Phasors 009

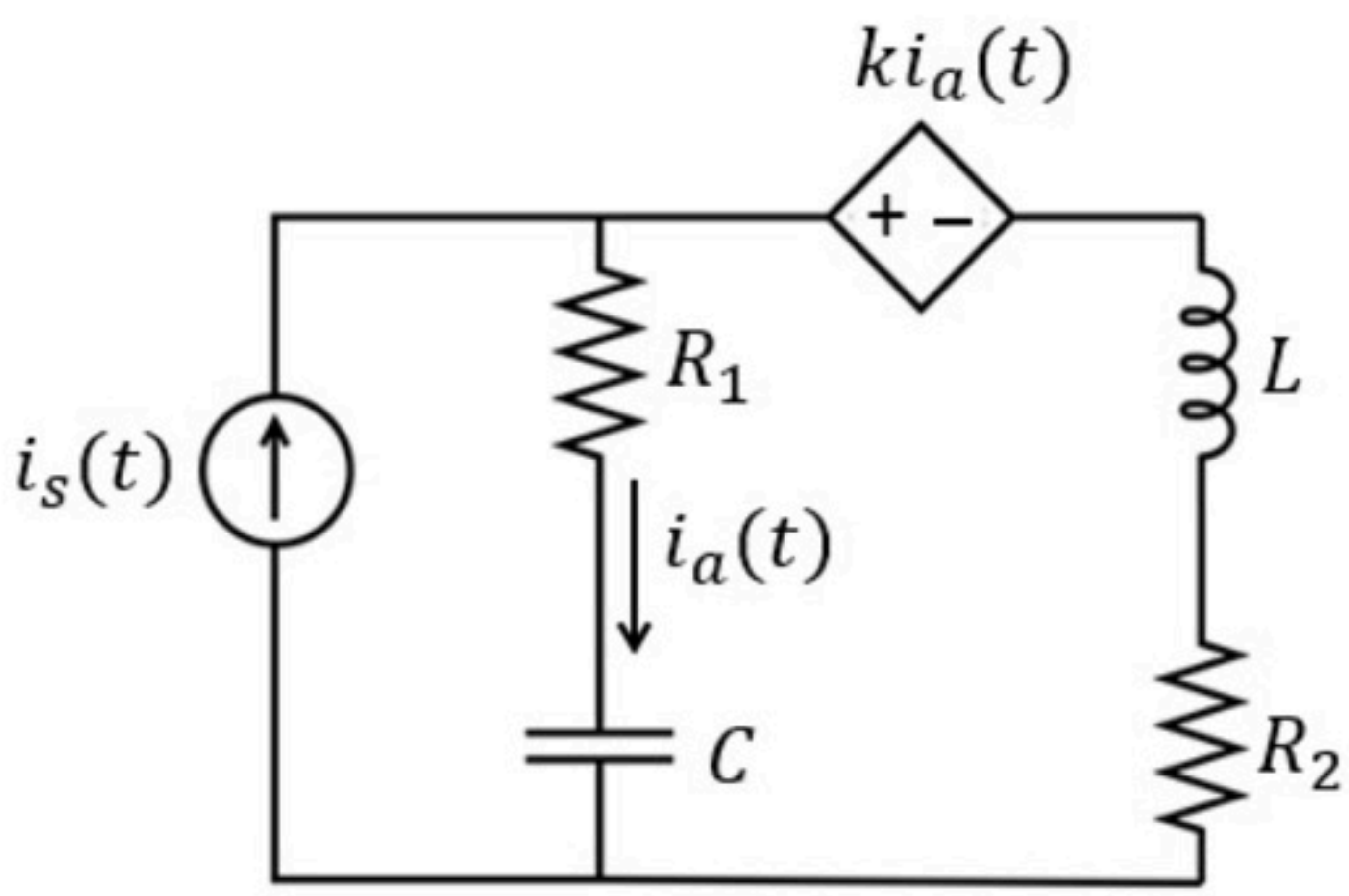
0 of 5 attempts made

$$i_s(t) = A_1 \cdot \cos\left(1000t + \frac{\pi}{2}\right) + A_2 \cdot \cos\left(2000t - \frac{\pi}{2}\right)$$

Assume the system is in steady state. Find the current i_a at times

$t_1 = 4\pi$ ms: $i_a(t_1) = B_1$

$t_2 = 5\pi$ ms: $i_a(t_2) = B_2$



Given Variables:

A1 : 1 A

A2 : 1 A

L : 1 mH

C : 250 uF

R1 : 1 ohm

R2 : 2 ohm

k : 4 V/A

Calculate the following:

B1 (A) :

-2.5

B2 (A) :

-1.5

$i_s(t) = A_1 \cdot \cos(1000t + 90) + A_2 \cdot \cos(2000t - 90)$

Assume the system is in steady state. Find the current i_a at times

$t_1 = 4\pi$ ms: $i_a(t_1) = B_1$

$t_2 = 5\pi$ ms: $i_a(t_2) = B_2$

A1 : 6 A

A2 : 9 A

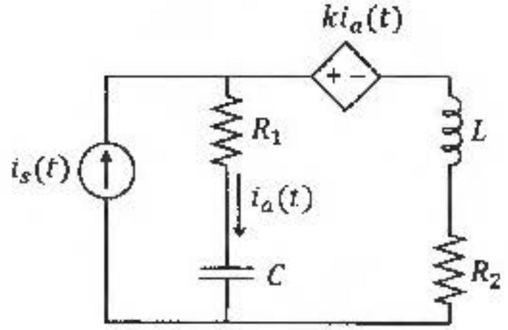
L : 1 mH

C : 250 uF

R1 : 8 ohm

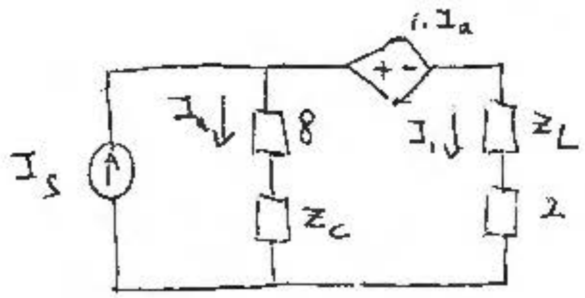
R2 : 2 ohm

k : 1 V/A



2 DIFFERENT ω !

WE NEED TO USE SUPERPOSITION



$\underline{\omega = 1000}$. $Z_L = j \cdot 1000\, L = j$

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

$I_S = 6 e^{j\frac{\pi}{2}} = 6j$

$\underline{\omega = 2000}$. $Z_L = j\, 2000\, L = 2j$

$Z_C = \frac{1}{j\, 2000\, C} = -2j$

$I_S = 9 e^{-j\frac{\pi}{2}} = -9j$

$I_1 = I_S - I_a \Rightarrow I_a(8 + Z_C) = 1 \cdot I_a + (I_S - I_a)(2 + Z_L)$

$\Rightarrow I_a = I_S \dfrac{2 + Z_L}{9 + Z_C + Z_L}$

① $\underline{\omega = 1000}$: $I_a = 6j \dfrac{(2+j)}{(9 - 4j + j)} = \dfrac{6\,(-1+2j)}{3\,(3-j)} \dfrac{(3+j)}{(3+j)} = \dfrac{2}{10}(-5 + 5j) = -1 + j$

$i_{a_1}(t) = \sqrt{2} \cos(1000t + 135°)$

② $\underline{\omega = 2000}$: $I_a = (-9j) \dfrac{2 + 2j}{9 + 2j \cancel{-2j}} = 2(1 - j) \Rightarrow i_{a_2}(t) = 2\sqrt{2} \cos(2000t - 45°)$

③ $i_a(t) = i_{a_1}(t) + i_{a_2}(t) = \sqrt{2} \cos\left(1000t + \frac{3\pi}{4}\right) + 2\sqrt{2} \cos\left(2000t - \frac{\pi}{4}\right)$

④ $\underline{t = 4\pi \cdot 10^{-3}}$ $i_a = \sqrt{2} \cos\left(4\pi + \frac{3\pi}{4}\right) + 2\sqrt{2} \cos\left(8\pi - \frac{\pi}{4}\right) = \sqrt{2} \cos\left(\frac{3\pi}{4}\right) + 2\sqrt{2} \cos\left(-\frac{\pi}{4}\right)$

$= \sqrt{2}\left(-\frac{\sqrt{2}}{2}\right) + 2\sqrt{2}\left(\frac{\sqrt{2}}{2}\right) = -1 + 2 = 1$ $\boxed{B_1 = 1\,A}$

$\underline{t = 5\pi \cdot 10^{-3}}$. $i_a = \sqrt{2} \cos\left(5\pi + \frac{3\pi}{4}\right) + 2\sqrt{2} \cos\left(10\pi - \frac{\pi}{4}\right) = \sqrt{2} \cos\left(-\frac{\pi}{4}\right) + 2\sqrt{2} \cos\left(-\frac{\pi}{4}\right)$

$= \sqrt{2}\left(\frac{\sqrt{2}}{2}\right) + 2\sqrt{2}\left(\frac{\sqrt{2}}{2}\right) = 1 + 2 = 3$ $\boxed{B_2 = 3\,A}$