Resistor

Phasor domain:

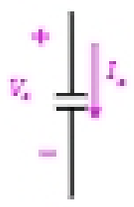
$$I_R = i_m \angle \phi_i$$

$$V_R = R i_m \angle \phi_i$$

$$Z_R = \frac{R i_m \angle \phi_i}{i_m \angle \phi_i} = R$$

Capacitor

$$Z_C = \frac{v_m \angle \phi_v}{\omega C v_m \angle \phi_v + 90^\circ} \qquad Z_C = \frac{1}{\omega C} \angle -90^\circ$$



$$V_C = v_m \angle \phi_v$$

$$I_C = \omega C v_m \angle \phi_v + 90^\circ$$

$$Z_C = \frac{-j}{\omega C} = \frac{1}{j\omega C}$$

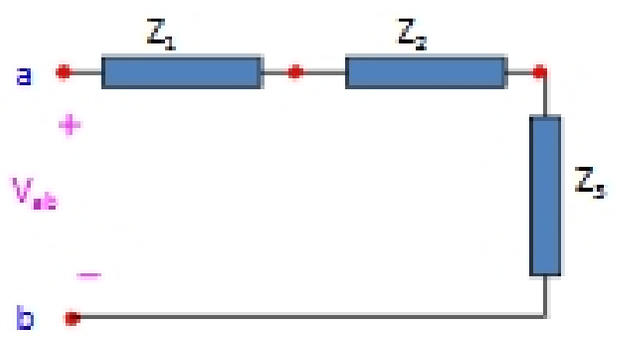
Inductor

$$V_L = \omega L i_m \angle \phi_i + 90^\circ \qquad Z_L = \frac{\omega L i_m \angle \phi_i + 90^\circ}{i_m \angle \phi_i} \qquad Z_L = \omega L \angle 90^\circ$$

$$I_L = i_m \angle \phi_i$$

$$Z_L = j\omega L$$

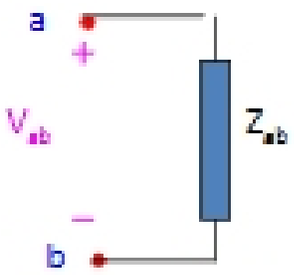
Combining impedances:



$$V_{ab} = I[Z_1] + I[Z_2] + I[Z_3]$$

$$V_{ab} = I\{[Z_1] + [Z_2] + [Z_3]\}$$

$$V_{ab} = I\{Z_{ab}\}$$



$$I_{ab} = I_1 + I_2$$

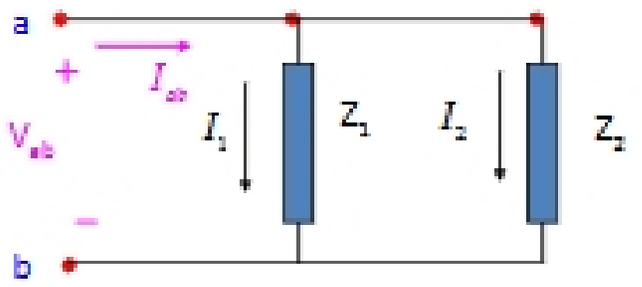
$$I_{ab} = \frac{V_{ab}}{Z_1} + \frac{V_{ab}}{Z_2}$$

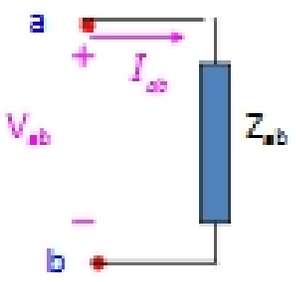
$$I_{ab} = V_{ab}\left[\frac{1}{Z_1} + \frac{1}{Z_2}\right]$$

$$I_{ab} = V_{ab}\left[\frac{Z_1 + Z_2}{Z_1 Z_2}\right]$$

$$V_{ab} = I_{ab}\left[\frac{Z_1 Z_2}{Z_1 + Z_2}\right]$$

$$\boxed{V_{ab} = I_{ab}\{Z_{ab}\}}$$





Complex Numbers:

$A = 5j \iff A = 5\angle 90°$

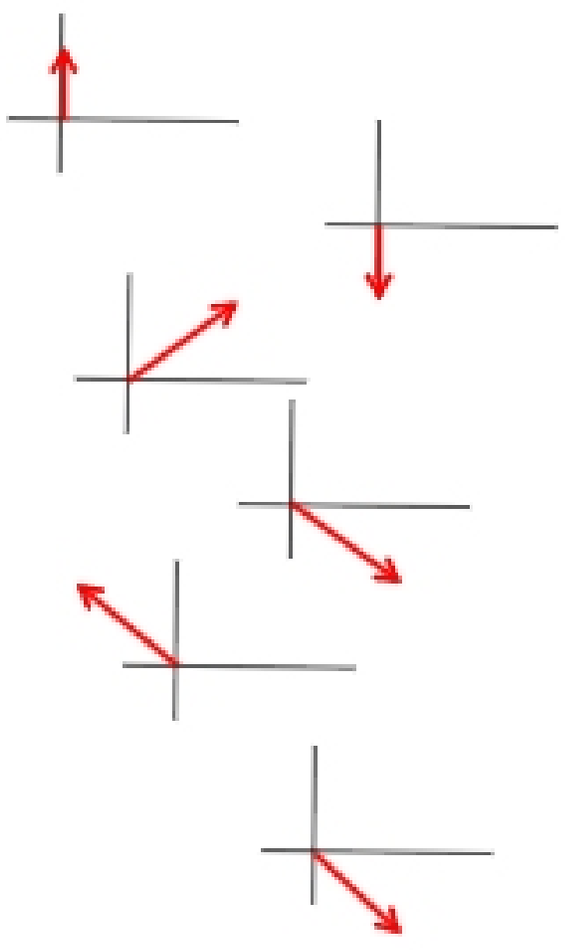
$A = -5j \iff A = 5\angle -90°$

$A = 5 + j5 \iff A = 5\sqrt{2}\angle 45°$

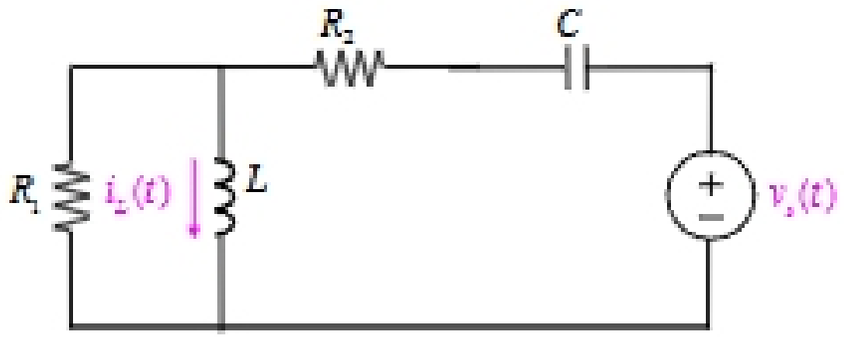
$A = 5 - j5 \iff A = 5\sqrt{2}\angle -45°$

$A = -5 + j5 \iff A = 5\sqrt{2}\angle 135°$

$A = -5 - j5 \iff A = 5\sqrt{2}\angle -135°$



Example (1):



Given: $v_s(t) = 300\cos(2000t)$ Find:

$R_1 = 100\Omega \quad R_2 = 10\Omega$ $i_L(t) = ?$

$L = 50mH \quad C = 10\mu F$

Hint: $\omega = 2000\ rad/sec \longrightarrow i_L(t) = i_m\cos(2000t + \theta)$

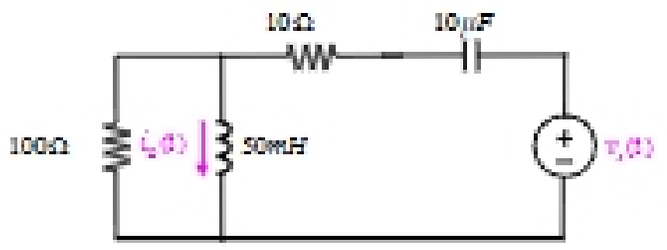
Find: $i_m = ?$ $\theta = ?$

Solution:

1. Transform the circuit from time domain to phasor domain

$\omega = 2000\ rad/sec$

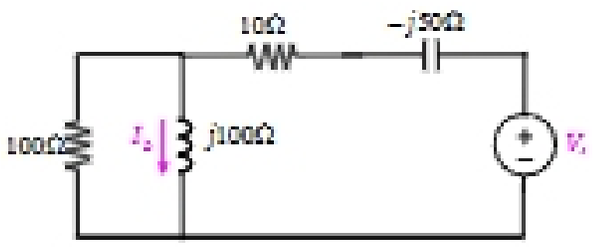
$v_s(t) = 300\cos(2000t)$



Element impedance:

$Z_L = j\omega L = j(2000)(0.05) = j100$

$Z_c = -\frac{j}{\omega C} = -j\frac{1}{2\times10^3\times10\times10^{-6}} = -j50$



Source:

$V_s = 300\angle 0°\ \ volt$