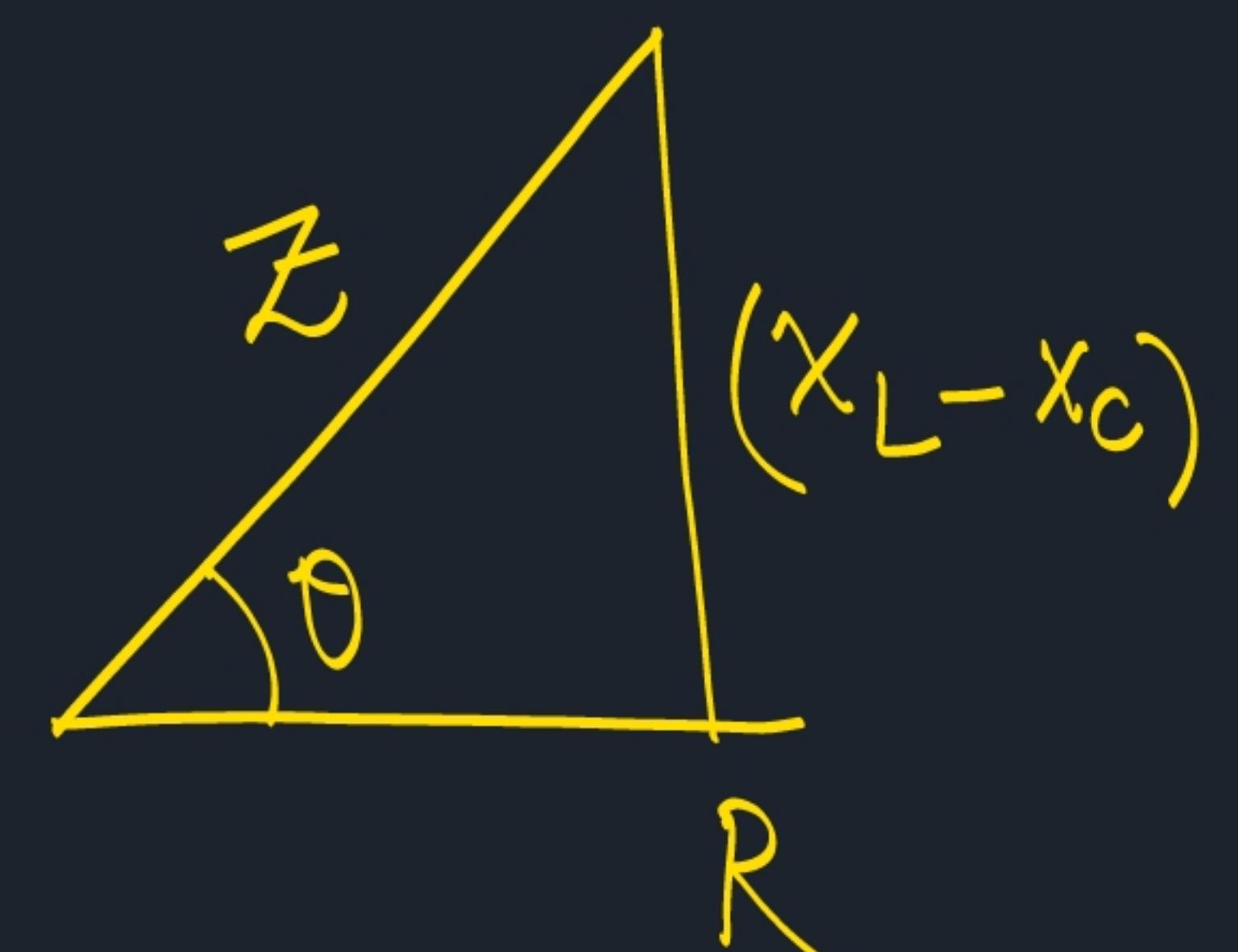
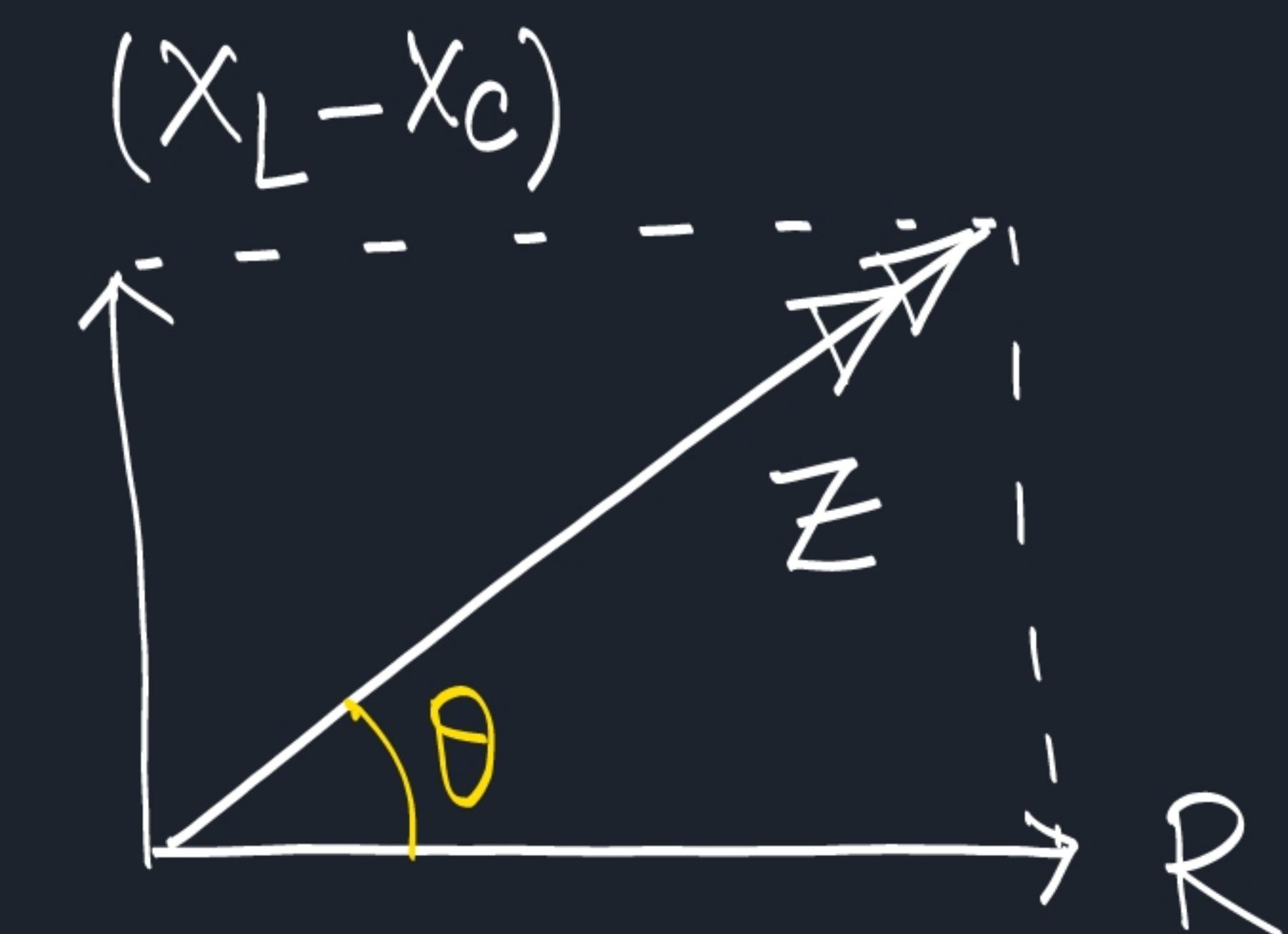
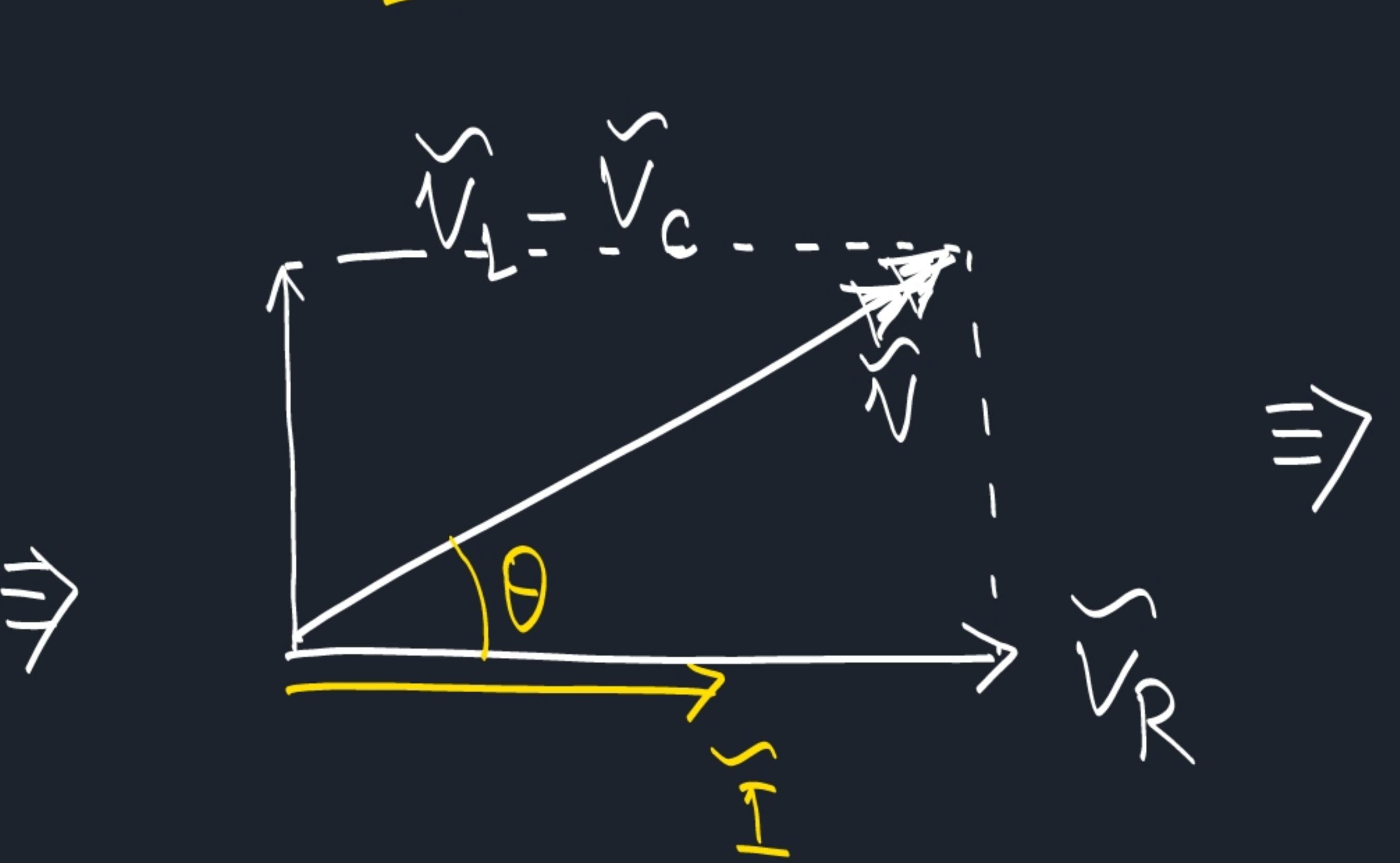
$$R = |Z| \cos \theta$$

$$X_{eq} = (X_L - X_C) = |Z| \sin \theta$$

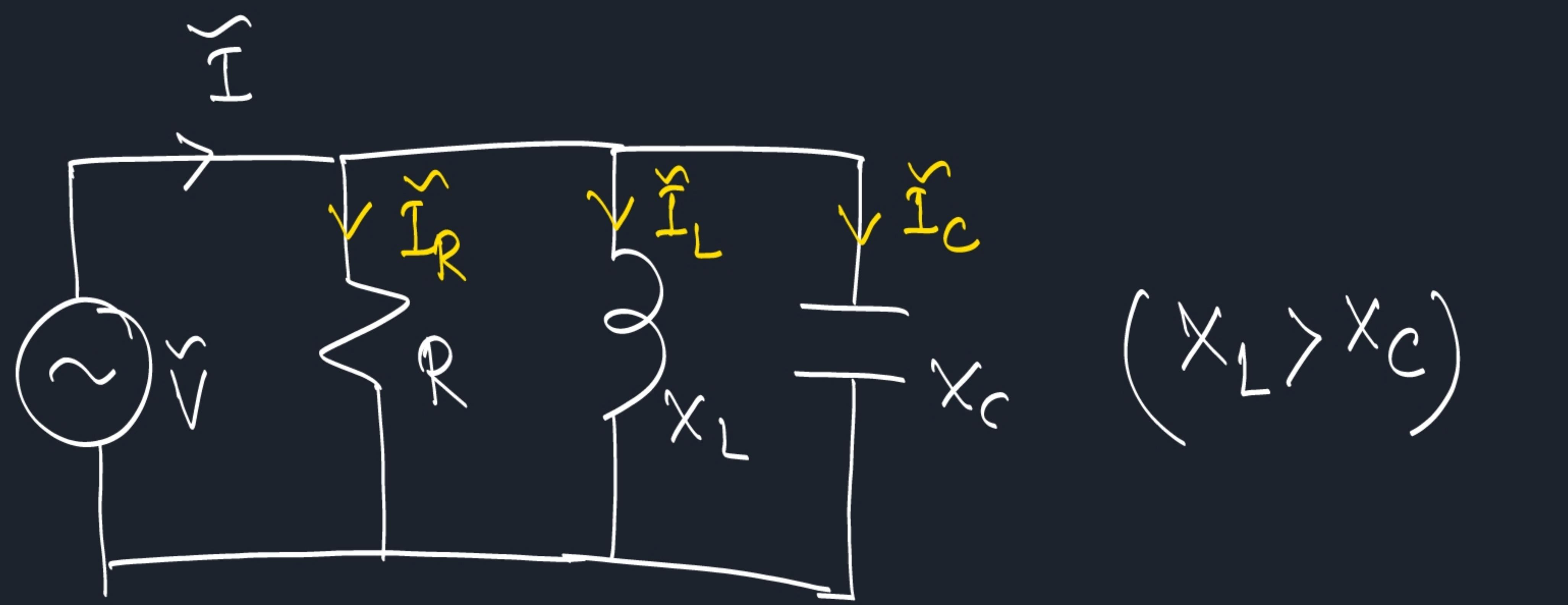


$$|V_L| > |V_C|$$

$$X_L > X_C$$



$$Y = \frac{1}{Z} = \underline{\text{admittance.}}$$



Draw phasor diagram.

Find out effective p.f.

$$S = \boxed{P + jQ = V I^*}$$

$$(V I^*)^* = (P + jQ)^*$$

$$\Rightarrow \boxed{V^* I = P - jQ}$$

$$\& P = \frac{V_m I_m}{2} \cos\theta$$

$$= V_\gamma I_\gamma \cos\theta$$

$$= I_\gamma |z| I_\gamma \cos\theta$$

$$= I_\gamma^2 |z| \cos\theta$$

$$= I_\gamma^2 \cdot R$$

$$P = \frac{I_m^2 R}{2}$$

$$Q = \frac{V_m I_m}{2} \sin\theta$$

$$= I_\gamma^2 |z| \sin\theta$$

$$= I_\gamma^2 \cdot X_{eq}$$

$$= I_\gamma^2 (X_L - X_C)$$

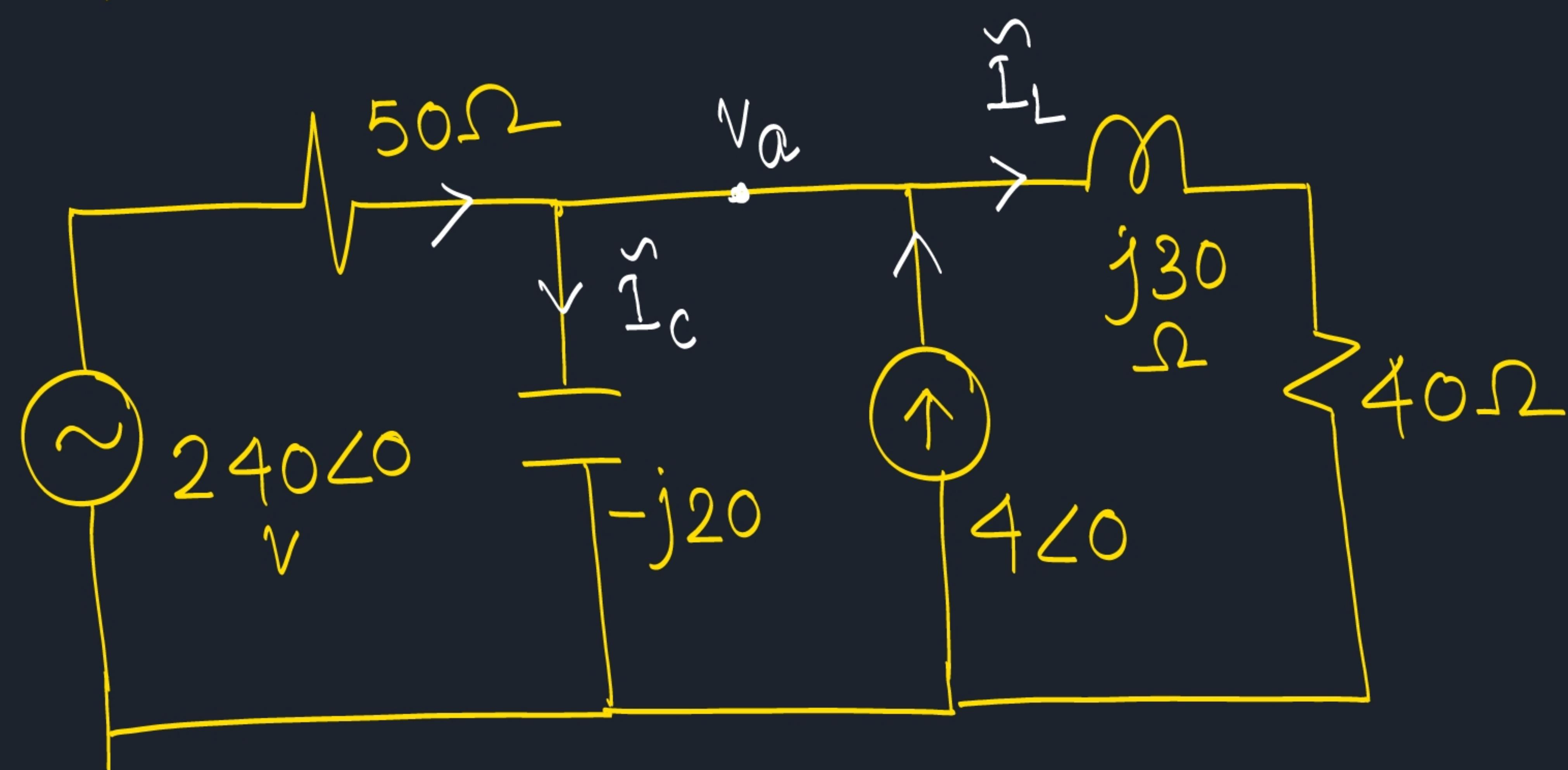
$$\tilde{V} = 2 \angle 90^\circ$$

$$\tilde{I} = 5 \angle 30^\circ$$

$$10 \angle (90^\circ - 30^\circ) = \tilde{V} \tilde{I}^* = P + jQ$$

$$10 \angle (30^\circ - 90^\circ) = \tilde{V}^* \tilde{I} = P - jQ$$

Q. Prob:-



Calculate Reactive power in  
inductor & capacitor.

$$P_L = |I_L|^2 \times 30 = (3.3623)^2 \times 30 = 339.15 \text{ VAR}$$

$$Q_C = |I_C|^2 \times 20 = (8.4057)^2 \times 20 = 1.413 \text{ kVAR}$$

$$\frac{240\angle 0 - V_a}{50} + 4\angle 0 = \frac{V_a}{-j20} + \frac{V_a}{40+j30}$$

$$\Rightarrow V_a \left( \frac{1}{50} + \frac{1}{-j20} + \frac{1}{40+j30} \right) = \frac{240\angle 0}{50} + 4\angle 0$$

$$\Rightarrow V_a = ? \quad 168.1153 \angle -46.548^\circ \text{ V}$$

$$I_L = ? \quad 3.3623 \angle -83.4178^\circ \text{ A}$$

$$I_C = ? \quad 8.4057 \angle 43.452^\circ \text{ A}$$