Phasors 007

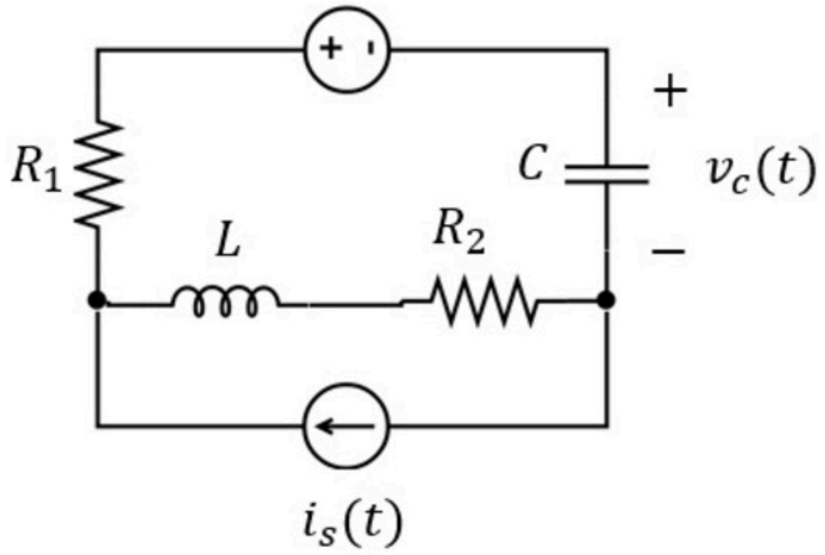
Problem has been graded.

$$v_s(t) = A_1\sqrt{2} \cdot \cos(W_1 t + B_1)$$

$$i_s(t) = 2 \cdot \cos(W_1 t - 90°) \quad \text{A}$$

Find steady state voltage

$$v_c(t) = A_2\sqrt{2} \cdot \cos(W_2 t + B_2) \quad \text{with } -180° < B_2 \leq 180°$$



Given Variables:

A1 : 14 V

B1 : -45 degrees

W1 : 2000 (1/s)

C : 125 uF

L : 2 mH

R1 : 4 ohm

R2 : 4 ohm

Calculate the following:

A2 (V) :

3 ✓

B2 (degrees) :

45 ✓

W2 (1/s) :

2000 ✓

> Hint: We do not need to use superposition, but we could if we wanted to.

$v_s(t) = A_1\sqrt{2} \cdot \cos(W_1 t + B_1)$

$i_s(t) = 2 \cdot \cos(W_1 t - 90°)$ A

Find steady state voltage

$v_c(t) = A_2\sqrt{2} \cdot \cos(W_2 t + B_2)$ with $-180° < B_2 \leq 180°$

A1 : 32 V

B1 : -45 degrees

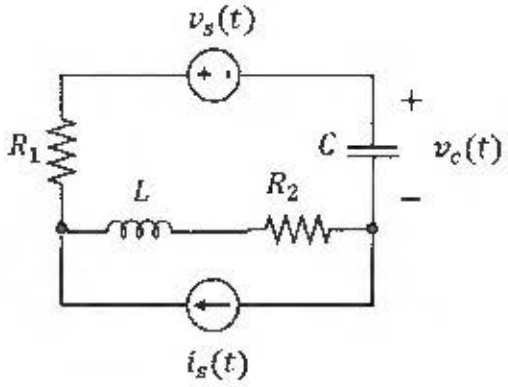
W1 : 2000 1/s

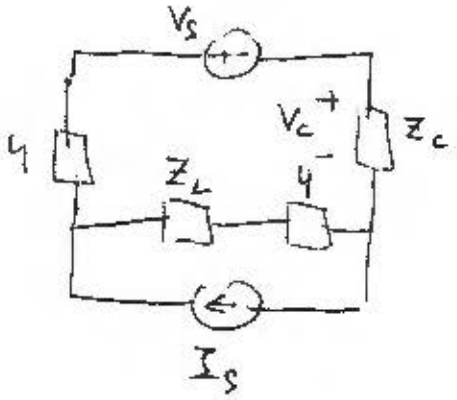
C : 125 uF

L : 2 mH

R1 : 4 ohm

R2 : 4 ohm





$$Z_c = \frac{1}{j\omega C} = \frac{10^6}{j\,2000\,125} = -4j$$

$$Z_L = j\omega L = j\,2000\,2\cdot10^{-3} = 4j$$

$$V_S = 32\sqrt{2}\,e^{-j45°} = 32\sqrt{2}\left(+\frac{\sqrt{2}}{2} - j\frac{\sqrt{2}}{2}\right)$$

$$= 32 - 32j$$

$$I_S = 2\,e^{-j90°} = -2j$$

① ONLY V_S $\quad V_{c_1} = -V_S \cdot \dfrac{Z_c}{Z_c + Z_L + 4 + 4} = \dfrac{(-32+32j)\cdot(-4j)}{-4j+4j+4+4} = \dfrac{-8j}{8}(-32+32j)$

$$= 16 + 16j$$

② ONLY I_S : $V_{c_2} = I_S \cdot \dfrac{Z_L + 4}{Z_L + 4 + Z_c + 4} Z_c = (-2j)\dfrac{4+4j}{4-4j+4j+4} \cdot (-4j)$

$$= -\frac{8(4+4j)}{8} = -4 - 4j$$

③ SUPERPOSITION : $V_c = V_{c_1} + V_{c_2} = 12 + 12j = 12\sqrt{2}\,e^{j45°}$

$$v_c(t) = 12\sqrt{2}\cos(2000t + 45°)$$

$A_2 = 12$ V

$B_2 = 45°$

$W_2 = 2000$ 1/s