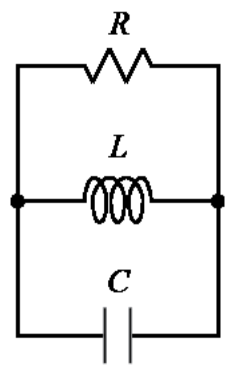
1.



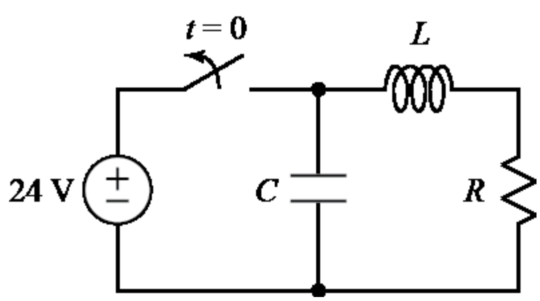
$R = 0.5\ \Omega$ $L = 1.5\ \mu H$ $C = 1.5\ \mu F$

a) Find the characteristic roots, s_1 and s_2, for the above circuit.

b) Is the circuit over-damped, critically-damped, or under-damped? Explain your answer.

c) If the L and C values in the circuit are decreased by a factor of two, (and R remains the same), will the circuit be over-damped, critically-damped, or under-damped? Justify your answer with calculations.

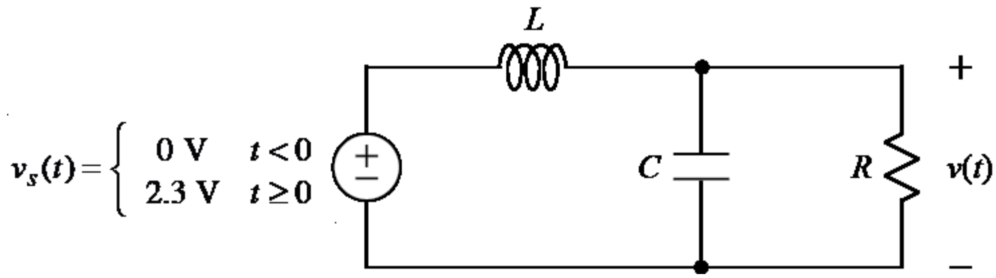
2.



$C = 1$ mF $L = 25$ mH

A relay is driven by a 24 V power supply, as shown above. Power is turned off at $t = 0$. The current, $i(t)$, for $t > 0$ has two terms that decay exponentially without oscillation. One term dies out quickly, and the other term dies out with a time constant of $\tau = 10$ ms, as in $e^{-t/10\text{ms}}$. Given the time constant and the information in the diagram above, find the value of R.

3.

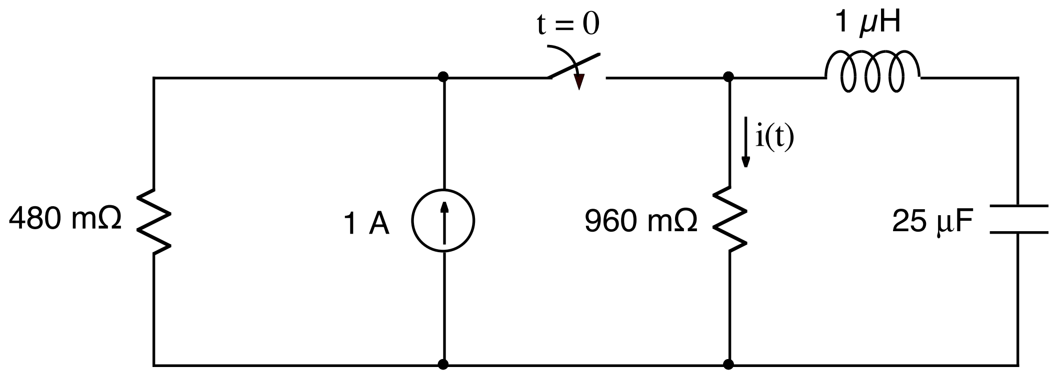


The above circuit models a digital logic gate driving another digital logic gate (modeled as R and C) via a long path of metal on-chip (modeled as L).

L = 10 pH C = 0,4 pF R = 1 GΩ

Find the shape of $v(t)$ versus time. That is, make a rough sketch of $v(t)$ based on the characteristic roots and final value of $v(t)$.

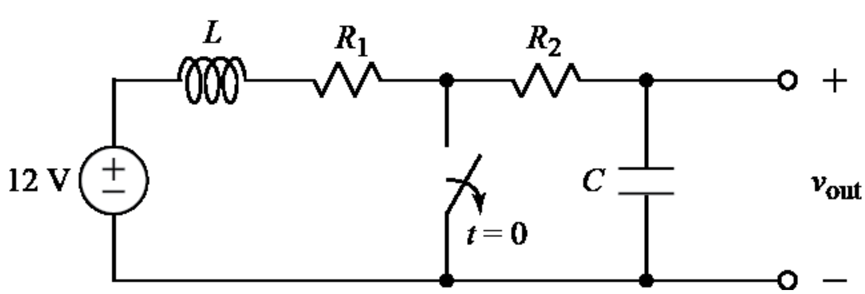
4.



After being open for a long time, the switch closes at $t = 0$.

Find $i(t)$ for $t > 0$.

5.



A 12 V power supply drives a long wire, (modeled as L and R_1), followed by a short wire, R_2, and a smoothing capacitor, C. There is a safety switch, located before the smoothing capacitor, to turn off the output at the remote end. The switch is closed for a long time before opening at $t = 0$.

L = 2 μH R_1 = 2.0 Ω R_2 = 0.1 Ω C = 200 μF

a) Find the characteristic roots, s_1 and s_2, for the above circuit.

b) Find v_{out} for $t > 0$.