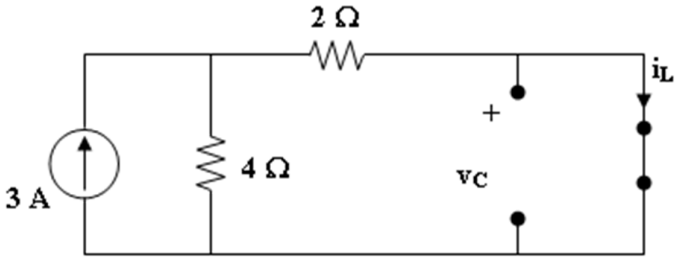
Assignment 3

Q1

Under dc conditions,



$i_L = \frac{4}{4+2}(3) =$ **2 A**, $v_c =$ **0 V**

$$w_L = \frac{1}{2} L\, i_L^2 = \tfrac{1}{2}\left(\tfrac{1}{2}\right)(2)^2 = \textbf{1 J}$$

$$w_c = \frac{1}{2} C\, v_c^2 = \tfrac{1}{2}(2)(v_c) = \textbf{0 J}$$

Q2

$$v = L_{eq}\frac{di}{dt} \rightarrow i = \frac{1}{L_{eq}}\int v(t)dt + i(0) = -0.1(e^{-3t} - 1) + i(0)$$

$$i_1 = \frac{3}{4} i\,, i_2 = \frac{1}{4} i$$

(a) $\boldsymbol{i_2(0) = -25 + 21.67 =}$ **– 3.33 mA**

(b) $\boldsymbol{i_1 = \frac{3}{4}(-0.1e^{-3t} + 0.08667)}$ **A =** **- 75e^{-3t} + 65 mA**

$\boldsymbol{i_2 =}$ **- 25e^{-3t} + 21.67 mA**

Q3

(a) $i(t) = i(\infty) + [i(0) - i(\infty)]e^{-t/\iota}$

$$\boldsymbol{i(t) = (3 - 9e^{-8t})\ A}$$

(b) -12 + 4i(0) + v=0, i.e. v = 12 – 4i(0) = **36 V**

(c) At steady state, the inductor becomes a short circuit so that

v = 0 V

Q4

$$Z_T = 2 + (4 - j6)||(3 + j4) =$$ **6.83 + j1.094 Ω = 6.917∠9.1° Ω**

$$I = \frac{V}{Z_T} = \frac{120\angle 10^\circ}{6.917\angle 9.1^\circ} = \underline{\mathbf{17.35\angle 0.9^\circ\ A}}$$

Q5

- There are different ways to solve this problem.
- The easiest way is to make the inductance and capacitance cancel each other out to result in a purely resistive circuit.

$$\underline{\boldsymbol{C = 1.235\mu F}}$$

Q6

Set $V_s = 145\angle 0^\circ X = \omega L = (2\pi)(60)L$

Based on $I = \frac{V_s}{80+R+jX}$

Obtain $V_1 = 80I$ and $V_o = (R + jX)I$

$$\underline{\boldsymbol{R = 102.8\ \Omega}}$$

$$\underline{\boldsymbol{L = 378.9\ mH}}$$

Q7

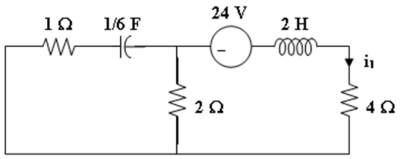
Apply superposition principle, $V_0 = V_1 + V_2$, where $V_1 = 6cos2t$ and $V_2 = 4sin4t$.

$$\underline{V_0 = \mathbf{4.243cos(2t + 45^\circ) + 3.578sin(4t + 26.57^\circ)\ volts}}$$

Q8

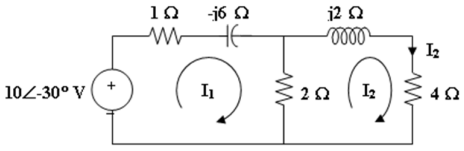
Let $i_0 = i_1 + i_2 + i_3$, where i_1 for the 24-V dc source, i_2 for the ac voltage source, and i_3 for the ac current source.

For i_1,



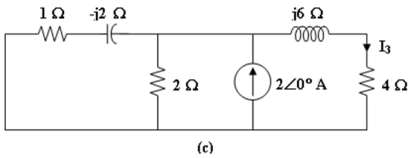
(a)

For i_2,



(b)

For i_3,



(c)

$$\underline{\boldsymbol{i_0 = i_1 + i_2 + i_3 = 4 + 0.504\sin(t + 19.1^\circ) + 0.3352\cos(3t - 76.43^\circ)\ A}}$$

Q9

$\boldsymbol{T = 2,}$ $\qquad$ $\boldsymbol{v(t) = \begin{cases} 5, & 0 < t < 1 \\ -5, & 1 < t < 2 \end{cases}}$

$$\underline{\boldsymbol{V_{rms} = 5\ V}}$$

Q10

(a) $I_{\text{rms}} = \underline{10\ \text{A}}$

(b) $V_{rms} = \underline{4.528\ \text{V}}$

(c) $I_{\text{rms}} = \underline{9.055\ \text{A}}$

(d) $V_{rms} = \underline{4.528\ \text{V}}$