ECE 35, Fall 2019

Quiz 3 – Section B

Sequence number

Grade

/ 10

Last name

First + middle name(s)

PID

Instructions:

- Read each problem completely and thoroughly before beginning.
- All calculations need to be done on these sheets.
- Write your answers in the answer boxes for each question. Make sure you list units!
- Answers without supporting calculations will receive zero credit.

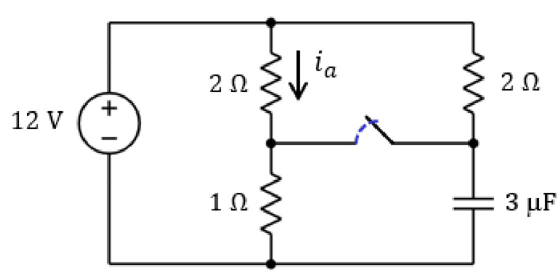
(1) *(5 points)* For $t < 2$ s, the switch is open, and you may assume the system has reached steady state. The switch closes at time $t = 2$ s.

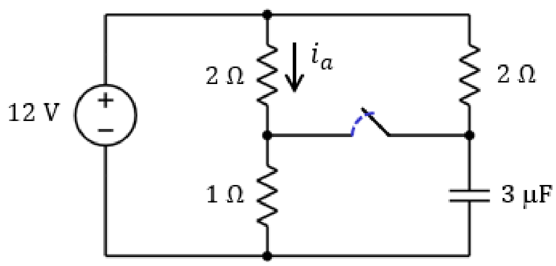
(a) Find $i_a(2^-\ \mathrm{s})$.

$i_a(2^-\ \mathrm{s})$

(b) Find $i_a(t)$ for $t > 2$ s.
Write the equation.

$i_a(t)$

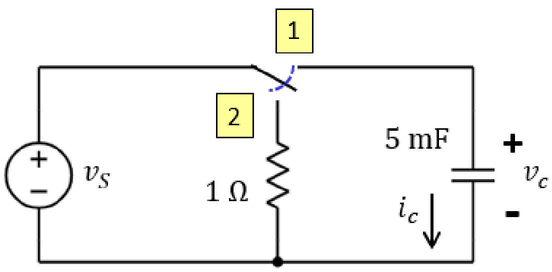


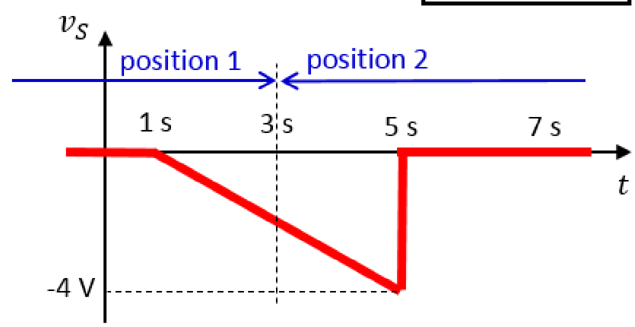

12 V
2 Ω
i_a
2 Ω
1 Ω
3 μF

(2) *(2 points)* The capacitor is fully discharged at *t* = 0 s. For *t* < 3 s, the switch is in position 1. The switch moves from position 1 to position 2 at time *t* = 3 s. You are given the curve of the voltage source v_S.

(a) Find v_c at time *t* = 4 s. $v_c(4)$ $\boxed{}$

(b) Find i_c at time *t* = 2 s. $i_c(2)$ $\boxed{}$





(3) *(3 points)* For $t < 0$ s, the switch is closed, and you may assume the system has reached steady state. <u>The switch opens at time $t = 0$ s</u>. You are given the curve of the current i_L through the inductor for $t > 0$ s.

(a) On the curve, we see that $i_L = 1.5\text{ A}$ at time t_1. What is the voltage v_a at that same time t_1?

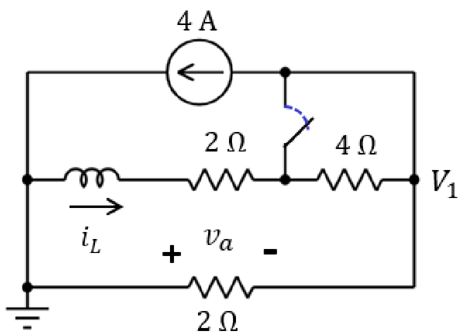
$v_a(t_1)$ ☐

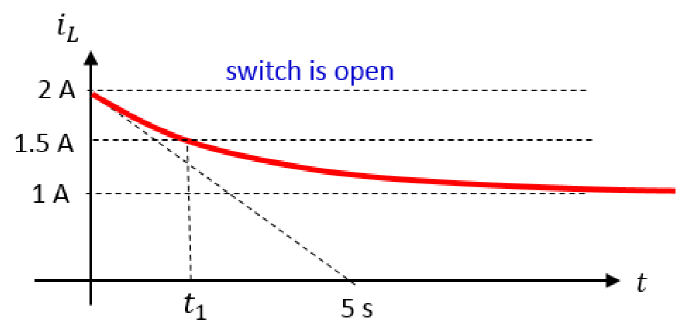
(b) What is the time constant τ of $i_L(t)$ for $t > 0$ s?

τ ☐

(c) What is the time constant τ of the node voltage $V_1(t)$ for $t > 0$ s?

τ ☐





ECE35 Equation Sheet

Basics: $i \triangleq \frac{dq}{dt}$ $\quad v_{ab} \triangleq \frac{dw}{dq}$ $\quad R = \rho \frac{l}{A}$

Capacitors: $C = \epsilon \cdot \frac{A}{d}$ $\quad Q = C \cdot v$ $\quad w_C = \frac{1}{2} C v^2$

Inductors: $L = \mu \cdot \frac{N^2 A}{l}$ $\quad B \sim i$ $\quad w_L = \frac{1}{2} L i^2$

AC power: $p(t) = \frac{1}{2} V_m I_m \cdot \cos(\theta_v - \theta_i) + \frac{1}{2} V_m I_m \cdot \cos(2\omega t + \theta_v + \theta_i)$

$$P = \frac{1}{2} V_m I_m \cos(\theta_v - \theta_i) \qquad Q = \frac{1}{2} V_m I_m \sin(\theta_v - \theta_i) \qquad X_{rms} = \sqrt{\frac{1}{T}\int_0^T x(t)^2 dt}$$

Trigonometry:

$\sin(-\alpha) = -\sin(\alpha)$ $\qquad \cos(-\alpha) = \cos(\alpha)$

$\sin(\pi - \alpha) = \sin(\alpha)$ $\qquad \cos(\pi - \alpha) = -\cos(\alpha)$

$\sin\left(\frac{\pi}{2} - \alpha\right) = \cos(\alpha)$ $\qquad \cos\left(\frac{\pi}{2} - \alpha\right) = \sin(\alpha)$

$\sin\left(\alpha - \frac{\pi}{2}\right) = -\cos(\alpha)$ $\qquad \cos\left(\alpha - \frac{\pi}{2}\right) = \sin(\alpha)$

$\sin(2\alpha) = 2\sin(\alpha)\cos(\alpha)$ $\qquad \cos(2\alpha) = \cos^2(\alpha) - \sin^2(\alpha)$

$\sin(\alpha \pm \beta) = \sin(\alpha)\cos(\beta) \pm \cos(\alpha)\sin(\beta)$

$\cos(\alpha \pm \beta) = \cos(\alpha)\cos(\beta) \mp \sin(\alpha)\sin(\beta)$

$\sin(\alpha)\sin(\beta) = 0.5 \cdot (\cos(\alpha - \beta) - \cos(\alpha + \beta))$

$\cos(\alpha)\cos(\beta) = 0.5 \cdot (\cos(\alpha - \beta) + \cos(\alpha + \beta))$

$\sin(\alpha)\cos(\beta) = 0.5 \cdot (\sin(\alpha - \beta) + \sin(\alpha + \beta))$

α:	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$
sin(α):	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1
tan(α):	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	∞