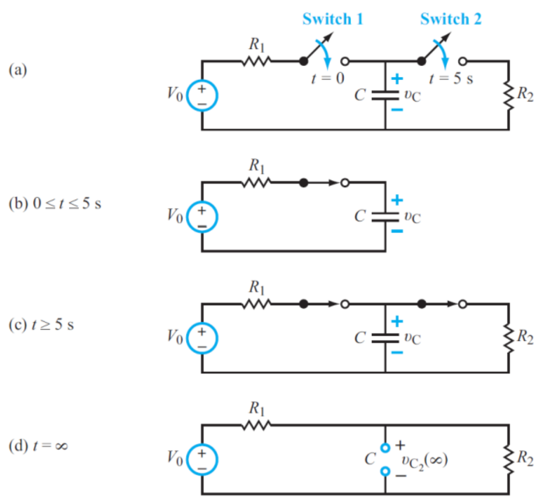
Homework 5

Due date:
Apr.16th, 2018
Turn in your homework in class

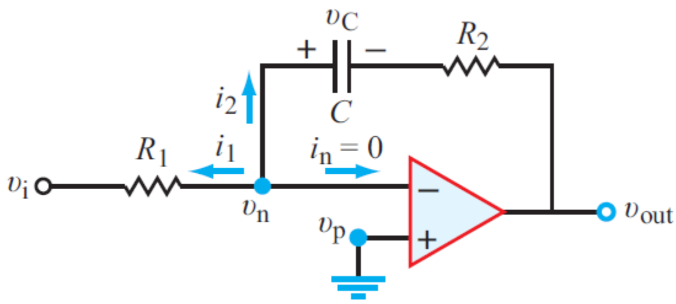
Rules:

- Please try to work on your own. Discussion is permissible, but identical submissions are unacceptable!
- Please show all intermediate steps: a correct solution without an explanation will get zero credit.
- Please submit on time. No late submission will be accepted.
- Please prepare your submission in English only. No Chinese submission will be accepted.

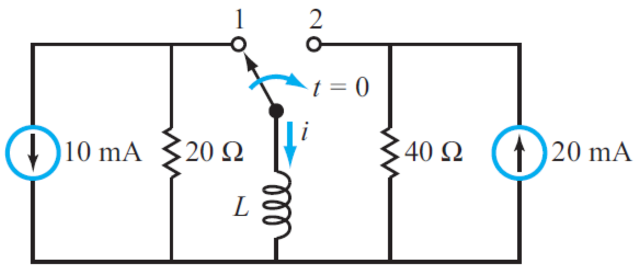
1. The circuit contains two switches, both of which had been open for a long time before t = 0. Switch 1 closes at t = 0, and switch 2 follows suit at t = 5 s. Determine and plot $V_c(t)$ for $t \geq 0$ given that $V_0 = 24V$, $R_1 = R_2 = 16\ k\Omega$, and $C = 250\mu F$. Assume $V_c(0) = 0$.



2. Relate V_{out} to V_i in the circuit. Assume $V_c = 0$ at $t = 0$.



3. The switch in the circuit was moved from position 1 to position 2 at t = 0, after it had been in position 1 for a long time. If L = 80 mH, determine i(t) for t ≥ 0.

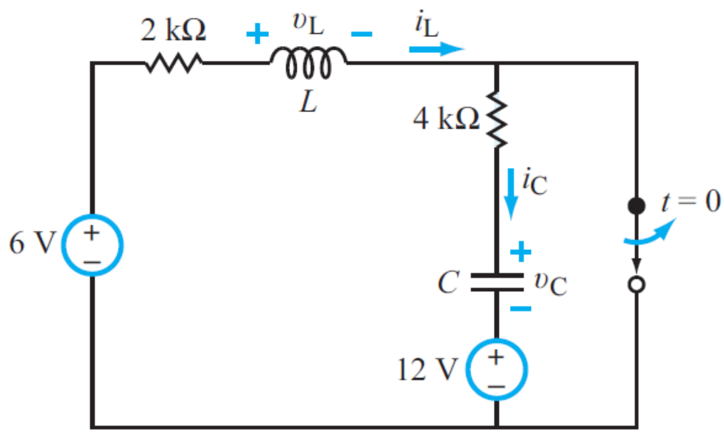


4. The switch in the circuit opens at t = 0 after it has been closed for a long time. Find

(1) $V_c(0^+)$and $i_L(0^+)$

(2) $i_c(0^+)$ and $V_L(0^+)$

(3) $V_c(\infty)$ and $i_L(\infty)$.

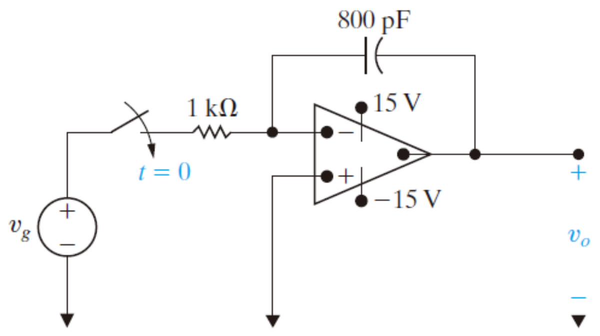


5. The voltage source in the circuit in the figure is generating the triangular waveform shown in figure. Assume that the energy stored in the capacity is zero at $t = 0$ and the Op-Amp is ideal.

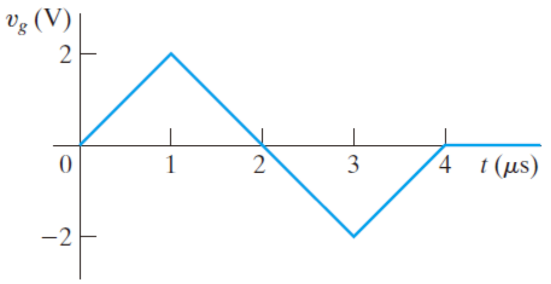
(1) Derive the numerical expressions for $V_0(t)$ for the following time in the following time intervals: $0 \leq t \leq 1\mu s$; $1 \leq t \leq 3\mu s$; $3 \leq t \leq 4\mu s$.

(2) Sketch the output waveform between 0 and 4μs.

(3) If the triangular input voltage continues to repeat itself for $t > 4\mu s$, what would you expect the output voltage to be? Explain.



(a)

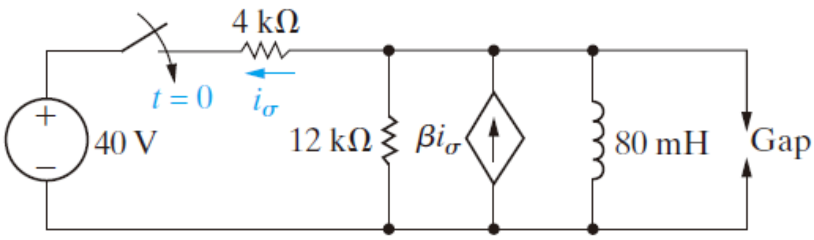


(b)

6. The gap in the circuit seen in figure will arc over whenever the voltage across the gap reaches 30 kV. The initial current in the inductor is zero. The value of β is adjusted so the Thevenin resistance with respect to the terminals of the inductor when the switch is closed is -4 kΩ.

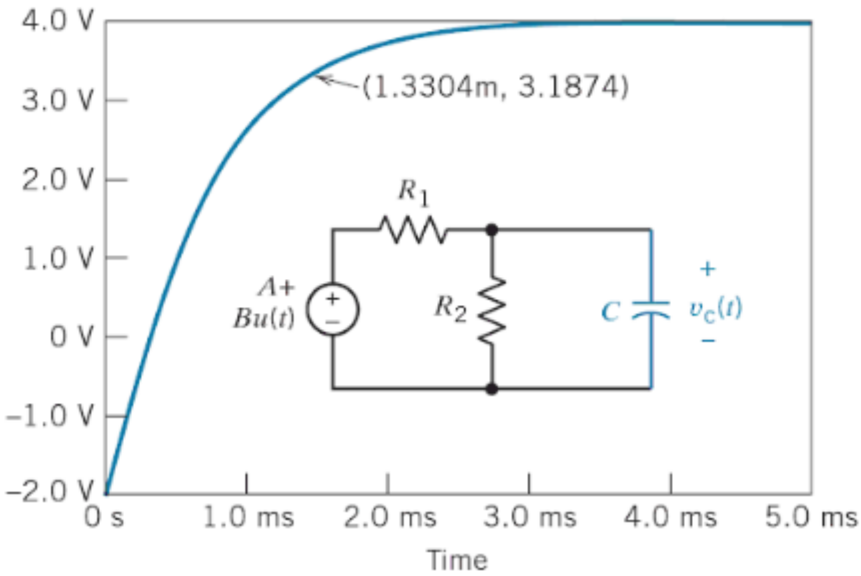
(1) What is the value of β?

(2) How many microseconds after the switch has been closed will the gap arc over?

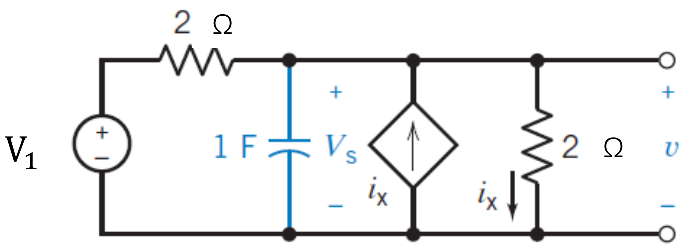


7. About one months ago, Wang Xiaoming went into the lab to find the principle of Thevenin circuit. Today, Keyi Yuan, who is an SIST student, is also interested in the principle of the circuit. He wanted to find how RL circuit works. With the help of Wang Xiaoming, he built a circuit like the one in figure.

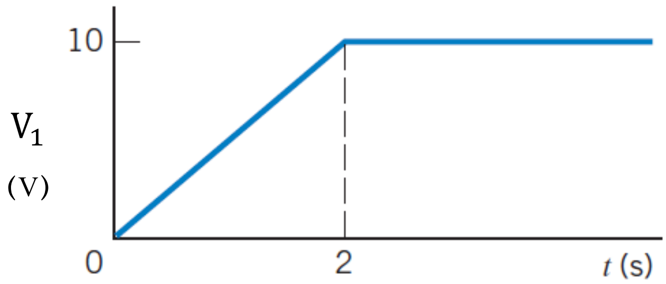
In the figure shows the transient response of a first-order circuit. A point on this transient response has been labeled. The label indicates a time and the capacitor voltage at that time. Assume that this circuit has reached steady state before the time t=0. Placing the circuit diagram on the plot suggests that the plot corresponds to the circuit. Suppose $R_1 = 1k\Omega, R_2 = 2k\Omega$. Specify values of A, B and C that cause the voltage across the capacitor in this circuit to be accurately represented by this plot.



8. Determine v(t) for the circuit shown in figure a when the voltage source V_1 varies as shown in figure. The initial capacitor voltage is $V_s(0^+) = 0$.

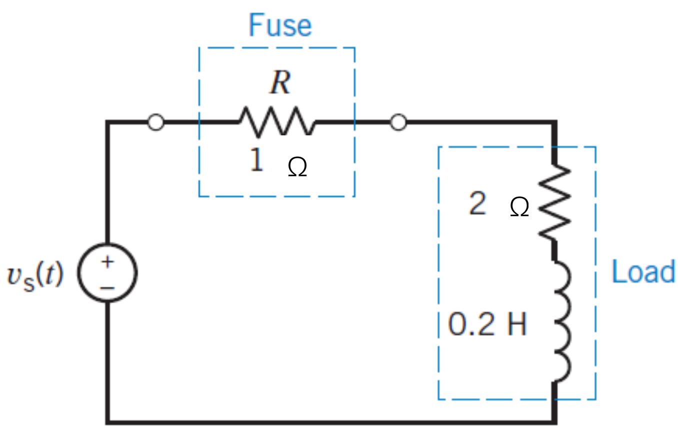


(a)



(b)

9. Fuses are used to open a circuit when excessive current flows. This circuit was designed by Wright in 1990. One fuse is designed to open when the power absorbed by R exceeds 10W for 0.5s. Consider the circuit shown in figure. The input is given by $V_s = A[u(t) - u(t - 0.75)]$. Assume that $i_L(0^-) = 0$. Determine the largest value of A that will not cause the fuse to open.



10. The switch in Figure closes at time 0, $2\Delta t, 4\Delta t, \cdots, 2k\Delta t$ and opens at times $\Delta t, 3\Delta t, 5\Delta t, \cdots, (2k+1)\Delta t$. When the switch closes, $v(t)$ makes the transition from $v(t) = 0$ to $v(t) = 5V$. Conversely, when switch opens, $v(t)$ makes the transition from $v(t) = 5V$ to $v(t) = 0$. Suppose we require that one transition be 95 percent complete before the next one begins.

(1) Determine the value of C required so that $\Delta t = 1\mu s$.

(2) How large must Δt be when $C = 2\mu F$?