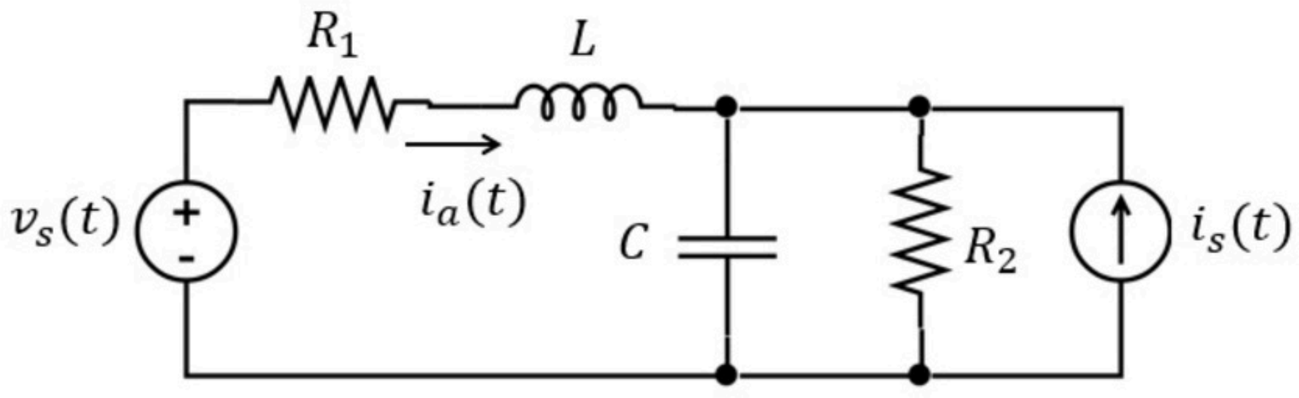
Phasors 010

Problem has been graded.

$v_s(t) = A_1 \cdot \cos(100t)$ and $i_s(t) = A_2$

Find $i_a(t) = A_3\sqrt{2} \cdot \cos(100t + B_3) + A_4$

with $-180° < B_3 \leq 180°$



Given Variables:

A1 : 100 V
A2 : 6 A
C : 0.1 mF
L : 1.5 H
R1 : 50 ohm
R2 : 100 ohm

Calculate the following:

A3 (A) :

0.5 ✓

B3 (degrees) :

-45 ✓

A4 (A) :

-4 ✓

Hint: Use superposition

$v_s(t) = A_1 \cdot \cos(100t)$ and $i_s(t) = A_2$

Find $i_a(t) = A_3\sqrt{2} \cdot \cos(100t + B_3) + A_4$

with $-180° < B_3 \leq 180°$

A1 : 100 V

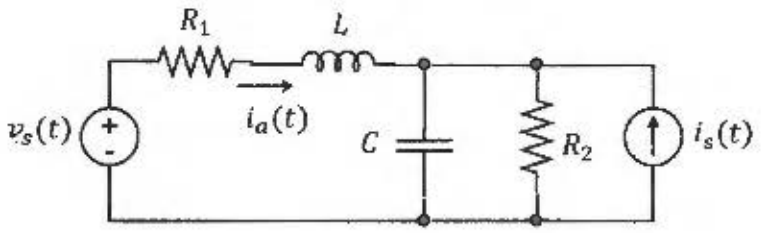
A2 : 6 A

C : 0.1 mF

L : 1.5 H

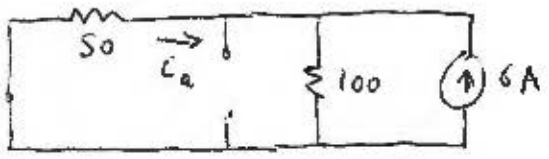
R1 : 50 ohm

R2 : 100 ohm



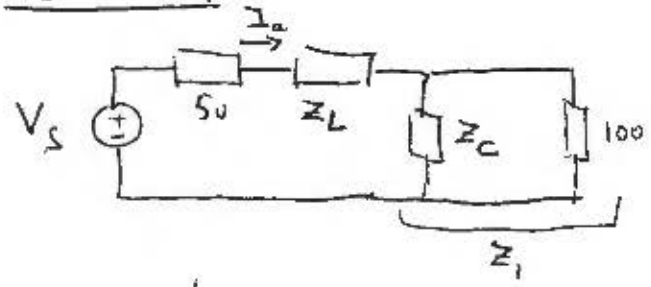
DIFFERENT ω ! WE NEED TO USE SUPERPOSITION

① $i_{s(t)}$ ONLY · $\omega = 0$ DC $\Rightarrow$ L SHORT / C OPEN



$$i_{a_1} = -\frac{100}{100+50} \cdot 6 = -4A$$

② $v_{s(t)}$ ONLY : $\omega = 100$



$$Z_L = j\,100\,L = 150j$$

$$Z_C = \frac{1}{j\,100\,C} = -100j$$

$$V_s = 100$$

$$Z_1 = \frac{1}{\frac{1}{100} + \frac{1}{-j\,100}} = \frac{100}{1+j} = 50(1-j)$$

$$I_a = \frac{V_s}{Z_1 + 50 + Z_L} = \frac{100}{50 - 50j + 50 + 150j} = \frac{100}{100 + 100j} = \frac{\sqrt{2}}{2} e^{-j45°}$$

$$i_{a_2} = \frac{\sqrt{2}}{2} \cos(100t - 45°)$$

③ $i_a(t) = i_{a_1} + i_{a_2} = \frac{\sqrt{2}}{2} \cos(100t - 45°) - 4$

$A_3 = 0.5$ A
$B_3 = -45°$
$A_4 = -4$ A