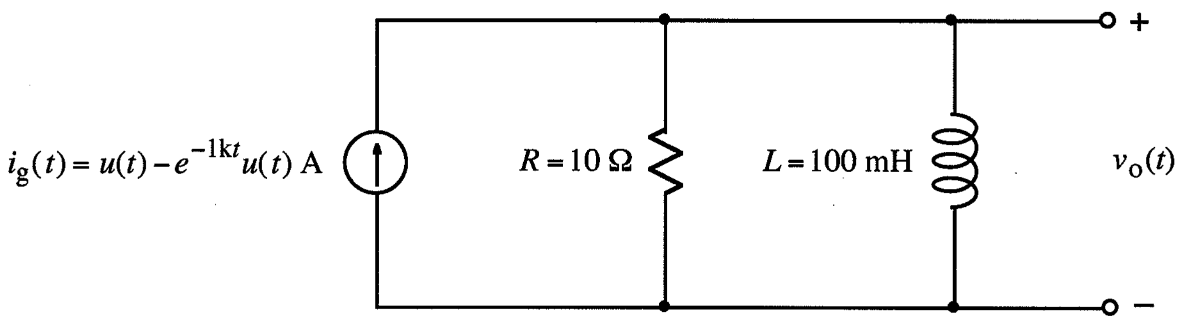
Ex:



a) Write the Laplace transform $I_g(s)$ of $i_g(t)$.

b) Write the Laplace transform $V_o(s)$ of $v_o(t)$. Be sure to include the effects of the initial current in the L.

c) Write a numerical time-domain expression for $v_o(t)$ where $t \geq 0$.

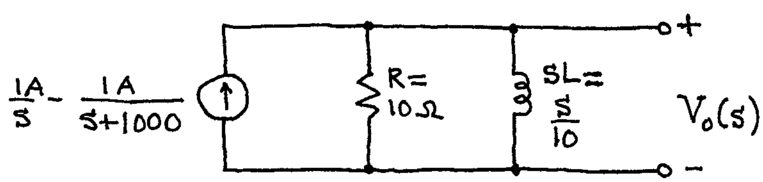
sol'n a) $\mathcal{L}\{i_g(t) = u(t) - e^{-1kt}u(t)\}$ A

$$= \mathcal{L}\{u(t)\} - \mathcal{L}\{e^{-1kt}u(t)\} \text{ A}$$

$$= \frac{1}{s} - \frac{1}{s+1000} \text{ A}$$

b) There is no current at $t = 0^-$ since there is no current from the source for $t < 0$.

s-domain model:



$$-10A_2 + A_2 = -10$$

$$-9A_2 = -10$$

$$A_2 = \frac{10}{9}$$

$$A_1 = -10A_2 = -10\left(\frac{10}{9}\right) = \frac{-100}{9}$$

Thus, $$\frac{-10s}{(s+1000)(s+100)} = \frac{-100/9}{s+1000} + \frac{10/9}{s+100}$$

$$V_o(s) = \frac{10\ V}{s+100} - \frac{100/9\ V}{s+1000} + \frac{10/9\ V}{s+100}$$

$$v_o(t) = 10e^{-100t} - \frac{100}{9}e^{-1kt} + \frac{10}{9}e^{-100t}\ V \qquad t>0$$

or $$v_o(t) = \left[10e^{-100t} - \frac{100}{9}e^{-1kt} + \frac{10}{9}e^{-100t}\right]u(t)\ V$$

$$V_o(s) = I_g(s) \cdot Z_{tot}$$

$$" = \left(\frac{1}{s}A - \frac{1A}{s+1000}\right) R \| sL$$

$$" = \left(\frac{1}{s}A - \frac{1A}{s+1000}\right) \frac{sRL}{sL+R}$$

$$V_o(s) = \left(\frac{1}{s}A - \frac{1A}{s+1000}\right) \frac{sR}{s+\frac{R}{L}}$$

$$V_o(s) = \left(\frac{1}{s}A - \frac{1A}{s+1000}\right) \frac{s\,10}{s+100}\,\Omega$$

$$V_o(s) = \frac{10}{s+100}V - \frac{10s}{(s+1000)(s+100)}V$$

c) We use partial fractions for the second term.

$$\frac{-10s}{(s+1000)(s+100)} = \frac{A_1}{s+1000} + \frac{A_2}{s+100}$$

$$= \frac{A_1(s+100) + A_2(s+1000)}{(s+1000)(s+100)}$$

Match coefficients of each power of s.

$A_1 + A_2 = -10$ coeffs of s

$100A_1 + A_2\,1000 = 0$ coeffs of constants

or $A_1 = -10A_2$