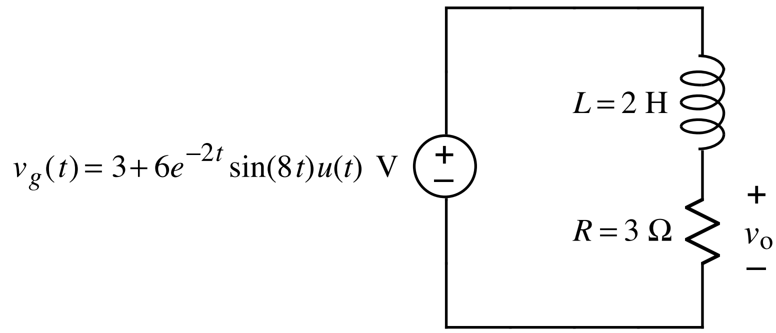
Homework 14

1.



Note: The 3 V in the $v_g(t)$ source is always on.

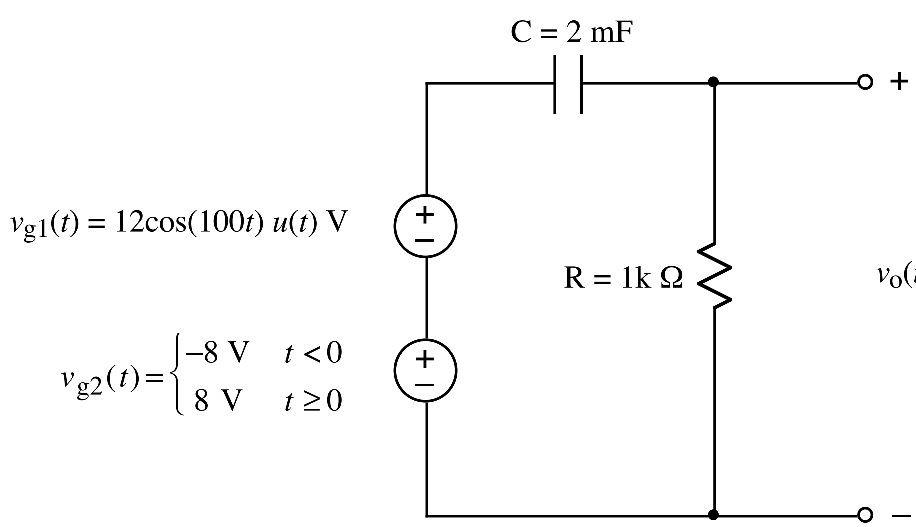
a) Write the Laplace transform, $V_g(s)$, of $v_g(t)$.

b) Draw the s-domain equivalent circuit, including source $V_g(s)$, components, initial conditions for L, and terminals for $V_o(s)$.

2. c) Write an expression for $V_o(s)$.

d) Apply the initial value theorem to find $\lim_{t \to 0+} v_o(t)$.

3.



a) Write the Laplace transform, $V_{g2}(s)$, of $v_{g2}(t)$.

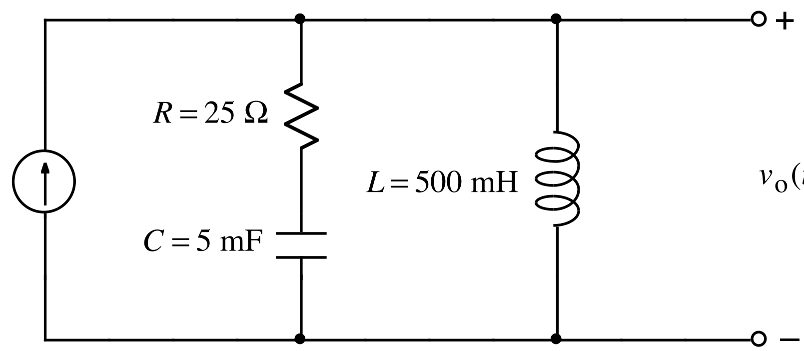
b) Draw the s-domain equivalent circuit, including sources $V_{g1}(s)$ and $V_{g2}(s)$, components, initial conditions for C, and terminals for $V_o(s)$.

4. a) For the circuit in problem 3, write an expression for $V_o(s)$.

b) Apply the final value theorem to $V_o(s)$ to find $\lim_{t \to \infty} v_o(t)$.

5.

$$i_g(t) = \begin{cases} 3\text{ A} & t < 0 \\ 0\text{ A} & t \geq 0 \end{cases}$$



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

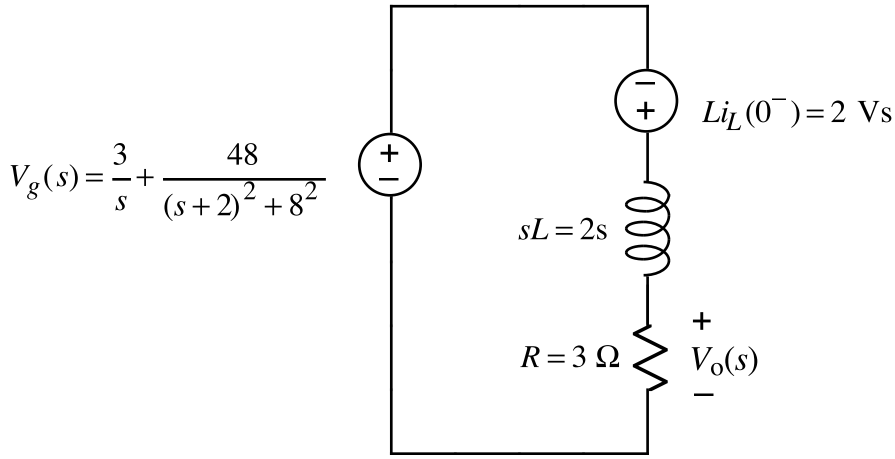
b) Write the Laplace transform $V_o(s)$ of $v_o(t)$. Be sure to include the effects of initial conditions, if they are nonzero.

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

Answers:

1.a) $V_g(s) = \frac{3}{s} + 6 \cdot \frac{8}{(s+2)^2 + 8^2} = \frac{3}{s} + \frac{48}{(s+2)^2 + 8^2}$

b)

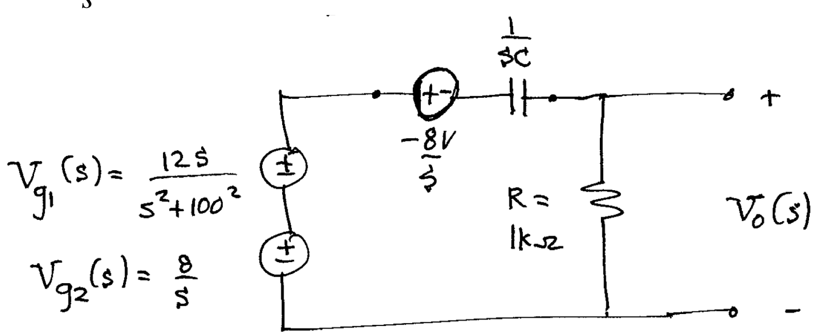


2.c) $V_o(s) = \left[V_g(s) + Li_L(0^-)\right]\frac{R}{sL+R} = \left[\frac{3}{s} + \frac{48}{(s+2)^2 + 8^2} + 2\right]\frac{3}{2s+3}$

d) $\lim_{t \to 0+} v_o(t) = 3$ V

3.a) $V_{g2} = \frac{8}{s}$

b)



4.a) $V_o(s) = \left(\frac{8}{s} + \frac{12s}{s^2 + 100^2} - -\frac{8}{s}\right)\frac{R}{R + \frac{1}{sC}}$

b) Thm does not apply because we have poles on the imaginary axis (solution oscillates forever).

5.a) $I_g(t) = \mathcal{L}\{i_g(t)\} = \mathcal{L}\{0\}\text{A} = 0\,\text{A}$

b) $V_o(s) = -75\,\text{V}\frac{s+8}{(s+10)(s+40)}$

c) $v_o(t \geq 0) = [5e^{-10t} - 80e^{-40t}]u(t)$ V