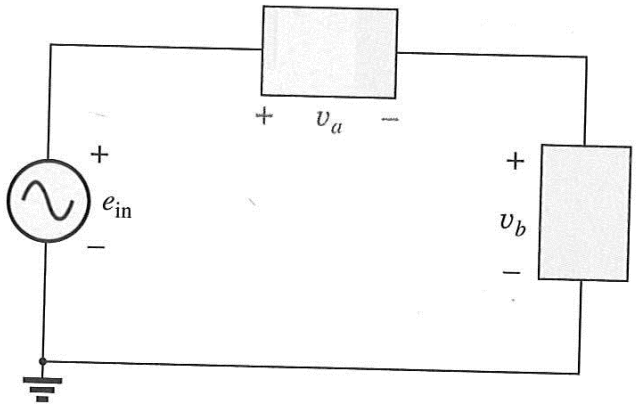
Attribution Nidhal Abdulaziz

ENGG104 Tutorial 10 Class Questions

Team Name: _____

Question 1 – [past exam question]



$$e_{in} = 60\sin(377t + 45°)$$
$$v_b = 20\sin(377t - 45°)$$

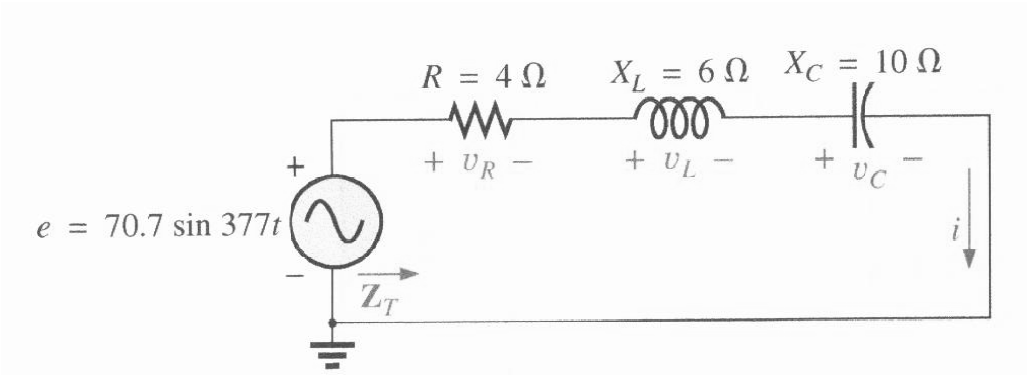
In the above circuit, e_{in} and v_b are given, determine the expression for v_a.

(Using peak values)

$$e_{in} = v_a + v_b \Rightarrow v_a = e_{in} - v_b$$
$$= 60\text{ V}\angle 45° - 20\text{ V}\angle -45°$$
$$= 63.25\text{ V}\angle 63.43°$$

and $e_{in} = 63.25\sin(377t + 63.43°)$

QUESTION 2 – [past exam question]



For the circuit above, find $Z_T, X_L, X_C, I, V_R, V_L, V_C$, Power delivered to the 4 Ohms resistor, and the power factor F_p

a. $\mathbf{Z}_T = 4\ \Omega + j6\ \Omega - j10\ \Omega = 4\ \Omega - j4\ \Omega = \mathbf{5.66\ \Omega\ \angle -45°}$

c. $X_L = \omega L \Rightarrow L = \dfrac{X_L}{\omega} = \dfrac{6\ \Omega}{377\ \text{rad/s}} = \mathbf{16\ mH}$

$X_C = \dfrac{1}{\omega C} \Rightarrow C = \dfrac{1}{\omega X_C} = \dfrac{1}{(377\ \text{rad/s})(10\ \Omega)} = \mathbf{265\ \mu F}$

d. $\mathbf{I} = \dfrac{\mathbf{E}}{\mathbf{Z}_T} = \dfrac{50\ \text{V}\angle 0°}{5.66\ \Omega \angle -45°} = \mathbf{8.83\ A\ \angle 45°}$

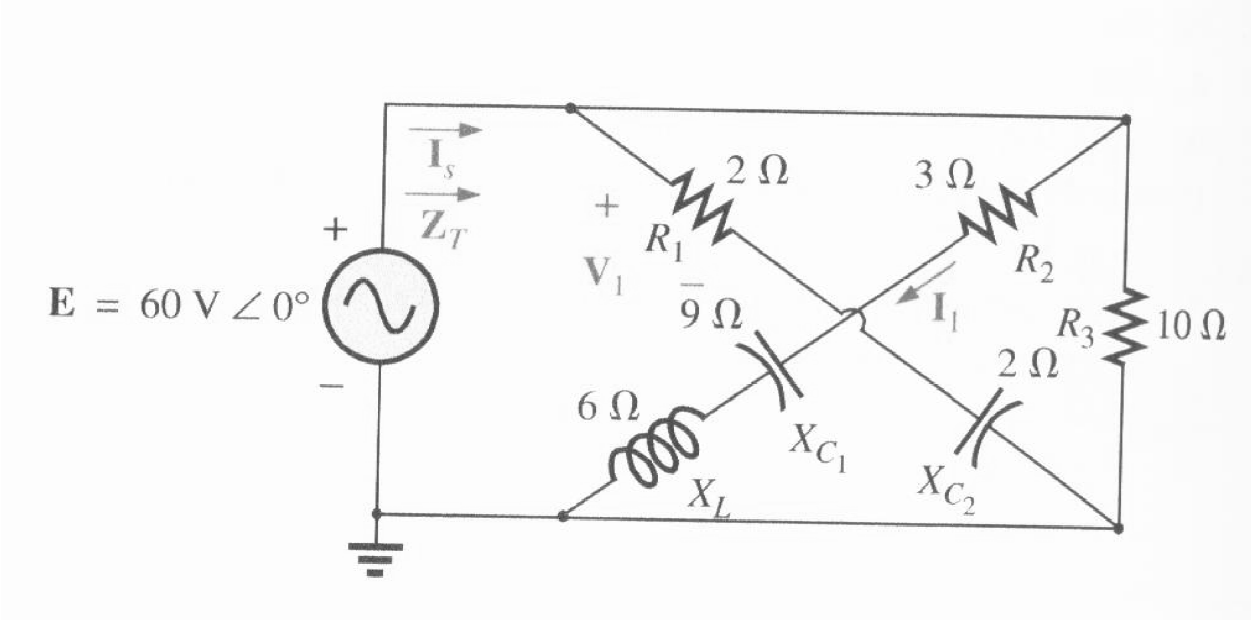
$\mathbf{V}_R = (I\angle\theta)(R\angle 0°) = (8.83\ \text{A}\ \angle 45°)(4\ \Omega\ \angle 0°) = \mathbf{35.32\ V\ \angle 45°}$
$\mathbf{V}_L = (I\angle\theta)(X_L\angle 90°) = (8.83\ \text{A}\ \angle 45°)(6\ \Omega\ \angle 90°) = \mathbf{52.98\ V\ \angle 135°}$
$\mathbf{V}_C = (I\ \angle\theta)(X_C\angle -90°) = (8.83\ \text{A}\ \angle 45°)(10\ \Omega\ \angle -90°) = \mathbf{88.30\ V\ \angle -45°}$

f. $\mathbf{E} = \mathbf{V}_R + \mathbf{V}_L + \mathbf{V}_C$
$50\ \text{V}\ \angle 0° = 35.32\ \text{V}\ \angle 45° + 52.98\ \text{V}\ \angle 135° + 88.30\ \text{V}\ \angle -45°$
$50\ \text{V}\ \angle 0° = 49.95\ \text{V}\ \angle 0° \cong 50\ \text{V}\ \angle\ 0°$

g. $P = I^2R = (8.83\ \text{A})^2\ 4\ \Omega = \mathbf{311.88\ W}$

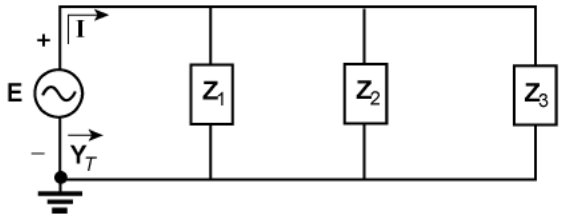
h. $F_p = \cos\theta_T = \dfrac{R}{Z_T} = 4\ \Omega/5.66\ \Omega = \mathbf{0.707\ leading}$

QUESTION 3 – [past exam question]



For the circuit above,find Z_T, V_1,I_1,and I_s

a.



$\mathbf{Z}_1 = 2\ \Omega - j2\ \Omega = 2.828\ \Omega \angle -45°$

$\mathbf{Z}_2 = 3\ \Omega - j9\ \Omega + j6\ \Omega$

$= 3\ \Omega - j3\ \Omega = 4.243\ \Omega \angle -45°$

$\mathbf{Z}_3 = 10\ \Omega \angle 0°$

$$\mathbf{Y}_T = \frac{1}{\mathbf{Z}_1} + \frac{1}{\mathbf{Z}_2} + \frac{1}{\mathbf{Z}_3} = \frac{1}{2.828\ \Omega \angle -45°} + \frac{1}{4.243\ \Omega \angle -45°} + \frac{1}{10\ \Omega \angle 0°}$$

$$= 0.354\ \text{S} \angle 45° + 0.236\ \text{S} \angle 45° + 0.1\ \text{S} \angle 0° = 0.59\ \text{S} \angle 45° + 0.1\ \text{S} \angle 0°$$

$$= 0.417\ \text{S} + j0.417\ \text{S} + 0.1\ \text{S}$$

$$\mathbf{Y}_T = 0.517\ \text{S} + j\,0.417\ \text{S} = \mathbf{0.66\ S \angle 38.89°}$$

$$\mathbf{Z}_T = \frac{1}{\mathbf{Y}_T} = \frac{1}{0.66\ \text{S} \angle 38.89°} = \mathbf{1.52\ \Omega \angle -38.89°}$$

b. $$\mathbf{V}_1 = \frac{(2\ \Omega \angle 0°)(60\ \text{V} \angle 0°)}{2\ \Omega - j2\ \Omega} = \frac{120\ \text{V} \angle 0°}{2.828 \angle -45°} = \mathbf{42.43\ V \angle 45°}$$

c. $$\mathbf{I}_1 = \frac{\mathbf{E}}{\mathbf{Z}'} = \frac{60\ \text{V} \angle 0°}{3\ \Omega - j9\ \Omega + j6\ \Omega} = \frac{60\ \text{V} \angle 0°}{3\ \Omega - j3\ \Omega} = \frac{60\ \text{V} \angle 0°}{4.243 \angle -45°}$$

$$= \mathbf{14.14\ A \angle 45°}$$

d. $$\mathbf{I}_s = \frac{\mathbf{E}}{\mathbf{Z}_T} = \frac{60\ \text{V} \angle 0°}{1.52\ \Omega \angle -38.89°} = \mathbf{39.47\ A \angle 38.89°}$$