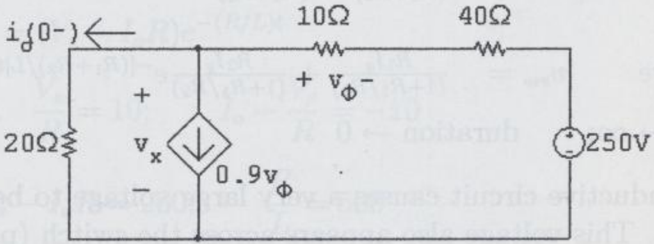
P 7.41 For $t < 0$



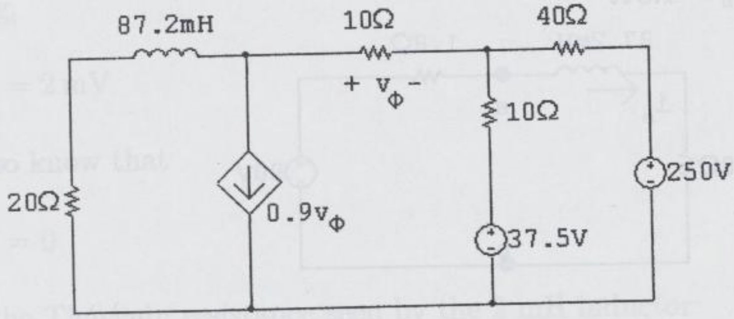
$$\frac{v_x}{20} + 9\left[\frac{v_x - 250}{50}\right] + \left[\frac{v_x - 250}{50}\right] = 0$$

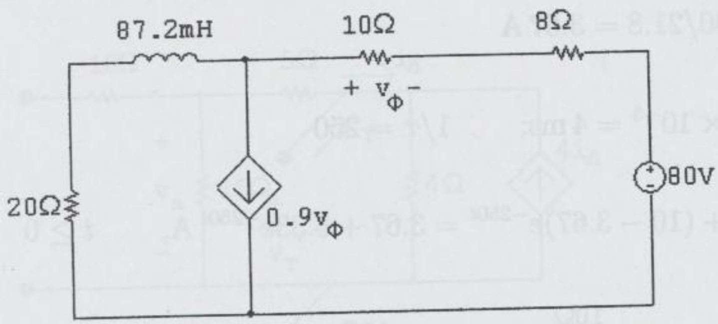
$$\frac{v_x}{20} + 10\frac{(v_x - 250)}{50} = 0$$

$$5v_x - 5000 + 20v_x = 0; \qquad v_x = 200\,\text{V}$$

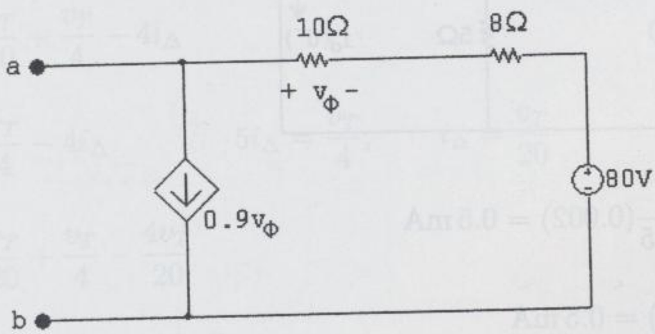
$i_o(0^-) = 200/20 = 10\,\text{A}$

$t > 0$

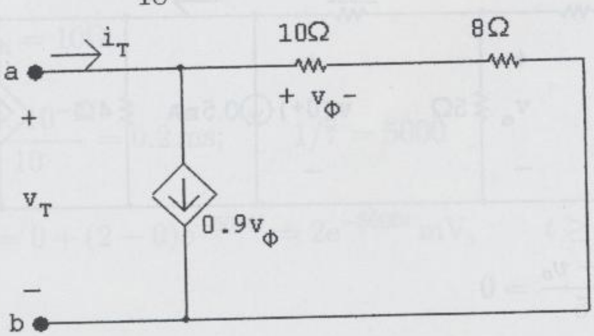




Find Thévenin equivalent with respect to a, b



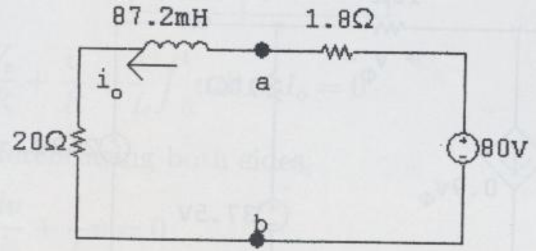
$$\frac{V_{\text{Th}} - 80}{18} + 9\frac{(V_{\text{Th}} - 80)}{18} = 0 \qquad V_{\text{Th}} = 80\,\text{V}$$



$$v_T = (i_T - 0.9v_\phi)18 = \left[i_T - 0.9\left(\frac{10v_T}{18}\right)\right]18$$

$$v_T = 18i_T - 9v_T \qquad \therefore \quad 10v_T = 18i_T$$

$$\frac{v_T}{i_T} = R_{\rm Th} = 1.8\,\Omega$$



$$i_o(\infty) = 80/21.8 = 3.67\,\text{A}$$

$$\tau = \frac{87.2}{21.8} \times 10^{-3} = 4\,\text{ms}; \qquad 1/\tau = 250$$

$$i_o = 3.67 + (10 - 3.67)e^{-250t} = 3.67 + 6.33e^{-250t}\,\text{A}, \qquad t \geq 0$$

P 7.91 [a] $\frac{C dv_p}{dt} + \frac{v_p - v_b}{R} = 0;\qquad$ therefore $\quad \frac{dv_p}{dt} + \frac{1}{RC}v_p = \frac{v_b}{RC}$

$$\frac{v_n - v_a}{R} + C\frac{d(v_n - v_o)}{dt} = 0;$$

therefore $\quad \frac{dv_o}{dt} = \frac{dv_n}{dt} + \frac{v_n}{RC} - \frac{v_a}{RC}$

But $\quad v_n = v_p$

Therefore $\quad \frac{dv_n}{dt} + \frac{v_n}{RC} = \frac{dv_p}{dt} + \frac{v_p}{RC} = \frac{v_b}{RC}$

Therefore $\quad \frac{dv_o}{dt} = \frac{1}{RC}(v_b - v_a);\qquad v_o = \frac{1}{RC}\int_0^t (v_b - v_a)\,dy$

[b] The output is the integral of the difference between v_b and v_a and then scaled by a factor of $1/RC$.

[c] $v_o = \frac{1}{RC}\int_0^t (v_b - v_a)\,dx$

$$RC = (40) \times 10^3 (25) \times 10^{-9} = 1\,\text{ms}$$

$$v_b - v_a = 50\,\text{mV}$$

$$v_o = 50\int_0^t dx = 50t;\qquad 50t_{sat} = 12;\qquad t_{sat} = 240\,\text{ms}$$

P 9.20 [a] $Y_2 = \frac{1}{R_2} - \frac{j}{\omega L_2}$

$$Y_1 = \frac{1}{R_1 + j\omega L_1} = \frac{R_1 - j\omega L_1}{R_1^2 + \omega^2 L_1^2}$$

Therefore $\quad Y_2 = Y_1 \quad$ when

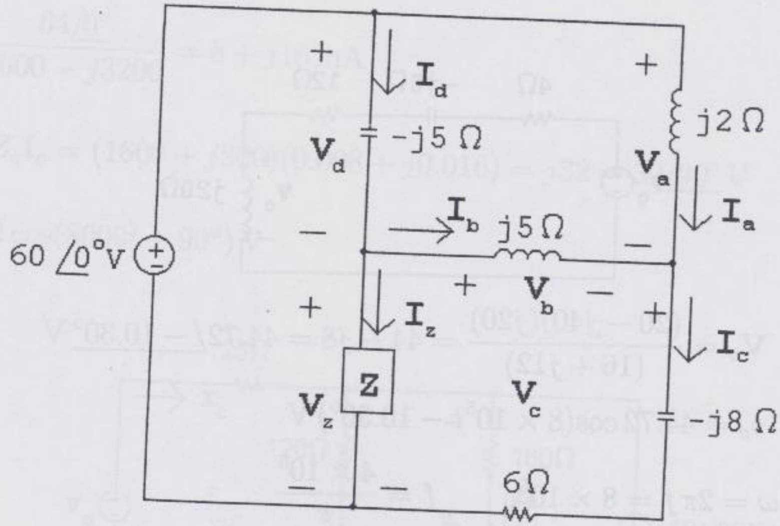
$$R_2 = \frac{R_1^2 + \omega^2 L_1^2}{R_1} \quad \text{and} \quad L_2 = \frac{R_1^2 + \omega^2 L_1^2}{\omega^2 L_1}$$

[b] $R_2 = \dfrac{25 \times 10^6 + 10^8(0.25)}{5 \times 10^3} = 10 \times 10^3$

$$\therefore \quad R_2 = 10\,\text{k}\Omega$$

$$L_2 = \frac{50 \times 10^6}{10^8(0.5)} = 1\,\text{H}$$

P 9.32



$$\mathbf{V}_a = j2\mathbf{I}_a = j2(-j5) = 10\underline{/0^\circ}\ \text{V}$$

$$\mathbf{V}_c = 60\underline{/0^\circ} - \mathbf{V}_a = 50\underline{/0^\circ}\ \text{V}$$

$$\mathbf{I}_c = \frac{\mathbf{V}_c}{6 - j8} = \frac{50\underline{/0^\circ}}{10\underline{/-53.13^\circ}} = 5\underline{/53.13^\circ} = 3 + j4\ \text{A}$$

$$\mathbf{I}_b = \mathbf{I}_c - \mathbf{I}_a = 3 + j4 - (-j5) = 3 + j9\ \text{A} = 9.49\underline{/71.57^\circ}\ \text{A}$$

$$\mathbf{V}_b = \mathbf{I}_b(j5) = (3 + j9)(j5) = -45 + j15\ \text{V}$$

$$\mathbf{V}_z = \mathbf{V}_b + \mathbf{V}_c = -45 + j15 + 50 + j0 = 5 + j15\ \text{V}$$

$$\mathbf{V}_d + \mathbf{V}_z = 60\underline{/0^\circ}; \qquad \therefore\ \mathbf{V}_d = 60 - 5 - j15 = 55 - j15\ \text{V}$$

$$\mathbf{I}_d = \frac{\mathbf{V}_d}{-j5} = 3 + j11\ \text{A}$$

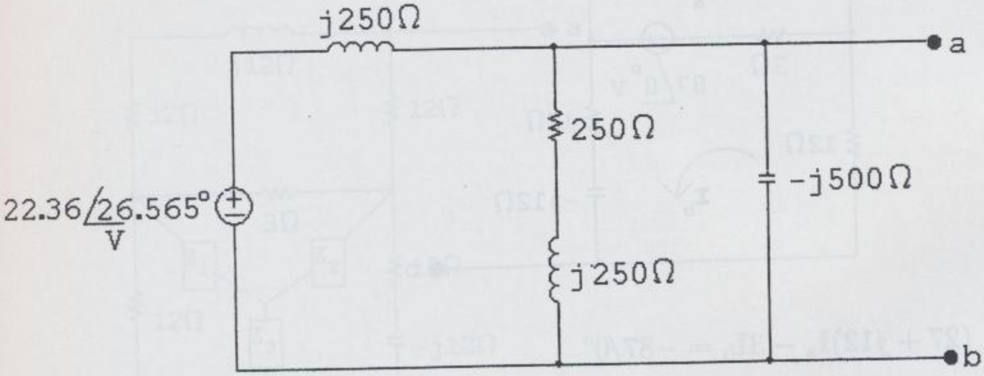
$$\mathbf{I}_z = \mathbf{I}_d - \mathbf{I}_b = 3 + j11 - 3 - j9 = j2\ \text{A}$$

$$Z = \frac{\mathbf{V}_z}{\mathbf{I}_z} = \frac{5 + j15}{j2} = 7.5 - j2.5\ \Omega$$

P 9.33 V is th...

P 9.42 [a] $j\omega L = j(5000)(50)\times 10^{-3} = j250\,\Omega$

$$\frac{1}{j\omega C} = -j\frac{1}{(5000)(400\times 10^{-9})} = -j500\,\Omega$$



Using voltage division,

$$\mathbf{V}_{\text{ab}} = \frac{(250+j250)\|(-j500)}{j250+(250+j250)\|(-j500)}(23.36\underline{/26.565^\circ}) = 20\underline{/0^\circ}$$

$$\mathbf{V}_{\text{Th}} = \mathbf{V}_{\text{ab}} = 20\underline{/0^\circ}\text{ V}$$

[b] Remove the voltage source and combine impedances in parallel to find $Z_{\text{Th}} = Z_{\text{ab}}$:

$$Y_{\text{ab}} = \frac{1}{j250} + \frac{1}{250+j250} + \frac{1}{-j500} = 2 - j4\text{ mS}$$

$$Z_{\text{Th}} = Z_{\text{ab}} = \frac{1}{Y_{\text{ab}}} = 100 + j200\,\Omega$$

[c]