電路學(10410EE221002)第二次期中考

2015年12月09日
時間：2 小時
Close Book

學號：________________________________

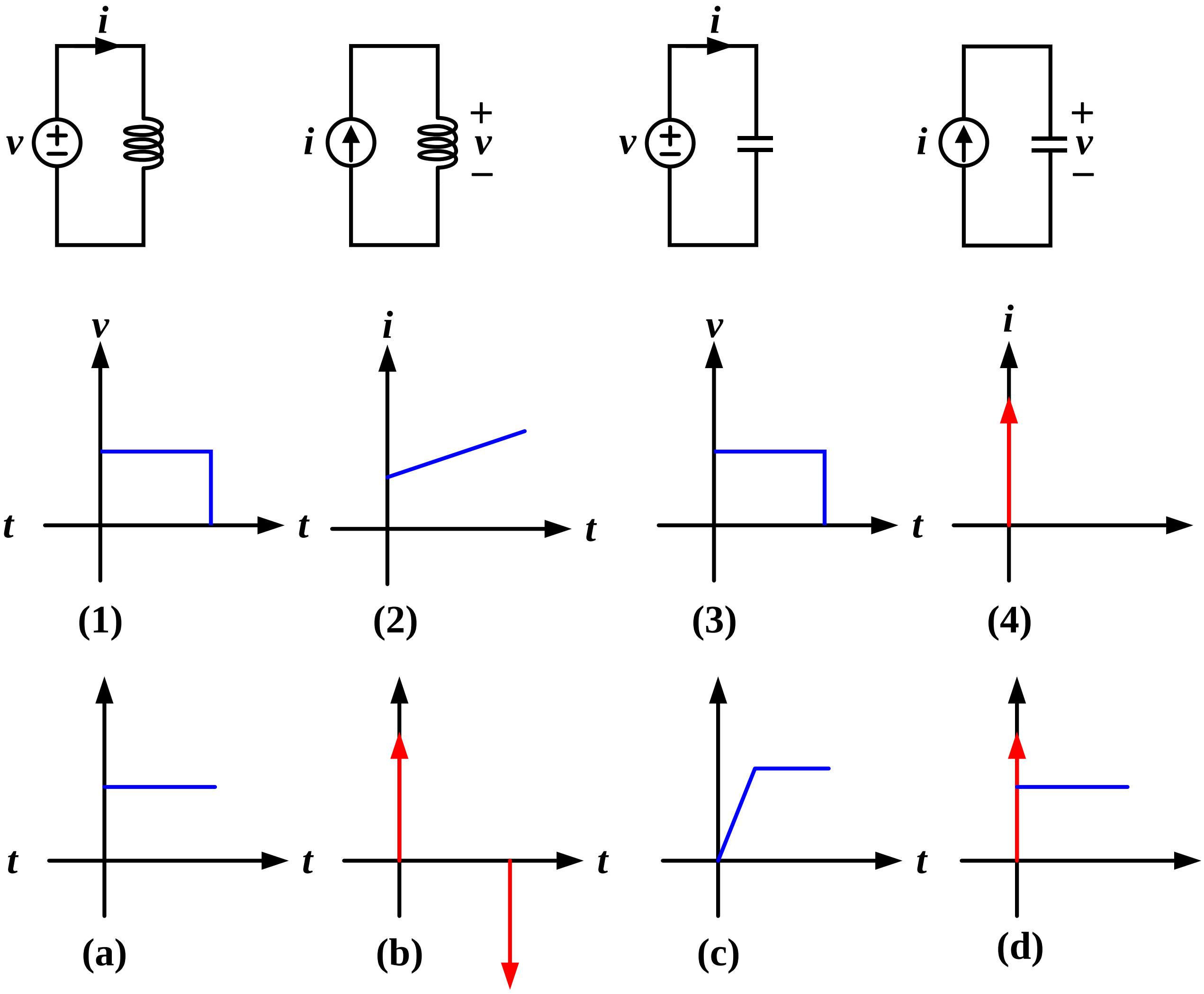
姓名：________________________________

- There are 12 pages in this midterm exam, including this cover page. Please check that you have them all.
- Please write your **學號 姓名** in the space provided above.
- **IMPORTANT:** The problems in this exam vary in difficulty; moreover, questions of different levels of difficulty are distributed throughout the exam. If you find yourself spending a long time on a question, consider moving on to later problems in the exam, and then working on the challenging problems after you have finished all of the easier ones.
- Do your work and enter your answer for each question within the boundaries of that question. You may do your work on the back of the preceding page. Give a brief explanation if you are asked to explain.
- Remember to include the sign and units for all numerical answers.
- This is a closed-book exam, but you may use a calculator.
- You have 2 hours to complete this exam.
- Good luck!

Table of grades:

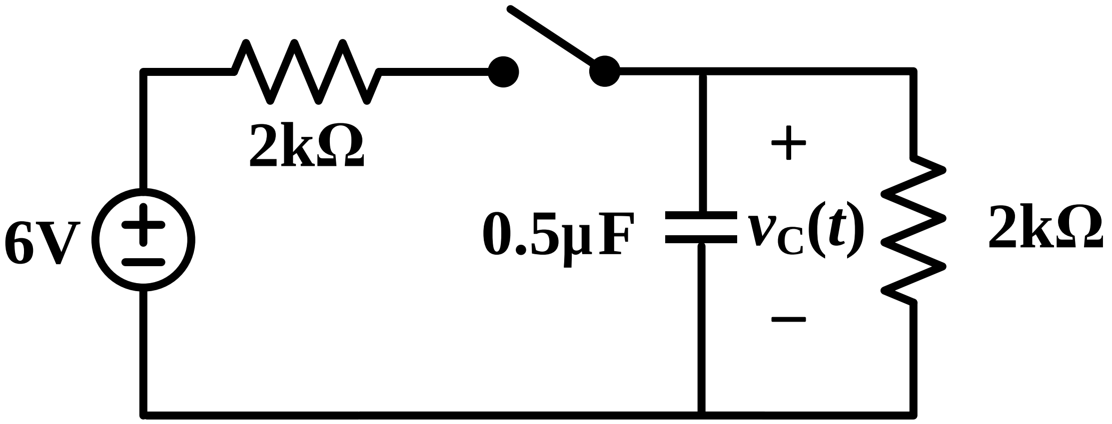
1.	**2.**	**3.**	**4.**	**5.**
6.	**7.**	**8.**	**9.**	
Total Grade:				

1. The following figures show four circuits, labeled "(1)" through "(4)", together with the waveform for the source in each circuit. The figures also show four branch-variable waveforms, labeled "(a)" through "(d)", that could correspond to branch currents i or branch voltages v labeled in circuits. Match the branch variable waveform (a to d) to the appropriate circuit and source waveform (1 to 4). (8%)



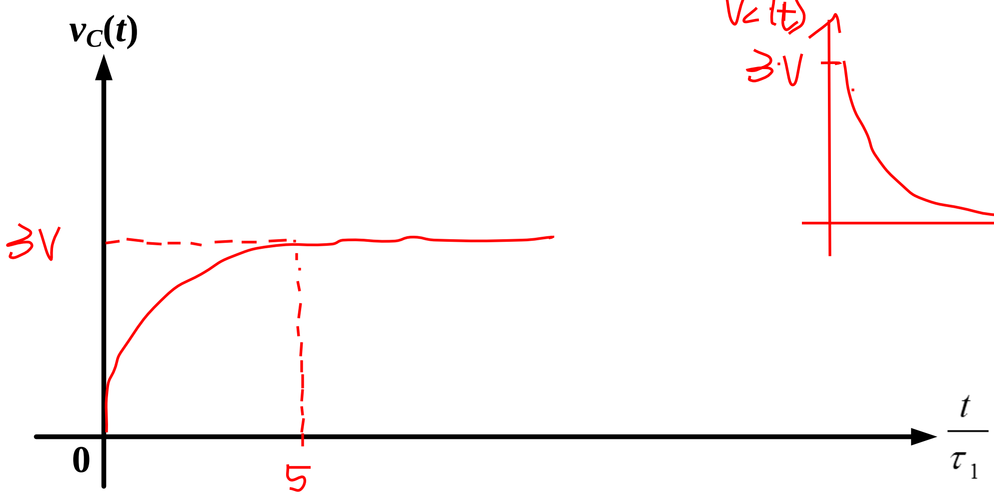
(1) → ____c____, (2) → ____d____, (3) → ____b____, (4) → ____a____.

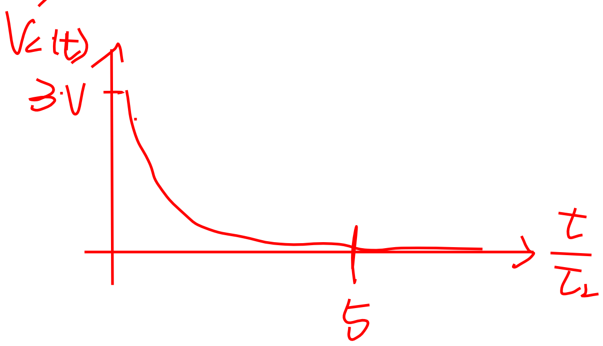
2. For the circuit as shown, the switch was opened for a long time before it was closed at time $t = 0$ and opened at $t = 2.5$ msec. Find $v_C(t)$ for $t \geq 0$. (12%)



$\tau_1(0 < t < 2.5\text{ms}) =$ ___0.5 ms___ (2%), $\tau_2(t > 2.5\text{ms}) =$ ___1 ms___ (2%),

$v_C(t) =$ ___$3 - 3e^{\frac{-t}{0.5\,ms}}$ (for $0 < t \leq 2.5$ ms), $3e^{\frac{-t}{1\,ms}}$ for $t > 2.5$ ms___ (4%).

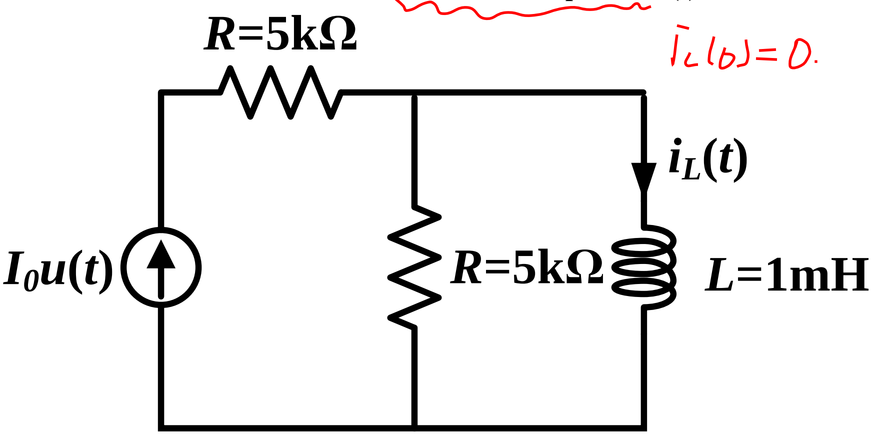




(4%).

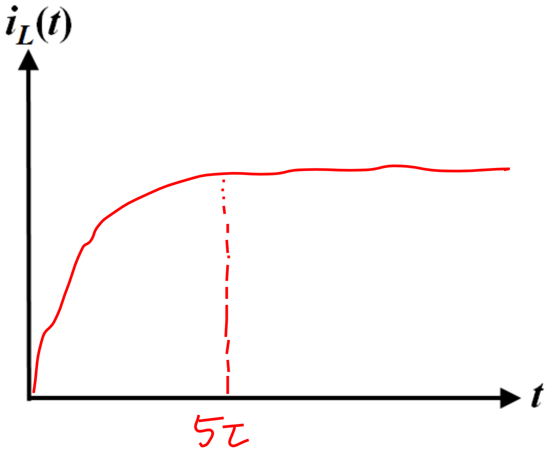
3. For the circuit as shown, find and sketch the zero state response $i_L(t)$ for $t \geq 0$. (10%)

$i_L(0) = 0.$



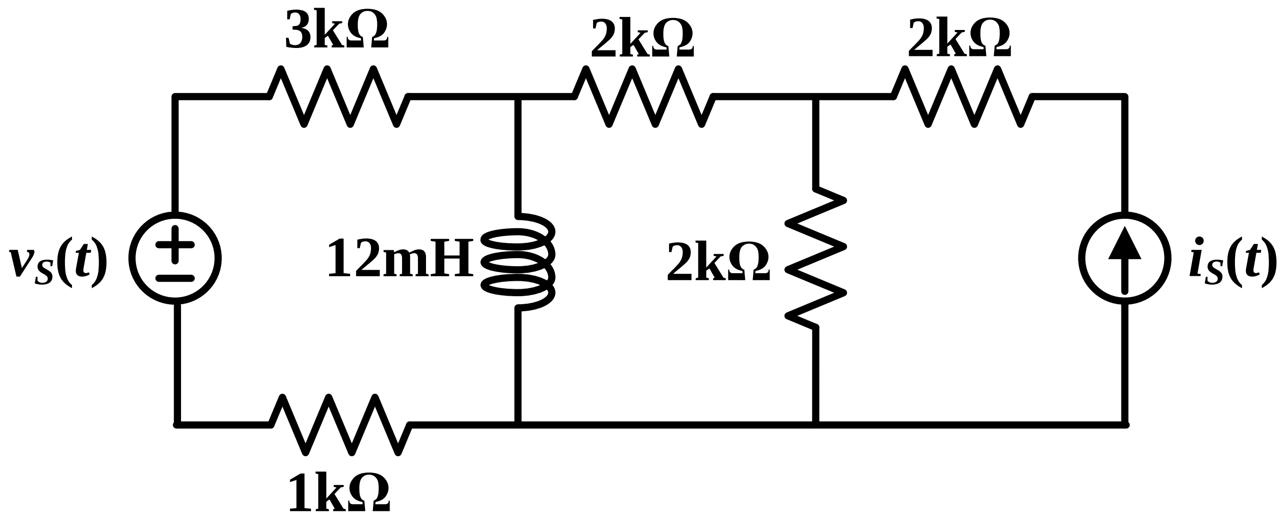
$\tau =$ $\frac{L}{R} = 2\times10^{-7}$ s (2%),

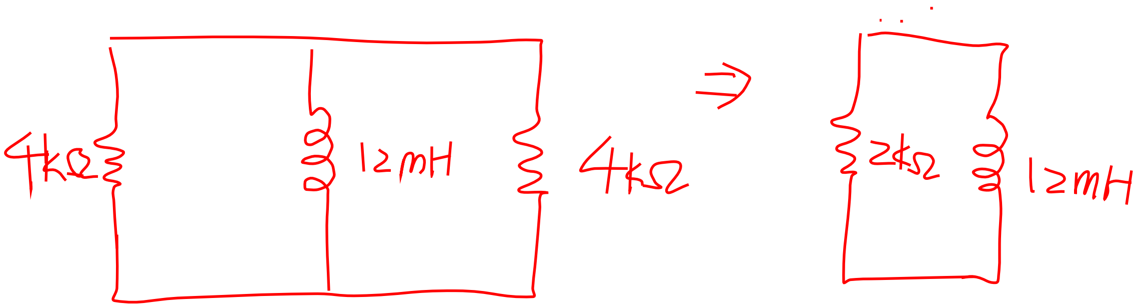
$i_L(t) =$ $I_0 - I_0 e^{\frac{-t}{L/R}}$ (4%),



(4%),

4. Find the time constant τ of the circuit as shown. (8%)

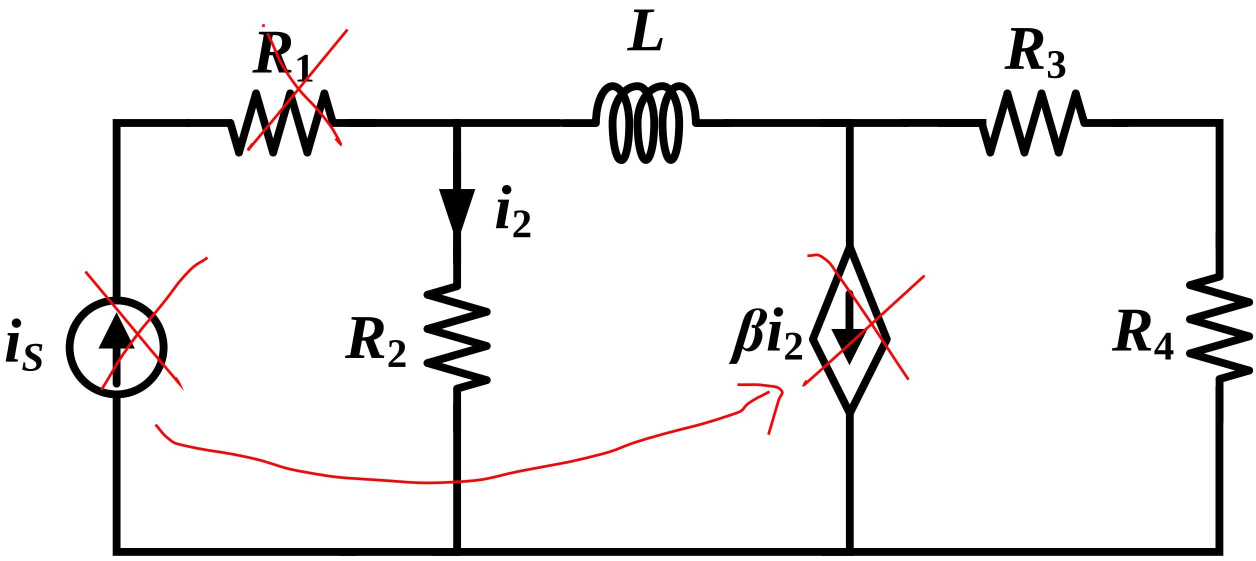




$$\tau = \frac{L}{R} = \frac{12\text{mH}}{2\text{k}\Omega} = 6\times10^{-6}\,\text{s}$$

τ = ______________________________.

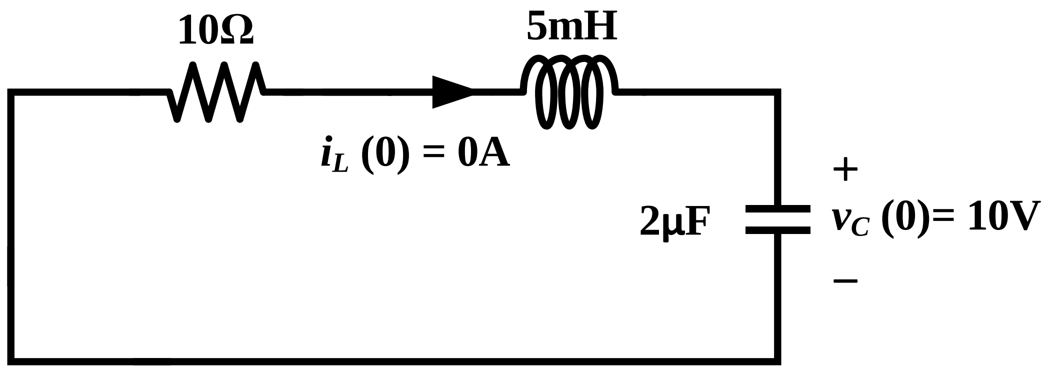
5. Find the time constant τ of the circuit show. (10%)



$$\therefore \tau = \frac{L}{R} = \frac{L}{R_2 + R_3 + R_4}$$

τ = ____.

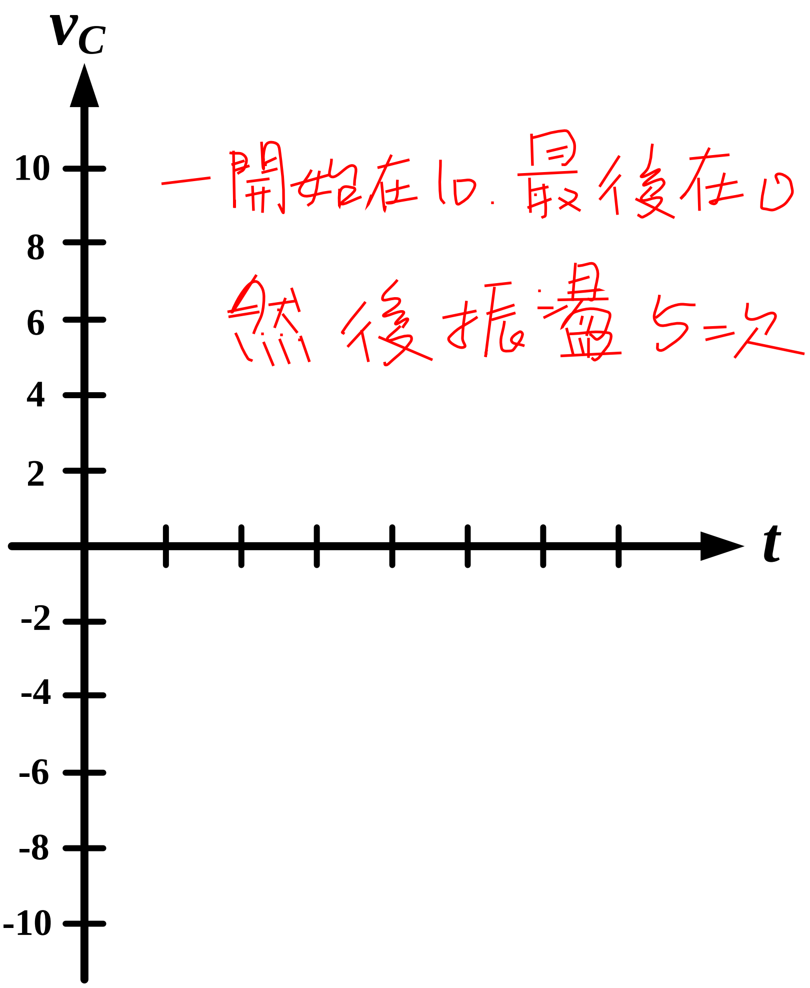
6. For the following circuit as shown, assume the initial state of the capacitor $v_C(0)$ is 10V and that of inductor $i_L(0) = 0$ A, answer that following questions. (16%)



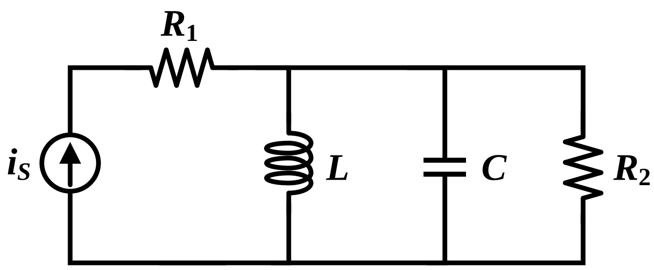
(1) Find the undamped natural frequence, ω_0. (2%)
(2) Find the damping factor, α. (2%)
(3) Find the approximate damped-natural frequence, ω_d. (2%)
(4) Find the approximate period of the ringing, T. (2%)
(5) Find the quality factor, Q. (2%)
(6) Find $v_C(0^+)$. (1%)
(7) Find $\dfrac{dv_C(0^+)}{dt}$. (1%)
(8) Sketch the zero-input response $v_C(t)$ for $t \geq 0$. (4%)

$\omega_0 =$ 10^4 rad/s, $\alpha =$ 10^3, $\omega_d \approx$ 9950, $T \approx$ 6.315×10^{-4} s,

$Q =$ $\frac{\omega_0}{2\alpha} = 5$, $v_C(0^+) =$ $V_c(0^-) = 10$, $\frac{dv_C(0^+)}{dt} =$ $\frac{i_c(0^+)}{C} = 0$,



7. Is the zero-input response of the following circuit under-damped, over-damped, or critically-damped assuming L = 2mH, C = 0.2μF, and $R_1 = R_2$ = 50 Ω? (10%)

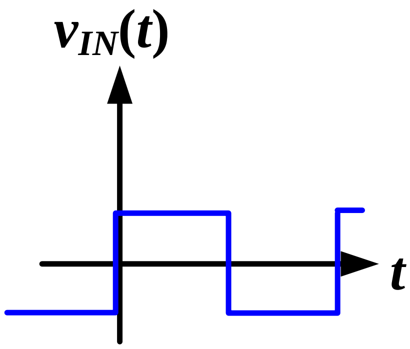


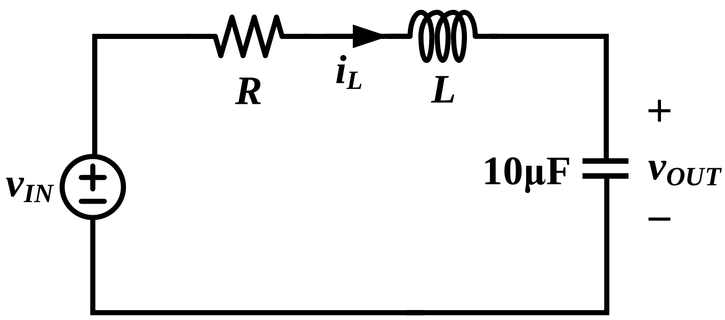
α = 5x10⁴ (3%), ω_0 = 5x10⁴ (3%),

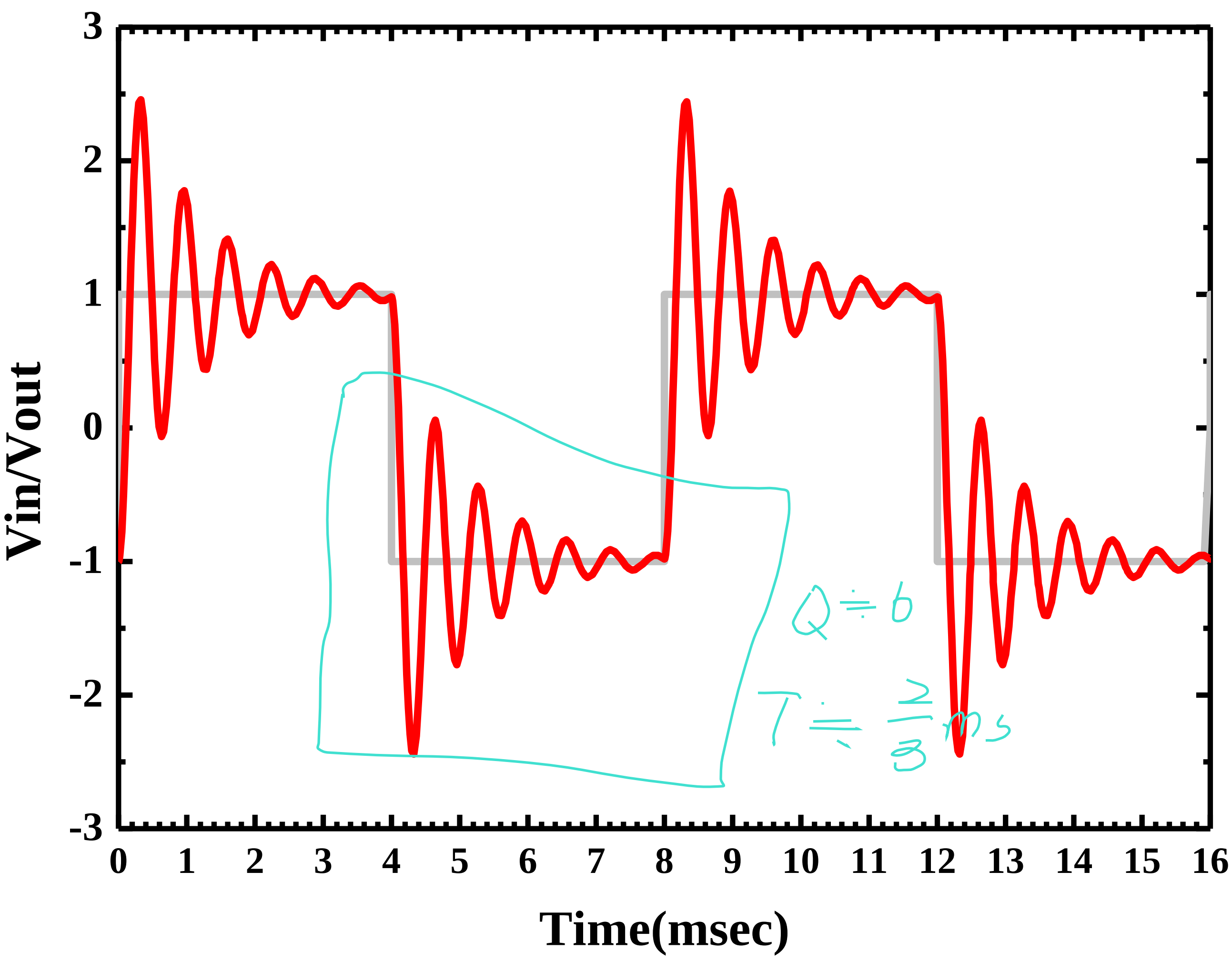
Answer: critically damped (4%).

8. For the RLC circuits as shown, this circuit is under a 125 Hz square wave excitation. The excitation and the response of the capacitator are also shown in the figure below. It is known that the capacitance is equal to 10 μF. From the information given, answer the following questions.

(a) What is the resistance (approximately) of the resistor that is in the circuit? (6%)
(b) What is the inductance (approximately) of the inductor that is in the circuit? (6%)



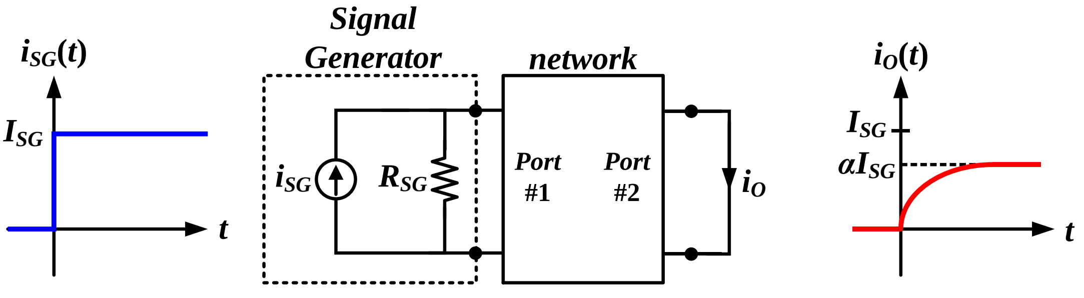




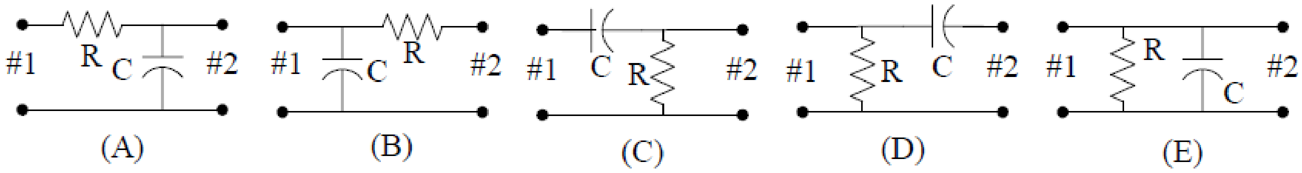
(a) $R =$ 1.7685 Ω

(b) $L =$ 1.126 mH

9. A signal generator having Norton resistance R_{SG} is connected to Port #1 of a two-port network as shown below. At $t = 0$, the Norton current $i_{SG}(t)$ of the signal generator takes a step from zero to I_{SG}, and the current $i_O(t)$ is measured at Port #2 as shown below with the port short-circuited. Note that α is a unitless constant satisfying $0 < \alpha < 1$, and τ is a time constant. Assume that the Norton current of the signal generator is zero for a very long time prior to the step.



(a) Which of the following could be the two-port network? (4%)



(a) Network (circle one): A B C D E

(b) Determine the values of R and C in the network you chose in Part (a). Express the values in terms of R_{SG}, α and τ. (10%)

$$R = \frac{1-\alpha}{\alpha} R_{SG}$$

$$C = \frac{\tau}{R /\!/ R_{SG}}$$

(b) R = ____________________, C = ____________________.