AC power 002

Unlimited Attempts.

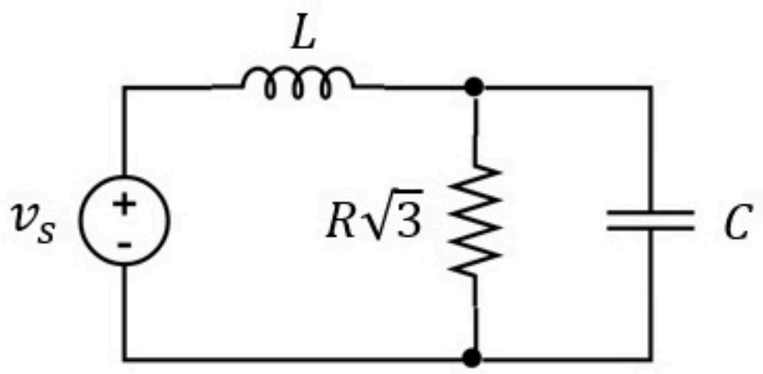
$$v_s(t) = A_1 \cos(1000t + B_1)$$

(a) Find the instantaneous power supplied by the power supply

$$p = A_2\sqrt{3} + A_3 \cos(2000t + B_3) \quad \text{with } -180° < B_3 \leq 180$$

(b) Find the instantaneous power received by the inductor

$$p = A_4\sqrt{3} + A_5 \cos(2000t + B_5) \quad \text{with } -180° < B_5 \leq 180$$



Given Variables:

A1 : 6 V

B1 : 45 degrees

R : 2 ohm

C : 500 uF

L : 1 mH

Calculate the following:

A2 (W) :

9 ✓

A3 (W) :

18 ✓

B3 (degrees) :

120 ✓

A4 (W) :

0 ✓

A5 (W) :

18 ✓

B5 (degrees) :

-120 ✓

Hint: Find the v(t) and i(t), or use the equations (video lecture)

$v_s(t) = A_1 \cos(1000t + B_1)$

A1 : 8 V

B1 : 135 degrees

R : 2 ohm

C : 500 uF

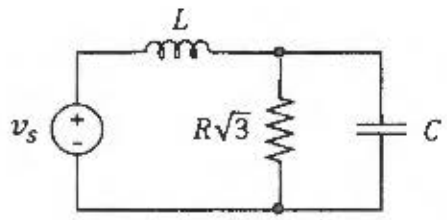
L : 1 mH

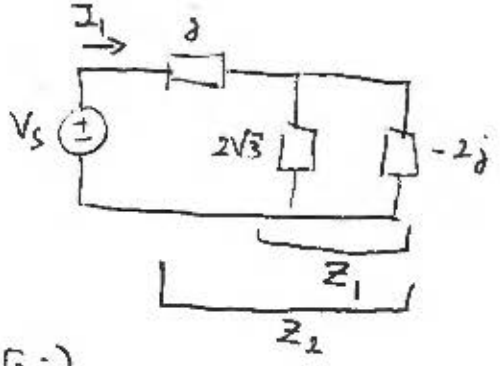
(a) Find the instantaneous power supplied by the power supply

$p = A_2\sqrt{3} + A_3 \cos(2000t + B_3)$

(b) Find the instantaneous power received by the inductor

$p = A_4\sqrt{3} + A_5 \cos(2000t + B_5)$





$V_s = 8\, e^{j135^\circ}$

$Z_1 = \dfrac{1}{\frac{1}{2\sqrt{3}} + \frac{j}{2}} = \dfrac{2\sqrt{3}}{1+\sqrt{3}j} = \dfrac{\sqrt{3}}{2}\left(1-\sqrt{3}j\right)$

$Z_2 = Z_1 + j = \dfrac{\sqrt{3}}{2} - \dfrac{j}{2} = 1 \cdot e^{-30^\circ}$ $\qquad I_1 = \dfrac{V_s}{Z_2} = 8\, e^{j165^\circ}$

INSTANTANEOUS POWER

$$p = \frac{1}{2} V_m I_m \cos(\theta_v - \theta_i) + \frac{1}{2} V_m I_m \cos(2\omega t + \theta_v + \theta_i)$$

(a) $V = V_s \Rightarrow V_m = 8\,V \quad \theta_v = 135^\circ$

$I = I_1 \Rightarrow I_m = 8\,A \quad \theta_i = 165^\circ$

$A_2\sqrt{3} = \frac{1}{2} V_m I_m \cos(\theta_v - \theta_i) = \frac{1}{2} \cdot 8 \cdot 8 \cdot \cos(-30^\circ) = 16\sqrt{3} \Rightarrow \boxed{A_2 = 16\,W}$

$A_3 = \frac{1}{2} V_m I_m = \frac{1}{2} \cdot 8 \cdot 8 \Rightarrow \boxed{A_3 = 32\,W} \quad B_3 = \theta_v + \theta_i = 300^\circ \quad \boxed{B_3 = -60^\circ}$

(b) $I = I_1 \Rightarrow I_m = 8A \quad \theta_i = 165^\circ$

$V = j I_1 \Rightarrow V_m = 8V \quad \theta_v = 165^\circ + 90^\circ = 255^\circ$

$A_4\sqrt{3} = \frac{1}{2} V_m I_m \cos(\theta_v - \theta_i) = \frac{1}{2} \cdot 8 \cdot 8 \cos(90^\circ) = 0 \Rightarrow \boxed{A_4 = 0\,W}$

$A_5 = \frac{1}{2} V_m I_m = \frac{1}{2} \cdot 8 \cdot 8 \Rightarrow \boxed{A_5 = 32\,W} \quad B_5 = \theta_v + \theta_i = 420^\circ$

$\boxed{B_5 = 60^\circ}$