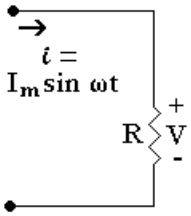
Series and Parallel AC Circuits

Resistive Elements



Ohm's Law

$I_m = V_m/R$ or $V_m = I_m R$

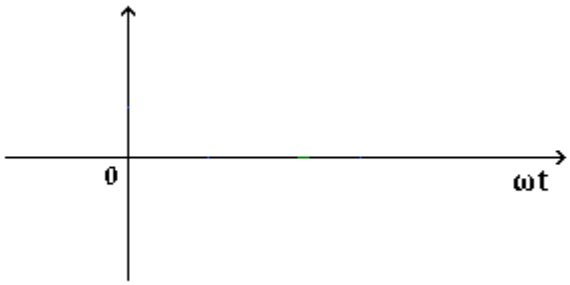
★ R = 5Ω ~> $\mathbb{Z}_R$ =

$\mathcal{V}$ = 100 sin Ωt ~> V_m =

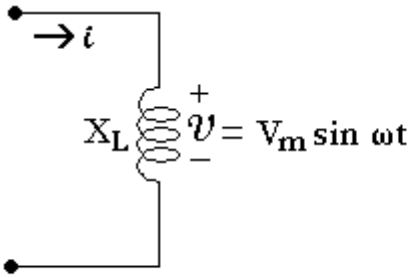
$\therefore \mathbb{V}$ =

$I = \mathbb{V}/\mathbb{Z}_R$ = _____ =

$\therefore \ i =$



Inductive Reactance



$$\mathbb{I} = \frac{\mathbb{V}\angle 0^\circ}{X_L \angle \theta_L} = \frac{V}{X_L}\angle 0^\circ - \theta_L$$

$$i = \sqrt{2}\left(\frac{V}{X_L}\right) \sin\left(\omega t - 90^\circ\right)$$

$$\mathbb{Z}_L = X_L \angle 90^\circ$$

Why does $\mathbb{Z}_L$ have a + 90° phase angle?

★ $X_L = 3\Omega$ ~> $\mathbb{Z}_L$ =

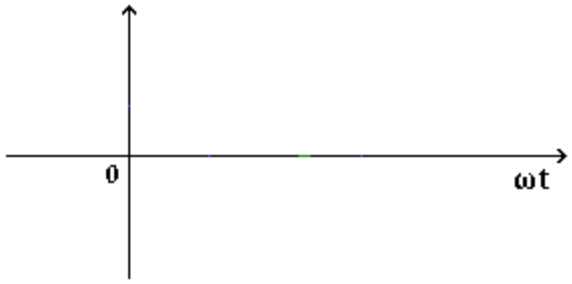
$\mathcal{V}$ = 24 sin ωt ~> V_m =

$\mathbb{V}$ =

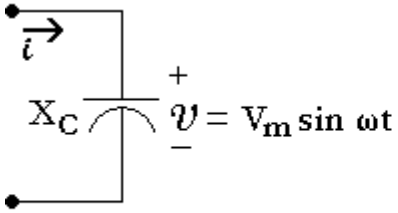
$$\mathbb{I} = \frac{\mathbb{V}}{\mathbb{Z}_L} = \text{————}$$

=

$\therefore$ i =



Capacitive Reactance



$$\mathbb{I} = \frac{\mathbb{V}\angle 0°}{X_C\angle \theta_C} = \frac{V}{X_C}\angle 0° - \theta_C$$

$$i = \sqrt{2}\left(\frac{V}{X_C}\right) \sin\left(\omega t - 90°\right)$$

$$\mathbb{Z}_C = X_C \angle -90°$$

Why does $\mathbb{Z}_C$ have a - 90° phase angle?

★ X_C = 2□ ~> $\mathbb{Z}_C$ =

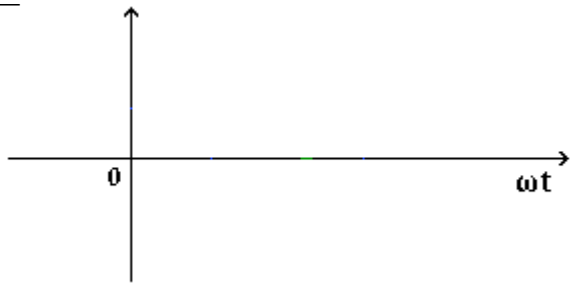
$\mathcal{V}$ = 15 sin □t ~> V_m =

$\mathbb{V}$ =

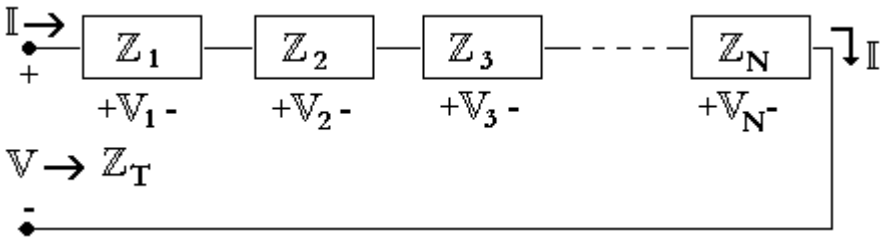
$\mathbb{I} = \mathbb{V}/\mathbb{Z}_C$ = _____

$\therefore \mathbb{I}$ =

i =



Series



$\mathbb{Z}_T$ =

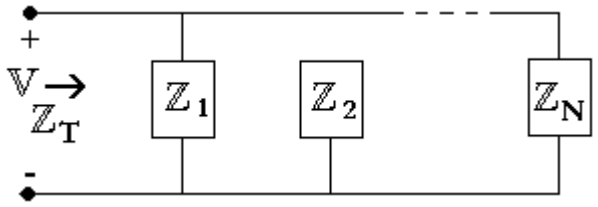
$\mathbb{I}$ = _____ or _____

$\mathbb{V}_1$ =

$\mathbb{V}_2$ =

$\mathbb{V}_N$ =

Parallel



$$\frac{1}{\mathbb{Z}_T} = \frac{1}{\mathbb{Z}_1} + \frac{1}{\mathbb{Z}_2} + \cdots + \frac{1}{\mathbb{Z}_N}$$

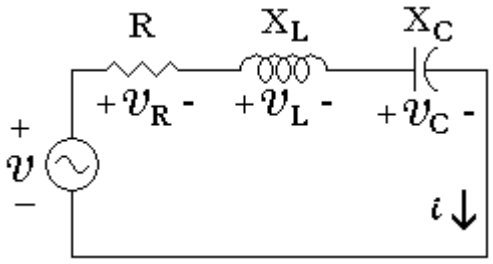
Terms: susceptance (B)

Admittance ($\mathbb{Y}$)

Unit:

R-L-C Circuits

★



Let R = 2Ω
X_L = 7Ω
X_C = 3Ω

Redraw the circuit

Phasor notation

$\mathbb{V}$ =

$\mathbb{Z}_T$ =

$\mathbb{I} = \mathbb{V} / \mathbb{Z}_T$

$\mathbb{V}_R$ =

$\mathbb{V}_L$ =

$\mathbb{V}_C$ =

$\therefore i =$

$V_R =$

$V_L =$

$V_C =$

$P_T = P_R + P_L + P_C$

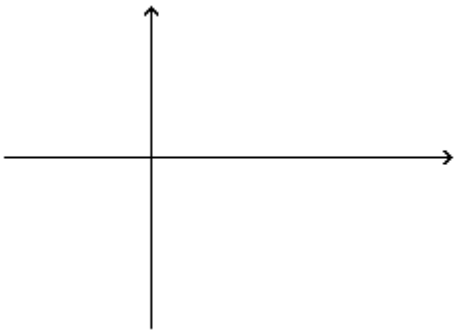
$= V_R I \cos \phi_R + V_L I \cos \phi_L + V_C I \cos \phi_C$

$=$

Power factor ➔ pf $= \cos \phi_T$

$=$

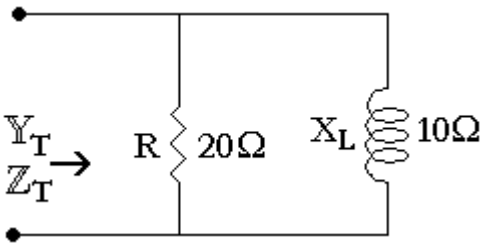
$=$



Another way to find $\mathbb{V}_R$, $\mathbb{V}_L$, $\mathbb{V}_C$, P_T

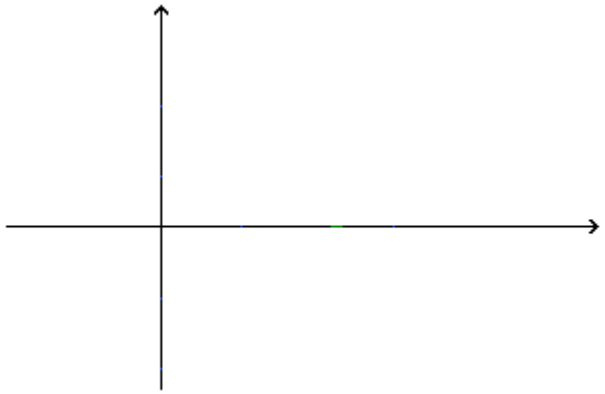
How?

★



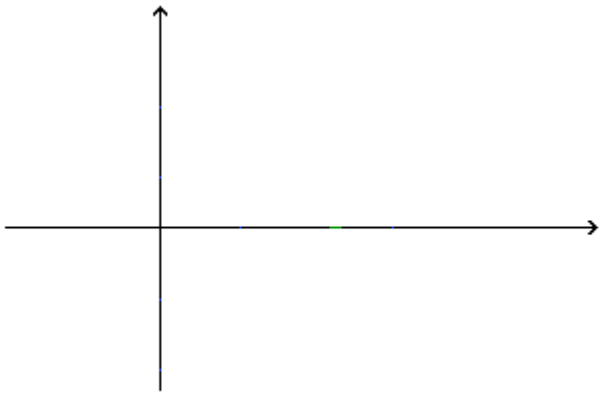
a. Input impedance

b. The impedance diagram

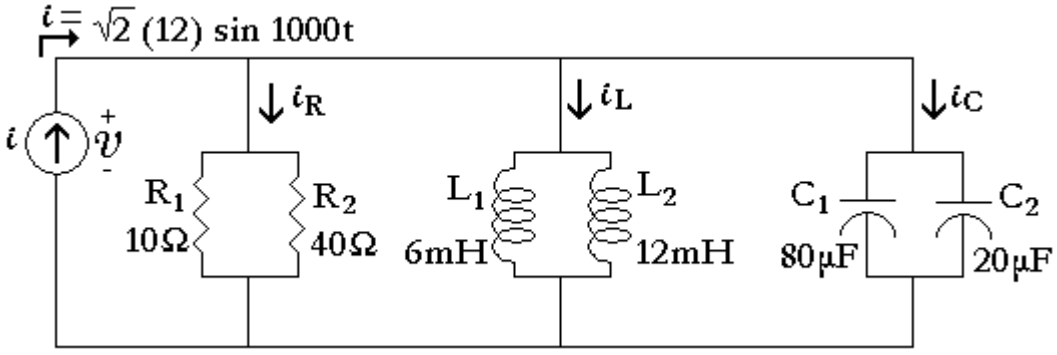


c. The admittance of each parallel branch

d. The input admittance and admittance diagram

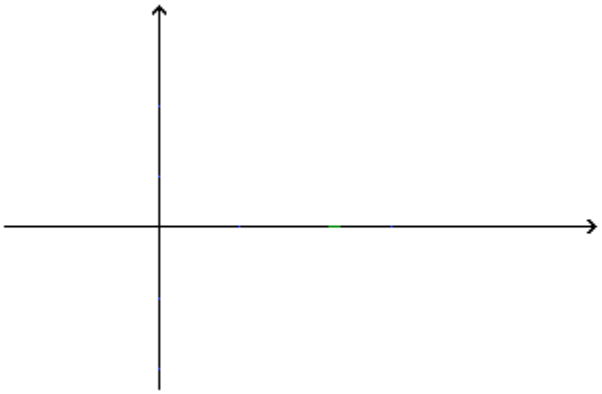


★



a. Find $\mathbb{Y}_T$ and $\mathbb{Z}_T$

b. Sketch the admittance diagram



c. Find $\mathbb{V}$ and $\mathbb{I}_L$

$\mathbb{V}$ =

$\mathbb{I}_L$ =

d. Compute the power factor of the network and the power delivered to the network.

pf =

P =

e. The equivalent circuit